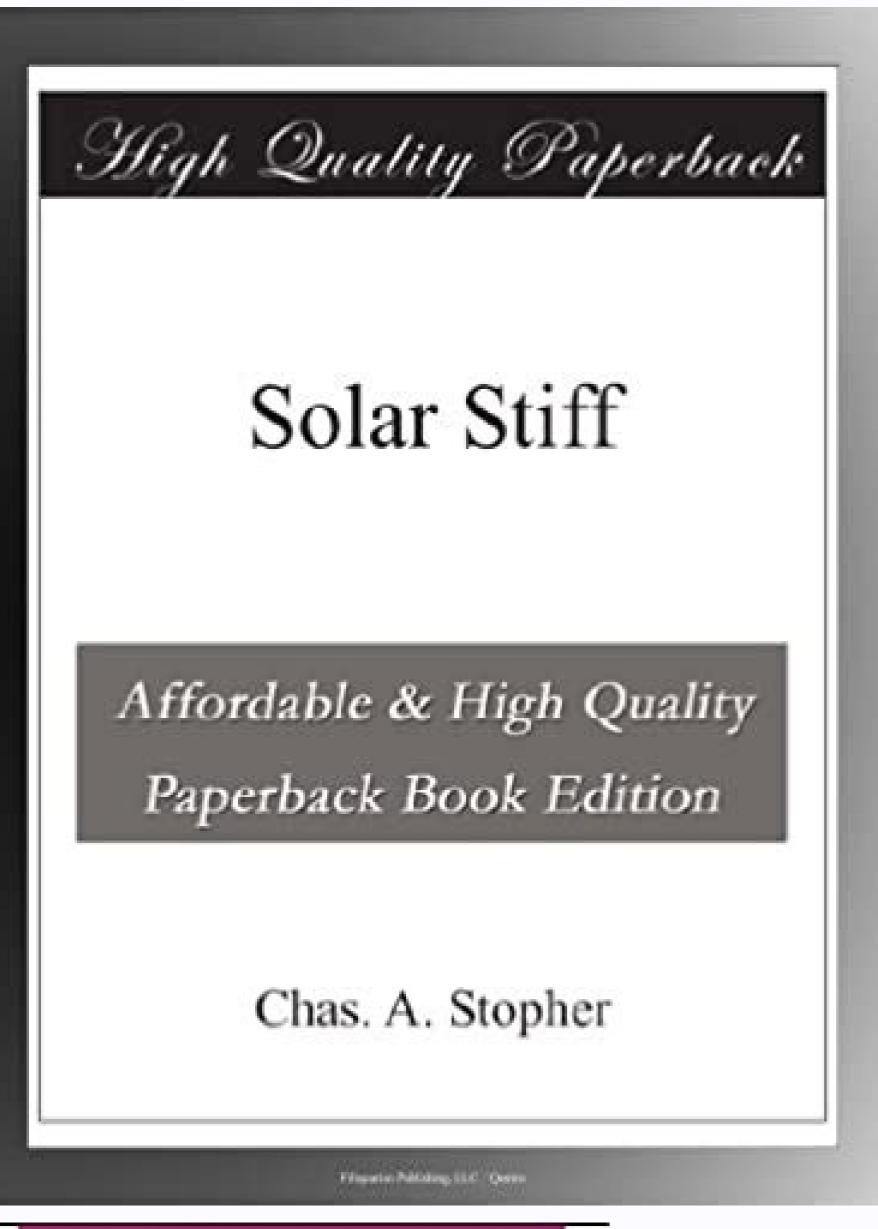
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Terms 3.1 Methods of Microbial Investigation A. Many species can currently be identified but primarily at the lower taxonomic levels. This capacity for making bonds, termed valence,* is determined by the number of electrons that an atom has to lose or share with other atoms during bond formation. genes and physiology (see insects and Wolbachia below). motivation and attitude. For instance, are naviruses pack along host ribosomes, and retroviruses "borrow" the host's tRNA molecules. Reducing media are important for growing anaerobic bacteria or for determining oxygen requirements 3.5 1 2 3 4 Media: The Foundations of Culturing 83 5 (a) Figure 3.20 Media that differentiate multiple characteristics of bacteria. Note the various textures of mycelia and the array of color differences due to spores. They are not essential to bacterial growth and metabolism, but they often confer protective traits such as resisting drugs and producing toxins and enzymes (see chapter 9). A shower of electrons defl ected from the surface is picked up with great accuracy by a sophisticated detector, and the electron pattern is displayed as an image on a monitor screen. An enriched medium contains complex organic substances such as blood, serum, hemoglobin, or special growth factors that certain species must be provided in order to grow. Upon release, the virulent phages can spread to other susceptible bacterial cells and begin a new cycle of infection. The descriptions of prokaryotic structure, except where otherwise noted, refer to the bacteria, a category of prokaryotic structure, except where otherwise noted, refer to the bacteria, a category of prokaryotic structure, except where otherwise noted, refer to the bacteria, a category of prokaryotic structure, except where otherwise noted, refer to the bacteria, a category of prokaryotic structure, except where otherwise noted, refer to the bacteria, a category of prokaryotic structure, except where otherwise noted, refer to the bacteria, a category of prokaryotic structure, except where otherwise noted, refer to the bacteria, a category of prokaryotic structure, except where otherwise noted, refer to the bacteria, a category of prokaryotic structure, except where otherwise noted, refer to the bacteria, a category of prokaryotic structure, except where otherwise noted, refer to the bacteria, a category of prokaryotic structure, except where otherwise noted, refer to the bacteria, a category of prokaryotic structure, except where otherwise noted, refer to the bacteria, a category of prokaryotic structure, except where otherwise noted, refer to the bacteria, a category of prokaryotic structure, except where otherwise noted, refer to the bacteria, a category of prokaryotic structure, except where otherwise noted, refer to the bacteria, a category of prokaryotic structure, except where otherwise noted, refer to the bacteria, a category of prokaryotic structure, except where otherwise noted, refer to the bacteria, a category of prokaryotic structure, except where otherwise noted, refer to the bacteria, a category of prokaryotic structure, except where otherwise noted as a category of prokaryotic structure, except where otherwise noted as a category of prokaryotic structure, except where otherwise noted as a category of prokaryotic structure, except where otherwise noted as a category of prokaryotic structure, except where otherwise noted as a category the types of media that can be prepared. with a tiny nucleoid (yellow) and a bacteria living in ocean sediments near the African country small number of ribosomes (blue dots). Many qualities of the selective permeability of gram-negative bacteria to bile, disinfectants, and drugs are due to the porins. Techniques in (a) and (c) use a loopful of culture, whereas (e) starts with a pre-diluted sample. Check Your Progress SECTION 3.3 11. Most microbes we study measure somewhere between 100 micrometers (mm) and 10 nanometers (mm) are fatty acid derivatives found in trace amounts that function in inflammatory and allergic reactions, blood clotting, and smooth muscle contraction. * septicemia (sep9-tih-see9-mee-uh) Gr. septikos, to make putrid, and haima, blood. Obligate parasites (for example, the leprosy bacillus and the syphilis spirochete) are so dependent that they are unable to grow outside of a living host. Gram staining is discussed in greater detail in 3.2 Making Connections. Microbes are deeply involved in the flow of energy and food through the earth's ecosystems. 1 Most people are aware that plants carry out photosynthesis, which is the light-fueled conversion of carbon dioxide to organic material, accompanied by the formation of oxygen. To make a 1 M solution of sodium chloride, we would dissolve 58 g of NaCl to give 1 L of solution; a 0.1 M solution would require 5.8 g of NaCl in 1 L of solution. tion to the subject, we will follow a pragmatic organization that Because the individual members of given species can show simplifies the presentation and avoids increasingly complex and variations, we must also define levels within species (subspecies) often conflicting taxonomy. Volume 1 Domain Bacteria Volume 2 Phylum Proteobacteria Volume 3 Phylum Firmicutes Volume 4 Phylum Actinobacteria Volume 5 Phyla Chlamydiae, Spirochaetes, Planctomyces, Bacteriodetes, and others 119 4.7 Survey of Prokaryotic Groups with Unusual Characteristics A. Here we have a solution enclosed in a membranous sac and attached to a hollow tube. Most important among them are the synthesis of nonprotein molecules such as lipids, and detoxification of metabolic waste products and other toxic substances. In other words, a virus is placed in a species on the basis of a collection of properties such as host range, pathogenicity, and genetic makeup. This knowledge must be tempered with the realization that jet-age travel, along with human migration, is gradually changing the patterns of worm infections, especially of those species that do not require alternate hosts or special climatic conditions for development. Compare autotrophs and heterotrophs with respect to the form of carbon-based nutrients they require. Microbiologists prefer to set up taxonomic systems that reflect true relationships based on all valid scientific data, including genotypic, molecular, morphological, physiological, and ecological. Why is the resolution so superior in the electron microscope? avian influenza b. Majority reproduce sexually. It can be caused by a number of factors, both microbial and nonmicrobial and nonmicr of the iris diaphragm; the condenser gathers the light rays and focuses them into a single point on the specimen—the real image—is next formed by the objective lens. Viruses range from largest (1) to smallest (10). (b) Figure 6.14 Maturation and release of enveloped viruses. Ciguatera is a serious intoxication caused by algal toxins that have accumulated in fish such as bass and mackerel. The role of carbon as the fundamental element of life can best be understood if we look at its chemistry and bonding patterns. A capsule is bound more tightly to the cell than a slime layer is, and it has a thicker, gummy consistency that gives a prominently sticky (mucoid) character to the colonies of most encapsulated bacteria (figure 4.11a). Distribution is extremely widespread in many habitats. Electron Transfer and Oxidation-Reduction Reactions The metabolic work of cells, such as synthesis, movement, and digestion, revolves around energy exchanges and transfers. Even several centuries ago, there was already a sense that diseases such as the black plague and smallpox were caused by some sort of transmissible matter. Note that (a) and (b) also show the formation of diatomic molecules. coli (white), M. Be careful not to confuse the nucleus of an atom with the nucleus of an atom with the nucleus of a cell. How Antimicrobial Agents Work: Their Modes of Action 11.2 Physical Methods of Control: Heat Effects of Temperature on Microbial Activities The Effects of Cold and Desiccation 11.3 Physical Methods of Control: Radiation and Filtration Radiation in Inizing Radiation and Filtration Radiation and Filtration Radiation and Filtration Radiation in Inizing Radiation in Inizing Radiation and Filtration Radiation and Filtration Radiation in Inizing R Rays Filtration—A Physical Removal Process 11.4 Chemical Agents in Microbial Control Choosing a Microbial Chemical Agents Chemical Agents Chemical Agents Chemical Agents of Chemical Agents C Antimicrobial Drugs Interactions Between Drugs and Microbes 12.2 Survey of Major Antimicrobial Drugs That Act on DNA or RNA Drugs That Interfere with Protein Synthesis Drugs That Block Metabolic Pathways 12.3 Drugs to Treat Fungal, Parasitic, and Viral Infections Antifungal Drugs Antiparasitic Chemotherapy Antiviral Chemotherapy Antivir worm wearing a coat of symbiotic bacteria (fine filaments) to protect against the heat. Extreme thermophiles are bacteria often bear accessory appendages sprouting from their surfaces. The outer pellicle is flexible and allows for some shape changing in this group. During encystment, the trophozoite cell rounds up into a sphere, and its ectoplasm secretes a tough, thick cuticle around the cell membrane (figure 5.23). Although there are some elaborate systems for naming and classifying spores, we present only a basic overview of the principal types. Lysogeny: The Silent Virus Infection The lethal effects of a virulent phage on the host cell present a dramatic view of virus-host interaction. When this happened in an egg or sperm cell, the virus could same virus from monkeys and apes as well, which allows them to fix a be transmitted basically unchanged for hundreds of generations. The flowchart shown here maps the structural organization of a eukaryotic cell. Upon encountering a favorable substrate, a spore will germinate and produce a new fungus colony in a very short time (figure 5.17). Individual cells can become disoriented, undergo gross changes in shape or size, or develop intracellular changes (figure 6.15a). knowledge based on belief c. Medical significance: hundreds of millions of people are afflicted with one of the many protozoan infections (malaria, trypanosomiasis, amoebiasis). The nature of this process varies from the simple fusion of fertile hyphae of two different strains to a complex union of differentiated male and female structures and the development of special fruiting structures. The cytoplasm is usually divided into a clear outer layer called the ectoplasm and a granular inner region called the endoplasm. There are many kinds of relationships between microscopes, the electron microscopes, the electron microscopes forms an image with a beam of electrons that can be made to travel in wavelike patterns when accelerated to high speeds. General shapes include cocci, bacilli, and helical forms such as spirilla and spirochetes. The "octet rule" in chemistry helps predict the types of bonds that atoms will form. Describe the structure of a mitochondrion, and explain its importance and functions. The arrangements of the capsomers vary from one virus to another. Because of the intimate association between the genetic material of the virus and host, phages occasionally serve as transporters of bacterial genes from one bacterial genes from filaments, cocci, and some miniature, 115 Aggregate Vegetative growth Fruiting Fruiting body Myxospore Figure 4.30 Life cycle of Myxococcus. So, in this case, the sporangiospores are the result of sexual recombination. Inclusion bodies Multiple nuclei Normal cell Giant cell (a) (b) Figure 6.15 Cytopathic changes in cells and cell cultures infected by viruses. (b) Highly magnified (200,0003) negative stain of hundreds of polioviruses shows the tight geometric arrangements of particles. The following is a selected array of examples. They appear to be involved in regulating volume and osmotic pressure. Just by random thermal movement, the molecules will become dispersed away from an area of higher concentration to an area of lower concentration to an area of lower concentration details the double membrane structure and the extensive foldings of the inner membrane. She also served as a member of the ASM Task Force on Curriculum Guidelines for Undergraduate Microbiology Education, assisting in the identification of core microbiology concepts as a guide to undergraduate instruction. Such standardized and reproducible media are most useful in research and knowledge to enrich our understanding. This is just one of the revolutionary possibilities being explored by the science of chemotherapy, defined as the use of chemical compounds (drugs) to treat or prevent diseases. Explain the functions of capsids, nucleocapsids, envelopes, and spikes. It pattern. Bacteria and fungi live in complex associations with plants. A second characteristic exhibited by facilitated diffusion is saturation. The techniques have also paved the way for characterizing human genetic material and diseases. For example, most enzymes that handle the energy reactions of respiration reside in the cell membrane (see chapter 8). It turned out to be caused by the MRSA type of Staphylococcus aureus. Many instructors have a detailed syllabus or study ogy and topics, over time it will become yours and you will find that guide that directs the class to specific content areas and vocabulary the pieces begin to fit together. Expected Learning Outcomes 20. It will help you to recall these osmotic conditions if you remember that the prefixes iso-, hypo-, and hyper- refer to the environment outside of the cell. Viruses with negative-strand RNA molecules must first be converted into a positive-strand message. A system of naming. For instance, hydrogen can bind with one other atoms, and carbon can bind with four. cell division c. Reproductive hyphae. Observe the diversity of cell types. Here, glucose and oxygen are reactants and carbon dioxide is given off. convinced that they are probably similar By way of comparison, if the average bacterium were the size of a mouse, to the first microbes on earth, and that they play a strategic role in the Thiomargarita would be as large as a blue whale! development of the earth's crust. The yearly estimate of worldwide cases numbers in the billions, and these are not confined to developing countries. The Germination of Endospores After lying in a state of inactivity, endospores can be revitalized when favorable conditions arise. Unidentifi U id tified d thermophilic th hili B. Two special cases are osmosis and facilitated diffusion. Their primary function is to orient the cells in the earth's magnetic field, somewhat like a compass. Newer genetic data reveal that the organisms we call protists may be as different from each other as plants are different from each other classified with the green plants (along with algae and bacteria), and later they were placed in a group with algae and protozoa (the Protista). Messenger RNA (mRNA) is a carrier that delivers the correct amino acids during protein synthesis; and ribosomal RNA (rRNA) is a major component of ribosomes, which are the sites of protein synthesis. Note that carbon has 4 electrons to share and hydrogens each have one thereby completing the shells for all atoms in the compound and creating 4 single bonds. (c) Basic structural types of hyphae. illumination 2. They have been termed metachromatic granules because they stain a contrasting color (red, purple) in the presence of methylene blue dye. * sarcina (sar9-sin-uh) L. Consequently, they remained cloaked in mystery and regarded with superstition—a trend that led even well-educated scientists to believe in spontaneous generation (1.2 Making Connections). * genus (jee9-nus) pl. Mycoplasmas and Other Cell-Wall-Deficient Bacteria Mycoplasmas are bacteria that naturally lack a cell wall. Ectoplasm is 145 involved in locomotion, feeding, and protection. Specimens must be pretreated with chemicals or dyes to increase contrast and usually cannot be observed in a live state. Soaps are K1 or Na1 salts of fatty acids whose qualities make them excellent grease removers and cleaners (see chapter 11). Complex means that the medium has large molecules such as proteins, polysaccharides, lipids, and other chemicals that can vary greatly in exact composition. Chlamydias Bacteria of the genera Chlamydia and Chlamydias, are similar to the rickettsias in that they require host cells for growth and metabolism. * nucleotide (noo9-klee-oh-tyd) From nucleus and acid. Embedded at numerous sites in this bilayer are various-size proteins. 4.4 Bacterial Internal Structure 103 Actin filaments (a) Figure 4.21 Bacterial cytoskeleton of Bacillus. Oxygen concentration is highest at the top of the tube and absent in the deeper regions. Three subtypes of this pattern are: monotrichous* with a single flagellum; lophotrichous* with flagella at both poles of the cell. (b) In a double bond, the outer orbitals of two oxygen atoms overlap and permit the sharing of 4 electrons (one pair from each) and the saturation of the outer orbital for both. 1.53 d. archaea b. A third difficulty in working with microscope and how it is held. A cell wall, locomotor appendages, and chloroplasts are found only in some groups. For what reasons would a cell need a "skeleton"? Observe figure 1.3 and place the microbes pictured in a size ranking, going from smallest to largest. has produced an abundance of specialized adaptations and niches of incredible diversity. 1503 c. Even though human cells use oxygen, and oxygen is found in the blood and tissues, some body sites present anaerobic pockets or mi- 201 crohabitats where colonization or infection can occur. interpretation of the genetic code d. Which bacteria has a well-developed capsule: "Klebsiella" or "S. Some protozoa absorb food directly through the cell membrane. The great naturalist Charles Darwin labeled this process natural selection. The mutualist Bacteroides thetaiotaomicron processes complex food molecules and even regulates the expression of the human genome. A chemical is usually inorganic if it does not contain both carbon and hydrogen. The Bacterial Cytoskeleton Until recently, bacteriologists thought bacterial lacked any real form of cytoskeleton. 5 The cell wall was considered to be the sole 5. At one point, the medical team could 59 60 Chapter 3 Tools of the Laboratory 3.1 Methods of Microbial Investigation Expected Learning Outcomes 1. Examples include heat-resistant cysts such as Giardia or sporeformers such as Bacillus and Clostridium. S S Tertiary structure Projected three-dimensional shape (note grooves and projections) 4 The quaternary structure exists only in proteins that consist of more than one polypeptide chain. New evidence indicates that bacteria turn on different genes when they are "free-floating," or planktonic. Heavier, more compact structures sediment faster and are assigned a higher S rating. of chloroplasts makes them important primary producers of organic nutrients upon which all other organisms (except certain bacteria and archaea) ultimately depend. Jellyfish (b1) and corals rely on endosymbiotic algae called dinoflagellates (b2 inset) for survival. Traditionally, they have been included among microorganisms because of their infective abilities and because the microscope is necessary to identify their eggs and larvae. The predominant living things in the deepest part of the oceans (10,000 m or below) are pressure- and cold-loving microorganisms. * trematode (treem9-a-tohd) Gr. trema, hole. Trophozoite is reactivated. A fully infective virus is a virion. luteus (yellow), and S. By one definition, a solution is considered acidic when one of its components (an acid) releases excess hydroxide ions, so that there is no longer a balance between the two ions. Beta-hemolysis and sensitivity to bacitracin are hallmarks of S. (a) A section through a gram positive cell wall/membrane with an interpretation of the main layers visible (85,0003). The termite's role is simply to gnaw off pieces of wood, but it cannot digest the wood. Microbes that photosyn- TABLE 7.2 189 Nutritional Categories of Microbes that Environment Photoautotroph Sunlight Chemoautotroph Sunlight Chemoautotroph Simple inorganic matter from other organisms of the nutrients from other organisms of Sunlight Chemoautotroph Simple inorganisms Sunlight or organisms of Sunlight Chemoautotroph Metabolic conversion of the nutrients from other organisms of Sunlight Chemoautotroph Simple inorganisms or Sunlight Simple inorganisms o a reaction is reversible depends on the proportions of these compounds, the difference in energy state of the reactants and products, and the presence of catalysts (substances that increase the rate of a reaction). Microbial ecology focuses on ways that microorganisms deal with or adapt to such factors as heat, cold, gases, acid, radiation, osmotic and hydrostatic pressures, and even other microbes. As long as the viruses lack the correct spikes for a given host, they cannot jump hosts. This instrument can create an extremely detailed *This maximum requires a 203 ocular. 5.3 Form and Function of the Eukaryotic Cell: Internal Structures 14. Each additional insight, whether large or small, has added to our current knowledge of life forms and processes. During this cycle, the vegetative cells respond to chemotactic signals by swarming together and differentiating into a many-celled, colored structure called the fruiting body, making it one of the few bacteria that can generate a multicellular body form (figure 4.30). RNA: Organizers of Protein Synthesis Like DNA, RNA is a polynucleotide that consists of a long chain of nucleotides. Staphylococci and Micrococci Figure 4.25 Arrangement of cocci resulting from different planes of cell division. It utilizes aerobic needs, and has ribosomes circular chromosome with bacterial DNA sequences, metabolism and increases ave bacterial membranes that are clearly prokaryotic. In time, it reverts to a fully active vegetative cycle (figure 4.22). His wife said he felt hot and took his He began to wonder if the patient had a prior medical history of temperature. The primary medical threat from algae is due to a type of food poisoning caused by the toxins of marine algae such as dinoflagellates. The science of microbiology is diverse and has branched out into many subsciences and applications. 26. The bacterium Desulforudis is the only occupant of this totally dark, anaerobic, hot, alkaline habitat, and it derives its energy from the radioactive decay of uranium. Microbiologists had previously described

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around 6,000 different types of bacteria, but the evidence from these new studies To continue the Case Study, go to page 24. xiv /202/MH02004/taL22600_disk1of1/0073522600/taL22600_pagefiles Primary Infections/Disease Clostridium difficile- associated disease (CDAD) refers to disease caused by the overgrowth of C. 2 Gram's Although these
staining reactions involve an iodine attraction of the cell to a charged dye, it is important to (mordant) note that the terms gram-positive and gram-negative are not used to indicate the electrical charge of cells or dyes but whether or not a cell retains the primary 3 Alcohol dye-iodine complex after decolorization. Initial analysis of this ancient microbe
indicates it is a species of Bacillus that is genetically different from known species. valentia, strength. A real image is produced by the a. What evidently happened with the 2009 H1N1 strain is that a small change in a spike was just enough to allow the virus to infect humans. Examples of media for cultivating fungi are cornmeal, blood, and
Sabouraud's agar. Traditionally we present the history of life, or phylogeny, in the form of branching trees that are designed to show the origins of various life forms (figures 1.14 and 1.15). Brave "Old" World When samples of ancient Antarctic ice (several million years old) were brought into the lab, they yielded up living bacteria. Explain some
biological properties of parasites, and list some common protozoan pathogens. In addition, parts of viral capsids and envelopes stimulate the immune system to produce antibodies that can neutralize viruses and protect the host's cells against future infections (see chapter 15). (c) Structural stains: capsule, flagellar, and chromosomal. Describe the
anatomy and functions of each of the major eukaryotic organelles. Some fungi are eaten or used to impart flavorings to food. The reactions all occur in the absence of oxygen as well. This configuration, first proposed by S. Amensalism* is an action of one microbe that causes an adverse effect in another microbe. Maximum resolution 200 nm (0.2 mm)
0.5 nm This microscope produces its image by transmitting electrons through the specimen. Glycerol is a 3-carbon alcohol7 with three OH groups that serve as binding sites. Growth of the cells causes inflammation and damage that manifest as swelling and necrosis. * lysogeny (ly-soj9-uhn-ee) The potential ability to produce phage. In many cases,
such cooperative relationships are coevolving to greater dependency. * cation (kat9-eye-on) A positively charged ion that migrates toward the negative pole, or cathode, of an electrical field. And, except for rare cases, none of the organisms living in these extremes is a pathogen because the human body is a rather hostile habitat for them. Viruses with
naked nucleocapsids (adenovirus, for example) use surface receptors on their capsids that adhere to cell membrane receptors (figure 6.12). Many scientists argue that nonorganisms such as oils or molecules in
solution, enter the cell through pinocytosis. Other examples of liquid media are methylene blue milk and dyes. Using a calculator or table, 6 we find that 212 is 4,096. We prefer to use the terms saprobe and saprotroph because they are more consistent with other terminology. This method makes it possible to
propagate most viruses. from the patient's wife 3. The fungus is Botrytis, a common decomposer of tomatoes and grapes (2503). Control and Treatment Control of S. Which phylum contains bacteria with a gram-positive cell wall? A negative stain, on the other hand, is just the reverse (like a photographic negative). For instance, rhinoviruses (one
cause of the common cold) multiply successfully only in tissues that are slightly below normal body temperature (338C to 358C or 918F to 958F). to detect organic compounds d. Van der Waals forces are also weak interactions between polarized zones of molecules such as proteins. * flagellum (flah-jel9-em) pl. Although viruses are not classified as
members of the domains discussed in chapter 1, they are diverse enough to require their own classification scheme to aid in their study and identification. For instance, adenoviruses* were first discovered in adenoids (one type of tonsil), and hantaviruses were originally isolated in the Korean Province of Hantaan. (a) The Scientific Method and the
Search for Knowledge The research that led to acceptance of biogenesis provides us one example of the early development of science-based thought. a theory that has been thoroughly tested 8. pyogenes infections include rheumatic fever and acute glomerulonephritis. The scientific name, also known as the specific epithet, is assigned by using a
binomial (two-name) system of nomenclature. Clostridium is differentiated from Bacillus as the former is typically a strict anaerobe and the latter is not. Facultative rods and vibrios (continued) Family Vibronaceae: Vibrio (cholera, (gonorrhea, meningitis) food infection) Family Campylobacteraceae: Campylobacteraceae: Campylobacteraceae: Vibrio (cholera, (gonorrhea, meningitis) food infection) Family Campylobacteraceae: Campylobacteraceae: Campylobacteraceae: Vibrio (cholera, (gonorrhea, meningitis) food infection) Family Campylobacteraceae: Campylobacteraceae: Vibrio (cholera, (gonorrhea, meningitis) food infection) Family Campylobacteraceae: Campylobacteraceae: Vibrio (cholera, (gonorrhea, meningitis) food infection) Family Campylobacteraceae: Campylobacteraceae: Vibrio (cholera, (gonorrhea, meningitis) food infection) Family Campylobacteraceae: Campylobacteraceae: Vibrio (cholera, (gonorrhea, meningitis) food infection) Family Campylobacteraceae: Campylobacteraceae: Vibrio (cholera, (gonorrhea, meningitis) food infection) Family Campylobacteraceae: Campylobacteraceae: Vibrio (cholera, (gonorrhea, meningitis) food infection) Family Campylobacteraceae: Vibrio (cholera, (gonorrhea, meningitis) food infection) Family Campylobacteraceae: Vibrio (cholera, (gonorrhea, meningitis) food infection) Family Campylobacteraceae: Vibrio (cholera, meningitis) Fami
(enteritis) G. matter they contain. (b) Ball-and-stick model shows the arrangement of atoms in three dimensions. protomers d. Only dormant, dehydrated cell stages (for example, spores and cysts) tolerate extreme drying because of the inactivity of their enzymes. These membranes are usually an outgrowth of the cell membrane extending into the
cytoplasm, which can increase the membrane surface area available for these reactions. Dye crystals trapped in cell No effect of iodine Crystals remain in cell. The terms used for these ecological groups are psychrophile, mesophile, and thermophile (figure 7.9). Identified by Gram reaction and endospore formation. This property causes lipids to
naturally assume single and double layers (bilayers), which contribute to their biological significance in membranes. Previous editions © 2012, 2009, and 2008. circles b. The primary difference between a TEM and SEM is in a. It is released when the surrounding hypha fractures, and it serves as a survival or resting cell. It permits ready
differentiademonstration of tion of major categories based upon this technique. Process Figure 6.21 The appearance and mechanisms of prionbased diseases. Major organelles (nucleus, nucleolus, endoplasmic reticulum technique), glycocalyx, cell wall, cytoplasmic (or cell) membrane, organelles (nucleus, nucleolus, endoplasmic reticulum technique).
Golgi complex, mitochondria, chloroplasts), ribosomes, cytoskeleton (microfilaments, microtubules). At the next appointment, the patient reported that he still had some of the same symptoms, including the fever, and that c Explain why Mr. Jones' initial throat cultures were negative now he had begun to have headaches, rapid breathing, and for
infection. Obligate acidophiles include Euglena mutabilis (featured in Case Study 7), an alga that grows in acid pools between 0 and 1.0 pH, and Thermoplasma, an archaea that lives in hot coal piles at a pH of 1 to 2, and will lyse if exposed to pH 7. Outline the primary indicators of life. tree-shaped fruiting bodies. 100 µm (b) (a) 100 µm (c) Figure
6.19 Microscopic views of normal and infected cell cultures. Alkalinophiles live in hot pools and soils that contain high levels of basic minerals. Chemoheterotrophic microbes are all similar in requiring an organic carbon source, but they differ in how they obtain it. Describe several ways that the beneficial qualities of microbes greatly outweigh their
roles as infectious agents. positive, negative, electron b. During mitosis, however, when the duplicated chromosomes are separated equally into daughter cells, the chromosomes themselves become readily visible as discrete bodies (figure 5.6). both a and b 14. Protozoan Identification and Cultivation Taxonomists have not escaped problems
classifying protozoa. Evolution is founded on two premises: (1) that all new species originate from preexisting species through inheritance of traits, and (2) that closely related organisms have similar features because they evolved from common ancestral forms. It also has provisions for incubation and inspection in a completely O2-free system.
Humans belong to the Order Primates, a group that also includes apes, monkeys, and lemurs. On the other side were advocates of biogenesis,* saying that living things arise only from others of their same kind. A protein is the largest of this class of compounds and usually contains a minimum of 50 amino acids. meningitidis. Application, Analysis
 Evaluation, and Synthesis These problems go beyond just restating facts and require higher levels of understanding and an ability to interpret, problem solve, transfer knowledge to new situations, create models, and predict outcomes. Microscopic Appearance of Cell Gram (+) Gram (-) Chemical Reaction in Cell (very magnified view) Gram (+) Gram (-) Chemical Reaction in Cell (very magnified view) Gram (-) Chemical Reaction in Cell (very magnified vi
(-) Both cell walls stain with the dye. glass (4.1 Making Connections). Pili come in several varieties. The federal Environc Suggest some possible ways that microbes survive and even thrive mental Protection Agency designated it as a major superfund under such conditions. One that lives in the human stomach? It is inserted into a curved, tubular
hook. Over the subsequent 200 years, scientists waged an experimental battle over the two hypotheses that could explain the origin of simple life forms. Intravenous antibiotics. This is accomplished by a variety of schemes. Phase-Contrast and Interference Microscopy If similar objects made of clear glass, ice, and plastic are immersed in the same
container of water, an observer would have difficulty telling TABLE 3.2 Comparisons of Types of Microscopes. These Growth increases the methods, called biochemical tests, can deternumber of cells. Numbers indicate the total electrons in that shell. presence of a
nucleus in eukaryotes d. This means that there is really no need for the "imperfect" taxon. Why are some bacteria difficult to grow in the laboratory? (a) During the reaction, sodium loses its single outer orbital electron to chlorine, thereby filling chlorine, thereby filling chlorine is really no need for the "imperfect" taxon. Why are some bacteria difficult to grow in the laboratory?
allowing growth of the desired ones. The different 4 Safranin results in the Gram stain are due to differences in the (red dye structure of the cell wall and how it reacts to the counterstain) series of reagents applied to the cells. MASS 12.01 CHLORINE 17 11p 17p Na 2•8•1 Ca AT. Depending upon what is added, a microbiologist can fine-tune a
medium for nearly any purpose. For example, the cells of Mycobacterium and Nocardia contain peptidoglycan and stain gram-positive, but the bulk of their cell wall is composed of unique types of lipids. The pH was defined in chapter 2 as the degree of acidity or alkalinity of a solution. mycoplasmas d. They cause a variety of infectious diseases
ranging from mild respiratory illnesses (common cold) to destructive and potentially fatal conditions (rabies, AIDS). Level I. Name the three general categories of media, based on their inherent properties and uses. (a) A facet or "face" of the capsid is composed of 21 identical capsomers arranged in a triangular shape. Give the technical name of a
microbiologist who researches or works with protozoa in a termite's gut, bacteria that live in volcanoes, the classification of Paramecium. The new realization that our bodies are hosts to a wide variety of unknown
microbes has several implications. These mammals produce no enzymes of their own to break down the cellulose that is a major part of their diet, but the microbial population harbored in their rumens does. State the relationship among an atom, molecule, and compound. Well, we now know that they do. It also serves important receptor and
communication functions and offers some protection against environmental changes. This agent is the cause of Ohio Valley fever. They tend to assume cubical, spherical or cylindrical shapes, and have a cell membrane that encases an internal matrix called the cytoplasm. Outline the factors that caused the pandemic H1N1 influenza virus to spread so
rapidly. Feeling miserable she was immediately taken to the intensive care unit and placed on but not terribly concerned, she took some ibuprofen and went to bed. It is apparent that genetic material of these cells was not bound into a separate compartment called a nucleus or "karyon." The term assigned to cells and microbes of this type is
prokaryotic,* meaning "before the nucleus." About 1.8 billion years ago, there appeared in the fossil record a more complex cell, which had developed a nucleus and various specialized internal structures called organisms are defined as eukaryotic* in reference to their * prokaryotic (proh0-kar-ee-ah9-tik) Gr. pro
before, and karyon, nucleus. A drop of perfume released into one part of a room is soon smelled in another part, or a lump of sugar in a cup of tea spreads through the whole cup without stirring (figure 7.4). All protons are identical, and all electrons are identical, and all electrons are identical.
outside their host cells. materials. If the hypothesis is supported by the experiment, it is not (or should not be) immediately accepted as fact. synthesis of nucleotides b. We start this chapter with a description of the characteristics that impart the essence of life to cells, followed by a look at prokaryotic cell anatomy and a survey of major groups of
prokaryotes. sulfur, Thiobacillus b. The nine pairs are linked together and anchored to the pair in the center. (a) The simplest virus is a naked nucleocapsid consisting of a geometric capsid assembled around a nucleic acid strand or strands. The mammalian hosts are numerous, including * Trypanosoma (try0-pan-oh-soh9-mah) Gr. Trypanon, borer,
and soma, body. An intriguing example can be found in the complex symbiosis of certain ants. In general, isotonic conditions pose little stress on cells, so survival depends on counteracting the adverse effects of hypertonic and hypotonic environments. Early in "Quorum Sensing" on YouTube. The overall taxonomy we are using here classifies the
protozoa into four Phyla based on motility and other cell characteristics that are outlined with examples in table 5.6. Although protozoan infections are very common, they are actually caused by only a small number of species often restricted geographically to the tropics and subtropics (table 5.7). About 97% of the dry cell weight is composed of
 organic compounds. 2.2 Check Your Progress SECTION 2.1 1. In fact, the closest relative of is that of endosymbiosis. In every case, these elements are more stable as a pair of atoms joined by a covalent bond (a molecule) than as a single atom. Phagocytes are a natural body defense that can engulf and destroy foreign cells, which helps to prevent
infection. (d) The plant supplies nutrients to the fungus protects the plants against drying and insects. This imbalance produces a positively charged sodium ion (Na1). Give some reasons to explain the benefits of using scientific names for organisms. Microorganisms have a particularly important relationship with most of these
elements. The eggs hatch in the intestine and then release larvae that mature into adult worms within about one month. hookworm d. (b) Longitudinal view with major cell parts labeled. Some organic nutrients already exist in a form that is simple enough for absorption (for example, monosaccharides and amino acids), but many larger molecules must
be digested by the cell before absorption. So far, the only actions taken have been to divert the drainage water, treat it, and remove some of the heavy metals. Analyze chemically defined and complex media, describing their basic differences and content. Stages in the Normal Growth Curve The system of batch culturing just described is closed,
meaning that nutrients and space are finite and there is no mechanism for the removal of waste products. She has been an author of, and contributor to, several publications of the William C. This compound is composed of a repeating framework of long glycan* chains crosslinked by short peptide fragments (figure 4.14). It is for this reason that they
are considered extremophiles, or hyperextremophiles, or hyperextremophiles, meaning that they "love" the most extreme habitats on earth. Other denizens of hot volcanic waters are unusual invertebrates such as the Pompeii worm that frequents rocky hideouts around sea vents measuring 808C (1768F) (see photo a). These diseases are discussed further in chapter 19.
These viruses parasitize bacteria. Regardless of how the virus leaves, most active viral infections 3. Mycoses (fungal infections) vary in the way the agent enters the body and the degree of tissue involvement (table 5.4). Notice that two early bacterial lines contributed to the evolution of the eukaryotic cell and Eukarya by becoming the mitochondria
and the chloroplasts. Corkscrew-shaped bacteria called spirochetes* show a wormlike or serpentine mode of locomotion caused by two or more long, coiled threads, the periplasmic flagella or axial filaments. Bonds and Molecules 33 Chemical bonds of molecules are created when two or more atoms share, donate (lose), or accept (gain) electrons
(figure 2.3). Not all flatworms and roundworms are parasites by nature; many live free in soil and water. Cells can be divided into two basic types: prokaryotes and eukaryotes. **This wide range recognizes the presence of people who may be long-term carriers of the tuberculosis (TB) bacterium. Cell wall teichoic acid is a polymer of ribitol or glycerol
and phosphate embedded in the peptidoglycan sheath. How are mass number and atomic number derived? This project was the brainchild of Dr. Craig biologists have dubbed this sort of shadow life Venter, a prominent genetics researcher,* whose goal was to surthat functions behind the scenes without yet being identified as vey the microbial
diversity of ocean water in more detail than "biological dark matter." ever before. This limitation, known as the host range, can vary from one virus to another. Whittaker's five-kingdom system served as the standard for a simple working model for a number of years. * cristae (kris9-te) sing. cell wall c. Describe cytopathic effects of viruses and the
possible results of persistent viral infections. The hydrocarbon portion of a fatty acid can vary in length from 4 to 24 carbons and, depending on the power of the ocular, the total magnification of standard light microscopes
can vary from 403 with the lowest power objective (called the scanning objective) to 2,00031 with the highest power objective (the oil immersion objective). Differentiate between transient and resident microbes. Small sugar molecules
called antibodies. vi LearnSmart Labs is a superadaptive simulated lab experience that brings meaningful scientific exploration to students. But they can only be used when the exact 80 Chapter 3 TABLE 3.6A Tools of the Laboratory Chemically Defined Synthetic Medium for Growth and Maintenance of Pathogenic Staphylococcus aureus 0.25 Grams
Each of These Amino Acids 0.5 Grams Each of These Amino Acids 0.12 Grams Each of These Amino Acids Cystine Histidine Leucine Phenylalanine Proline Tryptophan Tyrosine Arginine Glycine Isoleucine Lysine Methionine Serine Threonine Valine Aspartic acid Glutamic acid Additional ingredients 0.005 mole nicotinamide 0.005 mole thiamine —
Vitamins 0.005 mole pyridoxine 0.5 micrograms biotin 1.25 grams adjusted in 1,000 milliliters of distilled water and buffered to a final pH of 7.0. TABLE 3.6B Brain-Heart Infusion Broth: A Complex,
Nonsynthetic Medium for Growth and Maintenance of Pathogenic Staphylococcus aureus 27.5 grams brain-heart extract, peptone extract 2 grams glucose 5 grams sodium hydrogen phosphate Ingredients are dissolved in 1,000 milliliters of distilled water and buffered to a final pH of 7.0. nutritional needs of the test
organisms are known, electrons c. The process that selects for favorable adaptations is also a major force behind the evolution of species. (a) A walled cell is inflexible and cannot engulf large pieces of organic debris. They resist ordinary cleaning methods that use boiling water, soaps, and disinfectants, and they frequently contaminate cultures and
media. Invasion of the body is aided by several enzymes that digest fibrin clots (streptokinase), connective tissue (hyaluronidase), or DNA (streptodornase). Other types of archaea—the extreme halophiles—require salt to grow and may have such a high salt tolerance that they can multiply in sodium chloride solutions (36% NaCl) that would destroy
most cells. A major intent of this te x tb o ok has always b e en to promote an understanding of microb es and their intimate involvement in the lives of humans, but we have also aimed to stimulate an appreciation that go es f ar b eyond that. (b) Light pathway and image formation in light microscopes. Some cells lyse; enveloped viruses bud off host
cell membrane. They ended up with a virus that mimicked the structure, infectivity, and replication cycle of the poliovirus. What is molarity? (figure 2.26). polar and ionic chemicals with greatly reduced permeability. One virus (respiratory syncytial virus) is even named for this effect. laboratory animal. 1.7 The Origin and Evolution of Microorganisms
Expected Learning Outcomes 14. Capsule Page 96 Slime layer Page 96 Slime layer Page 96 Slime layer Page 101 Actin filaments Page 103 Chromosome (DNA) Page 103 Chromosome (DNA) Page 105 and some form of surface coating or glycocalyx. In gram-positive cells, a microscopic section resembles an open-faced sandwich with two layers: the thick cell wall, composed primarily of
peptidoglycan (defined in the next section), and the cell membrane. The chromophores of acidic dyes have a negative charge and therefore bind to areas of a cell carrying a positive charge. The most recent estimates from the World Health Organization (WHO) point to around 10 billion infections of all types across the world every year. Capsids and
envelopes are also responsible for helping to introduce the viral DNA or RNA into a suitable host cell, first by binding to the cell surface and then by assisting in penetration of the viral nucleic acid (discussed in later sections). Were any used in the Case Study, page 29? We consider the three most common sexual spores: * sporangium (spo-ran9-jee
um) pl. A simple example is hydrogen gas (H2), which consists of two hydrogen atoms. 8. Some unusual protozoa move by a gliding or twisting movement that does not appear to involve any of these locomotor structures. two oxygen atoms c. These associations are common on the skin, the oral cavity, and large intestine. Nonflagellar Appendages:
Fimbriae and Pili The structures termed fimbria* and pilus* both refer to common bacterial surface appendages that are involved in interactions with other cells but do not provide locomotion, except for some specialized pili. experience. (b1) Structural formulas clarify the exact relationships of the atoms in the molecule, depicting single bonds by a
single line and double bonds by two lines. Members * capsid (kap9-sid) L. Any membranous space in the cytoplasm. Define growth and explain the process of binary fission. For a stain to be considered differential, what must it do? (b) The cell spends more time on runs as it gets closer to an attractant. a molecule d. With special adaptations in lenses,
condensers, and light sources, four special types of microscopes can be described: bright-field, dark-field, phase-contrast, and interference. With gene therapy, the normal gene is inserted into a virus vector, such as an adenovirus, and the patient is infected with this altered virus. The building blocks of proteins are amino acids, which exist in 20
different naturally occurring forms. Prokaryotic cells are found only in the bacteria and archaea. One partner is favored by the association and the other is not harmed or helped. In most fungi, the hyphae are divided into segments by cross walls, or septa, a condition called septate (see figure 5.14c). The second shell has four orbitals and up to 8
electrons. They grow optimally in solutions of 25% NaCl but require at least 9% NaCl (combined with other salts) for growth. all of these 3. Check Your Progress SECTIONS 6.2 AND 6.3 5. When a team of curious scientists from nearby Montana Tech This site was formerly an open pit copper mine abandoned in 1982 University began examining
samples of the water under a microand left to fill up with water seeping out of the local aquifer. pyogenes pneumonia, and necrotizing fasciitis. The envelope has a unique architecture. (b) Three hexoses with the same molecular formula (C6 H12 O6) and different structural formulas. The valence of carbon makes it an ideal atomic building block to
form the backbone of organic molecules; it has 4 electrons in its outer orbital to be shared with other carbons) through covalent bonding. 5.7 Survey of Protists: Protozoa 147 Flagellum Ribosomes Mitochondrion Endoplasmic reticulum Nucleus Food vacuoles Pellicle Nucleolus Oral cilia in groove Cell membrane Golgi apparatus
Water vacuole Macronucleus Micronucleus Micronucleus Centrioles Gullet Water vacuoles (a) (c) Food vacuoles Apical complex Nucleus Secretory vesicle Golgi body Nucleus Endoplasmic reticulum Mitochondria Pseudopods Contractile vacuoles (b) Cell membrane (d) Figure 5.24 Comparisons of the trophozoite structure of four Phyla of protozoa. For
the first time, he used lesions from one child to inoculate another. One of the most prevalent groups products. What general characteristics are used to classify bacteria? Yeasts are single cells that form buds and pseudohyphae. For questions with blanks, choose the combination of answers that most accurately completes the statement. Theories that
withstand repeated scrutiny become laws in time. Pathogen Profile #3 Clostridium difficile Microscopic Morphology Grampositive bacilli, present singly or in short chains. Initially, a segment of the genetic code of DNA containing the instructions for producing a protein is copied into RNA and passed out through the nuclear pores directly to the
ribosomes on the endoplasmic reticulum. Because a water molecule is produced, this reaction is known as dehydration synthesis, a process common to most polymerization reactions (see proteins, page 50). The text is clear and there are graphics, stories, and well-organized information that builds in complexity to keep the student informed."—
Michelle Milner, Otawamba Community College x 6 en t 5' 3' 3' Nick 1 Like a great masterpiece hanging in a museum, Foundations in Microbiology is not only beautiful, but also tells a story, composed of many pieces. The word that overview of "The Chemical describes such a microbe is extremophile.* Elements" For additional information on the
functions on YouTube. Emerging diseases are newly identified conditions that are being reported in increasing numbers. 7.2 Classification of Nutritional Types Carbon Source Versus Carbon Function It may be helpful to clear up any confusion about the extracellular source of carbon as opposed to the intracellular function of carbon compounds.
minerologists studying (see photo). In general, microbes fall into one of three categories: those that do not use oxygen and can detoxify it; and those that do not use oxygen but can detoxify it; those that do not use oxygen but can detoxify it; and those that do not use oxygen but can detoxify it; those that can neither use oxygen but can detoxify it; and those that do not use oxygen but can detoxify it.
cell membrane, which functions as the gatekeeper for cellular activities. The large cells, named Epulopiscium fishelsoni ("guest at a banquet of fish"), meaThiomargarita Thi i namibia—giant ibi i cocci.i Three-dimensional micrograph of an sure around 100 mm in length, although some specimens Approximately how many times larger is ARMAN
measuring about 0.25 mm were as large as 300 mm. The endospore stain (spore stain) is similar to the acid-fast method in that a dye is forced by heat into resistant survival cells called spores or endospores. Every year hundreds of millions of chicken embryos are inoculated to prepare influenza vaccines. One viewpoint holds that viruses are unable to
exist independently from TABLE 6.1 Properties of Viruses • Obligate intracellular parasites of bacteria, protozoa, fungi, algae, plants, and animals • Ultramicroscopic size, ranging from 20 nm up to 450 nm (diameter) • Not cellular in nature; structure is very compact and economical. This tedious job fell this time to copy editor Bea Sussman and
proofreaders Dawnelle Krouse and Judy Gantenbein. In some cases, depending on the amount of contamination and the type of mold, these indoor fungi can also give rise to various medical problems. Depending on the water content of a cell as compared with its environment, a cell can gain or lose water, or it may remain unaffected. Show relatively
 advanced behavior (figure E) The majority of ciliates are free-living and harmless. This duplication is accomplished through the separation of the double DNA strand into two single strands. (b) Special staining reveals the microscopic appearance of a large, welldeveloped capsule (the clear "halo" around the cells) of Klebsiella (1,0003). Both species
have long, crescent-shaped cells with a single flagellum that is sometimes attached to the cell body by an undulating membrane. In terms of numbers, viruses are considered the most abundant microbes on earth. Other organelles include the Golgi apparatus, endoplasmic reticulum, vacuoles, and mitochondria (all discussed in chapter 5). These
techniques are aimed at reducing pathogens and do not necessarily sterilize. CHROMagar Orientation™ uses color-forming reactions to distinguish at least seven species and permits rapid identification and treatment. Check Your Progress questions to distinguish at least seven species and permits rapid identification and treatment.
simplest, methane (CH4; see figure 2.4c), which has a molecular weight of 16, to certain antibody molecules on earth. Check Your Progress SECTION 2.8 33. Antiviral drugs are designed to target one of the steps in the viral
life cycle you learned about earlier in this classification scheme—notably multicellular algae and the photosynthetic protozoans—most eukaryotic microbes have been readily accommodated in the Kingdom Protista as traditionally presented.
(a) Colorized TEM image of EM are the scanning probe mithe H1N1 influenza virus, displaying its internal contents. chlamydospore (klam-ih9-doh-spor) Gr. chlamydospore (klam-ih9-doh-spo
Gram Stain" to see a for bacteria. (a) A mixed culture of Micrococcus luteus and Escherichia coli can be readily differentiated by their colors. Mosquitoes (h1) are blood-sucking ectoparasites of humans that carry their own parasites of humans that carry their own parasites (h2) that can also infect humans. Check Your Progress SECTIONS 5.65.8 22. covalent 16. 4.3 The Cell Envelope: The
Boundary Layer of Bacteria A. What was a significant result of the Mars Phoenix project? Phosphate (PO432), a derivative of phosphoric acid (H3PO4), provides the final covalent bridge that connects sugars in series. This new "green" renewable energy source looks very promising. A parasite's actions generally damage the host through infection and
disease. Pasteur's Experiment Microbes being destroyed Vigorous heat is applied. The atmospheric gases that most influence microbial growth are oxygen (O2) and carbon dioxide (CO2). available at Answer Left: f A termite displayed d l d alongside l d its gut. 4 Enlargement of one cell to show genetic induction. What is the basis for a phylogenetic induction in fluence microbial growth are oxygen (O2) and carbon dioxide (CO2).
system of classification? * endocarditis (en9-doh-car-dye9-tis) Gr. endon, within, kardia, heart, and itis, an inflammation. A type of polygon. lated and poured in liquid form at temperatures (458C to 508C) that For an experiment to be properly controlled, sterile technique is necessary. Observe figure 3.15. Outline quorum sensing by using a flow
diagram to organize the stages. The eye examination given by optometrists is in fact a test of the resolving power of the human eye for various-size letters read at a distance of 20 feet. Explain the function of peptidoglycan and give a simple description of its structure. taL22600_ch04_088-121.indd Page 111 10/9/13 9:15 PM f-w-166 TABLE 4.3
/202/MH02004/taL22600 disk1of1/0073522600/taL22600 pagefiles Continued Volume 3 Phylum Firmicutes This collection of mostly gram-positive bacteria is characterized by having a low G 1 C content* (less than 50%). cocci (kok9-seye) Gr. Kokkos, berry. In general, the methods that a microbiologist uses to identify bacteria to the level of genus
and species fall into the categories of morphology (microscopic and macroscopic), bacterial physiology or biochemistry, serological analysis, and genetic techniques (chapter 17 and Appendix table C.1). The Origins and Dominance of Microorganisms For billions of years, microbes have extensively shaped the development of the earth's habitats and
influenced the evolution of other life forms. Additional details of viral diagnosis are provided in chapter 17. all of these Writing Challenge 5.2 and 5.3 Form and Function of the Eukaryotic Cell: External and Internal Structures A. Extremely high quality content, created by digital author Heidi Smith, includes case study modules, concept mapping
activities, animated learning modules, and more! Generate powerful data related to student performance based on question tagging for Learning Outcomes, ASM topics and outcomes, specific topics, Bloom's level, and more. 2Na 1 Cl2 - 2NaCl Most equations do not give the details or even exact order of the reaction but are meant to keep the
expression a simple overview of the process being shown. At the base are the oldest ancestral forms (somewhat like roots), and the trunk indicates the progression of major lines that emerge through selection. sporangia; Gr. sporos, seed, and angeion, vessel. Obviously, a community of microbes this large is bound to have enormous effects on our
physiology, immunity, and genetics. (a) General structure of a yeast cell, representing major organelles. www.mhhe.com Brief Contents CHAPTER 2 CHAPTER 2 CHAPTER 157 CHAPTER 7 CHAPTER 8 256 10 11 Physical and
Chemical Agents for Microbial Control 321 CHAPTER 12 Drugs, Microbes, Host—The Elements of Chemotherapy 353 CHAPTER 20 CHAPTER 21 Miscellaneous Bacterial Agents of Disease Genetic Engineering: A Revolution in Molecular Biology 293 CHAPTER 20 
Genetics CHAPTER 18 The Gram-Positive Bacilli of Medical Importance 574 An Introduction to Microbial Nutrition, Ecology, and Growth 185 CHAPTER 490 The Gram-Positive and Gram-Negative Cocci of
Medical Importance 543 6 An Introduction to Viruses 16 Disorders in Immunity CHAPTER 4 A Survey of Eukaryotic Cells and Microorganisms CHAPTER 4 A Survey of Eukaryotic Cells and Microorganisms 59
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CHAPTER 25 The RNA Viruses That Infect Humans 759 CHAPTER 26 Environmental Microbiology 799 CHAPTER 27 Applied and Industrial Microbiology 822 iii About the Authors Kathleen Park Talaro is a microbiology 799 CHAPTER 27 Applied and Industrial Microbiology 822 iii About the Authors Kathleen Park Talaro is a microbiology 822 iii About the Authors Kathleen Park Talaro is a microbiology 799 CHAPTER 26 Environmental Microbiology 822 iii About the Authors Kathleen Park Talaro is a microbiology 799 CHAPTER 27 Applied and Industrial Microbiology 822 iii About the Authors Kathleen Park Talaro is a microbiology 822 iii About the Authors Kathleen Park Talaro is a microbiology 822 iii About the Authors Kathleen Park Talaro is a microbiology 822 iii About the Authors Kathleen Park Talaro is a microbiology 822 iii About the Authors Kathleen Park Talaro is a microbiology 822 iii About the Authors Kathleen Park Talaro is a microbiology 822 iii About the Authors Kathleen Park Talaro is a microbiology 822 iii About the Authors Kathleen Park Talaro is a microbiology 822 iii About the Authors Kathleen Park Talaro is a microbiology 822 iii About the Authors Kathleen Park Talaro is a microbiology 822 iii About the Authors Kathleen Park Talaro is a microbiology 822 iii About the Authors Kathleen Park Talaro is a microbiology 822 iii About the Authors Kathleen Park Talaro is a microbiology 822 iii About the Authors Kathleen Park Talaro is a microbiology 822 iii About the Authors Kathleen Park Talaro is a microbiology 822 iii About the Authors Kathleen Park Talaro is a microbiology 822 iii About the Authors Kathleen Park Talaro is a microbiology 822 iii About the Authors Kathleen Park Talaro is a microbiology 822 iii About the Authors Kathleen Park Talaro is a microbiology 822 iii About the Authors Kathleen Park Talaro is a microbiology 822 iii About the Authors Kathleen Park Talaro is a microbiology 822 iii About the Authors Kathleen Park Talaro is a microbiology 822 iii About the Authors Kathleen Park Talaro is a microbiology 822 iii 
the multiplication cycle of lambda bacteriophages. Isolation of the microbes in the sample into discrete, separate colonies is one desired goal. * polymerase (pol-im9-ur-ace) An enzyme that synthesizes a large molecule from smaller subunits. An example is Gemmata (figure N). To compensate, they release enzymes to the extracellular environment and
digest the food particles into smaller molecules that can be transported into the cell (figure 7.3). Both (b) and (c) are examples of entry by endocytosis or engulfment, followed by uncoating. There is a big difference between forcing The next consideration involves your own learning style and yourself to memorize something to get by and really
wanting to what works best for you. The need for an intracellular habitat makes it necessary to grow viruses in living cells, either in isolated cultures of host cells (cell culture), in bird embryos, or in the intact host animal. Bacteriophages are viruses that attack bacteria. Which is the correct order of the taxonomic categories, going from most specific
to most general? During assembly of the virus, the nucleic acid is packed into the center of this icosahedron, forming a nucleocapsid. Origin of earth. The major difference between a spirochete and a spirillum is a. arbitrary, this definition still serves as a method to separate the bacteria into various kinds that can be cultured and studied. The
categories described here are meant to describe only the major nutritional groups and do not include unusual exceptions. brasiliensis Zoonotic/vector-borne Apicomplexan Protozoa Malaria: Plasmodium vivax, P. A polypeptide contains an unspecified number of amino acids but usually has more are meant to describe only the major nutritional groups and do not include unusual exceptions. brasiliensis Zoonotic/vector-borne Apicomplexan Protozoa Malaria: Plasmodium vivax, P. A polypeptide contains an unspecified number of amino acids but usually has more are meant to describe only the major nutritional groups and do not include unusual exceptions.
than 20 and is often a smaller subunit of a protein. structor has organized your course. They range in shape from filamentous to coccus or doughnut-shaped. First, the RNA of the virus becomes a message for synthesizing viral proteins (translation). How does the nucleus communicate with the cytoplasm? This phenomenon occurs because a hydrogen
atom in a covalent bond tends to be positively charged. 1 nm 0.5.5 nm DNA molecule Ultramicroscopic HIV Protein molecule 4.1 The sizes of the smallest organisms and objects. The terms ciliate and flagellate are common names of
protozoan groups that move by means of cilia and flagella. Negative Versus Positive Staining technique are used, depending upon how a dye reacts with the specimen (summarized in table 3.4). It can be transmitted to others. This is not a serious problem because, in such bacteria, the CFU is the smallest unit of colony
 formation and dispersal. By one estimate, viruses outnumber bacteria by a factor of 10. Obligate Mutualism Organisms are so intimately associated that they require each other to survive. Since these organisms are to intimately associated that they require each other to survive.
obligate intracellular parasites. differential medium MacConkey agar c. Nucleic acid (b) Capsid Hemagglutinin spike Neuraminidase spike Nucleocapsid Matrix protein Lipid bilayer Nucleocapsid Envelope 50 nm (b) (c) (d) Figure 6.6 Typical variations of viruses with helical nucleocapsids. of uncertain identity) introduced into it, like weeds into a
Figure 2.19 Phospholipids—membrane molecules. 4.6 Classification Systems of the Prokaryotic Domains: Archaea and Bacteria A. cyst passes through the stomach unharmed. Multiple-Choice Questions Select the correct answer from the answers provided. Most scientists expect that, in time, a majority of chronic conditions will be be linked to
microbial agents. • Microsporum is one cause of ringworm, which is a common name for certain heads (6003) fungal skin infections that often grow in a ringed pattern (see figure 22.18). Through differentiation, each of these cells enlarges to form an ascus, and its diploid nucleus undergoes meiosis (often followed by mitosis) to form four to eight enlarges to form an ascus, and its diploid nucleus undergoes meiosis (often followed by mitosis) to form four to eight enlarges to form an ascus, and its diploid nucleus undergoes meiosis (often followed by mitosis) to form four to eight enlarges to form an ascus, and its diploid nucleus undergoes meiosis (often followed by mitosis) to form four to eight enlarges to form an ascus, and its diploid nucleus undergoes meiosis (often followed by mitosis) to form four to eight enlarges to form an ascus, and its diploid nucleus undergoes meiosis (often followed by mitosis) to form four to eight enlarges to form an ascus, and its diploid nucleus undergoes meiosis (often followed by mitosis) to form four to eight enlarges to form an ascus, and its diploid nucleus undergoes meiosis (often followed by mitosis) to form four to eight enlarges to form an ascus, and its diploid nucleus undergoes meiosis (often followed by mitosis) to form four to eight enlarges to form an ascus, and its diploid nucleus undergoes meiosis (often followed by mitosis) to form four to eight enlarges to form an ascus, and its diploid nucleus undergoes meiosis (often followed by mitosis) to form four to eight enlarges to form an ascus, and its diploid nucleus undergoes meiosis (often followed by mitosis) to form four to eight enlarges to form an ascus, and its diploid nucleus undergoes to form an ascus, and its diploid nucleus undergoes to form an ascus, and its diploid nucleus undergoes to form an ascus, and its diploid nucleus undergoes to form an ascus, and its diploid nucleus undergoes to form an ascus, and its diploid nucleus undergoes to form an ascus, and its diploid nucleus undergoes to form an ascu
hapAscogonium (female) loid nuclei that will mature into ascospores. cell culture b. These spore types provide an important basis for classifying the major fungal divisions. The common term sugar (saccharide*) refers to a simple carbohydrate, * monomer (mahn9-oh-mur) Gr. mono, one, and meros, part. T an s oc y y l s t u a er ie io ut var rev M o icr
O CASE STUDY Part 1 Heart Valves and Biofilms n a summer morning in 2008, Mr. Maxwell Jones, a 65-yearculture was negative for bacterial pathogens he had to look for old man, woke up complaining of abnormal fatigue and other causes. two fatty acids and a phosphate bound to glycerol d. Check Your Progress SECTION 6.4 14. (c) Trophozoites
invade the large intestinal wall (see table 5.6, figure D.) (d) Mature cysts are released in the feces and may be spread through contaminated food and water. Numerous exciting technologies emerged from Koch's prolific and probing laboratory work. * spirochete (spy9-roh-keet) Gr. speira, coil, and chaite, hair. The general plan of virus organization is
very simple and compact. In electron micrographs, the appearance of a helical capsid varies with the type of virus. ruses that converted their RNA codes to DNA Another finding is a human bornavirus that belongs to a family of into a site in a host chromosome, and then became dormant and did not animal viruses that are not
retroviruses. Resolution defines the capacity of an optical system to distinguish two adjacent objects or points from one another. Distinguish different types of heterotrophs and their energy sources. Such media contain pure chemical nutrients that vary little from one source to another and have a molecular content specified by means of an exact
formula. Atoms with fewer than 4 valence electrons tend to donate electrons and those with more than 4 valence electrons tend to accept additional electrons; those with exactly 4 can do both. What is the pH of a solution with a concentration of 0.00001 moles/ml (M) of H1? cal substances that start a reaction and that are changed by the re13.
Explain how the images are formed, along with the role of light and the different powers of lenses. CHAPTER 5 A Survey of Eukaryotic Cells and Microorganisms Trypanosoma, a flagellated protozoan (1,5003) Hookworm larvae burrowing into the intestine (203) Larval schistosome, a parasitic roundworm (2003) Examples of microorganisms that
cause neglected diseases, distributed across the earth's tropical and subtropical zones (bands of blue) s ro g in ic he pal m t g of ua ted sin g ad ivid trac A u nnin d ex N tu be D in e hey he ir s um t t he d n ea t, as zed **. 176 Chapter 6 An Introduction to Viruses systems permits greater control, uniformity, and wide-scale harvesting of viruses. What
are their toxic effects? Which algal group is most closely related to plants? Subsequent illumination by ultraviolet radiation causes the specimen to emit visible light, producing an intense blue, yellow, orange, or red image against a black field. * anion (an9-eye-on) A negatively charged ion that migrates toward the positive pole, or anode. A number of
significant microbial groups (viruses, rickettsias, and a few bacteria) will only grow on live cells or animals. (c) Locomotor patterns seen in flagellates. ribosomes b. Phylum Fusobacteria 12. organic 15. bacill, small staff or rod. Bacterial Taxonomy: A Work in Progress There is no single official system for classifying the prokaryotes. 26 Chapter 1 The
Main Themes of Microbiology Level I. 29 30 Chapter 2 The Chemistry of Biology 2.1 Atoms: Fundamental Building Blocks of All Matter in the Universe Expected Learning Outcomes 1. Those hardest hit are residents in countries where access to adequate medical care is lacking. Several times since the 1960s, however, scientists have discovered
billion-year-old fossils of prokaryotes that look very much like modern bacteria (see figure 4.28c). Plotting the logarithm number over time provides a straight line indicative of exponential growth. The predominant organic molecules in cells are proteins, a fitting term adopted from the Greek word proteios, meaning first or prime. A similar section of a
gram-negative cell envelope shows a complete sandwich with three layers: an outer membrane, a thin peptidoglycan layer, and the cell membrane. Check Your Progress SECTION 7.2 5. Another weird, ancient ultraextremophile was discovered 3 kilometers down in an African gold mine. Using Cell (Tissue) Culture Techniques The most important early
discovery that led to easier cultivation of viruses in the laboratory was the development of a simple and effective way to grow populations of isolated animal cells in culture. Proteins are synthesized by linking amino acids with bonds. Clinical specimens for determining the cause of an infectious disease are obtained from body fluids (blood
cerebrospinal fluid), discharges (sputum, urine, feces), or diseased tissue. The synthesis and breakage of each type of bond require a specialized catalyst called an enzyme (see chapter 8). Flask inoculated Samples taken at equally spaced intervals (0.1 ml) 60 min 300 min 360 min 360 min 480 min 540 m
0.1 ml Sample is diluted in liquid agar medium and poured or spread over surface of solidified medium Plates are incubated, colonies are counted None Number of colonies (CFU) per 0.1 ml Bacilli are less varied in arrangement because they divide only in the transverse plane (perpendicular to the axis). trophozoite 4. Figure 2.8 Hydrogen bonding in
water. A unique type of inclusion found in some aquatic bacteria is gas vesicles that provide buoyancy and flotation. TABLE 4.5 The discovery and characterization of novel prokaryotic cells that have unusual anatomy, physiology, and genetics changed our views of microbial taxonomy and classification (see chapter 1 and table 4.3). Why are spores so
difficult to destroy? An area of microbiology students still experience this sensation, and even experienced microbiologists remember their first view. Another pathological effect observed in these diseases is the buildup of tiny protein fibrils in the brain
tissue (figures 6.21a and 6.21b). Without it, I would not be doing well." LearnSmart is the only adaptive learning program proven to effectively assess a student's knowledge of basic course content and help them master it. We know little about the earliest cells, called progenotes, except that they were prokaryotic. Looking at the tree of life (figure
1.14), determine which kingdom or kingdoms humans are most closely related to. Originating from, and continuous with, the outer membrane of the nucleus remains fixed in a specific cellular site, it must direct these activities
through a structural and chemical network (figure 5.8). Discuss the importance of prions and viroids and the diseases they cause the
 agent in modern genetic engineering techniques. TABLE 3.4 Comparison of Positive Staining Negative Staining Appearance of cell Colored by dye Clear and colorless Background Not stained (generally white) Staining Appearance of cell Colored by dye Clear and colorless Background Not stained (generally white) Staining Appearance of cell Colored by dye Clear and colorless Background Not stained (generally white) Staining Appearance of cell Colored by dye Clear and colorless Background Not stained (generally white) Staining Appearance of cell Colored by dye Clear and colorless Background Not stained (generally white) Staining Appearance of cell Colored by dye Clear and colorless Background Not stained (generally white) Staining Appearance of cell Colored by dye Clear and colorless Background Not stained (generally white) Stained (generally white) Staining Appearance of cell Colored by dye Clear and colorless Background Not stained (generally white) Stained (generally white) Staining Appearance of cell Colored by dye Clear and colorless Background Not stained (generally white) Stained (generally whit
Acidic dyes: Nigrosin India ink Subtypes of stains Several types: Simple stain Spore stain Structural stains Gram stain Spore 
mounts so that they can be observed as near to their natural state as possible. He had recently been studying the roles of microorganisms in the fermentation of beer and wine, and it was clear to him that these processes were brought about by the activities of microbes introduced into the beverage from air, fruits, and grains. Fungi are often found in
nutritionally poor or adverse environments. Centrioles Interphase (resting state prior to cell division) Chromatin 1 Cell membrane Nuclear envelope Prophase Nucleolus 2 Cytoplasm Daughter cells Cleavage furrow Telophase 9 Early metaphase 9 Early telophase 7 Metaphase 4 Late anaphase 6
Early anaphase 5 Process Figure 5.6 Changes in the cell and nucleus during mitosis of a eukaryotic cell (1) Before mitosis (at interphase), chromosomes are visible only as chromatin. Viruses Mycoplasmas Bacterial flagellum Comparison of objects that would not be resolvable under oil immersion at 1,0003
magnification. Clear patches in cell cultures that indicate sites of virus infection are called a. Close examination will also reveal darkly stained metachromatic granules. Explain how animal viral infections are treated and detected. Otherwise, the two types have numerous differences (table 3.3). (a) Mannitol salt agar can selectively grow
Staphylococcus species from clinical samples. spikes d. What are some of the reasons that account for this dilemma with our microbial coinhabitants? Because the wavelength must pass between the objects that are being resolved, shorter wavelengths (in the 400-500 nm range) will provide better resolution (figure 3.4). Because this layer in gram-
positive cells is thicker, the entrapment of the dye is far more extensive in them than in gram-negative cells. With the spread plate technique, a small volume of liquid from a diluted sample is pipetted onto the surface of the medium and spread around evenly by a sterile spreading tool (sometimes called a "hockey stick"). The eighth edition saw an
 unveiling of a new feature in the disease chapters called "Pathogen Profiles," which are abbreviated snapshots of the major pathogens in each disease chapter. Elements may exist in variant forms called isotopes. endocytosis, penetration, replication, maturation, and exocytosis 13. CHAPTER 7 Microbial Nutrition, Ecology, and Growth Euglena
mutabilis—metal eaters extraordinaire The Berkeley Pit—a murky brown soup of toxic chemicals s ro g in ic he pal m t g of ua ted sin g ad ivid trac A u nnin x e d e DN tu b in e hey he ir s um t t he d n ea t, as zed **. They are also one of a few groups of microbes that can convert nitrogen gas (N2) into ammonium (NH41) that can be used by plants
making them essential players in the nitrogen cycle. For survival, cells must transport waste materials out of the environmental surfaces and the development of biofilms and mats. The word itself can be used to indicate a lining or covering including such multicellular
structures as the mucous membranes of the body. But most molecules, for example carbon dioxide (CO2) and water (H2O), contain two or more different elements and are more appropriately termed compounds. For example, MacConkey agar contains neutral red, a dye that is yellow when neutral and pink or red when acidic. Notes requires you to
think about microbes and how to manage them. Wavelength of light in nm Resolving power (RP) 5 2 3 Numerical aperture of objective lens From this equation, it is evident that the resolving power is a function of the wavelength of light that forms the image, along with certain characteristics of the objective. New strands are then synthesized using
the original strands as guides to assemble the correct new complementary bases. Image and artist's interpretation of the ciliate Blepharisma, a common inhabitant of pond water. 75, 77-84 Identification Analysis of collected data to help support a final determination of the types of microbes present in the original sample. Polychaos—a l h giant i
amoeba b uses several pseudopods to feed on diatoms (1003) D. perfringens, the cause of gas gangrene. Model of an ATP molecule, the chemical form of energy transfer in cells. This worm causes trichinellosis. (a) (b) (c) Figure 1.5 A microscopic wonderland. Other Substances in the Virus Particle In addition to the protein of the capsid, the proteins
and lipids of envelopes, and the nucleic acid of the core, viruses can contain enzymes for specific operations within their host cell. The bacterial flagellum when viewed under high magnification displays three distinct parts: the filament, the hook (sheath), and the basal body (figure 4.3). (a) Prions and Other Nonviral Infectious Particles 6.8 Prions And Othe
Other Nonviral Infectious Particles Expected Learning Outcomes 24. proved 11. The term generation has a similar meaning as it does in humans. 1.4 Microbial Roles in Infectious Diseases A. Compare Domain Archaea with Domains Bacteria and Eukarya. Atomic Number Atomic Mass** Ionized Forms (See page 37). Describe the structure and position
of bacterial flagella and axial filaments, and their attachment patterns. The sampling itself can remove enough viable cells to alter the tabulations, but since the purpose is to compare relative trends in growth, these factors do not significantly change the overall pattern. Describe the general structure and size range of viruses. cruzi, species that are
closely related but geographically restricted. order, family b. As the bacterium shows little drug resistance, treatment is generally a simple course of penicillin. leishmaniasis f. Why was the abandonment of the spontaneous generally a simple course of penicillin. leishmaniasis f. Why was the abandonment of the spontaneous generally a simple course of penicillin.
thin out the sample over the surface of the medium. Describe the steps you would take to isolate, cultivate, and identify a microbial pathogen from a urine sample. Microbiologists have always been aware of microbes that could not be cultivated artificially, and now we can detect a single bacterium in its natural habitat without cultivation (see 3.1
 Secret World of Microbes). This structure explains many characteristics of membranes, including flexibility, permeability, specificity, and cleanliness are important. discovering precious metals 3. They are one of the main com
floating Quick Search community of microscopic organisms Find the video "Brink: Algae to called plankton. Tests for blood cultures and a white microbial biofilms." wife was worried over how pale he looked. Sulfur SO422 (sulfate) SH (sulfhydryl) Potassium K1 Mineral deposits, ocean water, soil Plays a role in protein synthesis and membrane
transport Sodium Na1 Same as potassium Major participant in membrane actions; maintains osmotic pressure in cells Calcium Ca1 Oceanic sediments, rocks, and soil A component of protozoan shells (as CaCO3); stabilizes cell walls; adds resistance to bacterial endospores Magnesium Mg21 Geologic sediments, rocks, and soil A central atom in the
chlorophyll molecule; required for function of membranes, ribosomes, and some enzymes Chloride Cl2 Ocean water, salt lakes May function in membrane transport; required by obligate halophiles to regulate osmotic pressure Zinc Zn21 Rocks, soil An enzyme cofactor; regulates eukaryotic genetics Iron Fe21 Rocks, soil Essential element for the
structure of respiratory proteins (cytochromes) Geologic sediments, soil Required in tiny amounts to serve as cofactors in specialized enzyme systems of some microbes but not all Micronutrients: copper, cobalt, nickel, molybdenum, manganese, iodine *As a portion of the earth's atmosphere. The nitrogen base is a cyclic compound that comes in two
forms: purines (two rings) and pyrimidines (one ring). Figure 5.24 depicts various aspects of these protozoan types. What are spikes, how are they formed, and what is their function? Figure 4.2 shows a three-dimensional illustration of a generalized (rod-shaped) bacterial cell with most of the structures from the flowchart. Decomposition involves the
breakdown of dead matter and wastes into simple compounds that can be directed back into the natural cycles of living things (figure 1.5b). It was spread from the Americas to Europe. Determinants of Population Growth In reality, a population of bacteria does not maintain its potential growth rate and does not double endlessly, because in most
systems numerous factors prevent the cells from continuously dividing at their maximum rate. 3.2 The Microscope: Window on an Invisible Realm them apart because they have similar optical properties. Figure 2.2 presents various simplified models of atomic structure and electron maps, superimposed over a partial display of the periodic table of
elements. On the beneficial side, however, fungi play an essential role in decomposing organic matter and returning essential minerals to the soil. Pseudopods are blunt, branched, or long and pointed, depending on the particular species. L-lysine D-glutamate L-lysine D-glutamate L-lysine D-glutamate L-alanine -glycine -glycin
glycine environmental conditions. 1.2 General Characteristics of Microorganisms and Their Roles in the Earth's Environments Expected Learning Outcomes 3. The outermost orbitals are most accurately portrayed as sets of lobe-shaped pairs rather than circles or spheres. Infectious diseases still devastate human populations worldwide, despite
significant strides in understanding and treating them. It is the cell that is the evolution of the Eukarya. Simple electron models show how the
electrons are shared in these bonds. Describe several cytopathic effects of viruses. Lysogeny is a less deadly form of infection than the full lytic cycle and is thought to be an advancement that allows the virus to spread without killing the host. The second edition of this large collection now includes genetic information that clarifies the phylogenetic
(evolutionary) history and relationships of the thousands of known species (figure 4.27). deoxyribose, phosphate, and nitrogen bases b. One of the main reasons that viruses are generally considered nonliving is that they are not cellular. If a microbe is not capable of dealing with toxic oxygen by these or similar mechanisms, it will be restricted to
habitats free of oxygen. The most noticeable of these are the chloroplasts, which contain, in addition to the green pigment chlorophyll, a number of other pigments that create the yellow, red, and brown coloration of some groups. * biogenesis (by-oh-gen9-uh-sis) to begin with life. They assist the plants in obtaining nutrients and water and may protect
them against disease. (a) Large particles (pink) of polyhydroxybutyrate are deposited in an insoluble, concentrated form that provides an ample, long-term supply of that nutrient (32,5003). 34 Chapter 2 The Chemistry of Biology Figure 2.4 Examples of molecules with covalent bonding, mine fundamental chemical characteristics such as nutrient
requirements, products given off during growth, presence of enzymes, and mechanisms for deriving energy. But this optimistic viewpoint was on a collision course with a vast army of very tiny invaders that are everywhere—namely, microorganisms. 22. presence of flagella c. The other factor influencing resolution is the numerical aperture (NA), a
mathematical constant derived from the physical structure of the lens. All life on earth evolved from simple cells appearing in ancient oceans about 3.5 billion years ago. Additional information on the connection between viruses and cancer is found in chapter 24. molecules such as proteins are now represented by computer 8. Note: This mechanism is
how wall-free cells divide. Proteins are collected within the RER cisternae and distributed through its network to other destinations. This process can be represented by logarithms (2 raised to an exponent) or by simple numbers. Some are restricted to a few substrates, whereas others (certain Pseudomonas bacteria, for example) are so versatile that
they can metabolize hundreds of different substrates. We will return to this discussion about viruses in chapter 6. Fertilized eggs are usually released to the environment and are provided with a protective shell and extra food to aid their development into larvae. Microscopic fungi are known as yeasts and molds. Describe the shapes and arrangements
of bacteria in figure 4.23a, b, e, and f. This work requires high-level biohazard containment. Discuss some advantages and disadvantages are disadvantages and disadvantages are disadvantages and disadvantages are disadvantages and disadvantages are disadvantages are disadvantages and disadvantages are disadvantages are disadvantages are disadvantages are disadvantages are disadvantages a
will serve to summarize their major characteristics and to compare and contrast them with prokaryotic cells (see chapter 4), especially from the standpoints of structure, physiology, and other traits (table 5.2). ties (nicotinamide adenine dinucleotide [NAD], for instance) are also derivatives of nucleotides (see chapter 8). Sucrose is formed when
glucose and fructose bind oxygen between their number 1 and number 2 carbons. 188 Chapter 7 TABLE 7.1 Microbial Nutrition, Ecology, and Growth Sources and Biological Functions of Essential Elements and Nutrients Element/Nutrient Forms Found in Nature Sources/Reservoirs of Compounds Significance to Cells Carbon dioxide)
gas CO322 (carbonate) Organic compounds Air (0.036%*) Sediments/soils Living things CO2 is produced by respiration and used in photosynthesis; CO322 is found in cell walls and skeletons; organic compounds are essential to the structure and function of all organisms and viruses. Indicates the minimum number of group members necessary to
conduct business. A common laboratory medium, nutrient broth, contains beef extract and peptone dissolved in water. Fatty acids having at least one carbon—carbon double bond are considered unsaturated (figure 2.18b). specere, kind. posed of short chains of amino acids, such as a dipeptide (two amino acids), a tripeptide (three), and a
tetrapeptide (four) (figure 2.22). Note the range of cell shapes (cocci, rods, and squares) found in this community. subsequent generations. mitochondrion; Gr. mitos, thread, and chondrion, granule. Gemmata—view of a budding cell O. 0.2 µm 1,000 × Bacillus 1 µm Diplococcus Rickettsias Yeast Streptococcus Resolvable In practical terms, this
calculation means that the oil immersion lens can resolve any cell or cell part as long as it is at least 0.2 mm (figure 3.6). Used for live specimens; specimen is contrasted against gray background; excellent for internal cellular detail. Describe the two
major groups of photosynthetic bacteria and how they are similar and different. The recombination of genes from these viruses can give rise to new viruses with spikes that fit all of the hosts. isolating intestinal pathogens (MacConkey agar, Hektoen enteric A selective medium (table 3.7) contains one or more agents [HE] agar) contain bile salts as a
selective agent (figure 3.19b). How are phagocytosis and pinocytosis similar? For questions with blanks, the statement. Answer available at Glycocalyx Page 126 T This new feature reminds studdents that videos, animation, aand pictorial displays that provvide further information on the topic are just a "click" away to uusing their smart-phone, tablet,
oor computer. In certain protozoa, cilia line the oral groove and function in feeding; in others, they fuse together to form stiff props that serve as primitive rows of walking legs. single type of capsomers (figure 6.7). vides a protective haven that favors survival of the lichen body. There are
variations in the mechanisms of photosynthesis. It contains lactose and bromcresol purple dye. Two general forms of EM are the transmission electron microscope (SEM) (see table 3.2). ion (Cl2). Some microscopes are equipped with 203 oculars or
special annuli that can double their magnification. This can cause severe side effects. It can be simply represented by the equation: Glucose [C6H12O6] 1 6O2 n 6CO2 1 6H2O 1 Energy(ATP) (a) (b) Figure 7.2 Examples of chemotrophy. Several viruses remain in a latent state, meaning that they remain inactive or nonproductive over long periods.
Because electrons cannot readily penetrate Image produced by Light rays Electron beam thick preparations, the specimen must be stained or coated with Image focused by Glass objective Electromagnetic metals that will increase image contrast and sectioned into exlens objective lenses tremely thin slices (20–100 nm thick). Another common
symbiotic relationship is commensalism.* Commensal organisms live in close contact, but only one partner benefits, while the other receives neither benefits neither benefits and the other receives neither benefits neither benefits neither benefits.
can be defined as a. Viruses, being much smaller than bacteria, fungi, and protozoa, had to be indirectly studied until the 20th century, when they were finally seen with an electron microscope. In this model, the two strands (helixes) coil together, with the sugar-phosphate forming outer ribbons, and the paired bases 53 2.8 Nucleic Acids: A Program
for Genetics Cells Events in Cell Division Events in Cell Division Events in DNA Replication A T C G A T G C Backbone strands H-bonding severed T A New bases C G A T G C Two single strands Base pairs Quick Search Look for an "Assembly of DNA" video on YouTube. The fossil record for these periods are incomplete because most of the tiny microbes were too delicate to
fossilize. Paddack, Weatherford College Kim Raun, Wharton County Robin Patterson, Butler County Community College George Risinger, Oklahoma City Community College Jenna Simpson, Iowa Western Community College Sherry Stewart, Navarro College Lisa M. Every line
of text and every piece of art in this book is scrutinized for instructional usefulness, placement, and distribute nutrients from the substrate. Folds in the cell membrane could wrap around the chromosome terial
cell would forge a to form a nuclear envelope. This is even true of bacterial pathogens in the body. Medically significant members include the obligately parasitic E. Unjoined ends of the nucleotides (a nick) must be connected by a ligase. Photosynthetic bacteria, however, are independent cells that contain special lighttrapping pigments and can use
the energy of sunlight to synthesize all required nutrients from simple inorganic compounds. Plotting the data arithmetically gives a constantly curved slope. The photosynthetic role * lysosome (ly9-soh-sohm) Gr. lysis, dissolution, and soma, body. The structure and behavior of flagella and cilia were discussed in section 5.1. Flagella vary in number
from one to several, and in certain species, they are attached along the length of the cytoplasmic membrane (see figure 5.26a). Describe the process of population growth and how it is measured. Answer available at such as prostate cancer and chronic fatigue syndrome. In reality, however,
most of the chemical reactions and structures of living things occur at the level of more complex molecules, termed organic chemicals. Other microbes are responsible for the breakdown and recycling of nutrients through decomposition. Shewanella oneidensis (shee0-wan-el9-uh oh-ny0-den9-siss). Procedures start at the central "hub" of specimen
collection and flow from there to inoculation, incubation, and so on. They form stable associations with plant roots (mycorrhizae) that increase the ability of the roots to absorb water and nutrients. Let us use the example of Staphylococcus aureus to calculate how many cells (Nf) will be present in an egg salad sandwich after it sits in a warm car for 4
hours. As a flagellum rotates counterclockwise, the cell itself swims in a smooth linear direction toward the stimulus; this action is called a run. This means that the vesicle membrane becomes altered so that the viral nucleocapsid or nucleic acid can be released into the cytoplasm. Magnification in most microscopes results from a complex interaction
between visible light waves and the curvature of the lens. porospore. Vaccine experts have engineered new types of vaccine by combining a less harmful virus such as HIV and herpes simplex. (a) Starting with a single cell, if each product of reproduction goes on to divide by binary
fission, the population doubles with each new cell division or generation. Starting in 2010, pertussis (whooping cough) cases began to increase dramatically over the next 2 years. Net diffusion of water is into the cell; this swells the protoplast and pushes it tightly against the wall. Nanomedicine is one of the most rapidly growing areas of research.
Many protozoans produce resistant survival cells called cysts, and worms go through complex reproductive phases with eggs and larvae. To read about a program to improve the conditions of the bottom billion go to . 187 Sunlight is the main source of energy for most organisms on earth. Microbes settle and grow throughout the Arctic and Antarctic
and in the deepest parts of the ocean in near-freezing temperatures. Which of these is/are an example(s) of neglected tropical protozoan diseases? Transport media are used to maintain and preserve specimens that have to be held for a period of time before clinical analysis or to sustain delicate species that die rapidly if not held under stable
conditions. Once a chain has assumed the secondary structure, it goes on to form yet another level of folding and compacting—the tertiary (38) structure. Expected Learning Outcomes 9. He dismissed his possible risk factors. Jenner and the Introduction of Vaccination We saw in figure 1.10 how the English physician and scientist Edward Jenner
modeled the scientific method. This microscope uses a laser beam of light to scan various depths in the specimen and deliver a sharp image focusing on just a single plane. (a) Semisolid media have more body than liquid media but are softer than solid media have more body than liquid media but are softer than solid media have more body than liquid media but are softer than solid media have more body than liquid media have more body than liquid media have more body than liquid media but are softer than solid media have more body than liquid media have more 
thermophilic rods that inhabit underwater volcanoes. This altered gene expression gives the bacteria a different set of characteristics, often making them impervious to antibiotics and disinfectants. The most recent projects were the Phoenix probe in 2012. Rhizopus 19. At first, the cause was not clear, but workers had
Is There a Fungus in the House? genetic material b. Prokaryotic cells are the basic structural unit of bacteria and archaea. A spherical conidium formed by the thickening of a hyphal cell. Viral genomes often encode toxins, Bacteriophage assembly line. (b) Differential stains: Gram, acid-fast, and spore. euglenid 22. This concept is best visualized by
comparing microbial groups with some organisms of the macroscopic world and also with the molecular world (figure 1.4). Chapter Summary with Key Terms s ro g in ic he pa l m t g of ua ted sin g ad ivid trac A u nnin x N e d in ey e D stu mb e h he ir u t t he d n ea t, as zed **. The Gram-Negative Cell Wall The gram-
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negative cell wall is more complex in morphology because it is composed of an outer membrane (OM) and a thinner shell of peptidoglycan (see figures 4.13 and 4.15). (a) A cell preserved in Siberian shale deposits dates from 850 million to 950 million years ago. This transmits a continuous cone of light from the condenser to the objective, thereby
increasing the amount of light and, consequently, the numerical aperture. (a) Major saccharide groups, named for the number of sugar units each contains. Children frequently reinfect themselves and also pass the parasite on to others. culture made in an embryo d. Some people call them "germs" or "bugs" in reference to their role in infection and
disease, but those terms have other biological meanings and perhaps place undue emphasis on the disagreeable reputation of microorganisms. Oxygen (AN 5 8) has a filled first shell and a partially filled second shell of 6 electrons. It then must be tested and retested. What are their distinctive biological characteristics? Figure 6.1 compares the sizes
of several viruses with prokaryotic and eukaryotic cells and molecules. Fungal cell walls have a thick, inner layer of polysaccharide fibers composed of chitin or cellulose and a thin outer layer of mixed glycans. The cell wall of gram-positive bacteria is loosely adherent to the cell membrane, but at their junction lies a small compartment called the
periplasmic* space. Compare the basic structure of the cell envelopes of gram-positive and gram-negative bacteria. mater, mother or origin. Humans appeared. The division of a bacterial cell occurs mainly through binary, or transverse, Quick Search fission. The term binary means that one Search the internet for the cell becomes two, and transverse
refers to video "A nice the division plane forming across the width introduction to of the cell. The too extreme conditions to support life as we microbial." results were mostly negative and positive staining, giving examples. Evolutionary change occurs when
the environment places pressure on organisms that selects for survival of those with more adaptive inheritable traits. It also refers to the effects of the agent on nervous tissue, which develops a spongelike appearance due to loss of nerve and glial cells (see figure 25.28b). * hypha (hy9-fuh) pl. Miscellaneous Lipids Steroids are complex ringed
compounds commonly found in cell membranes and animal hormones. The cells of eukaryotic organisms are so varied that no one member can serve as a typical example, so a composite structure of a eukaryotic cell is depicted in figure 5.2. No single type of microbial cell would contain all structures represented. this equation: Check Your Progress
15. It aims to explain how and why phenomena occur and to predict what is expected to happen under known conditions. The amoeba has no cell wall to protect it, so it must expend energy to deal with the influx of water. negative stain c. ium, and its nucleus produces, through meiosis, four haploid nuclei. Examples of solutions are salt or sugar
in 1,000 ml (1 liter) produces a 0.3% solution. + + + - - - + 39 + + + + + - + - + - Figure 2.12 Hydration spheres formed around ions in solution. * mitochondria (my0-toh-kon9-dree-uh) sing. The electron beam scans over the surface of the specimen and produces a dramatic threedimensional image. Table 4.5 outlines selected points of
comparison of the three domains. (e) Spread plate and (f) its result. Explain how this happens and cite examples in your answer. * hydrophobic (hy-droh-fob9-ik) Gr. phobos, fear. Both groups utilize sulfur compounds (H2S, S) in their metabolism. Distinguish different types of autotrophs and their energy sources. Compare the functions of the bacterial
chromosome (nucleoid) and plasmids. To get a perspective on proportions, consider this: If an atom were the size of a football stadium, the nucleus would be about the size of a marble! The stability of atomic structure is largely maintained by • • the mutual attraction of the protons and electrons (opposite charges attract each other), and the exact
balance of proton number and electron number, which causes the opposing charges to cancel each other out. Diffusion osmosis A fundamental property of atoms and molecules that exist in a state of random motion Nonspecific Brownian movement of small uncharged molecules across membranes Facilitated diffusion Molecule binds to a
carrier protein in membrane and is carried across to other side. This bacterium is widespread in many habitats, but its resistance to radiation sets it apart from every other organism ever known. Other fascinating viruslike agents in human disease are defective forms called satellite viruses that actually depend on other viruses for replication. 5.5 (a)
Sporangiospore 139 The Kingdom of the Fungi (b) Conidia Arthrospores Sporangiophore Columella 1 1 2 3 Sporangiophore Conidia Porospore Microconidia Porospores Sterigma Sporangiophore Columella 1 1 2 3 Sporangiophore Columella 1 3 3 5 Sporangiophore Columella 1 3 3 5 Sp
viruses, and so on. phialospore (fy9-ah-lo-spor) Gr. phialos, a vessel. dark-field c. A more accurate equation for this reaction is: 2H2 1 O2 - 2H2O In decomposition reactions, the bonds on a single reactant molecule are permanently broken to release two or more product molecules. capsulatum, but only if the genus name has already been stated. Are
they organisms; that is, are they alive? Synthesis: Replication and Protein Production The synthesis: Replication and Protein Protein Protein Production The synthesis: Replication and Protein 
Pages 129, 130 Microfilaments Page 131 Flagellum or cilium* Pages 127, 128 Smooth endoplasmic reticulum Page 127 Lysosome Page 131 Nucleolus Pages 127, 128 Smooth endoplasmic reticulum Page 127 Lysosome Page 131 Nucleolus Pages 127, 128 Smooth endoplasmic reticulum Page 127 Lysosome Page 130 Flagellum or cilium* Pages 127, 128 Smooth endoplasmic reticulum Page 127 Lysosome Page 131 Nucleolus Pages 127, 128 Smooth endoplasmic reticulum Page 128 Structure not present in all cell
types Figure 5.2 Overview of composite eukaryotic cell. Membranes are dynamic and constantly changing because the lipid phase is in motion, which allows some proteins to migrate to specific locations where they are needed. biofilm formation, free-floating or swimming microbes—often described as planktonic—are attracted to a surface and composite eukaryotic cell.
to rest or settle down, as a group (figure 4.5). 193 differing concentrations where the solute cannot pass across (protein, for example), then under the laws of diffusion, water will diffuse at a faster rate from the side that has more water to the side that has less water. They develop either by pinching off the tip of a special fertile hypha or by
segmentation of a preexisting vegetative hypha. How can a capsule or slime layer be detected even at the level of a colony? Biochemistry is the study of molecules that are found in living things. Describe the structure of the cell membrane, and explain several of its major roles in bacterial cells. HIV, the AIDS virus, belongs in this group. It is
approximately 20 nm in diameter and varies from 1 to 70 mm in length. begins pouring in from many of these environments, it is clear that after 300 years of observing the microbial world, we have really just scratched the surface. Note the range of sizes as compared with eukaryotic cells and viruses. boiling temperature Volume 1 Domain Bacteria
This domain contains deeply branching and photosynthetic bacteria that are considered the oldest evolutionary lines still in existence. All macromolecules except lipids are formed by polymerization, a process in which repeating subunits termed monomers* are bound into chains of various lengths termed polymers.* For example, amino acids
(monomers), when arranged in a chain, form proteins (polymers). Discuss features of eukaryotic ribosomes. The mechanisms for transport of molecules into cells are summarized in table 7.3. Process is endocytosis; examples are phagocytosis and pinocytosis check Your Progress SECTION 7.3 9. If one also takes into account prominent viral infections
found only in certain regions of the world (dengue fever, Rift Valley fever, and yellow fever), the total could easily exceed several billion cases each year. This debate has greater philosophical than practical importance because viruses are agents of disease and must be dealt with through control, therapy, and prevention, whether we regard them as
living or not. As additional information four divisions. (b) In an enveloped virus such as herpesvirus, the entire virus is taken into a vesicle with subsequent release of the DNA. buds c. Photosynthesizers use it to produce organic nutrients that feed other organisms. (b) Trophozoites (amoebas) emerge from cysts.
not by itself an indicator of life? Phylum Spirochetes These bacteria are distinguished by their shape and mode of locomotion. Periplasmic Flagella. These fruiting structures are often large enough to be seen with the unaided eye on tree
bark and plant debris. I and my adjuncts have reduced the time we spend on grading by 90 percent and student test scores have risen, on average, 10 points since we began using Connect!" —William Hoover, Bunker Hill Community College Save time with auto-graded interactive
assignments using high-quality art from the textbook, and animations and videos from a variety of sources take you way beyond multiple choice. Enveloped viruses are liberated by budding or exocytosis3 from the membranes of the cytoplasm, nucleus, endoplasmic reticulum, or vesicles. During periods of nutrient abundance, some can compensate by
storing nutrients as inclusion bodies, or inclusions, of varying size, number, and content. You will also see the terms formula weight and molecular weight and molecular weight and molecular weight used interchangeably, and they are indeed synonyms. organelles, providing support, and permitting shape changes and movement in some cells. 43 44 Chapter 2 The Chemistry of Biology
CLINICAL CONNECTIONS Nanoparticles—Molecule-Sized "Smart" Pills In the near future, it may be possible to treat an infection or cancer by taking a single tiny dose of medicine by nose, mouth, or skin. Some proteins form a binding layer between the envelope and capsid of the virus, and glycoproteins (proteins bound to a carbohydrate) remain
exposed on the outside of the envelope. As a result, it can form stable chains containing thousands of carbon atoms and still has bonding sites available for forming covalent bonds with numerous other atoms. Occasionally, they are cultured in order to verify all of the life stages. Miscellaneous Environmental Factors Descent into the ocean depths
subjects organisms to increasing hydrostatic pressure. organisms free-floating in the aquatic environment 3. These inducer molecules enter biofilm cells and stimulate specific genes on their chromosomes to begin expression. Substances found in abundance are robust colonists had survived, grown, and turned out to be teeming lead, cadmium, iron
copper, arsenic, and spread into available habitats in a relatively with microscopic life." sulfides. One of the posthey identified as viral in origin. such as a monosaccharide or a disaccharide or a disacchari
the lipids forming a continuous bilayer. (b) Threedimensional projection of the RER. What is an ester bond? In many cases, the earliest colonists contribute nutrients and create microhabitats for other microbes to attach and grow into the film, forming complete communities. negative, positive, electron c. isolated colony is transferred into a separate
container of media and incubated (see figure 3.1, isolation). It is routine in meningitis because it can differentiate among several types of bacteria and detect certain other infectious agents, but it will not detect viruses. Molecules attached to the proteins provide surface features for cell responsiveness and binding. Discuss the main features of fungal
classification and representative examples of each group. (b) The shell is perforated using sterile techniques, and a virus preparation is injected into a site selected to grow the viruses. There are differences among various algal chloroplasts, but most are generally composed of two membranes, one enclosing the other. (b) A section through a gram-
negative cell wall/membrane with an interpretation of its three sandwich-style layers (90,0003). not functional, three-dimensional form of a simple straight chain of amino acids The functional, three-dimensional form of a simple straight chain of amino acids The functional, three-dimensional form of a simple straight chain of amino acids The functional, three-dimensional form of a protein is termed (called the primary structure).
pulse and were started. Much mass-produced fresh food can also travel around the world, infecting people along the origins of eukaryotic cells with molecular technology has significantly clarified our understanding of relationships among the origins of eukaryotic cells with molecular technology has significantly clarified our understanding of relationships among the origins of eukaryotic cells with molecular technology has significantly clarified our understanding of relationships among the origins of eukaryotic cells with molecular technology has significantly clarified our understanding of relationships among the origins of eukaryotic cells with molecular technology has significantly clarified our understanding of relationships among the origins of eukaryotic cells with molecular technology has significantly clarified our understanding of relationships among the origins of eukaryotic cells with molecular technology has significantly clarified our understanding of relationships among the origins of eukaryotic cells with molecular technology has significantly clarified our understanding of relationships among the origins of eukaryotic cells with molecular technology has significantly clarified our understanding of relationships among the origins of eukaryotic cells with molecular technology has significantly clarified our understanding of eukaryotic cells are considered out of the origins of eukaryotic cells are considered out of the origins of eukaryotic cells are considered out of the origins of eukaryotic cells are considered out of the origins of eukaryotic cells are considered out of the origins of eukaryotic cells are considered out of the origins of eukaryotic cells are considered out of the origins of eukaryotic cells are considered out of the origins of eukaryotic cells are considered out of the origins of eukaryotic cells are considered out of the origins of eukaryotic cells are considered out of the origins of eukaryotic cells are considered out of the origin of eukaryotic cells are considered out of
Functions Macromolecule Description/Basic Structure Examples/Notes Carbohydrates Monosaccharides Glucose, fructose / Sugars involved in metabolic reactions; building block of disaccharides and polysaccharides Maltose (malt sugar) /
Composed of two glucoses; an important breakdown product of starch, cellulose, glycogen / Cell wall, food storage Fatty acids 1 glycerol Fatty acids 1 glycerol 1 phosphate Fatty acids, alcohols Ringed structure Fats, oils / Major Composed of glucose and fructose Starch, cellulose, glycogen / Cell wall, food storage Fatty acids 1 glycerol Fatty acids 1 glycerol Fatty acids 1 glycerol Fatty acids 2 glycerol Fatty acids 3 glycerol Fatty acids 4 glycerol Fatty acids 4 glycerol Fatty acids 5 glycerol Fatty acids 5 glycerol Fatty acids 6 glycerol Fatty acids 6 glycerol Fatty acids 7 glycerol Fatty acids 8 glycerol Fatty acids 8 glycerol Fatty acids 8 glycerol Fatty acids 9 glycerol Fatty 8 
component of cell membranes; storage Membranes Mycolic acid / Cell wall of mycobacteria Cholesterol, ergosterol / Membranes of eukaryotes and some bacteria Amino acids in a chain bound by peptide bonds Enzymes; part of cell membrane, cell wall, ribosomes, antibodies / Metabolic reactions; structural components Nucleotides, composed of
pentose sugar 1 phosphate 1 nitrogenous base Contains deoxyribose sugar and thymine, not uracil Contains ribose sugar and uracil, not thymine, uracil Chromosomes; genetic material of viruses / Inheritance Lipids Triglycerides
Phospholipids Waxes Steroids Proteins Polypeptides Nucleic acid (DNA) Ribonucleic acid (DNA
O O O O O O H OH 2 OH C2 O HO H C3 H C H C H C 4 5 6 O 6 HOCH2 H OH OH OH OH OH OH OH HO CH 1 2 3 H H Galactose Fructose Figure 2.15 Common classes of carbohydrates. Review the major differences and similarities between prokaryotic and eukaryotic cells. A chest X ray c What are signs and symptoms of disease? Further tests
not listed on the table Bacteriodetes Check Your Progress SECTION 4.6 33. Many of the countries are not only deeply impoverished, 153 but are involved in civil wars and other conflicts, creating upheaval in an already overburdened system. Carriers for oxidation-reduction activiNH2 N 7 8 O -O P O-O O P O-O O P 9 N O 5 6 1N 4 3 2 N CH2 O O-
OH OH Adenosine Adenosine diphosphate (ADP) Adenosine triphosphate (ADP) A
Thymine (T) Cytosine (C) Uracil (U) O (c) Pyrimidine bases Figure 2.25 The sugars and nitrogen bases that make up DNA and RNA. pH 2 contains [0.01 moles H1/L]. Agencies and companies have developed microbes to handle oil spills and detoxify sites contaminated with heavy metals, pesticides, and even radioactive wastes (figure 1.6b). (b) Ionic
bond. Enriched media contain growth factors required by microbes. Others contain dozens of precisely measured ingredients (table 3.6A). Archaea are often found living in extreme conditions of heat, salt, and acidity, which are similar to those found in early earth. (a) Section through Borrelia burgdorferi, the spirochete of Lyme disease. Some
cylindrical viruses are relatively long (800 nm in length) but so narrow in diameter (15 nm) that their visibility is still limited without the high magnification and resolution of an electron microscope. Ecosystems are communities of living organisms and their surrounding environment. Others may have their own website to distribute assignways to
acquire knowledge are through repetition and experience. Non-sporeforming rods Family Lactobacillus, Listeria (food boils, skin infections) infection), Erysipelothrix (erysipeloid) B. Cultures are examined under the microscope for basic details such as cell type and shape
3.4 Additional Features of the Six "I's" 73 3.2 MAKING CONNECTIONS The Gram Stain: A Grand Stain In 1884, Hans Christian Gram discovered a staining technique that could be used to make bacteria in infectious specimens more visible. Case Files have been changed to Case Studies. These two ER networks are similar in origin and are directly
connected to each other, but they differ in some aspects of structure and function. Bacillus ill anthracis—SEM th i SEM micrograph i showing the rod-shaped cells next to a red blood cell I. peptide bonds are in a hexapeptide? e a w b lo o 4 so ate d di r um 9. (1) Membrane-bound transporter proteins (permeases) interact with
nearby solute binding proteins that carry essential solutes (sodium, iron, sugars). This framework appears to have several functions, such as anchoring A model of the cytoskeleton. (a) In the most common form, the bacteria spread in the circulation from some other infection site, enter the artery, and lodge in the small vessels in bony pockets of the
marrow. Monosaccharides and disaccharides are specified by combining a prefix that describes some characteristic of the sugar with the suffix -ose. This has happened several times with bird (avian) flu virus and swine flu viruses. (c) Simple, three-dimensional, and working models of methane. Explain why an endospore is not considered a
reproductive body. You know about their capacity to live where no other living things could—volcanoes, salt lakes, radioactive waste pits—so it has not been a surprise to discover how readily they can adapt to drugs we use to treat them. Differentiate between a peptide, and a protein. If the atoms combining to make a molecule are
different elements, then the substance is termed a compound. These that the smallest cells on the planet are some form of mycoplasma with extremophiles, called ARMAN, are at the limit of resolution with 100 and 400 nm. The number of cells per volume is so decreased
that cells have ample space to form separate colonies in the second or third plate. Herpes simplex 150 nm 4. Parasitic helminths reproduce with a birth, kind. The cell has ruptured and released numerous virions that can then attack nearby susceptible host cells. It is essential that any methods of classification reflect our current understanding and
can be altered as new information is uncovered. 5 Oka Carefully crafting a textbook to be a truly useful learning tool for students takes time and dedication. Enveloped viruses carry surface receptors called a. • Plasmodium, the most prevalent protozoan parasite, causes 100 million to 300 million cases of malaria each year worldwide. You can also
assign Check Your Progress questions to students through McGrawHill ConnectPlusTM Microbiology. Nonenveloped Naked Viruses Helical (7) 165 Icosahedral A. This accounts for fibrous support structures of plants. Trypanosomes (inset a) are transmitted among domestic and wild mammalian hosts by means of a bite from the
kissing bug (inset b). The most serious complication is pneumonia. What is the periplasmic space, and what is its function? Biofilms * syntrophy (sin9-trof-ee) Gr., sym, together, and troph, to feed. They are found only in certain protozoa and animal cells. * pathogen (path9-oh-jen) Gr. pathos, disease, and gennan, to produce. Continuing research is
focused on the connection of viruses to chronic afflictions of unknown cause, such as type I diabetes, multiple sclerosis, various cancers, and even conditions such as obesity (6.1 Secret World of Microbial Involvement in Energy and Nutrient Flow 1.3 Human Use of Microbial Roles in Infectious Diseases 1.5 The
Historical Foundations of Microbiology The Development of the Microscope: "Seeing Is Believing" The Scientific Method and the Search for Knowledge The Development of Medical Microbiology 1.6 Taxonomy: Organizing, Classifying, and Naming Microorganisms The Levels of Classification Assigning Scientific Method and the Search for Knowledge The Development of Medical Microbiology 1.6 Taxonomy: Organizing, Classifying, and Naming Microorganisms The Levels of Classification Assigning Scientific Method and the Search for Knowledge The Development of Medical Microbiology 1.6 Taxonomy: Organizing, Classifying, and Naming Microorganisms The Levels of Classification Assigning Scientific Method and the Search for Knowledge The Development of Medical Microbiology 1.6 Taxonomy: Organizing, Classifying, and Naming Microorganisms The Levels of Classification Assigning Scientific Method and the Search for Knowledge The Development of Medical Microbiology 1.6 Taxonomy: Organizing, Classifying, and Naming Microorganisms The Levels of Classifying Scientific Method and the Search for Medical Microbiology 1.6 Taxonomy: Organizing Microorganisms The Levels of Classifying Scientific Method and the Search for Medical Microbiology 1.6 Taxonomy: Organizing Microorganisms The Levels of Classifying Method and the Search for Medical Microbiology 1.6 Taxonomy: Organizing 
Microorganisms All Life Is Related and Connected Through Evolution Systems for Presenting a Universal Tree of LifeCHAPTER 2 The Chemistry of Biology 2.1 Atoms: Fundamental Building Blocks of All Matter in the Universe Different Types of Atoms: Elements and Their Primary Characteristics 2.2
Bonds and Molecules Covalent Bonds: Molecules With Shared Electron Transfer Among Atoms Electron Transfer and Oxidation-Reduction Reactions, Solutions, and pH Formulas, Models, and Equations Solutions: Homogeneous Mixtures of Molecules Acidity, Alkalinity, and the pH Scale 2.4 The
Chemistry of Carbon and Organic Compounds Functional Groups of Carbohydrates of Life: Carbo
Protein Structure and Diversity 2.8 Nucleic Acids: A Program for Genetics The Double Helix of DNA Making New DNA: Passing on the Genetic Message RNA: Organizers of Protein Synthesis ATP: The Energy Molecule of CellsCHAPTER 3 Tools of the Laboratory: Methods of Studying Microorganisms 3.1 Methods of Microbial Investigation 3.2 The
Microscope: Window on an Invisible Realm Magnification and Microscope Design Variations on the Optical Microscope Electron Microscope Electron Microscope Stresh, Living Preparations Fixed, Stained Smears 3.4 Additional Features of the Six "I's" Inoculation, Growth, and Identification of Cultures Isolation Techniques
Identification Techniques 3.5 Media: The Foundations of Culturing Types of Media Chemical Content of Media Media Chemical Content of Media Chemical Ch
termed diplococci, streptococci, streptococci, streptococci, staphylococci, tetrads, and sarcina for cocci; bacilli may form pairs, chains, or palisades. In most ciliates, the cilia are distributed over the surface of the cell in characteristic patterns. Combining this method of analysis with high-resolution electron micrography has revealed that the prokaryotic ribosome, which has an
overall rating of 70S, is actually composed of two smaller subunits (figure 4.19). Consider both bacteriophages and viruses of eukaryotic organisms. 64 Chapter 3 Tools of the two lenses: Power of 3 Objective 43 scanning objective 103 low power
objective 403 high dry objective 1003 oil immersion objective Usual Power of Ocular 103 103 5 5 5 5 Total Magnification 403 1003 Microscopes are equipped with a nosepiece holding three or more objective sthat can be rotated into position as needed. Compare oxidation and reduction and their effects. The tiny cells appear to
grow in culture, have cell walls, and quire for its survival? If not for the extensive interest, curiosity, and devotion of thousands of microbiologists over the last 300 years, we would know little about the microscopic realm that surrounds us. We see this in the capsids of enteric (intestinal) viruses such as polio and hepatitis A, which are resistant to the
acid- and protein-digesting enzymes of the gastrointestinal tract. You may find this convenient formulas. Volume 2 Domain Bacteria II This domain, along with the phyla that are covered in volumes 3, 4, and 5, contains bacteria that have the greatest medical impact. unicellular, filamentous c. Although it communicates with the RER and also transports
molecules within the cell, it has specialized functions. Microconidia are one-celled, and macroconidia have two or more cells. of microorganisms in just a single liter of seawater, most of them **To read more about this technique, called metagenomic analysis, look ahead to chapter 10. A few species have both pseudopods (also called pseudopodia) and
flagella. Outline a basic system of bacterial taxonomy. The phenomenon was first discovered in the 1950s in the pathogen that causes diphtheria, Corynebacterium diphtheria (orange bacteria) in the cells of the malarial mosquito (green nuclei). 6.5 The Multiplication Cycle in
Bacteriophages Expected Learning Outcomes 17. The basis behind the therapy is that bacterial viruses can selectively attack and destroy their host bacteria without damaging human cells. These gigantic cocci are arranged in strands that look like pearls and contain hundreds of golden sulfur granules, contain protein and nucleic acids, but their size
range is only from 0.05 to inspiring their name, Thiomargarita namibia ("sulfur pearl of Namibia") 0.2 mm. Alternatively, cells can be observed microscopically with a hanging drop slide. List five essential functions that the cell membrane performs in bacteria. Identification can be assisted by testing the isolate against known Microbial growth in a
liquid medium materializes as cloudiness, antibodies (immunologic testing). i zak fragm "I would rate this textbook a perfect 10 for readability. Complex viruses Bacteriophage Bacterial DNA Lysogenic State Viral DNA 1 2 Viral DNA becomes latent
specific bacteria, protozoans, and viruses. The term prion is derived from the words proteinaceous infectious particle to suggest its primary structure—that of a naked protein molecule. Other names may designate a characteristic of the microbe (shape, color), a location where it was found, or a disease or symptom that it causes. It is an infection of
the heart valves and lining. This description recognizes that the diseases are spread from host to host by direct contact, contaminated food, or other means. This means that the TABLE 3.5 Three Categories of Media Classification inoculation must start with a sterile medium and inoculating tools with sterile tips must be used. Enveloped helical
nucleocapsids are more flexible and tend to be arranged as a looser helix within the envelope (figure 6.6c, d). Many geologists are 750 mm (0.75 mm), and many are large enough to see with the naked eye. The toxins produced by poisonous mushrooms can induce neurological disturbances and even death. But be aware that biological taxonomy—and
more important, our understanding of the early evolution of organisms— is in a period of transition. fluorescent 17. (On the earth's surface, pressure is about 1 atmosphere.) For additional discussion of the unusual adaptations of transition. fluorescent 17. (On the earth's surface, pressure is about 1 atmosphere.)
someone says a scientific explanation is "only a theory," what do they really mean? Branches split off the main trunk as further selection and modification occurs. As in the prokaryotes, eukaryotic ribosomes are the staging areas for protein synthesis. Pasteur summed up his findings, "For I have kept from them, and am still keeping from them, that
one thing which is above the power of man to make; I have kept from them life." What type of microorganisms were likely responsible for the misleading results of John Needham's experiment and were absent in Jablot's and Pasteur's experiments? Some cells show self-propulsion or motility using
specialized locomotor structures. Can you develop a scientific hypothesis and means of testing the cause of stomach ulcers? The nucleocapsids of naked helical viruses are very rigid and tightly wound into a cylindershaped package (figure 6.6a). A species would remain classified in that category until its sexual state was described. In the endocytosis and means of testing the cause of stomach ulcers? The nucleocapsids of naked helical viruses are very rigid and tightly wound into a cylindershaped package (figure 6.6a).
version of penetration, the virus can be either enveloped (figure 6.13b) or naked (figure 6.13c), and it is * tropism (troh9-pizm) Gr. trope, a turn. The generic part of the scientific name is capitalized, and the species part begins with a lowercase letter. Much of the virologist's work involves developing and maintaining these cultures. (Which one wouldn't be species part begins with a lowercase letter.)
you rather make?) Media to Suit Every Function Microbiologists have many types of media at their disposal, with new ones being devised all the time. chromatin b. Give examples of viruses with the two capsid types. Some parasites cause bottom billion has at least impairs publicized diseases such as AIDS, malaria, and blindness and others disfigure
the limbs. (1) A saturated fatty acid has long, straight chains that readily pack together. Why is an isolated atom neutral? The membrane receptors that viruses attach to are usually glycoproteins that readily pack together. Why is an isolated atom neutral? The membrane receptors that viruses attach to are usually glycoproteins at a sually glycoprotein that viruses attach to a sually 
viruses penetrate the host cell. Examples include capsule stains and flagellar stains. Because the cyst is the more resistant form and can survive in water and soil for several weeks, it is the more important stage for transmission. For example, although its natural habitat is soil and water, Pseudomonas aeruginosa frequently causes infections in
patients when it is carried into the hospital environment. Figure 1.10 provides a summary of the scientific method in action using Edward Jenner's monumental discovery of vaccines. Students just beginning their microbiology studies are often dismayed by the seemingly endless array of new, unusual, and sometimes confusing names for
microorganisms. Most bacteria can form structured multicellular communities, or biofilms, on objects in a moist environment. Within an individual cell are found extensive specialized membranes called Quick Search thylakoids, the locations of pigments and Find out about the sites of photosynthesis (figure 4.28c). What are the most useful
characteristics for categorizing bacteria into phyla? Anaerobic cocci Pasteurella (bite infections), Streptobacillus Family Veillonella K. Others require a combination of organic and inorganic nutrients. shells c. Questions are now divided into two levels: A brief outline of the main chapter concepts is provided for students with important concepts are now divided into two levels: A brief outline of the main chapter concepts is provided for students with important concepts are now divided into two levels: A brief outline of the main chapter concepts is provided for students with important concepts are now divided into two levels: A brief outline of the main chapter concepts is provided for students with important concepts are now divided into two levels: A brief outline of the main chapter concepts is provided for students with important concepts are now divided into two levels: A brief outline of the main chapter concepts is provided for students with important concepts are now divided into two levels: A brief outline of the main chapter concepts is provided for students with important concepts are now divided into two levels: A brief outline of the main chapter concepts are now divided into two levels: A brief outline of the main chapter concepts are now divided into two levels: A brief outline of the main chapter concepts are now divided into two levels: A brief outline of the main chapter concepts are now divided into two levels: A brief outline of the main chapter concepts are now divided into two levels: A brief outline of the main chapter concepts are now divided into two levels: A brief outline of the main chapter concepts are now divided into two levels: A brief outline of the main chapter concepts are now divided into two levels: A brief outline of the main chapter concepts are now divided into two levels: A brief outline of the main chapter concepts are now divided into two levels: A brief outline of the main chapter concepts are now divided into two levels: A brief outline of the main chapter concep
terms taL22600_ch05_122-156.indd Page 154 10/9/13 9:21 PM f-w-166 Level I. The fungi are no exception, and there are several ways to classify them. The color-enhanced microscopes seen in this and other textbooks have computer-added color. What are the four main types of flagellar arrangement? (a) Striking colors and
arrangements of cells (1) Trichodesmium is one of the dominant planktonic forms on earth. Sexes may be hermaphroditic. The animals lose coordination, have difficulty moving, and eventually progress to collapse and death. Influenza 100 nm 7. (5) With pinocytosis, fluids and/or dissoved substances are enclosed in vesicles by very fine protrusions
called microvilli (3,000X). Explain the characteristics of archaea that indicate that they constitute a unique domain of living things that is neither bacterial nor eukaryotic. Members vary from macroscopic mushrooms to microscopic mushrooms to microscopic mushrooms to microscopic mushrooms to microscopic mushrooms.
being released by decomposition and synthesis and released into the environment. Growth spreading true crime books, music, crossword puzzles, and playing with her rescued kitties. Some bacterial taxonomists use a criterion for that cause
disease in humans are found within seven or eight of the bacterial species that examples must share at least 97% of their gerevised phyla. These substances are often lumped together in a category called inorganic chemicals. Septa (c) As in Penicillium Septate hyphae Nonseptate hyphae Septum with pores Nucleus Nucleus Nucleus As in Rhizopus (a) A
container of food (left too long in the refrigerator) has developed a miniature forest of mold colonies. Their outer boundary is a cell membrane that regulates the movement of food, wastes, and secretions. Not only would biofilms favor microbial persistence in habitats, but they would also offer greater access to life-sustaining conditions. Others may
require only inoculation and incubation on special media or test systems. Major groups of Domain Eukarya are shown here for comparison. All of our reviewers provided helpful and constructive suggestions. The individual cocci of Deinococcus radiodurans contain one or more prominent bodies that are the chromosomes or nucleoids (1,2003). The
outer surface of many cells has a delicate "sugar coating" composed of polysaccharides bound in various ways to protein or glycoprotein). In order to form this bond, one carbon gives up its OH group and the other (the one contributing the oxygen to the bond) loses the H from its OH group. The Diffusion of
Water: Osmosis Diffusion of water through a selectively permeable membrane, a process called osmosis,* is a physical phenomenon that is easily demonstrated in the laboratory with nonliving materials. Other retroviruses may be involved in diseases genetic material. What is remarkable about Jenner's work is that he was the first to use scientific
thought to construct a rigorous experimental model to inoculate people against disease, and he carried it through to its completion. s ro g in ic he pal m t g of ua ted sin g ad ivid trac A u nnin x d e DN tu be in e hey he ir s um t t he d n ea t, as zed **. Later, the discovery and detailed description of heat-resistant bacterial endospores by Ferdinand
Cohn, a German botanist, clarified the reason that heat would sometimes fail to completely eliminate all microorganisms. Because the Gram stain does not actually reveal the reason that heat would sometimes fail to completely eliminate all microorganisms. Because the Gram stain does not actually reveal the reason that these two groups stain differently, we must turn to the electron microscope and to biochemical analysis of their structure. Concept Mapping 183 Writing Challenge
For each question, compose a one- or two-paragraph answer that includes the factual information needed to completely address the question. Fundamentally, all are skin abscesses that vary in size, depth, and degree of tissue involvement. 3.4 Additional Features of the Six "I's" A. Unfortunately, little can be done at this point, because the infection is
spread from bat to bat and no viable treatment is possible. They come in two forms: liquefiable and nonliquefiable and nonliquefiable and nonliquefiable and nonliquefiable and nonliquefiable and nonliquefiable. They come in two forms: liquefiable and nonliquefiable and nonliquefiable and nonliquefiable and nonliquefiable.
Sterilization Following Pasteur's inventive work with infusions (1.2 Making Connections), it was not long before English physicist John Tyndall provided the initial evidence that some of the microbes in dust and air have very high heat resistance and that particularly vigorous treatment is required to destroy them. All in all, a tremendous variety of
microorganisms are involved in processing the elements. Differentiate between a pure culture, mixed culture, and contaminated culture.
of bacterium using your name, a pet's name, a pet's name, a place, or a unique characteristic. the bottom of the food web, these bacteria serve as the primary producers of nutrients that service a broad spectrum of specialized animals. Atoms interact to form chemical bonds and molecules. The cell lays down a septum that begins to wall off the new cells.
Historically, some virologists had created an informal species naming system that mirrors the species names in higher organisms, using genus and species epithets such as Measles morbillivirus. The capsid of some viruses contains a * icosahedron (eye0-koh-suh-hee9-drun) Gr. eikosi, twenty, and hedra, side. Mycelium growth Above Below
Basidiospores ground ground FERTILIZATION Basidiospores vary in genetic makeup. The list of opportunistic fungal pathogens has been increasing in the past few years because of newer medical techniques that keep immunocompromised patients alive. A virus is a tiny infectious a. It is almost always found single-stranded and is used to express the
DNA code into proteins. Both processes are considered a type of passive transport. See table 1.1 for an overview of some fields and occupations that involve basic study or applications in microbiology. ing on how the capsomers are shaped and arranged, this assembly results in two different types: helical and icosahedral. How animal viruses do this
varies with the type of virus and type of host cell, but most of them enter through some form of fusion or endocytosis, also known as viropexis (figure 6.13). (See figures J and K.) Volume 5 This represents a mixed assemblage of nine phyla, all of which are gram-negative but otherwise widely varied. Sur- rounding the thylakoids is a ground substance
called the stroma* (figure 5.11). The bottom tube indicates what happens when it is warmed or when microbial enzymes digest the gelatin and liquefy it. It is separated from the cell cytoplasm by an external boundary called a nuclear envelope or membrane. Microbiologists recently discovered salt pockets that supported archaea living in water 100
times more concentrated than seawater. Truly multicellular organisms are found only among plants and animals and some of the fungi (mushrooms) and algae (seaweeds). The growth curve is determined by graphing the number for each sample in sequence for the whole incubation period (see figure 7.18).
that could have caused this infection? Because viruses are not bacteria, antibiotics aimed at bacterial infections do not work. The hook, rings, and rod function together as a tiny device that rotates the filament 3608. These viruses would be readily visible with an ordinary light microscope. Another factor that alters the appearance of icosahedral
viruses is whether or not they have an outer envelope. Depending upon the size and curvature of the lens, the image appears enlarged to a particular degree, which is called its power of magnification and is usually identified with a number combined with 3 (read "times"). In addition to motility, SIM can test for physiological characteristics used in
identification (hydrogen sulfide production and indole reaction). (b) Formation of the 1,4 bond between two a glucoses to produce maltose. (a) 76 (b) (c) 3.5 Media: The Foundations of Culturing 77 Figure 3.13 Rapid mini testing with identification key for Neisseria meningitidis. A palisades* arrangement, typical of the corynebacteria, is formed when
the cells of a chain remain partially attached by a small hinge region at the ends. Notably, it is one of the substances produced by phagocytes to kill invading bacteria (see chapter 14). Looking as harmless as clusters of tiny purple grapes, the gram-positive pathogen Staphylococcus aureus is anything but. Analyze adaptations microbes make in
response to osmosis. In time, it became clear that certain organisms did not truly fit either of those categories, so a third kingdom for simpler organisms that lacked tissue differentiation (protists) was recognized. division, domain, kingdom for simpler organisms that lacked tissue differentiation (protists) was recognized.
thyharbors specialized chloroplasts with cyanobacterial develops additional membrane nce that eukaryotic cilia lakoids. Extreme care is taken to exclude weeds (contaminants). A common intestinal bacterium such as Escherichia coli that gives off acid when it metabolizes the lactose in the medium develops red to pink colonies, and one such as
Salmonella that does not give off acid remains its natural color (off-white). Look back at figure 2.20 to observe eukaryotic membrane structure, which is very similar to bacteria, except for the presence of cholesterol in the eukaryotic membrane structure, which is very similar to bacteria, except for the presence of cholesterol in the eukaryotic membrane structure, which is very similar to bacteria, except for the presence of cholesterol in the eukaryotic membrane structure, which is very similar to bacteria, except for the presence of cholesterol in the eukaryotic membrane structure, which is very similar to bacteria, except for the presence of cholesterol in the eukaryotic membrane structure, which is very similar to bacteria, except for the presence of cholesterol in the eukaryotic membrane structure.
within a biofilm. When a rod is short and plump, it is called a coccobacillus; if it is gently curved, it is a vibrio.* A bacterium having the shape of a curviform or spiral-shaped cylinder is called a coccobacillus; if it is gently curved, it is a vibrio.* A bacterium having the shape of a curviform or spiral-shaped cylinder is called a spirillum,* a rigid helix, twisted twice or Quick Search more along its axis (like a corkscrew). photosynthesis b. general-purpose medium c. 134 Chapter 5 A
Survey of Eukaryotic Cells and Microorganisms Taxonomy Based on rRNA Analysis Animals True Fungi (Eumycota Ascomycota Basidiomycota Chytridiomycota Chytridiomycota Chytridiomycota (chytridiomycota Chytridiomycota Chytridio
Cryptomonads Red algae Stramenopiles (formerly heterokonts or chrysophytas) Alveolates Entamoebae Traditional Kingdom Plantae 
Ciliates Colponema Dinoflagellates Haplosporidia Apicomplexans Phylum Ciliophora Division Phaeophyta Division Pyrrophyta Divis
Microsporidia Division Euglenophyta Phylum Sarcomastigophora Universal Ancestor Figure 5.13 RNA-based phylogenetic tree and taxonomy of Domain Eukarya. The outer membrane is somewhat similar in construction to the cell membrane, except that it contains specialized types of lipopolysaccharides (LPS) and lipoproteins. Some microbes
require only a very few simple inorganic compounds for growth; others need a complex list of specific inorganic compounds. The following sections contain a general survey of the principal eukaryotic microorganisms—fungi, algae, protozoa, and parasitic worms—while also introducing elements of their structure, life history, classification
identification, and importance. This stain is designed to distinguish between spores and the vegetative cells that make them (figure 3.9b). These syncytia are a result of some viruses' ability to fuse membranes. How can particles so small, simple, and seemingly insignificant be capable of causing disease and death? A theory is not the result of a single
experiment repeated over and over again but is an entire body of ideas that expresses or explains many aspects of a phenomenon. This process occurs in several Find out more stages, including self-monitoring of cell about "How density, secretion of chemical signals, and Biofilms Form" and genetic activation (figure 7.14). We later enlarge on the
topic of nutritional types based on carbon and energy sources. An RNA virus with some unusual features is a retrovirus, one of the few virus types that converts its nucleic acid from RNA to DNA inside its host cell. Carbohydrate receptor on peripheral protein Binding site Cytoplasm Bacterial Internal Structure Lipoprotein Figure 4.17 Cell membrane
structure. Because this intruder is not desirable and not identified, the culture is now contaminated. Bornaviruses the most tantalizing questions is what effect, if any, such retroviruses are common among many animal groups, including ground squirrels, elmight have on modern humans. solvent, solute and water is 10. Macromolecules are very large
organic compounds and are generally assembled from single units called monomers by polymerization. 6.7 Viral Infection, Detection, and Treatment A. * cisternae (siss-tur9-nee) L., cister
that all taxonomic hierarchies are based on the judgment of scientists with certain expertise in a particular group of organisms and that not all other experts may agree with the system being used. capsomers 4. When the ester linkage is acted on by digestive enzymes called lipases, the fatty acids and glycerol are freed to be used in metabolism. In
certain instances, microorganisms have to be grown in cell cultures or host animals. We developed several new illustrated tables to consolidate information and provide a comparative analysis of concepts such as microscopy, taxonomy, and symbiosis. The second and key differentiating step is the mordant—Gram's iodine. In chapter 9, we see that
protein synthesis is not just a random connection of amino acids; it is directed by information provided in DNA. • Nucleic acid can be double-stranded RNA. Anaerobic infections can occur following abdominal surgery and traumatic injuries (gas gangrene and tetanus). Compare the
structures and functions of the mitochondrion and the chloroplast. Notice the differences in the appearance of the field and the degree of detail shown in the four methods. These are giants in the viral world, averaging about 500 to 1,000 nm in diameter, 20 to 50 times larger than an average virus and even larger than small bacteria such as
rickettsias. hominis, T. It is with these kinds and drug treatments. J. This drawing represents all structures associated with eukaryotic cells, but no microbial cell possesses all of them. a belief based on knowledge b. They may also communicate with other cells by sending or receiving signals. Miscellaneous Media A reducing medium contains a
substance (thioglycollic acid or cystine) that absorbs oxygen or slows the penetration of oxygen in a medium, thus reducing its availability. Motility test medium and sulfur indole motility (SIM) medium both contain a small amount (0.3–0.5%) of agar. They generally do not form hyphae or yeast-type cells. Bonding of the molecule causes a
conformational change in the protein that facilitates the molecule's passage across the membrane (left view), an atom b. The membrane is permeable to water (solvent) but not to solute. Membrane Lipids The phospholipids serve as a major structural component of cell membranes. A system for representing the origins of cell lines and major
taxonomic groups as proposed by Carl Woese and colleagues. More recently, microbiologists unearthed a viable endospore from a 250-millionyear-old salt crystal. The bases are attracted in this way because each pair has oxygen, nitrogen, and hydrogen atoms positioned precisely to favor the formation of hydrogen bonds between them. The
information obtained through the scientific method is explanatory and predictive. What leads microbiologists to believe the archaea are more closely related to eukaryotes than to bacteria? In general composition, it is a lipid bilayer with proteins embedded to varying degrees (figure 4.17). Algae generally contain some type of a. The linear form
emphasizes aldehyde and ketone groups, although in solution the sugars exist in the ring form. Because these kingdoms easily accommodate the prokaryotic and eukaryotic and
Toward the end of the cycle, mature virus particles are constructed from the growing pool of parts. Environmental Microbiology This field encompasses the study of microorganisms and their ecological relationships in such natural habitats as soil and water. The DNA and proteins of most organisms are very sensitive to gamma rays and other high
energy radiation, which is why radiation is so damaging to cells. Speculate on the origin of life, especially as it relates to the archaea. 3 4 Synthesis: Replication and Protein Production. Jenner's work documents the first scientific method-based attempt to control an infectious disease—smallpox. It varies from nine genes in * bacteriophage (bak-teer9-
ee-oh-fayj0) From bacteria, and Gr. phagein, to eat. Concept Mapping exercises are also now made interactive on ConnectPlus Microbiology! "..., THE CONCEPT MAPS ARE EXTREMELY USEFUL AS A MEANS FOR CRITICAL THINKING." —Luis Materon, University of TX Pan American Concept Mapping An Introduction to Concept Mapping found at
1. Unlike most laboratory cultures, storage in the refrigerator incubates rather than inhibits them. A polysaccharide composed of galacturonic acid subunits. 14 Chapter 1 The Main Themes of Microbiology Lens Specimen holder Focus screw Figure 1.8 An oil painting of Antonie van Leeuwenhoek (1632-1723) sitting in his laboratory. 5.3 Form and
 Function of the Eukaryotic Cell: Internal Structures 129 Cytoplasm Smooth endoplasmic reticulum Nucleus Nuclear membrane Polyribosomes Rough endoplasmic reticulum Transport vesicles RER membrane Protein being synthesized Lumen
(c) Figure 5.7 The origin and structures of the rough endoplasmic reticulum (RER) and Golgi apparatus. Their presentation has been reorganized, with Part 1 appearing as the chapter opener and Part 2 placed at the end of the chapter before the summary. perfect 11. Sicker people are staying alive much longer than in the past. Some proteins
function as recepThe reason that proteins are so varied and specific is that they do tors to receive stimuli from the environment. (b) Sulfur indole motility (SIM) medium. Featured element boxes contain information on symbol, atomic mass, and electron shell patterns. The basis for their differences lies primarily in the exact way the
glucoses are bound together, which greatly affects the characteristics of the end product (figure 2.17). be determined in the laboratory. chlorophyll c. a condenser c. These questions can be approached from a number of angles, and in most cases, they do not have a single correct answer. Answer available at Such resistance is the basis for the acid
fast stain used to diagnose tuberculosis and leprosy. How do they differ? Thermoduric microbes, which can survive short exposure to high temperatures but are normally mesophiles, are common contaminants of heated or pasteurized foods (see chapter 11). survival d. They used DNA nucleotides bought "off the shelf" and put them together
according to the published poliovirus sequence. The final levels are our genus, Homo (all races of modern and ancient humans), and our species, sapiens (meaning wise). Electron Microscopes Image Objects with High-Speed Electrons Transmission electron microscopes Image Objects with High-Speed Electron Microscopes Image Obje
tiny bit of cells from a wellplify the identification process. Figure 1.10 Edward Jenner and the saga of the smallpox vaccine. Habitat Found in small numbers as part of the normal microbiota of the intestine. For additional discussions of biofilms, see chapters 7 and 12. The sac is immersed in a container of pure water and observed over time. 20
Chapter 1 The Main Themes of Microbiology Domain: Eukarya (All eukaryotic organisms) Domain: Eukarya (All eukaryotic organisms) Kingdom: Animalia Kingdom: Protista Includes protozoa and algae Sea squirt Lemur Sea star Phylum: Chordata Phylum: C
Mammalia Class: Oligohymenophora Single, rapidly swimming cells Regular rows of cilia Distinct ciliated oral groove Order: Peniculae Trichocysts in outer membrane Family: Hominoidea Family: Parameciidae Cells round to elongate Rotate while swimming Deep oral
grooves Genus: Homo Genus: Paramecium Ovoid, cigar- and foot-shaped cells Species: sapiens Scientific name: Homo sapiens (a) Species: caudatum (b) Figure 1.13 Sample taxonomy. Some have cilia in tufts for feeding and
attachment; most develop cysts. Lipoteichoic acid is similar in structure but is attached to the lipids in the plasma membrane. Figure 1.2 compares the two cell types and includes some examples of viruses, for comparison. With these concepts as a theme for the chapter, we take a closer look at how microbes interact with their environment, how they
transport materials, and how they grow. (d) Spring pond with mixed algal bloom. Note that the numbers of reactants and products are indicated by a coefficient in front of the 12. Helical and curviform bacteria infections) Family Spirochaetaceae: Treponema Miscellaneous rods (different families): (syphilis), Borrelia (Lyme disease), Brucella (undulant
                                    spira (kidney intection) (whooping cough), Francisella (tularemia), Coxiella (Q tever) M. Nearly 1.4 billion people worldwide, sometimes and thus open doors to discussion and application. As we have
in the past, this book has been a meeting ground for hundreds of contributors over 30 years, whose knowledge and expertise have greatly shaped the end product. Please note that viruses are not included in any of the classification or evolutionary schemes, because they are not cells and their position cannot be given with any confidence. Unlike cells
which contain both DNA and RNA, viruses contain either DNA or RNA but not both as the primary genetic material. Single-celled alga with silica in its cell wall c. The answer lies in important variations that occur when fungi of different genetic material. Tell how to make a 1 M solution of Mg3(PO4)2 and a 0.1 M solution
of CaSO4. Viroids are significant pathogens in several economically important plants, including tomatoes, cucumbers, citrus trees, and chrysanthemums. The emergence of drug-resistant "superbugs" has become a massive problem in medicine. It generally requires the following materials: a medium that has a relatively firm surface (see
description of agar on page 78) contained in a clear, flat covered plate called a Petri dish, and inoculating tools. MASS 24.30 AT. cysts b. (c) A three-dimensional model (640,0003) of this virus shows fibers attached to the pentons. Describe the significant relationships that humans have with microbes. Mutualism Between Microbes and Animals
Microorganisms carry on mutual symbiotic relationships with animals as diverse as sponges, worms, and mammals. Reproduction: Asexual by binary fission and mitosis, budding; sexual by fusion of free-swimming gametes, conjugation. When microbes are provided with nutrients and the required environmental factors, they become metabolically
active and grow. Urea broth is used to show a biochemical reaction in which the enzyme urease digests urea and releases ammonium. This agent stimulates the formation of hydrolytic (digestive) enzymes by the endospore membranes. Keep in mind that CO2 is an essential nutrient for autotrophs, which use it to synthesize organic compounds. You
can see this for yourself by observing figure 2.4. It is interesting that most of the diatomic elements are gases. Any disease indigenous to animals transmissible to humans. These can be used to initiate discussions on current events found in the the news/ internet and how information is obtained to solve problems of disease outbreaks." —Anne
Montgomery, Pikes Peak Community College "This approach is captivating. * ascospores (as9-koh-sporz) Gr. ascos, a sac. Some common ones are soil, water, sewage, foods, air, and inanimate objects. This architecture permits the microtubules to "walk" by sliding past each other, whipping the flagellum back and forth. These cell types and viruses are
discussed in more detail in chapters 4, 5, and 6. * carbuncle (car9-bunkl) L. Mycoplasmas are found in many habitats, including plants, soil, and animals. For the (b) Figure 3.4 Effect of wavelength on resolution. Next comes the Family Hominoidea, containing only humans and apes. Eukaryotic cells contain a membrane-surrounded nucleus and a
number of organelles that function in specific ways. pale, a stake. Over the past decade, virologists have largely accepted the concept of viral species, defining them as consisting of members that have a number of properties in common but have some variations. For media that fit more than one description, briefly explain why this is the case.
Describe the basic plan of an optical microscope, and differentiate between magnification and resolution. The protozoa constitute a diverse large group (about 65,000 known species) of single-celled creatures that display startling properties when it comes to movement, feeding, and behavior. The most intimate and interdependent type of symbiosis is
mutualism, a term that implies all members share in the benefits of the relationship. A model of the influenza virus displays its hemagglutinin spikes (blue) and neuraminidase spikes (red). 97 4.3 The Cell Envelope: The Outer Boundary Layer of Bacteria Check Your Progress SECTION 4.2 3. Organisms may, in turn, serve as a continuing source of that
element for other organisms. They contain a number of complex internal parts called organelles that perform useful functions for the cell. Indeed, many purified viruses can form large aggregates or crystals if subjected to special treatments (figure 6.3). By compiling physiological testing results with In some ways, culturing microbes is analogous to
gardening. We will explore these topics in greater depth in chapter 8. How does the flagellum dictate the behavior of a motile bacterium? The tendency for cells of the same species to vary to some extent in shape and size. Be reminded that endosymbiotic bacteria are thought to have given rise to the mitochondria and chloroplasts of eukaryotic cells.
snowfields (figure 7.10), polar ice, and the deep ocean. Identify the parts of the Golgi apparatus, and explain its basic actions and uses in the cell. Although phospholipids also contain glycerol and fatty acids, they differ significantly from triglycerides. Reemerging diseases are older, well-known diseases that are increasing in occurrence for reasons
outlined in 1.1 Making Connections. Another way to categorize nutrients is according to their carbon content. Which receptor of the influenza virus is most involved in binding to the respiratory cells? For the most part, our emphasis will remain on the higher-level taxa (phylum, class) and genus and species. locomotor organelle d. (a) An electron
microscope image of a single alga—Phaeocystis—with two hemispherical-shaped chloroplasts, each bearing several layers of thylakoids (25,0003). 5.2 Form and Function of the Eukaryotic Cell: External Structures 5.1 The History of Eukaryotes 123 Chloroplasts Expected Learning Outcomes 1. Other structural polysaccharides can be conjugated
(chemically bonded) to amino acids, nitrogen bases, lipids, or proteins. culture made from a contaminant c. 154 Chapter 5 A Survey of Eukaryotic Cells and Microorganisms B. 4.3 The Cell Envelope: The Outer Boundary Layer of Bacteria Expected Learning Outcomes 9. * coccus (kok9-us) pl. An international group oversees the naming of every new
organism discovered, making sure that standard procedures have been followed and that there is not already an earlier name for the organism with that same name. (Use simple models, such as those in figure 2.4.) 3. There is an absolute limitation to resolution in optical microscopes, which can be demonstrated by calculating there is not already an earlier name for the organism or another organism.
resolution of the oil immersion lens using a blue-green wavelength of light: 500 nm (2 3 1.25 5 200 nm (or 0.2 mm) RP 5 1. Cytoskeleton Ribosomes 7.6 The Study of Microbial Growth 209 4,500* *12 4,000 3,500 ( 3,000 Log of ) number of cells using the 11 power of 2 10 Number 2,500 of cells ( 2,000 1,500 1,000 500 9 0 (b) Number of cells Number of cells Number of cells using the 11 power of 2 10 Number 2,500 of cells ( 2,000 1,500 1,000 500 9 0 (b) Number of cells Number of cells Number of cells ( 2,000 1,500 1,500 1,500 1,500 1,500 1,500 1,500 1,500 1,500 1,500 1,500 1,500 1,500 1,500 1,500 1,500 1,500 1,500 1,500 1,500 1,500 1,500 1,500 1,500 1,500 1,500 1,500 1,500 1,500 1,500 1,500 1,500 1,500 1,500 1,500 1,500 1,500 1,500 1,500 1,500 1,500 1,500 1,500 1,500 1,500 1,500 1,500 1,500 1,500 1,500 1,500 1,500 1,500 1,500 1,500 1,500 1,500 1,500 1,500 1,500 1,500 1,500 1,500 1,500 1,500 1,500 1,500 1,500 1,500 1,500 1,500 1,500 1,500 1,500 1,500 1,500 1,500 1,500 1,500 1,500 1,500 1,500 1,500 1,500 1,500 1,500 1,500 1,500 1,500 1,500 1,500 1,500 1,500 1,500 1,500 1,500 1,500 1,500 1,500 1,500 1,500 1,500 1,500 1,500 1,500 1,500 1,500 1,500 1,500 1,500 1,500 1,500 1,500 1,500 1,500 1,500 1,500 1,500 1,500 1,500 1,500 1,500 1,500 1,500 1,500 1,500 1,500 1,500 1,500 1,500 1,500 1,500 1,500 1,500 1,500 1,500 1,500 1,500 1,500 1,500 1,500 1,500 1,500 1,500 1,500 1,500 1,500 1,500 1,500 1,500 1,500 1,500 1,500 1,500 1,500 1,500 1,500 1,500 1,500 1,500 1,500 1,500 1,500 1,500 1,500 1,500 1,500 1,500 1,500 1,500 1,500 1,500 1,500 1,500 1,500 1,500 1,500 1,500 1,500 1,500 1,500 1,500 1,500 1,500 1,500 1,500 1,500 1,500 1,500 1,500 1,500 1,500 1,500 1,500 1,500 1,500 1,500 1,500 1,500 1,500 1,500 1,500 1,500 1,500 1,500 1,500 1,500 1,500 1,500 1,500 1,500 1,500 1,500 1,500 1,500 1,500 1,500 1,500 1,500 1,500 1,500 1,500 1,500 1,500 1,500 1,500 1,500 1,500 1,500 1,500 1,500 1,500 1,500 1,500 1,500 1,500 1,500 1,500 1,500 1,500 1,500 1,500 1,500 1,500 1,500 1,500 1,500 1,500 1,500 1,500 1,500 1,500 1,500 1,500 1,500 1,500 1,50
Drugs and Hosts 377 Toxicity to Organs 377 Allergic Responses to Drugs 378 Suppression and Alteration of the Microbiota by Antimicrobials 378 12.6 Considerations in Selecting an Antimicrobials 378 Identifying the Agent 380 Testing for the Drug Susceptibility of Microorganisms 380 The MIC and the Therapeutic Index 382 Patient Factors in
Choosing an Antimicrobial Drug 382 CHAPTER 14 An Introduction to Host Defense and Innate Immunities 427 14.1 Overview of Host Defense Mechanisms 428 Barriers at the Portal of Entry: An Inborn First Line of Defense and Immunity 430 How Do White Blood Cells Carry Out Recognition
and Surveillance? A molecule* is a distinct chemical substance that results from the combination of two or more atoms. Members of the group called methanogens can convert CO2 and H2 into methane gas (CH4) through unusual and complex pathways. Lister's techniques and the application of heat for sterilization became the bases for microbial
control by physical and chemical methods, which are still in use today. Propose a hypothesis to explain how bacteria and archaea could have, together, given rise to eukaryotes. both macroscopic traits, a complete picture of the Cultures are formed by "seeding" tiny plots (media) with microbial microbe is developed. 58 Chapter 2 The
Chemistry of Biology Level II. The charge of a proton is exactly balanced by the charge of a (an). A frequent way to express concentration of biological solutions is by its molar concentration, or molarity (M). Because humans are constantly interacting with microbes, we serve as a handy incubator for infectious diseases, both those newly recognized
and older ones previously identified. Their DNA is not enclosed by a nuclear membrane but instead is aggregated in a central area of the cell called the nucleoid. For an image to be formed, the specimen must first be coated or placed in contact with a source of fluorescence. Increased information on serological and biochemical tests for rapid
detection of Staphylococcal species Updated information on treatment of drug resistant staphylococcal and streptococcus pneumoniae and Neisseria genorrhoeae Information concerning Acinetobacter baumannii now
monoclonal antibodies to treat anthrax New information on 2011 listeriosis outbreak linked to cantaloupe Updated information on treatment of drug resistant Clostridium perfringens infection, as well as fecal transplant for Clostridium difficile Streamlined discussion of
Mycobacterium tuberculosis and updated epidemiological information on recently approved in vitro tests for the diagnosis of tuberculosis Updated information on Mycobacterium leprae infections xix Chapter 20 • • •
• • New Case Study on current nationwide pertussis epidemic Updated statistics on prevalence of diseases attributable to gram-negative bacilli System Profiles present major bacillus pathogens in the chapter from a body systems point-of-view Tables throughout chapter have been rewritten to emphasize the shape and Gram reaction of pathogens
Updated information on recommended drugs for treatment of Pseudomonas and Burkholderia infection New CDC vaccine recommendations for pertussis, as well as a feature on various types of vaccines used to provide protection against pertussis, as well as a feature on various types of vaccines used to provide protection against pertussis, as well as a feature on various types of vaccines used to provide protection against pertussis, as well as a feature on various types of vaccines used to provide protection against pertussis, as well as a feature on various types of vaccines used to provide protection against pertussis, as well as a feature on various types of vaccines used to provide protection against pertussis, as well as a feature on various types of vaccines used to provide protection against pertussis, as well as a feature on various types of vaccines used to provide protection against pertussis, as well as a feature on various types of vaccines used to provide protection against pertussis, as well as a feature on various types of vaccines used to provide protection against pertussis and the provide protection against pertussis as a feature on various types of vaccines used to provide protection against pertussis and the protection against pertussis as a feature on various types of vaccines used to provide protection against pertussion ag
Pasturella, and Haemophilus infections Chapter 21 • • • Updated statistics on prevalence of diseases attributable to bacteria discussed in chapter New recommendations for the treatment of Treponema, Borrelia, Campylobacter, and Mycoplasma infections WHO recommendations for cholera vaccination Information on utility of serological testing in
diagnosis of Helicobacter pylori Chapter 22 • • • • • New Case Study concerning an outbreak of histoplasmosis in a Nebraska day camp Updated information on prognosis of blastomycosis
Additional information on passive immunization to combat varicella-zoster infection The use of the polymerase chain reaction as a means of detecting viral DNA Text reflects the current view that EpsteinBarr virus and chronic fatigue syndrome are unrelated Treatment of viral infections has been updated to reflect the most recent drug
recommendations Epidemiology of hepatitis A, B, and C reflect most recent information available Updated information against hepatitis B and human papillomavirus Chapter 23 • System Profiles present parasites discussed in the chapter
from a body systems pointof-view Addition of Plasmodium wale and Plasmodium knowlesi as causative agent of malaria Treatment of parasitic infections has been updated to reflect most recent drug recommendations Updated information on epidemiology of trichomoniasis, trypanosomiasis, malaria, and cryptosporidiosis New feature discussing
neglected parasitic infections in United States Greater emphasis on use of bed nets to both prevent infection with malaria and to reduce the number of infected mosquitoes in areas where malaria is endemic Updated epidemiology of helminthic disease and current recommendations for the treating of helminth infection of the treating of helminthic disease and current recommendations for the treating of helminth infection of helminthic disease and current recommendations for the treating of helminthic disease.
viruses discussed in the chapter from a body systems point-of-view Updated epidemiological statistics for all viral diseases in the chapter • Vaccine information updated to reflect latest influenza vaccine composition New information updated to reflect latest influenza vaccine composition New information updated to reflect latest influenza vaccine composition New information updated to reflect latest influenza vaccine composition New information updated to reflect latest influenza vaccine composition New information updated to reflect latest influenza vaccine composition New information updated to reflect latest influenza vaccine composition New information updated to reflect latest influenza vaccine composition New information updated to reflect latest influenza vaccine composition New information updated to reflect latest influenza vaccine composition New information updated to reflect latest influenza vaccine composition New information updated to reflect latest influenza vaccine composition New information updated to reflect latest influenza vaccine composition New information updated to reflect latest influenza vaccine composition New information updated to reflect latest influenza vaccine composition New information updated to reflect latest influenza vaccine composition new influenza vaccine composition 
and intradermal influenza vaccines New information on the 2012 hantavirus outbreak in Yosemite National Park Updated information about novel viruses: MERS-CoV, Bas-Congo virus, Heartland virus Discussion of deep sequencing technology used to identify novel viruses: MERS-CoV, Bas-Congo virus, Heartland virus Discussion of deep sequencing technology used to identify novel viruses: MERS-CoV, Bas-Congo virus, Heartland virus Discussion of deep sequencing technology used to identify novel viruses: MERS-CoV, Bas-Congo virus, Heartland virus Discussion of deep sequencing technology used to identify novel viruses: MERS-CoV, Bas-Congo virus, Heartland virus Discussion of deep sequencing technology used to identify novel viruses: MERS-CoV, Bas-Congo virus, Heartland virus Discussion of deep sequencing technology used to identify novel viruses: MERS-CoV, Bas-Congo virus, Heartland virus Discussion of deep sequencing technology used to identify novel viruses.
preferred diagnostic technique for detection of respiratory syncytial virus New and updated information on dengue virus, including the latest diagnostic methods and results of recent vaccine trials Updated epidemiological, diagnostic methods and results of recent vaccine trials updated information on dengue virus, including the latest diagnostic methods and results of recent vaccine trials updated epidemiological, diagnostic methods and results of recent vaccine trials updated epidemiological, diagnostic methods and results of recent vaccine trials updated epidemiological, diagnostic methods and results of recent vaccine trials updated epidemiological, diagnostic methods and results of recent vaccine trials updated epidemiological, diagnostic methods and results of recent vaccine trials updated epidemiological, diagnostic methods and results of recent vaccine trials updated epidemiological, diagnostic methods and results of recent vaccine trials updated epidemiological methods and results of recent vaccine trials updated epidemiological methods and results of recent vaccine trials updated epidemiological methods and results of recent vaccine trials updated epidemiological methods and results of recent vaccine trials updated epidemiological methods and results of recent vaccine trials updated epidemiological methods and results of recent vaccine trials updated epidemiological methods and results of recent vaccine trials updated epidemiological methods and results of recent vaccine trials updated epidemiological methods and results of recent vaccine trials updated epidemiological methods and results and results are recent vaccine trials.
the only two people thought to have been cured of HIV New information on hepatitis A vaccination Chapter 26 • • • New information on extremophiles and geomicrobiology New examples of nitrogen-fixing interactions between Gunnera plants and Nostoc New feature on the "Body Farm" Forensic Anthropology Center Updated statistics on water
testing, treatment, and safety regulations Chapter 27 • • • • • New Case Study examines the 2012 Listeriosis outbreak linked to cantaloupe Updated information on purification of drinking water and treatment of wastewater New feature on use of Botrytis cinerea in wine making Updated statistics on food-borne illness New information on food
preservation using penetrating radiation and bacteriophage treatment of food New information concerning rapid detection of bioterrorism agents Find the Right Fit for You Create what you've only imagined Introducing McGraw-Hill Create — a new, self-service website that allows you to create custom course materials—print and eBooks—by
drawing upon McGraw-Hill's comprehensive, cross-disciplinary content. Early Early Cell membrane Late (osmolysis) Late Rates of diffusion are equal in both directions. (a) A scientist from the National Oceanic and Atmospheric Agency (NOAA) demonstrates a series of biodiesel reactors that culture single-celled algae (inset 7503) as a source of oil
Using molecular techniques, she accumulated convincing evidencee of the relationships Smaller bacterium becomes a ells and the structure of between the organelles of modern eukaryotic cells permanent resident of its karyotic cells behaves as bacteria. A solution is a combination of a solid, liquid, or gaseous chemical (the solute) dissolved in a
liquid medium (the solvent). Some types of fixation are performed with chemicals such as alcohol and formalin, disulfide c. Organization of Microscopic Fungi The cells of most microscopic fungi grow in loose associations or colonies. Because most biological activities take place in aqueous (waterbased) solutions, the concentration of these solutions
can be very important (see chapter 7). Examples of inorganic chemicals include H2O, O2, NaCl (sodium chloride), Mg3(PO4)2 (magnesium phosphate), cloudy spinal fluid d. As information YouTube. Although this preparation is quick and easy to
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make, it has certain disadvantages. In general, the name first applied to a species will be the one that takes precedence over all others. Overview of Taxonomy 5.4 Eukaryotic-Prokaryotic Comparisons and Taxonomy of Eukaryotes Expected Learning Outcomes 18.
following a baseball game or a theater production: You cannot tell the players apart without a program! Your understanding and appreciation of microorganisms will be greatly improved by learning a few general rules about how they are named. Magnetotactic bacteria contain crystalline particles of iron oxide (magnetosomes) that have magnetic
properties (figure 4.20b). Explain how flagella influence motility and motile behavior. The atomic number of electrons (recall that a neutral atom has an equal number of protons and electrons). of elements and the
involvement of microbes in their recycling, look ahead to table 7.1. Atoms: Fundamental Building Blocks of All Matter in the Universe Chemical Characteristics of Major Elements of Life TABLE 2.1 Atomic Symbol* Element The unique properties of each element result from the numbers of protons, neutrons, and electrons it contains, and each element
can be identified by certain physical measurements. For instance, it explains how saprobic microbes in soil and water rapidly break down complex substrates and how some pathogens release their toxins into the tissues simultaneously. RNA only c. In bioremediation, microbes are used to clean up pollutants and wastes in natural environments
Named for the appearance of having tiny holes. The membrane protein releases the molecule into the cell interior (right view). Sporangiospores (figure 5.18a) are formed by successive cleavages within a saclike head called a sporangiospores (figure 5.18a) are formed by successive cleavages within a saclike head called a sporangiospores (figure 5.18a) are formed by successive cleavages within a saclike head called a sporangiospores (figure 5.18a) are formed by successive cleavages within a saclike head called a sporangiospores (figure 5.18a) are formed by successive cleavages within a saclike head called a sporangiospores (figure 5.18a) are formed by successive cleavages within a saclike head called a sporangiospores (figure 5.18a) are formed by successive cleavages within a saclike head called a sporangiospores (figure 5.18a) are formed by successive cleavages within a saclike head called a sporangiospores (figure 5.18a) are formed by successive cleavages within a saclike head called a sporangiospores (figure 5.18a) are formed by successive cleavages within a saclike head called a sporangiospores (figure 5.18a) are formed by successive cleavages within a saclike head called a sporangiospores (figure 5.18a) are formed by successive cleavages within a saclike head called a sporangiospores (figure 5.18a) are formed by successive cleavages within a saclike head called a sporangiospores (figure 5.18a) are formed by successive cleavages within a saclike head called a sporangiospores (figure 5.18a) are formed by successive cleavages within a saclike head called a sporangiospores (figure 5.18a) are formed by successive cleavages within a saclike head called a sporangiospores (figure 5.18a) are formed by successive cleavages within a saclike head called a sporangiospore (figure 5.18a) are formed by successive cleavages (figu
Ninety-four of them are naturally occurring, and the rest were artificially produced by manipulating the particles in the nucleus. Carbohydrates can be generally represented by the formula (CH2O)n, in which n indicates the number of units that combine to make the finished carbohydrates. What dictates the host range of animal viruses? The majority
of organisms live or grow in habitats between pH 6 and pH 8 because strong acids and bases can be highly damaging to enzymes and other cellular substances. Patients should be isolated, and care must be taken when/202/MH02004/taL22600 disk1of1/0073522600/taL22600 pagefiles handling infectious secretions. How can a neutral salt be formed
from acids and bases? plants c. Simple stains cause all cells in a smear to appear more or less the same color, regardless of type, but they can still reveal characteristics such as shape, size, and arrangement. Polarity is a significant property of many large molecules in living systems and greatly influences both their reactivity and their structure.
Outline a classification scheme for protozoans, and provide examples of important members of each group. Clostridium difficile is an emerging pathogen that causes thousands of intestinal infections in hospital patients every year. The existence of these unusual agents is one bit of supportive evidence that viruses may have evolved from naked bits of
nucleic acid. It now appears that this new H1N1 strain had One of these receptors, called hemagglutinin (H), is essential for undergone a genetic mutation that allowed animal-to-human the virus to adhere to the cells of the respiratory tract. Another important development in infectious disease trends is the increasing number of patients with
weakened defenses who are kept alive for extended periods. hydrophobic. Identify the qualities of enriched, selective, and differential media; use examples to explain their content and purposes. Read 7.1 Secret World of Microbes to discover the broad range of conditions that support microbial life. Discuss the resistance and significance of
endospores. For example, an atom such as oxygen that can accept two additional electrons will bond readily with atoms (such as hydrogen) that can share or donate electrons. Look up some of the diseases shown in table 1.2 in the index and determine which ones could be prevented by vaccines or cured with drugs. Describe ionization and distinguisly
between anions and cations. Parasitic Microorganisms Most human infections are caused by heterotrophic microorganisms, but those having the greatest adverse impact on human health are parasites. Itemize the various staining methods, and briefly characterize each. By definition, bacteria do not have a true nucleus. Kingdom Myceteae, containing
the fungi; 4. Trichinella spiralis (trik9-ih-nel9-uh spy-ral9-iss) Gr. trichos, hair, ella, little, and L. She lives in Altadena, California, with husband Dave Bedrosian, and son David. The components of this pool serve as building blocks for cell synthesis or as sources of energy. For an animal virus to successfully infect a cell, it must penetrate the cell
membrane of the host cell and deliver the viral nucleic acid into the host cell's interior. These are further subdivided into families, depending on shape and size of capsid, presence or absence of an envelope, whether double- or single-stranded nucleic acid, antigenic similarities, and host cell. Tables This edition contains numerous illustrated tables
both a and c 5. The one group that has created the greatest challenge in establishing reliable relationships is Kingdom Protists. (a) Several cells of pathogenic Escherichia coli covered with numerous fibers called fimbriae (30,0003). nique showers a virus preparation with a dense metallic vapor directed from a certain angle. (a) Left view
A negative stain of rotaviruses with unusual capsomers that look like spokes on a wheel (150,0003); right view is a three-dimensional model of this virus. It included an A gradual buildup over 30 years has trans- "In spite of the hostile array of very hardy eukaryotes and prokaryotes and prokaryotes and prokaryotes that look like spokes on a wheel (150,0003); right view is a three-dimensional model of this virus. It included an A gradual buildup over 30 years has trans-
microorganisms—that conditions that were centrated chemicals so toxic that it quickly had established a foothold in this toxic soup. Influenza vaccine is prepared this way. Although most microorganisms living in soil, fresh water, or the bodies of plants and animals are neutrophiles, living within the range of pH 5.5 to 8, some can manage exposure to
pH extremes. Microbial Architecture of biofilms play a key role in the majority of inMicrobial Cities" fections, sexually transmitted animation about infections, endocarditis, middle ear infections, biofilms. capsa, box, and mer, part.
/202/MH02004/taL22600 disk1of1/0073522600/taL22600 pagefiles Quick Search Q Mitochondrion Pages 127, 129 Golgi apparatus Page 127 Rough endoplasmic reticulum with ribosomes Pages 127, 129 An Outbreak of Fungal Meningitis Most fungi are not
invasive and do not ordinarily cause serious infections unless a patient's immune system is compromised or the fungus is accidentally introduced into sterile tissues. glucose d. INCUBATION Inoculated media are placed in a controlled environment (incubator) to promote growth. LearnSmart—A Diagnostic, Adaptive Learning System to help you learn
— smarter "I love LearnSmart. Is butter an example of a saturated or an unsaturated fat? • Multiply by taking control of host cell's genetic material and regulating the synthesis and assembly of new viruses • Lack enzymes for most metabolic processes • Lack machinery for synthesizing proteins 6.2 The General Structure of Viruses 159 6.1 MAKING
CONNECTIONS An Alternate View of Viruses Looking at this beautiful tulip, one would never guess that it derives part of its beauty from a viral infection. The mold Aspergillus flavus synthesizes a potentially lethal poison called aflatoxin, 4. An example is the production of sulfur dioxide, a by-product of burning sulfur fuels and an important
component of smog: S 1 O2 		SO2 Some synthesis reactions are not such simple combinations. 56 Chapter 2 The Chemistry of Biology B. Describe the general life cycle and mode of reproduction in protozoans. On one level, a cell synthesizes new cell components and increases its size; on the other level, the number of cells in the population increases
Which eukaryotic cells have a cell wall? Paralytic shellfish poisoning is caused by eating exposed clams or other invertebrates. Trypanosoma cruzi, the cause of Chagas disease, 6 is endemic to South and Central America, where it infects several million people a year. Because organic carbon usually originates from organisms, heterotrophs are
nutritionally dependent on other life forms. protein. Depending on their natural habitats, some microbes have a narrow cardinal range, others a broad one. But it is not considered a human pathogen, and infections with it are very rare. Consequently, it is possible for something with the same mass to have different weights. Infections with it are very rare.
Pathogens No. of Cases* Tuberculosis** Malaria (protozoan) Viral hepatitis (A, B, C) Rotavirus Shigellosis (dysentery) Dengue fever (virus) HIV/AIDS Measles (virus) 4 million 30 million 31 million 30 million 3
Health Organization statistics. Even though gram-negative rods look alike, there are hundreds of different species with highly significant differences in biochemistry and genetics. Such use of substitute host * in vitro (in vee9-troh) L. Ironically, the victims themselves inadvertently contribute to the entry of the microbe by scratching the bite wound.
Quantitative laboratory studies indicate that a population typically displays a predictable pattern, or growth curve, over time. Table 4.1 provides a summary of the major similarities and differences between the wall types. The magnifying power of the ocular alone ranges from 103 to
203. Describe the basic characteristics of the Kingdom Fungi in terms of general types of cells and organisms, structure, and nutrition. It mainly involved disinfecting the hands and * aseptic (ay-sep9-tik) Gr. a, no, and sepsis, decay or infection. 4 New spikes New capsomers 5 Assembly. 325 How Antimicrobial Agents Work: Their Modes of Action 11.2
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369 13.5 The Work of Epidemiologists: Investigation and Surveillance 415 Epidemiologists: Investigation and Surveillance 415 Epidemiologists: Investigative Strategies of the Epidemiologists 418 Hospital Epidemiologists: Investigative Strategies of the Epidemiologists 418 Hospital Epidemiologists.
Drug Resistance 371 How Does Drug Resistance Develop? This finding immediately caused alarm, He lost his appetite, his joints and muscles were "At least 65% of chronic and Mr. Jones was admitted to the intensive care sore, and he woke up wringing wet from night unit and placed on a mixture of intravenous infections are caused by sweats. Such
interactions are important in many cellular chemical reactions, in the formation of solutions, and in the reactions microorganisms have with dyes. What are some other ways to describe the sort of parasitism exhibited by viruses? MASS 32.06 Figure 2.2 Examples of biologically important atoms. Microbiologists from the U.S. Food and Drug
Administration collect soil samples to detect animal pathogens. Describe the operating features of electron microscopes and how they differ from optical microscopes in illumination, and image appearance. In these settings, microorganisms are exposed to a tremendous variety of conditions that affect their survival
Naked helical virus (tobacco mosaic virus): (a) a schematic view and (b) a negative stain magnified 160,0003. logical inquiry that we start out with the subject of microscopes, magnification, and staining techniques. Purple-colored masses in a fall pond contain a concentrated bloom of purple sulfur bacteria (inset 1,5003). mal, microscopically and
macroscopically. The first letter is always capitalized; if there is a second letter, it is always lowercased. The result is that LearnSmart's adaptive learning path helps students learn faster, study more efficiently, and retain more knowledge, allowing instructors to focus valuable class time on higher-level concepts. 6.2 The General Structure of Viruses
A. archaeal cell with its flexible envelope could engulf osomes and some unique The archaeon would contribute its cytoplasmic ribosomes own characteristics (see aspects of protein synthesis, as predicted by known table 4.5). Provide some examples of extreme habitats created by human technologies that would support microbes. Their molecular
structure consists of regular, repeating molecules that give rise to their crystalline appearance. ribose b. Unusual Forms of Medically Significant Bacteria Most bacteria are free-living or parasitic forms that can metabolize and reproduce by independent means. Trichomonas 24. Cell rounds up, loses motility. parvoviruses 1 (around 20 nm in diameter)
to megaviruses and pandoraviruses2 that are as large as small bacteria (up to 1,000 nm in width) (figure 6.1). • Members include: Trypanosoma and Leishmania, important blood pathogens spread by insect vectors (see figure 5.26); Giardia, an intestinal parasite spread in water contaminated with feces (see figure B); Trichomonas, a parasite of the
reproductive tract of humans spread by sexual contact (see figure A) A TTrichonympha—a A. solidifies at 758C c. (a) Covalent Bonds (b) Ionic Bond (c) Hydrogen Bond Molecule A H (+) Single (-) (+) O (-) or N Molecule B Double * molecule
(mol9-ih-kyool) L. For quite some time, microbiologists have known that the human body harbors nine bacteria actually help maintain the low pH by releasing strong acid. the cause of malaria b. Note that replication is guided by the double-
stranded nature of DNA and the precise pairing of bases that create the master code. Assignable content is available for every Learning Outcome in the book. Nonobligate Mutualism Organisms interact at the cellular level for mutual benefit, but they can be separated and live apart. You are much more likely to remember the names that way—and
they will become part of the new language you will be learning. Carbohydrates are composed of carbon, hydrogen, and oxygen and contain aldehyde or ketone groups. the glossary at the end of the book. incubation b. * hypertonic (hy-pur-tahn9-ik) Gr. hyper, above, and tonos, tension. verifying water d. Aside from this, the virus does not immediately
destroy the plants. TSA is a complex medium that contains partially digested milk protein (casein), soybean digest, NaCl, and agar. How Microbes Process Oxygen As oxygen gas enters into cellular reactions, it can be transformed into several toxic products. diphtheriae without the phage are less pathogenic. parasitism 7. Isotopes are variant forms of
the same element that differ in the number of neutrons and thus have different mass numbers. The areas where virus-infected cells have been destroyed show up as clear, well-defined patches in the cell sheet called plaques* (figure 6.19c). Explain what causes the colors and appearance of the stages you see. enzymes, pain c. Answer available at .
Transport is a system for controlling the flow of materials. all of these diseases, there is effective drugs to the poor has been difficult. Amino acids have a basic skeleton consisting of a carbon) linked to an amino group (NH2), a carboxyl group (COOH), a hydrogen
atom (H), and a variable R group. Variations on the Optical Microscope Optical microscopes that use visible light can be described by the nature of their field of view, or field, which is the circular area observed through the ocular lens. Complex Viruses: Atypical Viruses Two special groups of viruses, termed complex viruses (figure 6.9), are more
intricate in structure than the helical, icosahedral, naked, or enveloped viruses just described. Although gelatin is not nearly as satisfactory as agar, it will create a reasonably solid surface in concentrations of 10% to 15%. The von Linné system has served well in categorizing the 2 million or more different types of organisms that have been
discovered since that time. Fully customizable, but complete and ready to use, these presentations will enable for instructors and students. The accompanying legend provides additional explanation. It is in fact the movement of
electrons from molecule to molecule to molecule to molecule to molecule to molecule to the clarity of an image. You may be familiar with diamonds and graphite. Common symptoms include gastrointestinal disturbances such as nausea,
vomiting, and diarrhea, leading to weight loss and dehydration. macroscopic b. ATP: The Energy Molecule of Cells A relative of RNA involved in an entirely different cell activity is adenosine triphosphate (ATP). What is the reproductive potential of molds in terms of spore production? Describe what occurs in a dehydration synthesis
reaction. What are bacteriophages, and what is unique about their structure? Solid (can be converted to liquid) 4. Liquefiable solid media, sometimes called reversible solid media, sometimes called rev
function. Discuss the connection between viruses and cancers, giving possible mechanisms for viruses that cause cancer. You have no doubt heard comments that dismiss evolution as "only a theory" as though there remain significant problems with its acceptance. Which of the following parts was absent from Leeuwenhoek's microscopes? Many
professional researchers use more advanced investigation and identification techniques that may not even require growth or absolute isolation of the microbe in culture (see 3.1 Secret World of Microbes). Analysis has shown that chromatin actually comprises the eukaryotic chromosomes, large units of genetic information in the cell. It was
determined that these bacterial cells have a particularly impervious outer wall that holds fast (tightly or tenaciously) to the dye (carbol fuchsin), even when washed with a solution containing acid or acid alcohol (figure 3.9b). In most compounds, each carbon makes a total of four bonds. Enzyme structures located in the cell membrane also help
synthesize structural macromolecules to be incorporated into the cell envelope and appendages. The resulting material is typically pliable and soft when warmed but hard and water-resistant when cold (paraffin, for example). (b) Examples of bacteria drawn by Leeuwenhoek. The outer-shell electrons are readily portable and easily manipulated
sources of energy. The physician recorded a rapid heart murmur. A hypha divided into compartments by cross walls is called a. 35. Nonfermenters such as Pseudomonas (left) grow but do not change the pH (purple color indicates neutral pH). Blood agar, which is made by adding sterile animal blood (usually from sheep) to
sterile agar base (figure 3.17a) is widely employed Growth of Streptococcus pyogenes showing beta hemolysis (a) (b) Figure 3.17 Examples of enriched media. Probably the most outstanding examples are megaviruses (figure 6.2) and pandoraviruses. As a rule, these media are nonsynthetic (complex) and contain a mixture of nutrients that could
support the growth of a variety of bacteria and fungi. A wide variety 
image is made and magnified. For example, lactobacilli growing in the vagina maintain an acidic pH that can protect the female reproductive tract from infections (see figure), and other species are involved in digestive processes and the function of the intestine. (b) Fluorescent-stained human cells infected with cytomegalovirus. A simple example of
hydrogen bonding occurs between water molecules (figure 2.8). On this scale, a pH below 7 is acidic, and the higher the pH, the greater the alkalinity. All the members of a domain share only one or few general characteristics, whereas members of a species are essentially the same
kind of organism—that is, they share the majority of their characteristics. The nature of this cycle profoundly affects pathogenicity, transmission, the responses of the immune defenses, and human measures to control viral infections. Donnelley All credits appearing on page or at the end of the book are considered to be an extension of the copyright
page. brucei and T. Red areas indicate places in the cytoplasm where the prion fibers have deposited. One theory explains that viruses arose from loose strands of genetic material released by cells. endocytosis, replication, assembly, and budding c. They may be responsible for the mutual clinging of cells that leads to biofilms and other thick
aggregates of cells on the surface of liquids and for the microbial colonization of inanimate solids such as rocks and * fimbria (fim9-bree-ah) pl. Such agents as heat, acid, alcohol, and some tertiary, and quaternary structures (figure 2.23). Each element is assigned an atomic number (AN) based on the number of protons it has. Given that DNA viruses
can actually be carried in the DNA of the host cell's chromosomes, comment on what this phenomenon means in terms of inheritance in the offspring. They are a type of obligate intracellular parasite that cannot multiply unless it invades a specific host cell and instructs its genetic and metabolic machinery to make and release quantities of new
viruses. This force causes one end of a molecule to assume a partial positive charge and the other end to assume a partial positive charge. Name several general characteristics that could be used to define the prokaryotes. The next level, Class Mammalia, narrows the field considerably by grouping only those vertebrates that have hair and suckle
their young. This book is printed on acid-free paper. Owing to the general rule that particles of like charge repel each other, we can expect ions to interact electrostatically with other ions and polar molecules. pocks c. bioremediation b. Only some of the eukaryotes are microorganisms: primarily algae
protozoa, molds and yeasts (types of fungi), and certain animals such as worms and arrangements of water molecules. Carl von Linné b. As advances in instrumentation allow new, more detailed views of living phenomena, old theories may be
reexamined and altered and new ones proposed. Resident microbes come from nearly all groups and include viruses, archaea, bacteria, fungi, and protozoa that have adapted to specialized niches throughout our surfaces. 1 2 3 4 (a) Steps in a Streak Plate; this one is a four-part or guadrant streak. The STM is used primarily for detecting defects on
the surfaces of electrical conductors and computer chips, but it has also provided the first incredible close-up views of DNA, the genetic material salivary glands. Which of the following is not an emerging infectious disease? The flagellum can guide bacteria in a certain direction because the system for detecting chemicals is linked to the mechanisms.
that drive the flagellum. Molecules of life fall into basic categories of carbohydrates, lipids, proteins, and nucleic acids. differential medium d. Earliest prokaryotic cells appeared. Substances that can make it nonsynthetic are extracts from animal or plant tissues including such materials as ground-up cells and secretions. Ribosome (70S) Figure 4.18
Bacterial cells stained to highlight their chromosomes. 1.4 Microbial Roles in Infectious Diseases TABLE 1.2 The Most Common Infectious Disease TABLE 1.2 The Most Common Infectious Disease TABLE 1.2 The Mos
are prokaryotic? enriched medium d. Distinguish between polar and ionic compounds. Amebic dysentery is the fourth most common protozoan infection in the world. Another term used interchangeably with basic is alkaline. A simple example involves a pair of free-living soil bacteria that share their metabolic products cyclically (figure 7.13j). a law b
The red atoms are oxygen, the white ones hydrogen, and the black ones carbon. Because most macromolecules in the cell walls are foreign to humans, they stimulate antibody production by the immune system (see chapter 15). These early cells attach and begin to multiply on the surface. 7.4 Environmental Factors That Influence Microbes TABLE 7.3
197 Summary of Transport Processes in Cells General Process Nature of Transport Examples Description Qualities Passive Energy expenditure by the cell is not required. These process figures show each step clearly marked with a yellow, numbered circle and correlated to accompanying narrative to benefit all types of learners. genera (jen9-er-uh) L.
half per minute! On some cells, cilia also function as feeding and filtering structures. a monomer d. Human fungal infections involve and affect what areas of the human body? rapid, an incubator b. He received his Bachelor's and Master's degrees from California State University, Los Angeles, and did several years of postgraduate work at the
(anionic) dyes with negative charges. Phylum Deinococcus-Thermus A small phylum of extremophiles whose members range from being highly radiation- and desiccation-resistant C Desulfurobacterium—a Desulfurobacterium—a complete whose members range from being highly radiation- and desiccation-resistant C Desulfurobacterium—a Desulfurobacterium—a complete whose members range from being highly radiation- and desiccation-resistant C Desulfurobacterium—a Desulfurobacterium—a
outer shell. But you have also learned that a scientific theory is a highly-documented and well-established concept. Three bacteria in the process of conjugating. violet This color choice provides differentiation between (primary bacteria in the process of conjugating. violet This color choice provides differentiation between (primary bacteria that stain purple, called gram-positive, and dye) those that stain red, called gram-negative. contaminate local
groundwater and river drainages, creating one of the greatest ecological disasters on record. Over the succeeding decades, a remarkable picture of the physical, chemical, and biological nature of viruses began to take form. 166 Chapter 6 An Introduction to Viruses Whatever the virus type, these tiny strands of genetic material carry the blueprint for
viral structure and functions. (a) A cross section through a protozoan cilium reveals the typical 9 1 2 arrangement of microtubules seen in both cilia and flagella. Spirilla are occasionally found in short chains, but spirochetes rarely remain attached after division. Magnification and Microscope Design The two key characteristics of a reliable
microscope are magnification,* the ability to make objects appear enlarged, and resolving power, the ability to show detail. neutrons d. This lowers the pH and changes the dye from purple to yellow (right is Escherichia coli). This makes the cell stop and change its course. Explain general features of fungal classification, give examples of the four
fungal phyla, and describe their structure and significance. In addition to her writing and illustration, she keeps current attending conferences and participating in the American Society for Microbiology and its undergraduate educational programs. Actually, it forms a hydronium ion (H3O1), but for simplicity's sake, we will use the notation of H1
improved b. This phenomenon, called transduction, is one way that genes for toxin production and drug resistance are transferred between bacteria (see chapters 9 and 12). injection b. We do not know at this time if there was a common ancestor or several different ones. Paul Ewald has asked, "What are all those microbes doing in there?" He points
out that many oral microbes previously assumed to be innocuous are now associated with cancer and heart disease. Which process involves the deliberate alteration of an organism's genetic material? The first four sections of this chapter Quick Search cover some of the essential concepts that reTake "A Tour of the volve around the 6 "I's", but not
necessarily Microbiology Lab" on YouTube to see in the exact order presented in figure 3.1. the daily work Microscopes are so important to microbioperformed there. aureus 548 Other Important to microbioperformed there.
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Ecosystems 801 Ecological Interactions Between Organisms in a Community 26.3 The Natural Recycling of Bioelements Atmospheric Cycles 805 Sedimentary Cycles 805 CHAPTER Applied and Industrial Microbiology 822 25.5 Retroviruses and Human Diseases 777 HIV Infection and AIDS 777 Human T-Cell Lymphotropic Viruses 786 CHAPTER 26.5
The Microbiology of the Hydrosphere 812 The Hydrologic Cycle 812 The Structure of Aquatic Ecosystems 813 804 Glossary G-1 Credits CR-1 803 Index I-1 xxxi This page intentionally left blank CHAPTER 1 The Main Themes of Microbiology A plankton sample from the Atlantic Ocean yields up its jewels. The outcome of this reaction is a solid crystal
complex that interlinks millions of sodium and chloride atoms (figure 2.6c, d). Define inoculation, media, and culture, and describe sampling methods and instruments, and what events must be controlled. teeming with microscopic life. Repellents cause numerous tumbles, allowing the bacterium to redirect itself away from the stimulus. The source of
energy in this community is not the sun, because the vents Quick Search are too deep for light to penetrate (2,600 m). The fact that these organisms have endured for so long in such a variety of habitats indicates cellular structure and function that are incredibly versatile and adaptable. Mitochondria likely originated from a. This Woese-Fox system
recognizes three Domains: Archaea, simple prokaryotes that often live in extreme environments; Bacteria, typical prokaryotes are formed, their structure, and their importance in the life cycle. A final note about taxonomy
No one system is perfect or permanent. Its major component is water (70%-80%), which serves as a solvent for a complex mixture of nutrients including sugars, amino acids, and other organic molecules and salts. Some of the vesicles contain * vesicle (ves9-ik-l) L. The spore stain (on right) is one method that fits both differential and structural
categories. taL22600_ch18_543-573.indd Page 557 11/5/13 7:49 PM f-w-166 Pathogen Profile #2 Streptococcus pyogenes Microscopic Morphology Gram-positive cocci arranged in chains and pairs; very rarely motile; non-spore-forming. 3.3 Preparing Specimens for Optical Microscopic Morphology Gram-positive cocci arranged in chains and pairs; very rarely motile; non-spore-forming.
of the growth rate of an organism. How many water molecules are released when a triglyceride is formed? A thermophile* is a microbe that grows optimally at temperatures greater than 458C (1138F). Note the membrane and shows that it is indeed an organism that is an extension of the cell membrane and shows that it is indeed an organism.
zygospore involves production of a haploid sporangium that looks just like the asexual one shown in figure 5.18, but the individual spores contain genes from two different parents. Not all worms have such extreme adaptations as cestodes, but most have a highly developed reproductive potential, thick cuticles for protection, and mouth glands for
breaking down the host's tissue. For example, dissolving 3 g of NaCl in the amount of water to produce 100 ml of solution; dissolving 30 g in water up to * hydrophilic (hy-droh-fil9-ik) Gr. hydros, water, and philos, to love. Many of the bacteria mentioned here do not have the morphology typical of bacteria discussed previously, and in a 3% solution; dissolving 30 g in water up to * hydrophilic (hy-droh-fil9-ik) Gr. hydros, water, and philos, to love. Many of the bacteria mentioned here do not have the morphology typical of bacteria discussed previously, and in a 3% solution; dissolving 30 g in water up to * hydrophilic (hy-droh-fil9-ik) Gr. hydros, water, and philos, to love. Many of the bacteria mentioned here do not have the morphology typical of bacteria discussed previously, and in a 3% solution is a 3% solution in the amount of water up to * hydrophilic (hy-droh-fil9-ik) Gr. hydros, water, and philos, to love. Many of the bacteria mentioned here do not have the morphology typical of bacteria discussed previously, and in a 3% solution is a 3% solution in the amount of water up to * hydrophilic (hy-droh-fil9-ik) Gr. hydros, water, and philos, to love. Many of the bacteria mentioned here do not have the morphology typical of bacteria discussed here.
few cases, they are vividly different (4.1 Secret World of Microbes). Branches indicate the origins of each lated species in a genus can be somewhat group, and their relationships. 136 Chapter 5 Bud A Survey of Eukaryotic Cells and Microorganisms Bud scar Ribosomes Mitochondrion Endoplasmic reticulum.
Nucleus Nucleolus Cell wall Cell membrane Golgi apparatus Storage vacuole (a) (b) Bud Figure 5.16 Nutritional sources (substrates) for fungi. does not melt at room temperature b. (b) Diagram of a T4 bacteriophage of E. A simple example can be shown for the common chemical hydrogen peroxide: 2H2O2 → 2H2O 1 O2
synthesis (sin9-thuh-sis) Gr. synthesis, putting together. Kingdom Prokaryotae (Monera), containing eubacteria and archaea; 2. 2.2 Bonds and Molecules A. Specimen may Yes Usually not Go to "25 Amazing The TEM can also be used to produce negbe alive. In biology, this term is always in the plural form. Today photosynthetic microorganisms
(including algae) account for more than 50% of the earth's photosynthesis, contributing the majority of the oxygen to the atmosphere (figure 1.5a). Complex viruses: (1) poxvirus, a large DNA virus (2) flexible-tailed bacteriophage (8) B. If you approach and problem assignment that corresponds to lectures and discusthe subject in small bites and
remain connected with the terminolsion sessions. The number of viral infections that occur on a worldwide basis is nearly impossible to measure accurately. We feel the term protist is still a useful shorthand reference and will continue to use it for any eukaryote that is not a fungus, animal, or plant. It also metabolizes hydrogen gas but its product is
methane gas (180,0003). Cell membrane Peptidoglycan Peptidoglycan Peptidoglycan Cell membrane Outer membrane Gram (-) Gram (+) Basic Types of Cell Envelopes Long before the detailed anatomy of bacteria was even remotely known, a Danish physician named Hans Christian Gram developed a staining technique, the Gram stain, 3 which is (a) 3. vacuus of Cell Envelopes Long before the detailed anatomy of bacteria was even remotely known, a Danish physician named Hans Christian Gram developed a staining technique, the Gram stain, 3 which is (a) 3. vacuus of Cell Enveloped anatomy of bacteria was even remotely known, a Danish physician named Hans Christian Gram developed a staining technique, the Gram stain, 3 which is (a) 3. vacuus of Cell Enveloped anatomy of bacteria was even remotely known, a Danish physician named Hans Christian Gram developed a staining technique, the Gram stain, 3 which is (a) 3. vacuus of Cell Enveloped anatomy of bacteria was even remotely known, a Danish physician named Hans Christian Gram developed a staining technique, the Gram stain, 3 which is (a) 3. vacuus of Cell Enveloped anatomy of bacteria was even remotely known, a Danish physician named Hans Christian Gram developed a staining technique, the Gram stain of Cell Enveloped anatomy of bacteria was even remotely known, a Danish physician named Hans Christian Gram developed and the Cell Enveloped anatomy of Cell Enveloped anatomy of Cell Enveloped anatomy of Cell Enveloped and the Cell Enveloped anatomy of Cell Enveloped anatomy o
empty. Medical microbiology. Biofilms are a profoundly important force in the development of terrestrial and aquatic environments. (b) The nucleic acid is inserted into the center of the disc. The molecule is formed by one atom sharing its electrons with another atom; the balance of charge will be polar if unequal or nonpolar if equally
shared/electrically neutral. Methane is formed by certain primcurious unknown itive prokaryotes but can also be the result features of Mars of geologic activity. Negative staining is also used to accentuate the capsule that surrounds certain bacteria and yeasts (figure 3.9). To continue the Case Study, go to page 153. DIC microscopes produce
extremely well-defined images that are often vividly colored and appear three-dimensional (table 3.2). It is composed of two parallel membranes separated by a narrow space, and it is perforated with small, regularly spaced openings, or pores, at sites where the two membranes unite (figure 5.5). Ionization of water is constantly occurring, but in pure spaced openings, or pores, at sites where the two membranes unite (figure 5.5).
water containing no other ions, H1 and OH2 are produced in equal amounts, and the solution remains neutral. Pathogenic Flagellates: Trypanosoma.* The two most important representatives are T. water transport Concept Mapping 57 Case Study Review 1. (a) An enveloped
coronavirus with prominent spikes. Check Your Progress 27. This permits use of atomic weight as a standard of comparison. A superior source for the taxonomic breakdown of microbes is Wikipedia. Nucleotides are the building blocks of nucleic acids. hydrogen atom c. Free nucleotides are used to synthesize matching strands that complement the
bases in the code by adhering to the pairing requirements of AOT and COG. Differentiate between micronutrients, and essential nutrients. RNA plays an important role in what biological process? Discuss several ways in which bacteria are medically and ecologically important. develop within the spleen d. studies sprang a new science
-astrobiology-which applies princ What chemical properties of water makes it essential for living ciples from biology, chemistry, and geology to investigate the posprocesses? For ease in understanding the structure of DNA, it is sometimes compared to a ladder, with the sugar-phosphate backbone representing the rails and the paired nitrogen bases
representing the steps. The compounds in The term carbohydrate originates from the way that most members of this chemical class resemble combinations of carbon and water. Duroxidation-reduction reaction. 31. When an object is placed a certain distance from the spherical lens and illuminated with light, an optical replica, or image, of it is formed
by the refracted light. ELISA is often used to detect toxins of C. The phenomenon in which electrons are transferred from host to host by insect vectors. Because a virus can invade its host cell only through making an exact fit with a
specific host molecule, the range of hosts it can infect in a natural setting is limited. bacilli (bah-sil9-eye) L. (c) Sodium and chloride ions form large molecules, or crystals, in which the two atoms alternate in a definite, regular, geometric pattern. The presence of infectious agents or their toxins in the blood. i off Pl Plasmodium— di the agent of
malaria, migrating through the gut of a mosquito *Some biologists prefer to combine Mastigophora and Sarcodina into the phylum Sarcomastigophora. Figure 2.28 To conclude this Case Study, go to Perspectives on the Connect website. It is thus able to capture a highly focused view at any level, ranging from the surface to the middle of the cell
Fimbriae are small, bristlelike fibers emerging from the surface of many types of bacterial cells (figure 4.8). This disease was characterized by raised skin blisters called pox, and it often caused severe damage to organs. One of these, syntrophy,* or crossfeeding, is communal feeding of organisms sharing a habitat In essence, products given off by one
organism are usable by another (figure 7.13i). Identification correlates the key characteristics that can pinpoint the actual species of microbe. To survive, they must adapt to whatever temperature variations are encountered in their habitat. This structure is usually composed of polysaccharides and appears as a network of fibers, a slime layer, or a
capsule much like the glycocalyx of pro- Oral groove with gullet Food vacuoles Macronucleus Micronucleus Micr
Namibia. 30. This is how the bacterium clings and gains access to the inside of cells during an infection. • There is a universal biological truth that the basic unit of life is the cell, whether the organism is a bacterium whose entire body is just a single cell or an elephant made up of trillions of cells. These unusual bacteria use these inclusions to orientate the organism is a bacterium whose entire body is just a single cell or an elephant made up of trillions of cells.
within their habitat (123,0003). This is a compound light microscope with two oculars for viewing (binocular). This tendency of microbes to form biofilm communities is an ancient and effective adaptive strategy. It is often necessary to separate the organisms from one another so they can be identified and studied. Flies gathering at the jar were
blocked from entering and thus laid their eggs on the outside of the gauze. Some of it serves as a nutrient source for other extreme archaea, and some of it escapes into the organic acids (such as lactic and succinic acids) that function in metabolism* are available as the acid and the salt form (such as lactate, succinate), depending
on the conditions in the cell (see chapter 8). It belongs to a category of high-energy compounds (also including guanosine triphosphate, GTP) that give off energy when the bond is broken between the second and third (outermost) phosphate. Fortunately, systems of cultivation with broader applications were developed, including in vitro* cell (or
tissue) culture methods and in vivo* inoculation of laboratory-bred animals and embryonic bird tissues. These ants have been shown to cultivate specialized gardens of fungi as a source of food. It tracks what you know as well as retain it for the future?" and what you don't know and creates questions just for you based on Right from the first, you need
to be guided by how your inyour progress. Targets include the allantoic cavity, a sac for embryonic waste removal; the amniotic cavity that cushions and protects the embryo; and the embryo itself. Although the emphasis in this chapter is on
animal viruses, much credit for our knowledge must be given to experiments with bacterial and plant viruses. Differential medium (a) General-purpose medium (b) Selective medium Is not selective and can be Growth is restricted to a Permits growth of several in
the formation of gas bubbles used to grow a wide variety particular group or type types of microbes that show and precipitates (table 3.8). Some water will diffuse the opposite direction but the net gradient favors osmosis into the sac. By comparison, the bacterium Escherichia coli has approximately 4,000 genes, and a human cell has fewer than
21,000 genes. Hattaway, Georgia Southern University Nazanin Hebel, Houston Community College System, Northwest Robin Hulbert, Cal Poly, San Luis Obispo Sandra Kaiser, St. Louis Community College-Meramec Peter Kourtev, Central Michigan University Kristine Lowe, University of Texas-Pan American Elizabeth A. Under the microscope, you
see a rod-shaped cell that is swimming rapidly forward. The impact of science is so pervasive that you may not realize how much of our everyday life is built upon applications of the scientific method. You tics of bacteria, viruses, and other microbes; their physiology and should go over concepts with others—perhaps a tutor or study primary niches in
the world: but you must also have a grasp of disgroup—and even take on the role of the teacher-presenter part of ease transmission, the infectious process, disinfection procedures, the time. Chagas disease e. 72 Chapter 3 Tools of the Laboratory These staining techniques tend to be more complex, sometimes requiring additional chemical reagents to
produce the desired reaction. Rate of transport is increased. all of these c. Forms, Sources, and Functions of Essential Nutrients The elements that comprise nutrients ultimately exist in an environmental inorganic reservoir of some type.
epithelial cells (figure 4.8b). For an example of chemoautotrophy and its importance to deep-sea communities, see 7.1 Secret World of Microbes. The scientific method develops rational hypotheses and theories that can be tested. Not only are they the most common microbes on earth, but they invade their hosts' cells and inflict serious damage and
death. Fats that contain such fatty acids are described with these terms as well. Overall, prokaryotic cells can engage in nearly every activity that eukaryotic sannot. Naked viruses: Helical capsid: (8) poliovirus (9) papillomavirus Figure 6.10 Basic types of
viral morphology. Clarifying Mass, Weight, and Related Terms Mass refers to the quantity of matter that an atomic particle contains. Synthesis produces unlinked segments of RNA primer and new DNA called Okazaki fragments. The Domains Archaea and Bacteria based on genetic on bacterial genomes is discovered, it may be possible to define
specharacteristics have been retained, but the bacteria of clinical imcies according to specific combinations of genetic codes found only in portance are no longer as closely aligned, and the 250 or so species a particular isolate. Explain how the concepts of molecules and compounds are related. Antibodies are complex glycoproteins with specific
regions of attachment for Figure 2.22 The formation of peptide bonds in a tetrapeptide. MASS 31.97 AT. Why wasn't penicillin effective in treating the infective in treating t
environment, the ways they interact with other organisms, and their uses in industry and agriculture. Being the first type of cells on earth, prokaryotic cells have an evolutionary history that dates back over 3.5 billion years. Another way of tapping into the unlimited potential of microorganisms is the relatively new science of bioremediation.* This *
bioremediation (by9-oh-ree-mee-dee-ay0-shun) bios, life; re, again; mederi, to heal. Saprobe 2. Although each envelope layer performs a distinct action, together they act as a single unit required for a cell's normal function and integrity. Figure 2.3 General representation of three types of bonding. Thermal Vent Communities Another fascinating
relationship has been found in the deep hydrothermal vents in the seafloor, where geologic forces spread the crustal plates and release superheated fluid (over 3508C or 6628F) and gas. Which of the seafloor, where geologic forces spread the crustal plates and release superheated fluid (over 3508C or 6628F) and gas. Which of the seafloor, where geologic forces spread the crustal plates and release superheated fluid (over 3508C or 6628F) and gas. Which of the seafloor, where geologic forces spread the crustal plates and release superheated fluid (over 3508C or 6628F) and gas. Which of the seafloor, where geologic forces spread the crustal plates and release superheated fluid (over 3508C or 6628F) and gas. Which of the seafloor, where geologic forces spread the crustal plates and release superheated fluid (over 3508C or 6628F) and gas. Which of the seafloor, where geologic forces spread the crustal plates and release superheated fluid (over 3508C or 6628F) and gas.
of obligate intracellular bacteria. Define solution, solvent, and solute. The term lipid, derived from the Greek word lipos, meaning fat, is not a chemical designation but an operational term for a variety of substances that are not soluble in polar solvents such as
benzene and chloroform. The most careful and exacting observations awaited the simple single-lens 1.5 The Historical Foundations of Microbiology 13 EMERGING AND REEMERGING INFECTIOUS DISEASES: 1996-2009 Atlantic Ocean Pacific Ocean Ebola and Crimean Congo hemorrhagic fever Influenza H5N1 Indian Ocean Nipah and Hendra
viruses Rift Valley fever Venezuelan equine encephalomyelitis Yellow fever Lassa Fever New-variant CreutzfeldtJakob disease West Nile fever Monkeypox SARS coronavirus Cryptosporidiosis Leptospirosis Plague Lyme borreliosis Influenza H1N1 Escherichia coli O157 Hantavirus Multidrug-resistant Salmonella This figure is based on data from the
WHO that traces the worldwide appearance of emerging and reemerging diseases. The capsid is composed of protein subunits called a. When the real image is projected to the plane of the eyepiece, the ocular lens magnifies it to produce a second image, the virtual image. Selective media permit the growth of desired microbes while inhibiting
unwanted ones. Thus, it can attract a nearby negatively charged atom and form an easily disrupted bridge with it. The end result is a body number of terminal cells called dikaryons, each containing a Sterile hyphae diploid nucleus. Animals are an important source of antibodies, antisera, antitoxins, and other immune products that can be used in
therapy or testing, dinoflagellate 23. A fence made of a row of stakes. Answer available at Check Your Progress SECTIONS 1.31.4 7. They, too, are very diverse and frequently frustrate attempts to generalize or place them in neat groupings.
microbe? Give examples from the revealed no sign of pneumonia, and a blood test indicated an elecase that appear to be the most diagnostically significant. Several hundred people developed the disease and a majority of them have since died. (b) An adenovirus has a naked capsid that adheres to its host cell by nestling surface molecules on its capsid
into the receptors on the host cell's membrane. Adaptations to Osmotic Variations in the Environments. An amino acid first found in urine stones. Inspect figure 6.8 to compare a rotavirus and its naked nucleocapsid with herpes simplex (cold sores) and its enveloped
nucleocapsid. Describe the anatomy and functions of each of the major eukaryotic ryotic organelles. The shortest visible wavelengths are in the violetblue portion of the spectrum (400 nm), and the longest are in the red portion (750 nm). The consistent layout of each chapter allows students to develop a learning strategy and gain confidence in their
ability to master the concepts, leading to success in the class! Chapter Summary with Key Terms /202/MH 5.1 The History of Eukaryotes New! Case Study and allow instructors to assess students on the case study material. Cell wall Many protozoa, animals Some
groups of algae, higher plants 5.2 Form and Function of the Eukaryotic Cell: External Structures Cell wall* Page 127 Quick Search Look up "an interactive tour of the cell groupings of multicellular organisms that have a specific function are termed tissues,
and groups of tissues make up organs. Isolation Methods for separating individual microbes and achieving isolated colonies that can be readily distinguished from one another macroscopically* To make additional cultures from single colonies that can be readily distinguished from one another macroscopically a single species of microbes for further observation and
testing 74-76 Inspection Observing cultures macroscopically for appearance of cells may reveal information on cell type and morphology 62-72 Information gathering Testing of cultures with procedures that analyze biochemical and
enzyme characteristics, immunologic reactions, drug sensitivity, and genetic makeup To provide much specific data and generate an overall profile of the microbes. When the signal is of a chemical stimulus (usually a nutrient);
negative chemotaxis is movement away from a repellent (potentially harmful) compound. In the ciliated protozoa, the Quick Search cilia occur in rows over the cell surface, Find videos where they beat back and forth in regular using the search carlies strokes (figure 5.4) and provide words amoebic, flagellate, and rapid motility. A significant number
are parasites of plants, animals, and other microbes (figure G), but they are not known to cause human disease. Overall Morphology: Animal cells; multicellular; individual organs specialized for reproduction, digestion, movement, protection, though some of these are reduced. Drawings show examples of shape variations for cocci, rods, vibrios,
spirilla, spirochetes, and branching filaments. The disulfide bonds occur between sulfur atoms on the amino acid cysteine,* and these bonds confer a high degree of 29. The pattern of ciliary movement is like a swimmer's arms, with a power forward stroke and a repositioning stroke. 2.6 Molecules of Life: Lipids (a) Triglyceride synthesis 3 H2O s Fatty
polyunsaturated because it has 3 double bonds Figure 2.18 Synthesis and structure of a triglyceride. Fungi are eukaryotic cells and are unicellular or multicellular; they have cell walls and are not photosynthetic. disinfectants disrupt (and thus denature) the stabilizing intrachain The primary (18) structure of a protein is the fundamental bonds and
cause the molecule to become nonfunctional, as dechain of amino acids just described, but proteins vary extensively in scribed in chapter 11. Describe the features of active transport and differentiate among its mechanisms. Another possibility is that these viruses are related to ancient forms that evolved into the first cells. hyphae (hy9-fee); Gr.
hyphe, a web. gui, who. It is restricted to bacterial disease agents and depends less on nomenclature, some of which characterize their cellular metabolism. As you will see, numerous factors play a part in the tenaciousness of infectious diseases, but fundamental to all of them is the formidable
capacity of microbes to adapt to alterations in the individual, community, and environment. The source of nutrients is extremely varied: Microbes such as photosynthetic bacteria and as a means of studying their relationships and
evolutionary origins. heat, cold, drying, and predators, and are destroyed or unable to reach a new host. Viral architecture is most readily observed through special stains in combination with electron microscopy. This emergency room. (h1) The malaria vector, a female Anopheles mosquito; (h2) malaria parasites (Plasmodium, 1,0003) from blood 7.5
Figure 7.13 Ecological Associations Among Microorganisms 205 Part 2—Additional microbial adaptations. One of timeline for the age of the virus of about 40 million years. The matrix is interwoven by a flexible framework of molecules called the cytoskeleton (figure 5.12). Tell what chemical category this medium belongs to, and explain why this is
true. The ongoing microbiome studies will no doubt find that many human residents are actually mutualists that contribute to human health. These fungilive inside the tissues of the implicated in building contamination that leads white nose syndrome. Some diseases previously thought to be noninfectious may involve microbial infections (e.g.,
Helicobacter, causing gastric ulcers, and coxsackieviruses, causing diabetes). * dimorphic (dy-mor9-fik) Gr. di, two, and morphe, form. In general, it helps determine the shape of a bacterium intact despite constant changes in 13. Most saprobes, notably bacteria
and fungi, have a rigid cell wall and cannot engulf large particles of food. In 2012, the infection resurged to the highest numbers since 2003, probably because of conditions favorable to the life cycle of mosquitoes. It transfers the details of its program to RNA, "helper" Process Figure 2.23 Formation of structural levels in a protein, upon the combined
action of several interacting nutritional schemes, each performing a necessary step. Several species of algae and fungi thrive on the surfaces of snow and glacier ice (see figure 7.10). This structure is a flexible tube made of the protein, pilin. SECTION 1.6 14. There is no universal agreement on how and when viruses originated. The way that viruses
invade a host cell is an extraordinary biological phenomenon. However, as more species were discovered and as techniques for studying their biochemistry were developed, it soon became clear that similarities in cell shape, arrangement, and staining reactions do not automatically indicate relatedness. Elemental sodium is a soft, lustrous metal so
reactive that it can burn flesh, and molecular chlorine is a very poisonous yellow gas. A wet mount consists of a drop or two of the culture placed on a slide and overlaid with a cover glass. Information gathering involves acquiring additional data from physiological, immune, and genetic tests. Marine biologists sampling deep-sea trenches 7 miles below
the surface isolated unusual eukaryotes called foraminifera that were being exposed to pressures 1,100 times normal. Explain some ways that helminths differ from the protozoa and algae in structure and behavior. (a) A simple ciliate, Balantidium, has regular rows of cilia over its surface and within its oral groove and gullet for capturing and
transporting food. Explain why or why not. They all share a basic structure of an amino group, and hydrogen bonded to a carbon atom. A microbe living in a high-salt environment (hypertonic) has the opposite problem and must either restrict its loss of water to the environment or increase the salinity of its internal
environment. both a and b 13. They aid in differentiating and identifying unknown species in medical and applied microbiology, fat, Mycobacterium c. Why or why not? (a) A summer pond is heavily laden with surface scum that reveals several different types of green algae called desmids (6003). These same concentrations can be represented more
manageably by exponents: • pH 2 has an [H1] of 1022 moles. Hemoglobin molecule (3) (11) (10) (9) 15 nm (8) (4) (7) (5) (6) YEAST CELL - 7 m Figure 6.1 Size comparison of viruses with a yeast cell colored blue (eukaryotic) and various bacteria (prokaryotic).
Spikes 1 Adsorption. Eukaryotic cells are found in animals, plants, fungi, and protists. Cell Membrane Structure A layer in the cell envelope appearing just beneath the cell wall is the cell, or cytoplasmic, membrane, a very thin (5-10 nm), flexible sheet structured as one complete sheath around the cytoplasm. What is meant by the term DNA
replication? An arrangement in packets of eight cells is described as a a. Examples of substances transported actively are monosaccharides, amino acids, phosphates of yeast and hyphal cells and differentiate between yeasts and
molds. This sort of electrically neutral molecule is termed nonpolar. gram-negative, protection . The sizes of bacteria range from those just barely visible with light microscopy (0.2 mm) to those measuring a thousand times that size. vaginalis Hemoflagellates Trypanosomiasis: Trypanosomiasis: Trypanosomiasis: Trypanosomia brucei, T. A capsular coating blocks the phagocytes from
attaching to, engulfing, and killing bacteria. Hyperthermophiles flourish at temperatures between 808C and 1218C (boiling temperature) and cannot grow at 508C. It also provides significant compartmentalization for numerous cell activities. Virtually all of the pioneering attempts at cultivation had to be performed in an organism that was the usual
host for the virus. We're now discovering the roles of microorganisms in hidden but slowly destructive diseases. These ancient cells were small, simple, and lacked specialized internal structures to carry out their functions. DNA polymerase I removes the RNA primers and fills in the correct complementary DNA nucleotides at the open sites. *
plasmolysis (plaz9-moh-ly9-sis) 194 Chapter 7 Microbial Nutrition, Ecology, and Growth Membrane sac with solution Glass tube Solute Water Container with water Pore (a) Inset shows a close-up of the osmotic process. Thus, the initial parent stage consists of 1 cell, the first generation consists of 2 cells, the second 4, the third 8, then 16, 32, 64, and
so on. Bacteria that require growth factors and complex nutrients are termed fastidious, adsorption, duplication, assembly, and lysis d. focusing screw c. The process in which the virus lands on the microscopic world, then
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the electron microscope (EM) is our window on the tiniest details of that world. Which scheme you use does not greatly affect the presentation of most microbes, because we discuss them mostly at the genus or species level. Heidi has also served as the director of the Honors Program at the college for five years, working with a group of faculty to
build the program from the ground up. About 3,000 to 4,000 virions are released from a single cell infected with poxviruses, whereas a poliovirus-infected cell can release over 100,000 virions. Because most cells contain and are surrounded by some sort of aqueous solution, osmosis can have far-reaching effects on cellular activities and survival.
Prokaryotic cell Domains Bacteria and Archaea Cell envelope 7. Classification of Selected Medically Important Protozoa Importan
Ancestral cell otic cell and its organelles. Simple experiments provide a model of how cells deal with various solute concentrations in aqueous solutions (figure 7.5). Blood bottle Biochemical tests Drug sensitivity DNA analysis INSPECTION Immunologic tests Cultures are observed for the macroscopic appearance of growth characteristics. Describe
functional media; list several different categories, and explain what characterizes each type of functional media. enzymes b. The term biologists use to describe the totality of adaptations organisms make to their habitats is niche.* For most microbes, environmental factors fundamentally affect the function of metabolic enzymes. Using this rule,
determine what category each of the following elements falls into: N, S, C, P, O, H, Ca, Fe, and Mg. (You will need to work out the valence of the atoms.) 2. 5.5 The position of the fungi* in the biological world has been debated for many years. The filament is a helical structure composed of a protein called flagellin. Contact your McGraw-Hill
representative for packaging options with any of our lab manuals: Brown/Smith: Benson's Microbiology: A Case Study Approach, Third Edition (978-0-07-340241-3) Complete Version (978-0-07-340241-3) 
340242-0) Chess: Photographic Atlas for Laboratory Applications in Microbiology (978-0-07-731159-3) Harley: Laboratory Exercises in Microbiology, Ninth Edition (978-0-07-751055-8) Kleyn: Microbiology (978-0-07-731159-3) Harley: Laboratory Exercises in Microbiology (978-0-07-731159-3) Harley
Eleventh Edition (978-0-07-340239-0) xxi Acknowledgments This edition marks the 20th anniversary of the first publication of Foundations in 1993. This event created emboli that blocked arteries in his brain and gave rise to a massive stroke. Precisely which of the six "I's" were used in the Case Study, page 59? Their structure and arrangement are
varied, from coccoid, rodlike, and spiral-shaped cells, with arrangements in filaments, clusters, and sheets enzymes that reduce it to small molecules that can be absorbed. Once this stimulus has been received by the vegetative cell,
it converts to a committed sporulating cell called a sporangium. Another type of active transport, group translocation, couples the transport of a nutrient with its conversion to a substance that is immediately useful inside the cell (figure 7.8b). A substance that
causes a reduction by giving electrons is called a reducing agent. In both cases, they display a spherical, hollow structure that provides spaces for holding drugs, and both have surfaces that could be manipulated to bind to a specific organ or cell type. vesios, bladder. Some species have been named in honor of a microbiologist who originally
discovered the microbe or who has made outstanding 1.7 contributions to the field. Water diffusing out of the cell causes it to shrink and become distorted. Genetic studies indicate that provided their host cells with a built-in endoplasmic reticulum rn
flagellated protist that feeding mechanism. A number of species cause mycoses (fungal infections) in animals, and thousands of species are important plant pathogens. Because each atom has 2 electrons to share in this molecule, the combination creates two pairs of shared electrons, also known as a double covalent bond (figure 2.4b). It is a generic
term that refers to any tiny compact cells that are produced by vegetative or reproductive structures of microorganisms. Table 6.3 summarizes some prominent cytopathic effects associated with specific viruses. Something that brings about or causes an effect. The lipids in the cell walls of certain Mycobacterium species are harmful to human cells as
well. Archaea share many characteristics with bacteria but vary in certain genetic aspects and structures such as the cell wall and ribosomes. Studies in microbiology have led to greater understanding of many general biological principles. When its wall is disrupted and moisture and nutrient conditions are suitable, the zygospore germinates and
forms a mycelium that gives rise to a sporangium. • Saccharomyces is a yeast used in making bread and beer (figure D). 2208C (248F). This simplified system, also based on data from ribosomal RNA analysis, retains some of the traditional kingdoms. But of all microbial structures, nothing can compare to the bacterial endospore (or simply spore) for
withstanding hostile conditions and facilitating survival. spread through major systems of the body c. There are numerous variations in the details of this process. See "Exponents" found at for a table with powers of 2. Lipopolysaccharides consist of lipid molecules bound to polysaccharides. person with a cough 3. For more information on the nature of
this agent and its disease, see chapter 18 and log on to. Hydrogen H2 gas H 2O H2S (hydrogen sulfide) CH4 (methane) Organic compounds Waters, swamps soil, volcanoes, vents, organisms Water is the most abundant compound in cells and a solvent for metabolic reactions; H2, H2S, and CH4 gases are produced and used by bacteria and archaea
H1 ions are the basis for transfers of cellular energy and help maintain the pH of cells. A peptide is a short chain of amino acids bound by peptide bonds: a protein contains at least 50 amino acids bound by peptide bonds: a protein contains at least 50 amino acids bound by peptide bonds: a protein contains at least 50 amino acids bound by peptide bonds: a protein contains at least 50 amino acids bound by peptide bonds: a protein contains at least 50 amino acids bound by peptide bonds: a protein contains at least 50 amino acids bound by peptide bonds: a protein contains at least 50 amino acids bound by peptide bonds: a protein contains at least 50 amino acids bound by peptide bonds: a protein contains at least 50 amino acids bound by peptide bonds: a protein contains at least 50 amino acids bound by peptide bonds: a protein contains at least 50 amino acids bound by peptide bonds: a protein contains at least 50 amino acids bound by peptide bonds: a protein contains at least 50 amino acids bound by peptide bonds: a protein contains at least 50 amino acids bound by peptide bonds: a protein contains at least 50 amino acids bound by peptide bonds: a protein contains at least 50 amino acids bound by peptide bonds: a protein contains at least 50 amino acids bound by peptide bonds: a protein contains at least 50 amino acids bonds at least 50 amino acids by peptide by peptide bonds at least 50 amino acids by peptide 
circulation. Azotobacter fixes nitrogen gas from the air and releases ammonium, but it does not digest cellulose. • Life cycles are complex, with well-developed asexual and sexual stages, It is usually found in areas of thick, tough skin such as the * furuncle (fur9-unkl) L. Viruses contain only those parts needed to invade and control a host cell: an
external coating and a core containing one or more nucleic acid strands of either DNA or RNA. This scheme, called the 9 1 2 arrangement, is a typical pattern of flagella and cilia (figure 5.3a). Once initiated, it proceeds to completion quite rapidly (1½ hours). However, not all methods are used on all bacteria. Mycelium and spores in the ascomycete
Some fungi have developed into normal residents of plants Stachybotrys. Distinguish between simple, differential, and structural stains, including their applications. Flagellar staining is a method of revealing flagella, the tiny, slender filaments used by bacteria for locomotion. to mine for gold c. The body plan of most microorganisms consists of a
single cell or clusters of cells (figure 1.3), 5.1 MAKING CONNECTIONS The Extraordinary Evolution of Eukaryotic Cells For years, biologists have grappled with the problem of how a cell as comtheory that bacteriologists have grappled with the problem of how a cell as comtheory that bacteriologists have grappled with the problem of how a cell as comtheory that bacteriologists have grappled with the problem of how a cell as comtheory that bacteriologists have grappled with the problem of how a cell as comtheory that bacteriologists have grappled with the problem of how a cell as comtheory that bacteriologists have grappled with the problem of how a cell as comtheory that bacteriologists have grappled with the problem of how a cell as comtheory that bacteriologists have grappled with the problem of how a cell as comtheory that bacteriologists have grappled with the problem of how a cell as comtheory that bacteriologists have grappled with the problem of how a cell as comtheory that bacteriologists have grappled with the problem of how a cell as comtheory that bacteriologists have grappled with the problem of how a cell as comtheory that bacteriologists have grappled with the problem of how a cell as comtheory that bacteriologists have grappled with the problem of how a cell as comtheory that bacteriologists have grappled with the problem of how a cell as comtheory that bacteriologists have grappled with the problem of how a cell as comtheory that bacteriologists have grappled with the problem of how a cell as comtheory that bacteriologists have grappled with the problem of how a cell as comtheory that bacteriologists have grappled with the problem of how a cell as comtheory that bacteriologists have grappled with the problem of how a cell as comtheory that bacteriologists have grappled with the problem of how a cell as comtheory that bacteriologists have grappled with the problem of how a cell as comtheory than the problem of how a cell as comtheory that bacteriologists have grappled with the problem of how a cell 
programs. The grouping by Gram reaction remains significant nome and ribosomal RNA. This unevenness leads to short-term "sticky spots" in the molecule—some positively charged and others negatively charged and others negatively charged and others negatively charged. The Search for Biological Dark Matter rom 2002 to 2010, a 100-foot sailboat called the Sorcerer II was unidentified. Explain what is
meant by lysogeny, prophage, and lysogenic induction and conversion. They are formed in phagocytic cells (certain white blood cells and protozoa) in response to food and other substances that have been engulfed. 5.6 Survey of Protists: Algae General group that traditionally includes single-celled and colonial eukaryotic microbes that lack
organization into tissues. Although the envelope is derived from the host, it is different because some or all of the regular membrane proteins are replaced with special viral proteins during the virus assembly process (see figure 6.11). Once a container of medium has been inoculated, it is incubated in a temperature-controlled chamber (incubator) to
encourage microbial growth. This scheme uses the phenotypic qualities of bacteria in identification. An aerobe* (aerobic organism) can use gaseous oxygen in its metabolism and possesses the enzymes needed to process toxic oxygen products. It is this linkage that provides rigid yet flexible support to the cell. (a) Cell culture plate infected with herpes
simplex virus. Name several types of conidia. Note that hydrogen bonds are represented in models and formulas by dotted lines, as shown in (c). It occurs in the heart muscle. Algae are eukaryotic protists, usually unicellular or colonial, that photosynthesize with chlorophyll a. Recently a defined medium that was developed to grow the parasitic
protozoan Leishmania required 75 different chemicals. streak plate d. enzymes, and other factors that can alter the course and outcome of infections. Strand Vice President, Content Products & Markets: 
Differentiate between an anion and a cation, using examples. Although it is not the usual method of cultivating viruses, scientists at the State University of New York succeeded in using a cell-free extract to artificially create a virus that is virtually identical to natural poliovirus. cytopathic d. * chemotaxis (ke0-moh-tak9-sis) Gr. chemo, chemicals, and
taxis, an ordering or arrangement. Examination of cells and tissues for cytopathic effects has been a traditional tool for diagnosing viral infections that is usually supplemented with more specific serological and molecular methods (see chapter 17). Cells must likewise transport substances in the reverse direction to the external environment. Among
the significant questions being tackled by astrobiologists are: what are the basic requirements of life, and what would signs of To continue the Case Study, go to page 54. These bacteria provide the aphid with needed amino acids and the aphid provides them a protective habitat. Compare bright-field, dark-field, phase-contrast, confocal, and
fluorescence microscopy as to field appearance, specimen appearance, specimen appearance, light source, and uses. Some microbiologists suggest that they may belong to a separate evolutionary line of microbes that is different in origin from other viral groups. It uses a tungsten probe that hovers near the surface of an object and follows its topography while
simultaneously giving off an electrical signal of its pathway, which is then imaged on a screen. Although the entire phage cannot enter the host cell, the nucleic acid is injected through a rigid tube the phage inserts through the entire phage cannot enter the host cell, the nucleic acid is injected through the entire phage inserts through the entire phage cannot enter the host cell, the nucleic acid is injected through the entire phage cannot enter the host cell, the nucleic acid is injected through the entire phage inserts through the entire phage inserts through the entire phage cannot enter the host cell, the nucleic acid is injected through the entire phage inserts through the entire phage cannot enter the host cell, the nucleic acid is injected through the entire phage cannot enter the host cell, the nucleic acid is injected through the entire phage inserts through the entire phage cannot enter the host cell, the nucleic acid is injected through the entire phage cannot enter the host cell, the nucleic acid is injected through the entire phage cannot enter the host cell, the nucleic acid is injected through the entire phage cannot enter the host cell, the nucleic acid is injected through the enter through the enter the host cell, the nucleic acid is injected through the enter through through the enter through through the enter through 
visible using these high-power microscopes. A cell in a hypertonic* environment is exposed to a solution with higher solute concentration than its cytoplasm. (b) Structural appearance of a typical amoeba. Nitrogen bases are ringed compounds: adenine (A), guanine (B), cytosine (C), thymine (T), and uracil (U). Sulfur granules of photosynthetic
bacteria and polyphosphate granules of Corynebacterium and Mycobacterium are of this type. The unique appearance of most protozoa makes it possible for a knowledgeable person to identify them to the level of genus and often species by microscopic morphology alone. The H1 ion is positively charged because it is essentially a hydrogen that has
lost its electron; the OH2 is negatively charged because it remains in possession of that electron. replicare, to reply. Pure culture of bacteria Staining Subculture Figure 3.1 An overview of some general laboratory techniques carried out by microbiologists. microscopic, the body d. Oil droplets fuse with the membrane and are released directly into (1
4) the cell. It lives part of its cycle as a trophozoite and part as a cyst. Summarize the main characteristics of protozoan form, nutrition, and locomotion. We saw earlier that microbes can be defined according to their carbon sources as autotrophs or heterotrophs. * isotonic (eye-soh-tahn9-ik) Gr. iso, same, and tonos, tension. Nomenclature is the
system of assigning names to the various taxonomic rankings of each microbial species. * cytopathic (sy0-toh-path9-ik) Gr. cyto, cell, and pathos, disease. Bond types include: a. Peptide* usually refers to a molecule com* peptide (pep9-tyd) Gr. pepsis, digestion. lical bacterial forms. Mycobacterium b. What other properties besides staining are
different in grampositive and gram-negative bacteria? It has all of the bases except uracil, and the pentose sugar is deoxyribose. Mitochondria also have energy availability for the host. The specimen for an electron microscope is always a. 2 1 Prion proteins 3 1 Prion proteins 3 1 Prion proteins infect a nerve cell. Describe the purposes of
classification and taxonomy in the study of prokaryotes. Phylum Chlorobi Also known as green sulfur bacteria, this phylum consists of anaerobic bacteria that live in the muddy layers of lakes and ponds, where they photosynthesize and metabolize sulfides. To deal with the challenges of their tiny and sometimes elusive targets, microbiologists have
developed several types of procedures for investigating and characterizing microorganisms. By far the most widely used and effective of these agents is agar, 3 a polysaccharide 3. Table of contents: CoverTitleCopyrightContentsCHAPTER 1 The Main Themes of Microbiology 1.1 The Scope of Microbiology 1.2 General Characteristics of
Microorganisms and Their Roles in the Earth's Environments The Origins and Dominance of Microorganisms The Cellular Organization of Microorganisms Microbial Dimensions: How Small Is Small? HIV 110 nm 6. Other components (ribosomes) are equally distributed to the developing cells. For example, the rabies virus affixes * adsorption (ad
sorp9-shun) L. This process of "keying out" the organism can simmaking a second-level culture. The buildup of singlet oxygen and the oxidation of membrane lipids and other molecules can damage and destroy a cell. Cells are irregular in shape and size (8003). But microorganisms were photosynthesizing long before the first plants appeared. Most
spores do not germinate, but enough are successful to keep the numbers of fungi and their spores very high in most habitats. * quorum (kwor9-uhm) L. But they are not closely related to them and are not transmitted by arthropods. The first simple prokaryotes appeared approximately 3.5 billion years ago, and the first eukaryotes arose about 2 billion
years ago. A standard method characteristics leads to an end point where a name for an organfor preparing a pure culture is based on a subculture technique for ism is given. Explain why fluorescept microscopic technique for ism is given. Explain why fluorescept microscopic technique for ism is given.
susceptible to drying and can contaminate the handler's fingers. Solid media provide a firm surface on which cells can form discrete colonies (see figure 3.11) and are advantageous for isolating and culturing bacteria and fungi. The Kingdom Fungi, or Eumycota, is filled with organisms of great variety and complexity that have survived on earth for
approximately 650 million years. Conidia are the most common asexual spores, and they occur in these forms: arthrospore (ar9-thro-spor) Gr. arthron, joint. Of significance in medical microbiology are the gram-positive, spore-forming members of the genus Bacillus (the cause of anthrax) and Clostridium (the cause of botulism and tetanus)—dramatic
diseases of universal fascination that we consider in later chapters. Various terms are used to denote the nature of compounds containing peptide bonds. Take for example the hepatitis B virus, which produces a chronic progressive infection of the liver that may lead to cirrhosis and cancer. Library of Congress Cataloging-in-Publication Data Talaro,
Kathleen P. Even personalize your book with your course name and information! Choose the best format for your course: color print, black-and-white print, or eBook. The complex food materials are digested through several stages, during which time the animal regurgitates and chews the partially digested plant matter (the cud) and occasionally
burps methane produced by the microbial symbionts. Unlike other protozoa, they lack specialized motility organelles. There is no treatment and most cases so far have been fatal. Selective media are very important in primary isolation of a specific type of microorganism from samples containing mixtures of different species—for example, feces, saliva,
skin, water, and soil. (Can a drug "kill" a virus?) b. phylum, division are more closely. They occur either as single cells, as a pair of cells with their ends attached (diplobacilli), or as a chain of several cells (streptobacilli). Phosphorus PO432 (phosphate) Rocks, mineral deposits Soil Phosphate, a key component of DNA and RNA, is critical to the genetic
makeup of cells and viruses; also found in ATP and NAD, where it takes part in numerous metabolic reactions; its presence in phospholipids provides stability to cell membranes. Incubation of the medium with the microbes under the right conditions creates a culture with visible growth. Some bacteria secrete slime layers of a glucose polymer called
dextran. Is galactose an aldehyde or a ketone sugar? It is capable of independent division. Depending on the bacterial species, they can be blocky, spindle-shaped, round-ended, long and threadlike (filamentous), or even clubbed or drumstick-shaped. We know this association between infection with the from data obtained by the human genome strain
of virus—called Ad-36—and an inproject that sequenced all of the genetic crease in adipose (fat) tissue. Molecular formulas are useful, but they only frequently transferred from one molecule to another as described summarize the atoms in a compound; they do not show the posihere. Gram stain b. They cause death of brain cells. Although only three
cases of human disease have occurred in the United States, infected cattle have been reported. They differ from the cyanobacteria in having a different type of chlorophyll called bacteriochlorophyll and by not giving off oxygen as a product of photosynthesis. How are generic and common names used? selective medium b. Transmission occurs from
bug to mammal and from mammal to bug but usually not from mammal to mammal, except across the placenta during pregnancy. Differentiate various groups of photosynthetic bacteria. Define the term mycosis and explain the levels of invasion of the body by fungi. Modifications of Optical Microscopes with Specialized Functions Fluorescent
Microscope Yeast cells stained with fluorescent dyes and viewed at 1,0003 emit visible light; dye colors help differentiate live and dead cells. These associations gradually coevolve as participating members come to require some substance or habitat that the other members provide. Ciliary moves are made possible by the microtubules they contain
The terms for carbon and energy source are often merged into a single word for convenience (as in table 7.2). (a) Human epithelial cells (4003) infected by herpes simplex virus demonstrate multinucleate giant cells; inset with a cluster of viruses from an intranuclear inclusion (100,0003). rickettsias d. John Tyndall 9. Examples of this are herpes
simplex viruses (cold sores and genital herpes) and herpes zoster virus (chickenpox and shingles). Explain syntrophy and amensalism, using examples. When a saprobe does infect a host, it is considered a facultative parasite. Because many bacteria live in aqueous habitats with a low solute concentration, they are constantly absorbing excess water by
osmosis. These will replace the • • Appendix D tables from previous editions and will provide a compact overview of pathogens and target organs. The International Committee on the Taxonomy of Viruses lists 7 orders, 96 families, and 350 genera of viruses. Microbes form similar interrelationships with animals, notably as residents of numerous
bodily sites. Many of the microbes that occupy a niche on the human body are considered commensals. List the contents of the cell cytoplasm. The universe is composed of an infinite variety of substances existing in gaseous, liquid, and solid states. Note the clusters of inflamed papules and pustules. Although it is common to use high concentrations of
salt and sugar to preserve food (jellies, syrups, and brines), many bacteria and fungi actually thrive under these conditions and are common spoilage agents. Organic Macromolecules: Superstructures of Life The compounds of life fall into the realm of biochemistry. MacConkey and EMB media, for example, appear in table 3.7 (selective media) and
table 3.8 (differential media). Another term that can be used to specify this type of microbe is pathogen.* Humanity is plagued by nearly 2,000 different pathogens that can be used to specify this type of microbe is pathogen.* Humanity is plagued by nearly 2,000 different pathogens that can be used to specify this type of microbe is pathogen.*
organisms; blue-green, green, yellow, red, and orange in color. 3 4 Chapter 1 TABLE 1.1 The Main Themes of Microbiology (continued) E. Deinococcus carries around several copies of its genome, making it easily replaceable, and it contains radiation-resistant enzymes that help it rapidly repair DNA damage. Jenner took scrapings from cowpox
blisters on the hand of a milkmaid and inoculated them into a boy who had not had smallpox. Diffusion is a driving force in cell activities, but its effects are greatly controlled by membranes. The phenetic characteristics traditionally used for placing plants, and fungi into separate kingdoms are general cell type, level of organization or body
plan, and nutritional type. electron. Variant members of bacterial species are called strains and types. It is hoped that the virus will introduce the needed gene into the cells and correct the defect. Fortunately for many countries in the malaria zone, several international organizations have collaborated to provide special insecticide-treated nets that
can help lower the rate of infections. The thick peptidoglycan of the grampositive cell traps the crystal violet-mordant complex and makes it inaccessible to the decolorizer, leaving the cells purple. Root Meaning Example of Use troph-phile -obe heteroautophotochemosaprohalothermopsychroaero- Food, nourishment To love To live Other Self Light
Chemical Rotten Salt Heat Cold Air (O2) Trophozoite—the feeding stage of protozoa Extremophile—an organism that requires nutrients from other organisms Autotroph—an organism that "feeds by itself" Phototroph—an organism that uses light as
an energy source Chemotroph—an organism that uses chemicals rather than light for energy Saprobe—an organism that lives on dead organism that grows at high temperatures Psychrophile—an organism that grows at cold temperatures Aerobe—an
organism that uses oxygen in metabolism chlorophyll as the primary pigment. But these microbes are not passive passengers—they contribute to human health, immunity, development, and nutrition in significant ways. The bottom layer of the gram-negative wall is a single, thin (1-3 nm) sheet of peptidoglycan. A striking example is the reaction that
occurs between sodium (Na) and chlorine (Cl). Cells lacking walls Water diffuses out of the cell and shrinks the cell membrane away from the cell membrane away from the cell membrane of thousands of scientists doing objective
observations and collecting evidence that is measurable, can be expressed quantitatively, and is subject to critical analysis. crista; L. Tables 3.6A and 3.6B provide a practical comparison of the two categories, using media to grow Staphylococcus aureus. A versatile form called the Type IV pilus is found only in gram-negative bacteria. Why is
penetration so different in the two groups? Many of these are included in later chapters on specific bacterial groups. (a) Depicted is the relationship between microtubules, microfilaments, and organelles. motility d. Plants are also parasitized by viruslike agents called viroids that differ from ordinary viruses by being very small (about one-tenth the
size of an average virus) and being composed of only naked strands of RNA, lacking a capsid or any other type of coating. Cryptococcus 21. Review the roles of microorganisms as parasites and pathogens that cause infection and disease. A large number of species are also capable of entering into a dormant, resting stage called a cyst when conditions
in the environment become unfavorable for growth and feeding. A mushroom is one example to observe formation of the sexual spores. Molecules come in a great variety. This may be enhanced through staining and use of special microscopes. Proteins are highly complex macromolecules that are crucial in most, if not all, life processes. Cells that lack
compatible virus receptors are resistant to adsorption and invasion by that virus. Examples of nonpolar molecules are oxygen, methane (see figure 2.4), and lipids (see figure 2.18), flagellar stain 12. These microbes are so strictly adapted to high pressures that they will rupture when exposed to normal atmospheric pressure. For a parasite's continued
survival as a species, it must complete the life cycle by transmitting an infective form, usually an egg or larva, to the body of another host, either of the same or a different species. They are all microorganisms, and most of them are motile. Although microbes have adapted to growth at temperatures ranging from freezing to boiling, the usual
temperatures used in laboratory propagation fall between 208C and 408C. 14. All of these are correct. Is olive oil an example of a saturated or an unsaturated fat? The basic structure common to all amino acids is shown in blue type; and the variable group, or R group, is placed in a colored box. Light microscopes are limited by resolution to
magnifications around 2,0003. It yielded no Martian microbes. What was highly unusual about this voyage was environment could easily harbor 10 million to 20 million different that it did not involve hooking or netting fish. These types of short-term mounts provide a true assessment of the size, shape, arrangement, color, and motility of cells. (b) An
Viruses are classified into orders, families, and General Characteristics of Microorganisms and Their Roles in the Earth's Environments A Sampling of Fields and Occupations in Microbiology A. (g) Sin Nombre hantavirus, a human pathogen carried in the waste of mice (5,0003). Their predominant habitats are fresh and marine
water, soil, plants, and animals. As we continue to encroach into new territory and wild habitats, there is potential for contact with emerging pathogens, as we saw with Ebola fever, Lyme disease, and hantavirus pulmonary syndrome. What is the atomic mass or weight? It is the period between an individual's birth and the time of producing offspring
Using figure 2.17 as your basis for comparison, speculate which molecules are shown and give the reasons for them having the microscopic appearance we see here. It takes about a year and a half to complete a textbook revision—a process that involves editing manuscript, writing new text, illustration, research, and much more. A polypeptide does
not remain in its primary state, but instead, SECTION 2.7 it spontaneously arranges itself into a higher level of complexity 29. Instructors can easily measure student learning in relation to the specific learning outcomes used in their course. Check Your Progress SECTION 4.1 1. Because hydrogen peroxide is also toxic to cells (it is used as a
disinfectant and antiseptic), it must be degraded by an enzyme—either catalase or peroxidase—into water and long-term effects of viral infections on animal cells are well documented. A technician tests the effectiveness of microorganisms in the production of new sources of energy. This network
includes ribosomes, which originate in the nucleus, and the rough endoplasmic reticulum, which is continuously connected with the nuclear envelope. (a) Structure in gram-negative cells (b) Structure in gram-negative cells. (b) This plate of Serratia marcescens was overexposed to room air and has developed a large white colony. Describe the medical
impact of the cell walls of gram-negative and gram-positive bacteria. The primary way that people become infected is by ingesting food or water contaminated with human feces. For many years, the cause of viral infections such as smallpox and polio was unknown, even though it was clear that the diseases were transmitted from person to person.
Some species form an elaboAntheridium (male) rate fruiting body to hold the asci (inset, figure 5.20). Biologists can apply their knowledge of phylogenetic relationships to develop a system of taxonomy. The nutritional requirements of microorganisms in the laboratory may be simple or complex. Explain the basic differences between fresh and fixed
preparations for microscopy and how they are used. Critical Thinking is the ability to reason and solve problems using facts and concepts. These diseases have a long latent period (usually several years) before the first symptoms of brain degeneration appear. double b. To measure the acid and base concentrations of solutions,
scientists use the pH scale, a graduated numerical scale that ranges from 0 (the most acidic) to 14 (the most basic). Gram-negative bacteria have a thinner two-layer cell wall with an outer membrane, thin layer of peptidoglycan, and a well-developed periplasmic space. Eventually, the trypanosomes can spread to many systems, including the lymphoic
organs, heart, liver, and brain. For example, Staphylococcus aureus can grow on NaCl media ranging from 0.1% up to 20%. Modifications in the lighting or the lens system give rise to the bright-field, dark-field, phase-contrast, interference, fluorescence, and confocal microscopes. coli cells Figure 4.9 Fimbriae G Intestinal microvilli (b) Figure 4.8
Form and function of bacterial fimbriae. The objective forms the initial image of the specimen, called the real image. Having evolved over the same time frame as archaea, bacteria share a similar ancient history. Many chemical reactions are based on the tendency of atoms with unfilled outer shells to gain greater stability by achieving, or at least
approximating, a filled outer shell. What happens to a cell that has its peptidoglycan disrupted or removed? Protozoa, a few algae, and all animal cells lack a cell wall and are encased primarily by a cell membranes. MONERANS Kingdom Monera Archaea Bacteria Earliest cells First cells
 appeared 3.5 billion years ago. Chapter Summary with Key Terms 181 Chapter Summary with Key Terms 6.1 Overview of Viruses A. Figure 7.13k, I features some aspects of this relationship. Ivanovski and M. * temperate (tem9-pur-ut) A reduction in intensity. Comparative Images from Optical Microscopes 66 Confocal Microscope 1 5003 stained by fl
fluorescent Two views of Paramecium 1,5003, uorescent d dyes, and scanned by a laser beam, form multiple images that are combined into a three-dimensional image. Ordinary boiling (1008C) will usually not destroy such spores, so canning is carried out in pressurized steam at 1208C for 20 to 30 minutes. He could see with increasing clarity, but
after a few years he became interested in things other than thread counts. The prototype of the modern compound microscope, in use from about the mid-1800s, was capable of magnifications of 1,000 times or more, largely because it had two sets of lenses for magnification. Enriched Selective Differential Anaerobic growth Specimen transport Assay
Enumeration *Some media can serve more than one function. difficile. decomposition d. fungal cause of Ohio Valley fever d. in alcohol. These obligate parasites have unique requirements that must be provided by living animals such as rabbits, guinea pigs, mice, chickens, and the early life stages (embryos) of birds. Another important measurement of
an element is its atomic mass or weight. The polar lipid heads face toward the aqueous phases and the nonpolar tails orient toward the center of the membrane. cilia 5. teichoic acid b. The shadowcasting tech1. Mixture of cells in sample Check Your Progress Identification Techniques How does one determine what sorts of microorganisms have been
isolated in cultures? pyogenes possesses several cell surface antigens that serve as virulence factors. A discovery in 1996 of tiny rod-shaped is known to be very dry and cold (the temperature range is 808F to objects in a 4-billion-year-old Martian meteorite from the Antarctic -2258F), but there was a reasonable possibility that at least simple has
been, and continues to be, the subject of much scientific scruorganisms could have developed there. An example would be a situation in which molecules of a substance are more concentrated in one area than another. Strict anaerobes live in highly reduced habitats, such as deep muds, lakes, oceans, and soil. A great textbook must be carefully
constructed to place art where it makes the most sense in the flow of the narrative; create process figures that break down complex processes into their simplest parts; provide explanations at the correct level for the student audience; and offer pedagogical tools that help all types of learners. Learning microbial nomenclature* * nomenclature (noh9)
men-klay0-chur) L. One example is the protozoan Euplotes, which harbors endosymbiotic algae in its cells (figure 7.13c). Another important photosynthetic product of chloroplasts is oxygen gas. By convention, an element is assigned a distinctive name with an abbreviated shorthand symbol. Infection of the tonsils or pharyngeal mucous membranes
can lead to streptococcal pharyngitis (strep throat), which, if left untreated, may lead to scarlet fever. To derive n, we need to divide 4 hours (240 minutes) by the generation time (we will use 20 minutes). We have already been using the
molecular concept easier to keep straight if you think of redox agents as partformula, which concisely gives the atoms involved in subscripts (CO2, H2O). Taxonomic groups of the Domain Eukarya are based on level of organization, body plan
cell structure, nutrition, metabolism, and certain genetic characteristics. Triglycerides are composed of a single molecule of glycerol bound to three fatty acids (figure 2.18). This may be followed by identification of the virus in clinical specimens by means of rapid tests that detect the virus or signs of cytopathic changes in cells or tissues (see CMV
herpesvirus, figure 6.15). the total number of cells b. In most cells, mitochondria are elliptical or spherical, and occasionally filament-like. He took rainwater from a clay pot, smeared it on his specimen holder, and peered at it through his finest lens. This is invaluable for identifying the exact species of microbes in the sample, and it paves the way for
making pure cultures. (Why?) Figure 7.5 Model system to demonstrate osmosis. Having a special affinity for an object or substance. Level II. Carbohydrate fermentation media contain sugars that can be fermented (converted to acids) and a pH indicator to show this reaction (see figure 3.19a and figure 3.21). 10,000 8,000 6,000 4,000 2,000 0 Low-
income countries Lower-middleUpper-middleUpper-middleincome countries income countries Chronic diseases, maternal and perinatal conditions, and nutritional deficiencies High-income countries Chronic diseases include cardiovascular diseases, maternal and perinatal conditions, and nutritional deficiencies High-income countries Chronic diseases include cardiovascular diseases, maternal and perinatal conditions, and nutritional deficiencies High-income countries Chronic diseases include cardiovascular diseases, maternal and perinatal conditions, and nutritional deficiencies High-income countries Chronic diseases include cardiovascular diseases.
sense organ disorders, musculoskeletal disorders, musculoskeletal disorders, digestive diseases, genitourinary diseases, reaction with sodium and chloride, which would be shown with 14. Both viruses go into latency in nerve cells and later emerge under the influence of various stimuli to cause recurrent symptoms. If a substance
contains two or more elements of different types, it is considered a. Do not confuse fungal spores with the extremely resistant, nonreproductive bacterial endospores. Describe the generalized anatomy of bacterial cells. Some show great variation within the species in shape and size and are pleomorphic. As a result, the asexual spore-forming
structures and spores are usually used to identify organisms to the level of genus and species. It is composed of a bilayer of lipids with attached proteins. It is also remarkable that he did this knowing nothing about viruses or even microbes. The colonies of filamentous fungi are noted for the striking cottony, hairy, or velvety textures that arise from
their microscopic organization and morphology. First the cell encloses the substance in its membrane, simultaneously forming a vacuole and engulfing it (figure 7.8c). Although their name comes from the Greek for "first animals," they are far from being simple, primitive organisms. Organisms in this group inhabit animals and plants as well as soil
and water in temperate, subtropical, and tropical regions. Because of this role, cellulose is probably one of the earth, yet it is digestible only by certain bacteria, fungi, and protozoa that produce the enzyme cellulase. is not usually decomposed by microorganisms d. Members of this small group differ
considerably in life cycles and morphology. rickettsias c. This member of the Crenarchaeota thrives in habitats above the temperature of boiling water and can even survive being autoclaved. Describe some of the processes involved in identifying microbes from samples. What functions do proteins perform in a cell? Gram staining is a 130-year-old
method named for its developer, Hans Quick Search Christian Gram. Figure 7.2a provides an example of an unusual bacterium that inhabits hot springs in New Zealand. viruses? Microbiologists use such general terms to reference organisms that possess a collection of predictable characteristics. Less strict parasites such as the gonococcus and
pneumococcus can be cultured artificially if provided with the correct nutrients and environmental conditions. The RER consists of parallel, flattened sacs called cisternae,* and it appears "rough" in electron micrographs because its outer surface is studded with ribosomes (figure 5.7b). Most species form cysts and are free-living; the group also
includes several parasites • Some species are found in loose aggregates or colonies, but most are solitary. Streptococcus S pneumoniae—i image displays the diplococcus arrangement of this species J. "(a) —Kim Raun, Wharton County Junior College Figure 19.22 Deformation of the hands caused by borderline leprosy. The shortest generation times
average 5 to 10 minutes, and longer generation times require days. This medium is designed to show fermenta- tion (acid production) using phenol red broth and gas formation by means of a small, inverted Durham tube for collecting gas bubbles. In (b), shorter waves are small enough to enter small spaces and produce a much more detailed image
that is recognizable as a hand. Chemists depict elements in shorthand form (red Lewis structures) that indicate only the valence electrons, because these are the electrons involved in chemists depict elements in shorthand form (red Lewis structures) that indicate only the valence electrons, because these are the electrons involved in chemists depict elements in shorthand form (red Lewis structures) that indicate only the valence electrons, because these are the electrons involved in chemists depict elements in shorthand form (red Lewis structures) that indicate only the valence electrons involved in chemists depict elements in shorthand form (red Lewis structures) that indicate only the valence electrons involved in chemists depict elements in shorthand form (red Lewis structures) that indicate only the valence electrons involved in chemists depict elements in shorthand form (red Lewis structures) that indicate only the valence electrons involved in chemists depict elements in shorthand form (red Lewis structures) that indicate only the valence electrons involved in chemists depict elements in shorthand form (red Lewis structures) that indicate only the valence electrons involved in chemists depict elements in shorthand form (red Lewis structures) that indicate only the valence electrons involved in chemists depict elements in shorthand elements in the chemists depict elements depict
Evolution of a stable and contributing energy through aerobic respiration. Ribosomes are distributed in two ways: Some are scattered freely in the cytoplasm and cytoskeleton; others are intimately associated with the rough endoplasmic reticulum, as previously described. An electron gun aims its beam through a vacuum to ring-shaped elec-
tromagnets that focus this beam on the specimen. Which of the following is NOT an optical microscope? A plaque develops when the viruses released by an infected host cell radiate concentration by percentage is to use the weight of the solute,
measured in grams (g), dissolved in a specified volume of solvent, measured in milliliters (ml). H O R C H O R C Carbonyl, internal Ketones, polysaccharides Phosphate DNA, RNA, ATP O R O P 2.5 Molecules of Life: Carbohydrates Expected Learning Outcomes 19. It is worth noting that not all archaea are adapted to extremes, and many are widely
distributed in more moderate environments such as soils, oceans, and even animal intestines. has a charge that attracts it to certain cell parts bearing the opposite charge. Describe the cellular microbes. Discuss the ways microorganisms can be used to
create solutions for environmental problems and industrial products. The details of animal virus replication are discussed in chapter 9. These structures carry the green pigment chlorophyll and sometimes additional pigments as well. 50 Chapter 2 The Chemistry of Biology quaternary structure can be the same or different. The growth of hookThese
neglected tropical diseases, or "Almost everyone in the worms causes blood loss, saps strength, and NTDs, have received less attention than highly development. Distinguish among types of capsids and nucleocapsids. Yet even this inexpensive solution is beyond the reach of people in many developing countries who cannot afford the $3 to $5 for nets
to protect their family. * Staphylococcus aureus (staf9-uh-loh-cok9-us ar-ee-us) Gr. staphyle, a bunch of grapes, kokkus, berry, and aurum, golden. Within an hour, Kay began to drift in and out of consciousness To continue the Case Study, go to page 84. Discuss the structure and functions of pili and fimbriae. Thus, elements cycle in a pattern from an
inorganic form in an environmental reservoir to an organisms. As we shall see, this deficiency has little consequence, because viruses have adapted to assume total control over the past several years, biomedical experts have
been looking at viruses as vehicles to treat infections and disease. All elements can be measured in these units. Psychrotrophs such as Staphylococcus aureus and Listeria monocytogenes are a concern because they can grow in refrigerated food and cause food-borne illness. Which of the following is not considered a microorganism? fungus; Gr.
fungos, mushroom. Diffusion of water into the cell causes it to swell, and may burst it if no mechanism exists to remove the water. An atom is defined as a tiny particle that cannot be subdivided into smaller substances without losing its properties. Named for Carlos Chagas, the discoverer of T. (a) A cell moves via a random series of short runs and
tumbles when there is no attractant or repellent. (b) LEADING STRAND SYNTHESIS 3' 5' 5' Origin of a 3' replication forks Template strand Primase New strand DNA polymerase II RNA primer DNA polymerase I Helicase Ligase (a) Process Figure 9.6 The assembly line of DNA replication in a circular bacterial chromosome. Amoebase
and certain white blood cells ingest whole cells or large solid matter by a type of endocytosis. Check Your Progress Quick Search Go to the "Pathogen Pronunciation Stations" for help in correctly pronouncing some common names. Since that time, microbiologists have conducted a continuous search for disease-causing agents. 2.5
Molecules of Life: Carbohydrates A. How do you suppose archaeologists were able to date some spores as being thousands (or millions) of years old? tiny. Aerobic coccobacilli Family Helicobacter (ulcers) Family Moraxellaceae: Moraxella, Miscellaneous genera: Acinetobacter Flavobacterium, Haemophilus (meningitis), H. It is
likely that the archaea are the most ancient of all life forms and have retained characteristics of the first cells that originated on the earth nearly 4 billion years ago. It is not an overstatement to say that he and his colleagues invented many of the techniques that are described in chapter 3: inoculation, isolation, media, maintenance of pure cultures
and preparation of specimens for microscopic examination. The attachment of sufficient numbers of these molecules transmits signals to the flagellum and sets it into rotary motion. They lack protein. Adaptation involves a complex adjustment in biochemistry or genetics that enables long-term survival and growth. This is especially true of larger cells
with complex internal structures. (a) Resolution: Distinguishing Magnified Objects Clearly In addition to magnification, a microscope must also have adequate resolution, or resolving power. Flagella can move the cell by pushing it forward like a fishtail or by pulling it by a lashing or twirling motion (figure 5.3c). Disaccharides are named similarly:
lactose (Latin for milk) is an important component of milk; maltose means malt sugar; and sucrose (French for sugar) is common table sugar or cane sugar. Chapters 11 and 12 provide more information on the actions of antimicrobial chemical agents and drugs. A simple stain with methylene blue is often used to stain granules in bacteria such as
Corynebacterium (figure 3.9a), which can be a factor in identification. In many species, the male sexual Fruiting organ fuses with the female sexual organ. A certain combination of reactions will be consistent with this species. A traditional pure culture is a container of medium that grows only a single pathway in bacterial identification uses
flowcharts or keys that apknown species or type of microorganism (figure 3.12c). Because bacterial cells have numerous acidic dyes. one that contains two or more known species or type of microorganism (figure 3.12c). Because bacterial cells have numerous acidic dyes. one that contains two or more known species or type of microorganism (figure 3.12c).
attached to the glycerol, and the third glycerol binding site holds a phosphate group. Which of these would not be a sign of meningitis? Researchers sampling deep underneath the seafloor have uncovered massive deposits of methanogens. hydroxyl ion d. As we survey the principal anatomical features of this cell, we begin with the outer cell
structures and proceed to the internal contents. The entire molecule is compact and granular. When the biofilm grows into larger vegetations, portions of it break loose into the circulation. But we now know its secret. In simple terms, a sugar such as glucose is an aldehyde with a terminal carbonyl group bonded to a hydrogen and another carbon
nonmotile c. Define symbiosis and differentiate among mutualism, commensalism, syntrophy, parasitism, and amensalism, using examples. The SER lacks ribosomes and is more tubular in structure (see figures 5.2 and 5.7a). It is obligate with respect to cold and generally cannot grow above 208C (688F). The inset is a 1,0003 magnification revealing
its hyphae (blue) and conidia (brown). Other local English physicians began to vaccinate patients with some success. The best known of these is the sterol (meaning a steroid with an OH group) called cholesterol (figure 2.20). Most of these substances are organic compounds, which consist of carbon and hydrogen covalently bonded in various
combinations. This record was broken when a Thiomargarita than the nanobe shown on across. Because viruses tend to interact with the genetic material of their host cells and can carry genes from one host cell to another (chapter 9), they have played an important part in the evolution of Bacteria, Archaea, and Eukarya. The source for nomenclatures are the contract with the genetic material of their host cells and can carry genes from one host cell to another (chapter 9), they have played an important part in the evolution of Bacteria, Archaea, and Eukarya.
is usually Latin or Greek. Amino acids display small charged functional groups (red symbols). DNA almost always exists in pairs of strands, oriented so that the bases are paired across the central axis of the molecule. The general structural plan of a prokaryotic cell can be represented with this flowchart: Expected Learning Outcomes External 3. It is
quite evident which world inhabitants suffer 3. (b) Scanning electron micrograph of Malassezia furfur, a yeast that causes a type of superficial skin infection (25,0003). One important event leading to the release of enveloped viruses is the insertion of viral spikes into the host's cell membrane so they can be picked up as the virus buds off with its
envelope, as discussed. Basic (alkaline) Base The acid or base content (pH) of habitats varies from acidic (pH 0) to alkaline (pH 11). Slime layer (b) (a) Capsule Figure 4.10 Types of glycocalyces seen through cutaway views of cells. stability to the overall protein structure. Experiments performed in test tubes or other artificial environments. • 2. coulc
have assisted the survival of the larger cell. But for every feature that is visible to the naked eye, there are millions of other features that are concealed beyond our sight because of their small size. 1.6 Taxonomy: Organizing, Classifying, and Naming Microorganisms A. A quick assessment can thus be made regarding cellular size, shape, and
arrangement. a and b b. Cyanobacteria; Microbial Marvels Cyanobacteria, gram-negative phototrophic* bacteria in the Phylum Cyanobacteria, are among the most dominant microorganisms on earth, with a long list of significant contributions to the planet. 4. Sexual reproduction also occurs during the life cycle of most protozoa. Medical
microbiologists have also missed a large proportion of microbes that are normal residents of the body. In simple terms, what does the wirus nucleic acid do once it gets into the cell? A standard molar solution is obtained by dissolving 1 mole, defined as the molecular weight of the compound in grams, in 1 L (1,000 ml) of solution. Explain the position of
the glycocalyx. Several forms of prion diseases are known in mammals, including scrapie in sheep, (b) 2 Upon contact with normal proteins, the prions are able to shift the configuration of the normal proteins, converting them to prions. From its position as the exposed cell layer, the glycocalyx serves a variety of functions. Cells can slide in jerking
movements over moist surfaces by extending and then retracting pili in a repetitive motion. MASS 1.00 Na 12 12p 2.6 6p AT. microconidium and macroconidium. Then, arrange the content in a way that makes the most sense for your course. Included in this group are methane producers, hyperthermophiles, extreme halophiles, and sulfur reducers.
Digital Lecture Capture: Get Connected. It is expressed by the pH scale, a series of numbers ranging from 0 to 14, pH 7 being neither acidic nor alkaline. Let your instructor guide you as to which one is satisfactory for your course. What are the functions of the glycocalyx, cell wall, and membrane? One peculiar ciliate propels itself by affixing
symbiotic bacteria to its cell membrane to act as "oars." Other ciliates and amoebas harbor specialized bacteria or algae inside their cells to provide nutrients. (d) A 1,4 bond between a galactose and glucose produces lactose. (S 5 slime layer; CM 5 cell membrane) 118 Chapter 4 s ro g in ic he pa l m t g of ua ted sin g ad ivid trac A u nnin x N e d in ey
e D stu mb e h he ir u t t he d n ea t, as zed **. Although the term mating is sometimes used for this process, it is not a form of reproduction. Chlorine, on the other hand, has gained 1 electron and now has 1 more electron than protons, producing a negatively charged 4. An arthropod is an invertebrate with jointed legs, such as an insect, tick, or
spider. As novice microbiologists, most of you will be learning some basic microscope, inoculation, culturing, and identification techniques. Current research is focused on the connection of viruses to afflictions of unknown causes, such as type I diabetes and multiple sclerosis. The valence electrons determine the degree of reactivity and the types of
bonds an element can make. Differentiate between the structure and functions of pili and fimbriae. illumination b. they cannot reproduce by themselves c. Label the major structures you can observe in the images in figure 5.16a, table 5.3A, B, and D, and table 5.6C. In addition, the ConnectPlus eBook allows students to quiz themselves interactively
using these questions! NEW! Questions Are Divided into Two Levels Level I. Red dye has no effect. zygospores, and basidiospores, and basidiospores, and basidiospores. Draw the atomic structure of magnesium and predict what kinds of bonds it will make.
pathogenic fungi. The protozoan in (c) engulfs the algae but absorbs the nutrients they release and shelters them. Several functional types of RNA are formed using the major causes of death among world socioeconomic levels. Nonenveloped and complex viruses that
reach maturation in the cell nucleus or cytoplasm are released through cell lysis or rupturing. 3.3 Preparing Specimens for Optical Microscopes A. 6 Process Figure 6.11 General features in the multiplication cycle of an enveloped animal virus. This discovery energized the medical world and spurred the use of nonculture-based methods to find VBNCs
in the human body. Contrast the major structure of gram-positive and gram-negative cell walls. A fifth type of optical microscope, uses a laser beam. Explain the concepts behind the organization of the two main trees of life, and
indicate where the major groups of microorganisms fall on these trees. To counteract this formidable mortality rate, certain worms have adapted a reproductive capacity that borders on the incredible: A single female Ascaris7 can lay 200,000 eggs a day, and a large female can contain over 25 million eggs at varying stages of development! If only a
      number of these eggs makes it to another host, the parasite will have been successful in completing its life cycle. Why are hydrogen bonds relatively weak? The formation of these living layers is actually a universal phenomenon that all of us have observed. Fungi in Medicine, Nature, and Industry Nearly all fungi are free-living and do not require
a host to complete their life cycles. Upon closer review of Mr. Jones's case, the physician discovered that he had suffered from a skin infection the previous spring that had been treated and cured by a different physician. Over the next 100 years vaccination was brought to the rest of the world through local programs. It is an intact and self-supporting
unit, complete with its own sterile environment and nourishment. Some microbiologists use the terms interchangeably, but we will refer to the smaller common appendages as fimbriae and the ones with specialized functions as pili. in, and oculus, eye. Because it arises from a single cell or cluster of cells, an isolated colony consists of just one species.
Asexual spores are the products of mitotic division of a Sexual Spore Formation Because fungi can propagate successfully by producing millions of asexual spores, it is natural to wonder about the survival potential of sexual spores. How are saturated and unsaturated fatty acids different? Even though the terms algae and protozoa do not have
taxonomic status, they are still scientifically useful. We examine the more detailed functions of ribosomes in chapter 9. Many are extremophiles, adapted to extreme environments similar to the earliest of earth's inhabitants. This image is not seen but is projected into the ocular lens, which forms a final level of magnification called the virtual image.
One very clear advantage of cell culture is that a specific cell line can be available for viruses with a very narrow host range. S Mineral deposits, volcanic sediments Soil Elemental sulfur is oxidized by some bacteria as an energy source; sulfur is found in vitamin B1; sulfhydryl groups are part of certain amino acids, where they form disulfide bonds
that shape and stabilize proteins. When NaCl in the crystalline form is added to water, the ions are released from the crystall as separate charged particles (cations and anions) into solution. So dominant are they that, by one estimate, the average topsoil contains Spores nearly 9 tons of fungal mycelia per acre, other elements as well. Discoveries may
lead to applications for tapping energy sources, bioremediation, climate change, soil fertility, and even new medicines and industrial products. "Almost c What subjects are studied by the science of parasitology? Figure 5.26 shows the major features of the amebic dysentery cycle, starting with the ingestion of cysts. Colony without a capsule Colonies
with a capsule CLINICAL CONNECTIONS The Glycocalyx and Infection of the lungs), Haemophilus influenzae (one cause of meningitis), and Bacillus anthracis (the cause of anthrax). Cell shape can remain constant (as in most
ciliates) or can change constantly (as in amoebas). (b) This shows the molecular pattern of peptidoglycan. Viruses are much simpler than cells; they are composed essentially of a small amount of hereditary material wrapped up in a protein covering. numerous hydrogen bonds occurring between the CPO and NOH 30. The latter medium is useful in
isolating fungi from mixed samples because of its low pH, which inhibits the growth of bacteria but not of most fungi. An example is deep- sea thermal vent at hydrothermal vent 
diffusion gradient or in the same direction as the natural gradient but at a rate faster than by diffusion alone, 2. Writing Challenge For each question, compose a one- or two-paragraph answer that includes the factual information needed to completely address the question. A cycle starts when a person swallows microscopic eggs picked up from
another infected person by direct contact or by touching contaminated surfaces. T and so cally ers iety iou ut var rev M o icr CASE STUDY Part 1 The Mystery Influenza Virus n March 2009, the infectious disease monitoring system of Mexico In both groups of patients, investigators discovered identical began registering an increase in influenza (flu)
cases. In this minisurvey, we consider some medically important groups and some representatives of bacteria living free in the environment that are ecologically important. Prokaryotes divide by binary fission and do not utilize mitosis. AnTo appreciate their other spiral cell mentioned earlier in condifferences, look for "Spirochetes junction with
periplasmic flagella is the That Cause Lyme spirochete, a more flexible form that reDisease" and sembles a spring. The phosphate R O O P O - O HCH H HC CH O O O C Glycolipid Phospholipids Charged head Cell membrane Polar lipid molecule Glycerol Polar head
must be taken to prevent introduction of Consistency) Medium Contains) Medium Contains Medium
embedded in PowerPoint® for ultimate ease of use! Just copy and paste into your custom slide show and you're done! Take your course online—easily— with one-click Digital Lecture Capture McGraw-Hill Tegrity Campus™ records and distributes your lecture with just a click of a button. These factors create a colorless cell that will stain with a red
counterstain. It gives practical application to the subject of microbiology. Explain two ways that animal viruses are released by a host cell. Indeed, the earth's balance of both energy and metabolic gases greatly depends on this relationship. 2 Cell wall Cell membrane Chromosome is duplicated and separated. This is due to individual variations in cell
wall structure caused by nutritional or slight hereditary differences. a, without, bios, life, and genesis, beginning. well-developed "virus factories." Although both are unusually large for viruses fit on the "tree of life," if at all, is
still the subject of debate. Although it is true that an individual bacterial cell can live attached to others in colonies or other such groupings, each one is fully capable of carrying out all necessary life activities, such as reproduction, metabolism, and nutrient processing unlike the more specialized cells of a multicellular organism. The word spore can
have more than one usage in microbiology. Differentiate the structure and functions of lagella and cilia, and the types of cells that possess them. Cells show the basic essential characteristics of life. Happy reading! iv About the Authors Barry Chess has been teaching microbiology at Pasadena City College for over 15 years. Explain how ribosomes and
the nucleolus are related. So far, one biological constant is that the genome of all organisms is carried by and expressed through nucleic acids (DNA, RNA). From 5% to 15% of persons are asymptomatic carriers. * amensalism (ae-men9-sul-izm) Gr, a, not, and L. The activities of fungi under natural conditions include nutritional and protective
interactions with plants and algae, decomposition of organic matter and recycling of the minerals it contains, and contributions to biofilm networks that are needed to successfully colonize new habitats. The natural relatedness between groups of living things is called their phylogeny. Compare and contrast liquid, solid, and semisolid media, giving
examples. Answer available at (poured) into sterile Petri dishes and are allowed to solidify (harden). However, viruses completely lack the genes for synthesis of metabolic enzymes. The LPS layer in gram-negative cell walls releases cause at 1.4 Additional Features of the Six "I's" 75 able in differentiating the smaller, simpler prokaryotic cells from the
larger, more complex eukaryotic cells. Be reminded that chloroplasts are thought to have originated from intracellular cyanobacteria and resemble them in many ways. ribosomes 6. To emphasize just how broad the category kingdom is, ponder the fact that humans belong to the same kingdom as jellyfish. In nematodes, the sexes are separate and
usually different in appearance; in trematodes, the sexes can be either separate or hermaphroditic, meaning that male and female sex organs are in the same worm; cestodes are generally hermaphroditic, influenza viruses. In this ninth edition, the authors have gone through the book page by page, with more depth than ever before, to make sure it
maintains its instructional quality; fantastic art program; relevant and current material; and engaging, user-friendly writing style. What sets the myxobacteria apart from other bacteria is the complexity and advancement of their life cycle. Physical States of Media defined) 2. Functional groups help define the chemical class of certain groups of organic
compounds and confer unique reactive properties on the whole molecule (table 2.3). When ionic solution. To make an exact duplicate. The effect on cells lacking a wall is to shrink down and usually to collapse (figure 7.6). Cortex Process Figure 4.22 Sporangium
begins to actively synthesize spore layers around forespore. Rickettsias cannot survive or multiply outside a host cell and cannot carry out metabolism completely on their own, so they are closely attached to their hosts. Note the capsule around forespore. Rickettsias cannot survive or multiply outside a host cell and cannot carry out metabolism completely on their own, so they are closely attached to their hosts. Note the capsule around forespore.
the cytoplasmic membrane becomes turgid* from pressure. (Not to accurate scale.) 2.1 combinations, unique types of atoms called elements result. Fungal cell walls give off chemical substances that can cause allergies. Once liquefied, agar ent content and consistency, and can be specially formulated for a does not resolidify until it cools to 428C
(1088F), so it can be inocuparticular purpose. Ionic bonds, where one atom transfers its electron(s) to another atom that can come closer to filling up its outer orbital. To which taxonomic group do cyanobacteria belong? Describe how an isolated colony forms. Maximum resolution SEM 5 10 nm. The "harmless virus" approach is also being used to
treat genetic diseases such as cystic fibrosis and sickle-cell anemia. Outline the basics of eukaryotic taxonomy. B Balantidium l idi coli—a li parasite i of swine that can also cause intestinal infections in humans The Apicomplexa (Sporozoa) Cytostome Food vacuoles Nucleus • Motility is absent in most cells except male gametes. type of lenses 14. A
bright-field microscope forms its image when light is transmitted through the specimen. Rather, it is composed of distinct groups of cells that cannot exist independently of the rest of the body. This is why heat works so well as an agent in microbial control. Explain what occurs in symbiosis and coevolution. By convention, organized as cell
components enclosed by membranes that carry out specific activities involving metabolism, nutrition, and synthesis. Which ones were used in the Case Study, page 1? particle d. Wet mounts and hanging drop mounts permit examination of the characteristics of live cells, such as motility, shape, and arrangement. Differentiate between oxidation and
reduction, and between an reaction are called the products. The more successful parasites generally have no fatal 11. xxiii Contents CHAPTER 2.5 Molecules of Life: Carbohydrates in Cells 46 1 The Main Themes of Microbiology 1 1.1 The Scope of Microbiology 2 1.2 General
most of the world's habitats and are indispensable for normal, balanced life on earth. Indeed, this is an important guideline in the acceptance of a hypothesis. (b) Two examples of viruses. Fructose is a type of a. How would you categorize a virus? Inoculation of a medium with the specimen is the first step in culturing. They both mean the sum of
atomic weights of all atoms in a molecule. The outer membrane contributes an extra barrier in gram-negative bacteria that makes them more impervious to some antimicrobic chemicals such as dyes and disinfectants, so they are generally more difficult to inhibit or kill than are gram-positive bacteria. * symbiont An organism that lives in association
with another organism, from the term symbiosis (sim0-bye-oh9-sis) Gr, syn, together, and bios, to live. He was rushed to the operating room but died instructions to take oral penicillin and acetaminophen (Tylenol), during open heart surgery. Some microbes adapt to wide concentrations in solutes. Microfilaments are thin strands composed of the
protein actin that attach to the cell membrane and form a network through the cytoplasm. the nature of Carbohydrates (a) H 2O O + 6 C + O C H 1C H
(c) 5 H H C4 OH HO 3 C H 6 CH2OH O C 5 H H C4 OH HO 3 C H 6 CH2OH O H C + C5 H H 2 4 OH H C C OH OH 1 C H 2 OH 2 C H OH Galactose + H 1 C H OH 2 C OH Glucose H C OH O C 1 H 2 C OH 1 C OH 
Fructose 6 CH2OH O C 2 6 H Glucose H 1C 6 CH2OH O C 5 HO H C4 OH H 3 C H 6 CH2OH O C 5 H H O C4 OH H 3 C H 6 CH2OH O C 5 H H O C4 OH H 3 C H 6 CH2OH O C 5 H H O C4 OH H 3 C H 6 CH2OH O C 5 H OH C4 OH C4 OH H 3 C H 6 CH2OH O C 5 H OH C4 OH 
more distinctive appearance. Understanding the roles of endophytes promises to open up a new field of biological control to inoculate plants with harmless fungi rather than usbuilding syndrome." The usual source of harmful fungi is the presence of inq more toxic fungicides. Inoculation, Growth, and Identification of Cultures To cultivate, or culture, the presence of inq more toxic fungicides.
microorganisms, one introduces a tiny sample (the inoculum) into a container of nutrient medium* (pl. Differentiate among the ingredients and functions of enriched, selective, and differentiate among the ingredients and functions of enriched, selective, and differentiate among the ingredients and functions of enriched, selective, and differentiate among the ingredients and functions of enriched, selective, and differentiate among the ingredients and functions of enriched, selective, and differentiate among the ingredients and functions of enriched, selective, and differentiate among the ingredients and functions of enriched, selective, and differentiate among the ingredients and functions of enriched, selective, and differentiate among the ingredients and functions of enriched in the ingredients and in the ingredients and ingredients and ingredients and ingredients and ingredients and ingredients and ingredients are increased in the ingredients and increased in the ingredients are increased in the ingredients and increased in the ingredients are increased in the ingredients and increased in the ingredients are increased in the ingredient and increas
reasons would a eukaryotic cell evolve an endoplasmic reticulum and a Golgi apparatus? Important differential stains include the Gram stain, acid-fast stain, and the endospore stain. Forespore Sporangium Sporulation Cycle 7 4 Spora
cecal perforation, and, rarely, death. Recall the order of taxa and the system of notation used in creating scientific names. By considering both confidence level and responses to actual content questions, LearnSmart identifies what an individual student knows and doesn't know and builds an optimal learning path, so that they spend less time on
concepts they already know and more time on those they don't. Other bacteria produce capsules composed of repeating polysaccharide units, of protein, or of both. These pigments are responsible for "red herrings," the color of the Red Sea, and the red color of salt ponds (figure 4.32). The Frenchman Louis Jablot reasoned that even microscopic
organisms must have parents, and his experiments with infusions (dried hay steeped in water) supported that hypothesis. If the cell is spherical or ball-shaped, or even pointed variants. One form of commensalism observed in cultured
microbes is termed the "satellite phenomenon," in which one species releases various growth factors that are required by a nearby species to grow. Dr. Margulis also has convincing evidence pouches that become the ween spiral bacteria and flagella have arisen from endosymbiosis between endoplasmic reticulum and Golgi apparatus. • Inactive
macromolecules outside the host cell and active only inside host cells • Nucleic acid of the viral genome is either DNA or RNA but not both. It is used to grow fastidious pathogens like this notorious agent of bubonic plague. Cocci in clusters or packets that are aerobic or facultative E. These adaptations occur at the genetic level, and in some cases,
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genes are exchanged between the partners. genus species strain domain Borrelia burgdorferi Spirochaetes phylum Visual Challenge 121 Level II. The cytoplasm is divided into ectoplasm and endoplasm. Numerous species have carved a niche for themselves in the deepest layers of mud, swamps, and oceans, where oxygen gas and sunlight cannot
 penetrate. As a result, the specimen will produce an image that is darker than the surrounding brightly illuminated field. Up until now it has been generally accepted fornia have discovered ultrasmall archaea living in pink biofilms. In fact, defining life requires a whole collection of behaviors and properties that even the simplest organisms will have.
We have included viruses for the purposes of summarizing the biological characteristics of all microbes and to show you just how much viruses differ from cells. (2) Merismopedia displays a slimy sheath around its regular packets of cells. Animal tissues would be rather inhospitable to algae, so algae are rarely infectious. 12. Electron Orbitals and
Shells The structure of an atom can be envisioned as a central nucleus surrounded by a cloud of electrons that constantly spin within confined pathways surrounding the nucleus at exceedingly high speed (see figure 2.1). Some media, such as minimal media for fungi, contain nothing more than a few salts and amino acids dissolved in water.
Appendages can be divided into two major groups: those that provide motility (flagella and axial filaments) and those that provide attachments or channels (fimbriae and pili). Key terms are also included in Level II. Type IV pili are a major contributor to the infectiousness of Neisseria gonorrhoeae, the agent of gonorrhea, by providing a mechanism for
binding to the epithelial cells of the reproductive tract. 170 6.4 Modes of Viral multiplication 171 Viral nucleocapsid Host cell membrane Viral glycoprotein spikes Cytoplasm Capsid RNA Budding virion Free infectious virion with envelope Viral matrix protein (a) alters the genetic expression of the host and instructs it to synthesize the building blocks
for new viruses. Suggest what causes the difference in growth pattern between nonmotile and motile bacteria. The complete conversion of superoxide dismutase Step 1. It is basic to the function of all optical, or light, microscopes, though many of them have
additional features that define, refine, and increase the size of the image. Examples are triglycerides, phospholipids, sterols, and waxes. DNA, the master instruction manual of cells, contains a coded genetic program with detailed and specific instructions for each organism's heredity. Blue cheeses, soy sauce, and cured meats derive their unique
flavors from the actions of fungi. Note that figure 5.13 compares an rRNAbased system as first outlined in chapter 1 alongside the original Kingdom Protista with its assorted phyla and divisions. The cell walls in plants and many microscopic algae derive their strength and rigidity from cellulose, a long, fibrous polymer (figure 2.17a). Among the
genetically unique organisms that have been designed by bioengineers are bacteria that contain a natural pesticide, * biotechnology (by9-oh-tek-nol0-oh-gee) The use of microbes or their products in the commercial or industrial realm. Another common site for anaerobic infections is the large intestine, a relatively oxygen-free habitat that harbors a
rich assortment of strictly anaerobic bacteria. As is true of protein, the structure of DNA is intimately related to its function. The two major types of viruses are DNA and RNA viruses. For several years, pharmaceutical researchers have been exploring alternate ways to administer drugs using tiny delivery systems called nanoparticles.* This idea
comes from the science of nanotechnology, defined as the study and application of molecule-sized devices or structures (look ahead to 3.1 Making Connections). capsula, small sheath. Deoxyribonucleic acid (DNA) is a polymer of nucleotides that occurs as a double-stranded helix with hydrogen bonding between pairs of bases on the helices. Although
bacteria lack complex internal membranous organelles, some members develop stacked layers of internal membranes that carry out physiological processes related to energy and synthesis. * amphitrichous (am0-fee-trik9-us). Oral biologists had previously recovered about 500 bacterial strains from this site; the Stanford scientists found 30 species
that had never before been cultured or described. Many viruses can be manipulated in the laboratory to infect cells that they do not infect naturally, thus making it possible to cultivate them. Examples of cells with internal membranes are cyanobacteria, whose thylakoid membranes are the sites of photosynthesis (figure 4.28c). Overall Morphology
Most are unicellular; lack a cell wall. The formal system for organizing, classifying, and naming living things is taxonomy.* This science originated more than 250 years ago when Carl von Linné (also known as Linnaeus; 1701-1778), a Swedish botanist, laid down the basic rules for taxonomic categories, or taxa. Appropriate line art, micrographs, and
 quotes have been added to the chapter-opening page to help the students pull together the big picture and grasp the relevance of the material they're about to learn. v Integrated and Adaptive Learning Systems LearnSmartAdvantage.com SmartBook is the first and only adaptive reading experience available for the higher education market. Big
Bacteria Break Records In 1985, biologists discovered a new bacterium living in the intestine of surgeonfish that at the time was a candidate for the Guinness Book of World Records. Because of Leeuwenhoek's extraordinary contributions to microbiology, he is sometimes considered the father of bacteriology and protozoology. The Case Study
Perspective wraps up the case and can be found at www.mhhe.com/talaro9, or on the Connect website. It contains tulip mosaic virus, which alters the development of the plant cells and causes varying patterns of colors in the petals. With this type of replication, each new double strand contains one of the original single strands from the starting DNA
In time, this will evenly distribute the molecules in the solution. Use figure 2.13 to familiarize yourself with the pH readings of some common substances. In the case of fusion, the viral envelope fuses directly with the pH readings of some common substances. In the case of fusion, the viral enveloped viruses (figure 6.13a). A certain medium has the following composition: Glucose
15 g Yeast extract 5g Peptone 5g KH2PO4 2g Distilled water 1,000 ml a. Explain how the bacterial glycocalyx and certain surface appendages contribute to biofilm formation. (a) Simple stains and negative stains. The nematode worm that causes the food-borne infection, trichinellosis. A polymer of the sugar known as mannose. The cell membranes of
fungi also contain a unique sterol, called ergosterol. There are various degrees of parasitism. For instance, it magnifies in stages by means of two lens systems, and it has a condensing lens, a specimen holder, and a focusing apparatus. In addition to providing the viral habitat, the host cell is absolutely necessary for viral multiplication, which is
synonymous with infection. Sporangiospores Surface hyphae Asexual Spore Formation On the basis of the nature of the reproductive hyphae Hyphae Hyphae Hyphae (c) Germination Figure 5.18): Submerged hyphae Rhizoids Spore Germ tube Substrate (a) Vegetative Hyphae Hyphae Hyphae (c) Germination Figure 5.18):
5.17 Functional types of hyphae using the mold Rhizopus as an example. finding organic matter b. At the bottom are the details of hydrogen bonds between the nitrogen bases of the two strands. QR41.2.T35 2015 616.9'041-dc23 2013041001 The Internet addresses listed in the text were accurate at the time of publication. Multiple ribosomes are
often found arranged in short chains called polyribosomes (polysomes). Cell membrane Periplasmic space Cell wall (peptidoglycan) (b) Cell membrane Periplasmic space Peptidoglycan) (b) Cell membrane Periplasmic space Peptidoglycan) (c) Cell membrane Periplasmic space Peptidoglycan) (d) Cell membrane Periplasmic space Peptidoglycan) (d) Cell membrane Periplasmic space Peptidoglycan) (e) Cell membrane Periplasmic space Peptidoglycan) (e) Cell membrane Periplasmic space Peptidoglycan) (e) Cell membrane Periplasmic space Peptidoglycan) (f) Cell membrane Periplasmic 
reaches a steady state and cannot move faster despite further increases in the substance's concentration. When the prion comes in contact with a normal protein, it can induce spontaneous abnormal folding in the normal protein, it can induce spontaneous abnormal folding in the normal protein. In general, haploid spores called ascospores* are created inside a special fungal sac, or ascus (pl. Several members play
an important role in the function of the human gut and some are involved in oral and intestinal infections. Incubators can also control the content of atmospheric gases such as oxygen and carbon dioxide that may be required for the growth of certain microbes. Recent estimates propose that, based on weight and numbers, up to 50% of all organisms such as oxygen and carbon dioxide that may be required for the growth of certain microbes.
exist within and beneath the earth's crust in soil, rocks, and even the frozen Antarctic (figure 1.5c). Fibrin Staphylococci Core of pus Subcutaneous tissue Infiltrating granulocytes (phagocytes) (a) Sectional view of a boil or furuncle, a single pustule that develops in a hair follicle or gland and is the classic lesion of the species. Media fall into three
general categories based on their properties: physical state, chemical composition, and functional type (table 3.5). We converted the "Take Notes" concepts and set them as regular text under their own headings. From these microbes or geologic artifacts. • Instructors have access to a variety of resources including assignable and gradable interactive
questions based on textbook images, case study activities, tutorial videos, and more. Aspergillus C A ill fumigatus, f i displaying its flowery conidial • Histoplasma is the cause of Ohio Valley fever (see figure 1.3). protozoan d. The variations among the amino acid and imparts the unique
characteristics to the molecule and to the proteins that contain it. Because many molds and yeasts tolerate moderate acidity, they are the most common spoilage agents of pickled foods. In an 2.3 Chemical Reactions, Solutions, and pH equation, the reactant(s) are on the left of an arrow and the product(s) on the right. Summarize how gram-positive
and gram-negative cells differ in their reactions. Viruses cannot be cultivated in a. Certain bacterial toxins (poisonous proteins) react with only one specific Protein Structure and Diversity organ or tissue. * adenovirus (ad0-uh-noh-vy9-rus) G. When these two atoms come together, the sodium atom will readily donate its single valence electron and the
chlorine atom will avidly receive it. A cross section reveals nine pairs of closely attached microtubules surrounding a single central pair. (b) In group translocation, (1) a specific molecule is actively captured, but on its passage through the membrane protein carrier (2) it is chemically altered or activated for use in the cell. Bacterial endospores are the
hardiest of all life forms, capable of withstanding extremes in heat, drying, freezing, radiation, and chemicals that would readily kill ordinary cells. T an s oc aly ers iety iou ut var rev M o icr CASE STUDY Part 1 Neglected Tropical Diseases S ome of the greatest suffering in the world originates from The chronic, progressive actions of these infectious
agents can cause a group of ancient infectious diseases that exist primarily in debility and disfigurement. Heidi Smith is the lead faculty for microbiology, anatomy/physiology, and biotechnology. 1.6 Taxonomy:
Organizing, Classifying, and Naming Microorganisms Expected Learning Outcomes 11. These are called osmotolerant. In other cases, animals or insect vectors serve as reservoirs or are required to complete worm development. 149 Major Pathogenic Protozoa, Infections, and Primary Sources The Parasitic Way of Life • The microbe is transmitted to
the human host from a source such as soil, water, food, other humans, or animals. These carrier proteins exhibit specificity, which means that they bind and transport only a single type of molecule. Attachment of free planktonic cells to surface 2 2-3. Not surprisingly, the samples planets, orbiting an average of 225 million miles away from earth. The
envelope usually has special receptor spikes inserted into its membrane. Severe cases are treated with oral vancomycin or metronidazole, along with probiotics or fecal microbiota transplants to restore the normal microbiota. Characterize the cell wall and membrane of eukaryotic cells. fungi b. The term culture refers to the in . Even more complex
interactions occur in the cycling of elements such as sulfur, phosphorus, and nitrogen (look ahead to chapter 26). A bacteriologist from the U.S. Department of Energy checks cultures of genetically modified bacteria for growth. Overall Morphology: Are unicellular, colonial, filamentous or larger forms such as seaweeds. One form of bioremediation
that has been in use for some time is the treatment of water and sewage. Because some viral diseases can be life threatening, it is essential to have a correct diagnosis as soon as possible. Describe the major environmental factors to which microbes must adapt for survival. xii T he Relevance of an E xper tly Craft ted Learning Tool taL22600 ch19 574 is essential to have a correct diagnosis as soon as possible.
603.indd Page 597 11/6/13 7:56 PM f-w-166 /202/MH02004/taL22600_disk1of1/0073522600/taL22600_pagefiles retroviruses may be involved in
diseases genetic material. The glycocalyx and cell wall can bar the passage of large molecules, but they are not the primary transport apparatus. Although it acts as a somewhat rigid protective structure, as previously described, its thinness gives gram-negative bacteria a relatively greater flexibility and sensitivity to lysis. Poliomyelitis 30 nm 10. The
megaviruses were first discovered as parasites inside the cells of amoebas living in aquatic habitats. Deep-sea microbes called barophiles exist under pressures many times that of the atmosphere. Certain amoebas (foraminiferans) encase themselves in hard shells made of calcium carbonate. What does it mean to say microbes are ubiquitous? of
isolates (described in chapter 7). During this golden age of microbiology, he realized that study of the microbial world would require separating microbes from each other and growing them in culture. 2.6 Molecules of Life: Lipids A. a cell wall 2. Size Range As a group, viruses represent the smallest infectious agents (with some unusual exceptions to
be discussed in section 6.8). His experiments ultimately gave rise to the first viable method to control smallpox by inoculating patients with a closely related disease agent. bacterium c. Fair, Florida State College at Jacksonville, South Campus Mark Farinha, Ph.D., Anne Arundel Community College Daniel Ford, University of Kansas Jason Gee, East
Carolina University Robert A. Monster Viruses In chapter 4, we featured discoveries of unusual types of bacteria. Control and Treatment Mild cases generally respond to withdrawal of the antibiotic. A primary culture retains several characteristics of the original tissue from which it was derived, but this original line generally has a limited existence
Animals have eukaryotic cells, are multicellular, do not have cell walls, and derive nutrients from other organisms. Reactions are (1) no growth; (2) growth with no acid production in all areas of the medium; (5) acid and H2S production in butt (black precipitate). chloroplasts)
are of the larger 80S variety that is a combination of 60S and 40S subunits. Compare and contrast the optical compound microscope with the electron microscope with the electron microscope. Two different hemolysins, streptolysin O (SLO) and strept
red rash characteristic of S. Several episodes of a severe infection caused by Pfiesteria piscicida, a toxic algal form, have been reported over the past several years in the United States. So compounds are one major type of molecule. Runs are interrupted at various intervals by tumbles caused by the flagellum reversing its direction. How do slime
the 1990s, a different variant of CJD that appeared in Europe was traced to people eating meat from cows infected with the bovine form of encephalopathy. pyogenes disease. Applying newer methods for determining phylogeny has led to the development of a differently shaped tree—with important implications for our understanding of evolutionary
relatedness. Golqi, an Italian histologist who first described the apparatus in 1898. polysaccharide d. not possible 86 Chapter 3 Tools of the Laboratory 8. toxin fungi. Even some viruses, which are not cells, can have a membranous envelope. * species (spee9-sheez) L. The DNA in the cell's chromosome must be duplicated as the cell is dividing.
Parasites and pathogens are microorganisms that invade the bodies of hosts, often causing damage through infection and disease. The structure of the Shiga toxin, produced by Shigella bacteria, is a combination of separate polypeptides (shown in different colors). Other agents that have selective properties are antimicrobial drugs and acid. The
thick, impervious cortex and spore coats provide additional protection against radiation and chemicals. 

What is the definition of a vector, and how are vectors involved in these diseases? Whatever materials are provided, In the final analysis, the process of learning comes down to selfthis should be your primary guide in preparing to study. What
aspect of the plankton was actually analyzed by the marine researchers to arrive at their conclusions? A truly motile cell will flit, dart, or wobble around the field, making some progress, whereas one that is nonmotile jiggles about in one place but makes no progress. This is analogous to the larger space in gram-negatives, but it has different
functions. Investigations of unexplored areas of the earth continue to surprise and instruct us about the adaptation of these remarkable organisms. We have already reviewed the 13. The manner in which a slide 70 Chapter 3 Tools of the Laboratory specimen, or mount is prepared depends upon: (1) the condition of the specimen
either in a living or preserved state; (2) the aims of the examiner, whether it is bright-field, dark-field, phase-contrast, or fluorescence. and pneumonia. of life? Terms that we use for describing these conditions are isotonic,
hypotonic, and hypertonic3 (figure 7.6). How could you convert Staphylococcus medium (table 3.6A) into a nonsynthetic medium? What features of the new H1N1 influenza classified it as a pandemic? This is followed by culturing procedures and media. Why do some elements not bond readily? As these evolutionary periods progressed, the members
of the three domains evolved separately into major life trees of their own with many offshoots. Diaphysis Site of breakage Staphylococcus cells Metaphysis (a) (b) Figure 18.4 Staphylococcus cells Metaphysis Site of breakage Staphylococcus cells Metaphysis (a) (b) Figure 18.4 Staphylococcus cells Metaphysis (b) Figure 18.4 Staphylococcus cells Metaphysis (b) Figure 18.4 Staphylococcus cells Metaphysis (c) (c) Figure 18.4 Staphylococcus cells Metaphysis (c) (d) Figure 18.4 Staphylococcus cells Metaphysis (c) (d) Figure 18.4 Staphylococcus cells Metaphysis (d) (d) (d) Figure 18.4 Staphy
are multicellular animals equipped to some degree with organs and organ systems. Could the Gram stain be used to diagnose the flu? Functional Groups of Compounds One important advantage of carbon's serving as the molecular skeleton for living things is that it is free to bind with a variety of special molecular groups or accessory
molecules called functional groups. Other examples of classification schemes are provided in sections of chapters 4 and 5 and in several later chapters. Suggest some other possibilities. As a rule, a microbe that has adapted to an extreme habitat will die if placed in a moderate one. Some virologists contend that these virus ephants, guinea pigs, and
horses, where it causes a severe brain disease. regulatory control over molecules entering and leaving the cell. Others argue that they are searchers suggest they could be involved in psychoses such as schizojust genetic "garbage" that has accumulated over a long human history. 2 Nucleus 3 Uncoating. The chief actions in creating the tertiary
structure are addiExpected Learning Outcomes tional hydrogen bonds between charged functional groups, van der Waals forces between various parts of the polypeptide, and covalent 28. 2 The secondary structure develops when CO and NH groups on adjacent amino acids form hydrogen bonds. Name some enzymes that viruses may have for
invading and completing their cycles. TABLE 6.2 Important Human Virus Families, Genera, Common Names, and Types of Diseases Nucleic Acid Type Common Name of Genus Members Name of Diseases Nucleic Acid Type Common Names, and Types of Diseases Nucleic Acid Type Common Names, and Types of Diseases Nucleic Acid Type Common Names, and Types of Diseases Nucleic Acid Type Common Names, and Types of Diseases Nucleic Acid Type Common Names, and Types of Diseases Nucleic Acid Type Common Names, and Types of Diseases Nucleic Acid Type Common Names, and Types of Diseases Nucleic Acid Type Common Names, and Types of Diseases Nucleic Acid Type Common Names, and Types of Diseases Nucleic Acid Type Common Names, and Types of Diseases Nucleic Acid Type Common Names, and Types of Diseases Nucleic Acid Type Common Names, and Types of Diseases Nucleic Acid Type Common Names, and Types of Diseases Nucleic Acid Type Common Names, and Types of Diseases Nucleic Acid Type Common Names, and Types of Diseases Nucleic Acid Type Common Names, and Types of Diseases Nucleic Acid Type Common Names, and Types of Diseases Nucleic Acid Type Common Names, and Types of Diseases Nucleic Acid Type Common Names, and Types of Diseases Nucleic Acid Type Common Names, and Types of Diseases Nucleic Acid Type Common Names, and Types of Diseases Nucleic Acid Type Common Names, and Types of Diseases Nucleic Acid Types of Diseases Nucleic Acid Types Nucleic Acid
Human cytomegalovirus (CMV) Smallpox, cowpox Fever blister, cold sores Genital herpes Chickenpox, shingles CMV infections Adenovirus Human adenovirus (HPV) JC virus (JCV) Several types of warts Progressive
multifocal leukoencephalopathy Hepadnavirus Serum hepatitis B virus (HBV or Dane particle) Parvovirus Rhinovirus Coxsackievirus Hepatovirus Hepatovirus Hepatovirus Hepatovirus Coxsackievirus Hepatovirus Hepa
Eastern equine encephalitis virus Yellow fever virus St. Louis encephalitis virus Poliomyelitis Hand-foot-mouth disease Short-term hepatitis (WEE) Yellow fever St. Louis encephalitis Rubella virus Dengue fever virus West
Nile fever virus Bunyamwera viruses Sin Nombre virus Rift Valley fever virus Rift Valley fever virus Rift Valley fever virus Rubella (German measles) Dengue fever West Nile fever virus Bunyamwera viruses Sin Nombre virus Rift Valley fever virus Rubella (German measles) Dengue fever West Nile fever virus Rubella (German measles) Dengue fever virus Rubella (German measles) 
Ebola fever Colorado tick fever Rotavirus gastroenteritis Influenza virus, type A (Asian, Hong Kong, and swine influenza virus Poxviridae Herpesviridae Orthopoxvirus Simplexvirus DNA Viruses Poxviridae Chordopoxvirinae
Herpesviridae Adenoviridae Papillomaviridae Parvoviridae 
Rotavirus Orthomyxoviridae Influenza virus Paramyxoviridae Par
Rhabdoviridae Lyssavirus Oncornavirus Coronavirus Arenaviridae Arenavi
virus SARS virus Lassa fever Bronchitis Coronavirus enteritis Severe acute respiratory syndrome (AIDS) Viruses are closely associated with their hosts. CHAPTER 3 Meninges Tools of the Laboratory Methods of Studying Microorganisms Cerebrospinal fluid Nasal cavity Initial infection site A clinical "picture of
meningitis" would show meningococci (arrow) being engulfed by white blood cells in a sample of spinal fluid. biotechnology c. Identify functional groups and know some examples. Lyme disease c. In general, the DNA viruses (except poxviruses) enter the host cell's nucleus and are replicated and assembled there. What Is Life? Give the common name
of a eukaryotic microbe that is unicellular, walled, nonphotosynthetic, nonmotile, and bud-forming. array of examples. Although codes on the 46 human chromosomes. In other reactions, oxidation and reduction occur with the tion of bonds between atoms. (+) (-) Contact of mating hyphae Germination Figure 5.19 Formation of zygospores in Rhizopus
stolonifer. Most of them are not associated with a single infectious agent. 2.4 2.4 The Chemistry of Carbon and Organic Compounds Expected Learning Outcomes 16. Once attached, cells begin to release inducer* molecules that accumulate as the cell population grows. Maximum effective magnification SEM 5 650,0003. MASS 14.00 AT. Ecological
Associations Among Microorganisms Chromosome Inducer molecule Quorum-dependent protein 207 Food particles 1 5 4 2 Matrix 3 1 Free-swimming cells lose their motility and settle down onto a surface or substrate. Another compound Find "Mad Cow that shows some potential for treating and Disease 101" on preventing viral infections is a
naturally ocYouTube for a curring human cell product called interferon short overview of the condition. themselves. Endoplasm houses the nucleus, mitochondria, and food and contractile vacuoles. Within moments, a lab technician can possibly tell if there are bacterial cells, and they can observe their Gram reaction and shape. Louis Pasteur c. First,
most habitats (such as the soil and the human mouth) harbor microbes in complex associations. has less H1 b. Jenner also noted that milkmaids acquired cowpox only on the hands, and they appeared to be immune to smallpox. Tuberculosis, which has been known since ancient times, still causes 8 million new infections and kills 1 million to 2 million
people every year. Observe figure 2.26 and explain why adenine forms hydrogen bonds only with thymine and why cytosine forms them only with guanine. or change in the angle of the light ray as it passes through a medium such as a lens. Following the Water and Carbon on Mars T hroughout history, humans have gazed at the night sky and life look
like? As a result of peptide bond formation, it is possible to produce molecules varying in length from two amino acids to chains containing thousands of them. 2.3 Chemical Reactions, Solutions, and pH A. Flagella and internal axial filaments found in spirochetes are used for motility. Cutaway view of a rod- Fimbriae Page 94 Ribosomes Page 102 Cell
fusing of two parental nuclei followed by meiosis. What causes the appearance of the host cell, and how might it be used to diagnose viral infections? Another useful measurement is the mass number (MN), equal to the number of protons and neutrons. Probably the upward limit of tolerance is shown by proteobacteria in California's Mono Lake that
have adapted to pH 12. Explain the role of broad-spectrum antibiotics in disrupting the microbial symbionts of humans and the possible problems this can cause. These sacs have outer limiting membranes and cavities like those of the endoplasmic reticulum, but they do not form a continuous network (figure 5.7d). Currently the most effective way for
citizens of developing countries to avoid infection is to sleep under a bed net, because the mosquitoes are most active in the evening. to grow fastidious streptococci and other pathogens. Explain how microbiologists use the scientific method to develop theories and explanations for microbial phenomena. The basis for these interactions is also an
attraction of two regions on atoms or molecules and not just those containing hydrogen, oxygen, and nitrogen. Outline the adaptations of microbial groups to variations in pH. (Compare the effects of the cold virus with those of the rabies virus.) b. A
relatively new discovery, fullerene, is made by carbon atoms double-bonding with each other to produce a hollow sphere. It is an important respiratory gas, and it is also a powerful oxidizing agent that exists in many toxic forms. The method traditionally used to observe the population growth pattern is a viable count technique, in which the live cells
in a culture are sampled, grown, and counted during a growth period, as described in the next section. Jenner went on to inoculate 23 other test subjects with cowpox. Figure 3.12 Various states of cultures. The cell does not have to expend energy for transport. Primary Infections/Disease Local cutaneous infections include pyoderma (impetigo) or the
more invasive erysipelas. Kingdom Protista, containing primitive unicellular microbes such as algae and protozoa; 3. genus of black bread mold f. glycine d. These vents are a focus of tremendous biological and geologic activity. Primary structure β C C O H N C Secondary structure N C C O Detail of hydrogen bond
Fluorescence Microscopy The fluorescence microscope is a specially modified compound microscope furnished with an ultraviolet (UV) radiation source and filters that protect the viewer's eye from injury by these dangerous rays. Knowledge of the amoebic cycle and role of cysts has been helpful in controlling the disease. This becomes important in
the initial isolation of some pathogens from * microaerophile (myk0-roh-air9-oh-fyl) (a) Figure 7.11 Use of thioglycollate broth to demonstrate oxygen requirements. Those that must be obtained from food are called essential amino acids. MASS 40.08 AT. This is due to the roles microbes play in the cycling processes that maintain the elements in forms
readily fuse with the membrane of the cell they are targeting, immediately delivering their contents directly into the cytoplasm. (11 and 12) In the amensal phase of their ecology, the ants cultivate actinomycetes to protect their habitat from microbial pests. (c) Ciliate structure. Why are most pathogens mesophilic? Viruses are different from their habitat from microbial pests.
cells in size, structure, behavior, and physiology. endocytosis d. 28. organic matter in the ocean c. The members of the association are called commensals. The Algae: Photosynthetic organisms most readily recognized by their larger members, such as seaweeds and kelps. Chemical reactions caused the
pit to short time. beautiful B Ab if I mold, Id Circinella Ci i ll is i known for its curved sporangiophore (5003) Phylum II—Ascomycota (also Ascomycetes) • • • • Sexual spores: most produce ascospores in asci Asexual spor
phylum. Write a narrative that describes the stages in the multiplication of an enveloped animal virus. The disease was first reported in fish and was later transmitted to humans. Electrons fill the orbitals and shells in pairs, starting with the shell nearest the nucleus: 32 S P Ca 19p 16p • • • • The first shell contains one orbital and a maximum of 2
electrons. Finished vesicles leave the Golgi after processing and migrate to the cell membrane. The AFM is very useful in viewing the detailed functions of biological molecules such as antibodies and enzymes. Describe envelopes and spikes, and discuss their origins. Koos Product Developer: Mandy Clark Digital Product Analyst: John J. Metachromatic
granules are concentrated found in . Fructose sugar is a ketone with a carbonyl group bonded between two carbons. When you think of it, the patients were actually being inoculated in a way that assured the development of serious mycoses. vin n ju g w 0 e g ic a re a e te r 3. Compare and contrast three common laboratory techniques for them, as
you will no doubt witness in your own laboratory. Regardless of their origins, all cells share a few common characteristics. Scientists aboard the versel randomly collected surDr. David Thomassen, Chief Scientist, Department of Energy, face water about every 200 miles with very fine nets that extracted aptly expressed the outcome of these studies:
 'Microbes rule the the microscopic plankton, primarily bacteria, and sent samples earth. Explain what it means to be an obligate intracellular parasite. For example, archaea and eukaryotes share a number of ribosomal RNA sequences that are not found in bacteria, and their protein synthesis and ribosomal subunit structures are similar. Some
bacteria transport certain sugars, amino acids, vitamins, and phosphate into the cell by this mechanism. ow 0 's d 7. How astonishing to realize that Handle this curious and original man was the first human being on earth ever to glimpse the "cavorting wee beasties" (his description) of the microbial world! From the time of Leeuwenhoek, microscopes
became more complex and improved, with the addition of refined lenses, a condenser, finer focusing devices, and built-in light sources. The woven, intertwining mass of hyphae that makes up the body or colony of a mold is called a mycelium.* Although hyphae contain the usual eukaryotic organelles, they also have some unique organizational
features. Footnotes Footnotes Footnotes provide the reader with additional information about the text content. 1.7 The Origin and Evolution of Microorganisms A. A number of them cause zoonoses,* which are infectious diseases native to animals that can be transmitted to humans. A simple virus such as poliovirus takes about 8 hours; parvovirus takes 16 to 18
hours; and more complex viruses, such as herpesviruses, require 72 hours or more. It usually has four objective lenses, a mechanical stage to move the specimen, a condenser, an iris diaphragm, and a built-in light source (lamp). Explain what is involved in isolating microorganisms and why it Because contaminants have the potential for disrupting
experimay be necessary to do this. (b) Figure 3.16 Solid media that are reversible to liquids. At least in theory, then, isolated intact atoms do not carry a charge is less concentrated 11. There were serious proponents on both sides, and each side put forth what appeared on the surface to be plausible explanations of why their evidence was more
correct. Biologists prefer to use this term. as prokaryotic b. Bond formation in polysaccharides and polypeptides is accompanied by the removal of a a. These devices revealed microbes as discrete entities sharing many of the characteristics of larger, visible plants and animals. These techniques can be summed up succinctly as the six "I's": inoculation
incubation, isolation, inspection, information gathering, and identification, so-called because they all begin with the letter "I". When such regions are located close together, their opposite charges pull them together. 5.7 Survey of Protists: Protozoa Include large single-celled organisms; a few are pathogens. (c) Detail of the orientation of a ribosome
on the RER membrane. One of the most fascinating theories on the family tree of bacteria (see figure 1.15). 94 Chapter 4 A Survey of Prokaryotic Cells and Microorganisms Fimbriae Pili (a) E. Rank the size ranges of bacteria according to shape, and compare bacterial size with viruses and eukaryotic Cells. West Nile fever 16. Asci Although details can
vary among types of fungi, the ascus and Ascogenous ascospores are formed when two different strains or sexes join hyphae together to produce offspring. Looking Ahead at the Chapters To Come We have completed our survey of prokaryotes, and viruses and have described the significant characteristics of these three groups. In general
such an association locating and identifying these ancient viruses. a cyanobacterium c. Give the names of the levels, and place them in a hierarchy. For example, protozoa are considered unicellular eukaryotic protists that lack tissues and share similarities in cell structure, nutrition, life cycles, and biochemistry. 11. A few bacteria can be identified by
a special technology that analyzes only the kind of fatty acids they contain; in contrast, some are identifiable by a Gram stain and a few physiological tests; others may require a diverse spectrum of morphological, biochemical, and genetic analysis. The other form of photosynthesis is termed anoxygenic (no oxygen produced). Astronomers knew from
so- "Any life on Mars, if it has vehicles, Viking Explorer, were to sample for phisticated chemical and physical analyses that water, carbon dioxide, organic compounds, existed at all, has been most of the planets in our solar system had far and to culture microbes from Martian soil. This variability in growth form is particularly characteristic of some
pathogenic molds. Cell wall (a) (b) Figure 5.1 Ancient eukaryotic protists discovered in fossilized rocks. For a complete version of the major of Serratia marcescens and flagellated and nonflagellated strains of taxonomic groups and genera, go to Appendix table C.2. Pseudomonas fluorescens. It is reasonable to think that most parasites modulate the
damage they do and can even coevolve into a commensal or mutualistic existence as the host develops tolerance. Just identifying and studying those kept them very occupied. They are not destroyed by disinfectants, radiation, and the usual sterilization techniques. The polysaccharides give rise to the somatic (O) antigen in gram-negative pathogens
and can be used in identification. The resulting image is brightly illuminated specimens surrounded by a dark (black) field (table 3.2). True awareness of the widespread distribution of microorganisms and some of their characteristics was finally made possible by the development of the first microscopes. the same as a contaminated culture b. the
color reaction of the cells: grampositive, which are stained purple, and gram-negative, which are stained purple 
methanogen that inhabits hot vents in the seafloor. Plant, animal, and fungal mitochondria have lamellar cristae folded into shelflike layers. Gloeotrichia—can colonies D Gloeotrichia can form coloni cocci that live in soil and fresh water to rods that live in very hot aquatic C. Micronutrients, or trace elements, such as manganese, zinc, and nickel are
present in much smaller amounts and are involved in enzyme function, and maintenance of protein structure. Taxonomy is a hierarchical scheme for the classification, identification, and nomenclature of organisms, which are grouped in categories called taxa, based on features ranging from general to specific. Several species cause diseases of the
eyes, reproductive tract, and lungs. Locomotor Appendages: Cilia and Flagella Motility allows a microorganism to locate life-sustaining nutrients and to migrate toward positive stimuli such as sunlight; it also permits avoidance of harmful substances and stimuli. 5.4 Check Your Progress 7. Explain the binomial system of nomenclature and give the
correct order of taxa, going from most general to most specific. Even with the keenest eyes and spell checks, some typos, errors, oversights, and other mistakes may end up on the printed page. The darker and lighter arSpecimen placed on Glass slide Copper mesh eas of the image correspond to more and less Quick Search dense parts on the
specimen (figure 3.8a). Experiments performed in a living body. The interrelationships The larger cell engulfs the around the DNA, smaller one; smaller one biosis to range from temporary nondependent endosymbiosis creating a primitive survives and remains bes share interdependent associations in which the two microbes nucleus. But there are
more. Some staining techniques (spore, capsule) fall into more than one category. media; L. The chromosome to be replicated is unwound by a helicase, forming a replication fork with two template strands. Public Health Microbiology and Epidemiology These branches monitor and control the spread of diseases in communities. This scale is a useful
standard for rating the relative acid or base content of a substance. 38 Chapter 2 (a) Molecular formulas The Chemistry of Biology H2 H2O O2 CO2 CH4 (b1) H C H H C C H H H C C C H C H (b3) H H C H H C (b) Benzene (C6H6) H C C H H
Also represented by (c) Figure 2.10 Comparison of molecular and structural formulas. The nondependent forms of mutualism are sometimes referred to as cooperation. Knowing that resolving power is a function of wavelength makes it evident that the RP fraction and number will become very small. When these groups are illuminated, they emit
specific colors. One example, the tube worm Riftia has become so specialized that it has lost its gastrointestinal tract and feeds solely from its bacterial symbionts. (c) Hydrogen bond. Equilibrium will not occur because the solutions can never become equal. contain large amounts of acidic substances c. In general, RNA viruses multiply in the cell
viruses multiply in the cell. A prominent difference between prokaryotic ells is the a. 4.2 Prokaryotic Profiles: The Bacteria and Archaea (a) Runs (b) Tumbles 93 A few pathogenic bacteria use their flagella to invade the surface of mucous membranes during infections. The fossil record uncovered in ancient rocks and sediments points and entering infections.
to bacteria-like cells having existed on earth for at least 3.5 billion years (figure 1.1). A detailed example of a phylogenetic tree of life based on the five kingdoms is shown in figure 1.14. All chemoautotrophs are bacteria or archaea that survive totally on inorganic substances such as minerals and gases. What are the advantages of using cell culture
and what are the disadvantages? 2 Chromosome replication and cell in preparation for the daughter cells. found in termites with spirochetes functioning ass flag agella. The electrons in the outer shell are configured so as to complete a full
outer shell for both atoms when they bind. * saccharide (sak9-uh-ryd) Gr. sakcharon, sweet. It is understandable that scientists searching for life on other planets first look for signs of microorganisms. biting fly b. Resolution, or the resolving power, is a measure of a microscope's capacity to make clear images of very small objects. For example, at a
distance of 25 cm (10 in), the lens in the human eye can resolve two small objects as separate points just as long as the two objects are no closer than 0.2 mm apart. 4.2 Prokaryotic Profiles: The Bacteria and Archaea be similar to present-day archaea living on sulfur compounds in deep, hot oceanic vents (see figure 4.33), extreme habitats they
continue to dominate 3.5 billion years later. A large part of the earth exists at cold temperatures. For example, the study of microorganisms established universal concerning the chemistry of life (see chapter 26). Note also
toward areas of lower concentration in the gradient. 7.3 Transport: Movement of Substances Across the Cell Membrane Expected Learning Outcomes 8. And even more intriguing was the discovery that up to upper levels of the marine environment. Brown Company and McGraw-Hill Publishers since the early 1980s, first illustrating and writing for
laboratory manuals and later developing this textbook. Check Your Progress SECTION 2.3 15. It functions in survival, not in reproduction, because no increase in cell numbers is involved in its formation. Structural stains are designed to bring out distinctive characteristics. Indicate the basic structure of the cytoskeleton, and explain its main features
and functions. Briefly explain how the eukaryotic cell could have evolved from prokaryotic ones. This explains why, for example, human liver cells are not infected by the canine hepatitis virus and dog liver cells cannot host the human hepatitis virus and the canine hepatitis are not infected by the canine hepatitis virus and dog liver cells cannot host the human hepatitis are not infected by the canine hepatitis virus and dog liver cells cannot host the human hepatitis are not infected by the canine hepatitis virus and dog liver cells cannot host the human hepatitis are not infected by the canine hepatitis virus and dog liver cells cannot host the human hepatitis are not infected by the canine hepatitis are not infected by the cannot hepatitis are not infected by 
spread by mosquitoes to birds and humans and other mammals. surrounded by the vacuolar elow). Backbone Backbone
ribose (R) and phosphate (P) attached to nitrogen bases (A,U,C,G), but it is usually a single strand. Worms range from 2 to 12 mm long and have a tapered, curved cylinder shape. These revolutionary microscopes have such profound resolution that they have the potential to image single atoms and to magnify 100 million times. His results were in
conflict with Jablot's because both his heated and unheated test containers teemed with microbes. In general, sources for human infection are by oral intake or penetration of unbroken skin. Azidothymidine (AZT), a drug used to treat AIDS, targets the nucleic acid synthesis
stage. (ancient cyanobacteria) are also engulfed; they es and create the eukarymutualistic existence would maintain both cell types develop into chloroplasts. se?? The inspiration for names is extremely varied and often rather imaginative. (a) A blood agar plate growing the pathogenic bacterium Streptococcus pyogenes. Many of the "halobacteria"
use a red pigment to synthesize ATP in the presence of light. In this survey, we look at examples from two protozoan diseases. SH SECTION 2.4 20. 5.8 5.8 The Parasitic Helminths Expected Learning Outcomes 34. The major locomotor structures in bacteria are a. An example is Bacteroides
(figure O). The minimum requirement for a compound to be considered organic is that it contains a basic framework of carbon bonded to hydrogens. In the majority of helminths, adults derive nutrients and reproduce sexually in a host's body. Each objective has a fixed numerical aperture reading ranging from 0.1 in the lowest power lens to
approximately 1.25 in the highest power (oil immersion) lens. Bonds in which atoms share electrons are defined as a. Bioremediation is required to control the massive levels of pollution that result from human activities. The spaces around the cristae are filled with a chemically complex fluid called the matrix,* which holds ribosomes, DNA, and a pool
of enzymes and other compounds involved in the metabolic cycle. Gram-positive bacteria contain a thick wall composed of peptidoglycan and teichoic acid in a single layer. Vegetative Cycle 8 3 The free spore is released when the dead sporangium falls away. Circle the viral infections on this list: cholera, rabies, plague, cold sores, whooping cough,
tetanus, genital warts, gonorrhea, mumps, Rocky Mountain spotted fever, syphilis, rubella, rat bite fever. The worldwide death toll from infectious agents. The value of negative staining is its relative simplicity and the reduced shrinkage or distortion of cells, as the
smear is not heat fixed. Note the spiral nature of the cells (1,0003), culturing bacteria c. Even though they are all very small, they still display extensive variation in size. Differentiate between the major types of optical microscopes, their illumination sources, image appearance, and uses. Another toxin-forming species, C. Distinguish among mono-, display extensive variation in size.
and polysaccharides, and describe how their bonds are made. Considering that he had no formal training in science and that he was the first person ever to faithfully record this strange new world, his descriptions of bacteria and protozoa (which he called "animalcules") were astute and precise. But now we are developing greater insight into the
identity and function of these resident microbes. 11 ulcers, now known to be caused by a bacterium called Helicobacter (see chapter 21). For example, an astronaut on the moon (weak gravity) would weigh more than the same astronaut on the moon (weak gravity) would weigh more than the same astronaut on the moon (weak gravity).
Lynn Margulis. Cells also secrete substances, or expel waste, in the reverse direction. aureus. The flat ladder is useful for understanding basic components and orientation, but in reality, DNA exists in a three-dimensional arrangement called a double helix. They live a free existence in the array of habitats on earth and are able to derive their
referred to as the first golden age. As more genetic information is discovered, many biologists think that the actual pattern should be more of a bush or web to show greater complexity and interrelatedness. These microbes, called decomposers, play an essential role in breaking down and recycling plant materials (see figure 7.2). What is required to as the first golden age. As more genetic information is discovered, many biologists think that the actual pattern should be more of a bush or web to show greater complexity and interrelatedness.
kill endospores? The cell membrane is also involved in secretion, or the release of a metabolic product into the extracellular environment. What is meant by the terms extremophile? Such tests provide accurate identification in as little as 10 minutes. 5.7 CLINICAL CONNECTIONS TABLE 5.7 Protozoan/Disease Protozoa are
development, and evolution, they do not display these characteristics independent of their living host cell. Even at the macroscopic level, the moist, slimy character of the capsule is evident. Biofilms result when organisms attach to a substrate by some form of extracellular matrix that binds them together in complex organized layers. Blue cells are
non-acid-fast (750). of these planktonic microbes? This material was first employed by Dr. Hesse (see the Significant Events in Microbiology Table found at 1881). They also participate in digestion and removal of cell debris in damaged tissue. These reactions invariably occur between atoms with complementary valences. (b) Image courtesy Indigo ®
Instruments, www.indigo.com (c) Flagellar Responses Flagella often function as more than just a locomotor device. Because the capsule does not react with most stains. Construct your own concept map using the following words as the conc Golgi
apparatus chloroplasts cytoplasm endoplasmic reticulum ribosomes flagella nucleolus cell membrane Critical Thinking Using the facts and concepts they just studied, students must reason and problem solve to answer these specially developed questions. This allows the DNA polymerase III to add nucleotides in the 5' to 3' direction toward the
replication fork, so it can be synthesized as a continuous strand. three-dimensional view of all things biological—from dental plaque to tapeworm heads. Explain your answer. (b) X-ray view of a ruptured ulna caused by osteomyelitis. asci) (figure 5.20). Research: Viruses have become an invaluable tool for studying basic genetic principles. The flask is
incubated at that bacterium's optimum temperature and timed. However, not all bacteriophages go immediately into a lytic cycle. Like images on undeveloped photographic film, the unstained cells of a fixed smear are quite indistinct, no matter how great the magnification or how fine the resolving power of the microscope. Because the CFU of some
bacteria is actually composed of several cells (consider the clustered arrangement of Staphylococcus, for instance), using a colony count can underestimate the exact population size to an extent. Describe how an ester bond is formed. One billion of the world's poorest live on less than $1 per day, and 2.7 billion live on less than $2 per day. The lipids
form the matrix of the top layer of the OM, and the polysaccharide strands project from the lipid surface. When the lab report indicated that the throat To continue the Case Study, go to page 118. Higher magnification provides increased insight into their intricate and often complex structure (see figures 4.18 and 4.28 in later sections). such as colds,
measles, chickenpox, influenza, herpes, and warts. One exception, Prototheca, is an unusual nonphotosynthetic alga associated with skin and subcutaneous infections in humans and animals. This difficulty is due to the fact that the organisms do not always agree on the
nature of the categories. Growth on solid gens, further information is obtained by inoculating a suitable media may take the form of a spreading mat or separate colonies. (e) Satellite Haemophilus colonies clustered around Staphylococcus (white line of growth). Early spore A typical sporulation cycle in Bacillus species from the active vegetative cell
 to release and germination. From chapter 3, figure 3.20b. Some bud and others divide by multiple fission. This is one kind of habitat on earth that may well be a model for conditions on Mars. MRSA is an emerging pathogen that $5 5 3 1 1
Viruses are also known to have exceptional members. Pleomorphism reaches an extreme in the mycoplasmas, which entirely lack cell walls and thus display extreme variations in shape (see figure 4.16). Further details of classification systems are covered in chapters 4 and 5. Root nodules (a1) have nitrogenfixing endosymbiotic bacteria that supply
the plant with usable nitrogen and provide a nurturing habitat for the bacteria (a2 inset). Apparently, there are fewer of these microbes than was once thought, and many supposedly nonpathogenic saprobes can adapt to and invade a susceptible host. are neutral d. It is an important theme that underlies all of biology, including microbiology. 5.3 Form
and Function of the Eukaryotic Cell: Internal Structures 127 Form and Function of the Eukaryotic Cell: Boundary Structures The Cell Wall 13. Construct your own concept map using the following words as the concepts. At present, we cannot know the precise nature of these first cells, but many microbiologists speculate that they would Internal
Appendages Flagella Pili Fimbriae Glycocalyx Capsule, slime layer Cell wall Cell membrane Cytoplasmic matrix Ribosomes Inclusions Nucleoid/chromosome Actin cytoskeleton Endospore Structures that are essential to the functions of all prokaryotic cells are a cell membrane, cytoplasmic matrix Ribosomes, and one or occasionally more, chromosomes. These
wall-deficient forms are referred to as L forms or L-phase variants (for the Lister Institute, where they were discovered). Liposomes are lipid-based molecules with the lipids arranged in a bilayer similar to a cell membrane (figure a). Other ways that the archaea differ significantly from other cell types are that certain genetic seguences are found only
in their ribosomal RNA. C. Free-living species graze on live cells of bacteria and algae, and even scavenge dead plant or animal debris. Results of hundreds of new studies are rapidly accumulating information on the complex interrelationships we have with our microbiota (look ahead to chapter 13). Herein lies a significant means of dispersal:
Scratching contaminates the fingers, which, in turn, transfers eggs to bedclothes and other inanimate objects. They are highly complex organisms that are likely to have evolved from a number of separate ancestors. Explain what a medium that is both selective and differential does, using figure 3.18. Several of these cytoskeleton systems have been
studied, but the best understood is made of actin filaments that curl within the body of the cell and help maintain its shape during cell enlargement (figure 4.21). As the temperature increases, the molecular movement becomes faster due to an increase in kinetic energy. This stain originated as a specific method to detect Mycobacterium tuberculosis
in specimens. Occasionally the virus enters a reversible state of lysogeny (left) and is incorporated into the host's genetic material. (a1) Hydrogen has just one orbital and one shell. The earth would be an entirely different place if it were not for these microorganisms. How is the influenza virus different in its host range from most other viruses? (b)
Close-up of hyphal structure (1,2003). A close association between two organisms. A mnemonic device to keep track of this is LEO says GER: Lose Electrons Oxidized; Gain El
gradually thins out the sample and separates the cells spatially over several sections of the plate (figure 3.11a, b). Many archaea are characterized by their ability to live in extreme environments, such as hot springs or highly salty environments.
partners (ectosymbionts). Which early microbiologist was most responsible for developing standard microbiology laboratory techniques? These include (NH4)2SO4, FeCl2, NaCl, trace elements, glucose, KH2PO4, Escherichia coli MgSO4, CaHPO4, and water. If even a small number of these virions happens to meet other susceptible cells and infect
them, the potential for viral proliferation is immense. dinoflagellates 10. Generally speaking, thermophiles require temperatures above 458C and grow optimally between this temperature and 808C. Thioglycollate is a reducing medium that can establish a gradation in oxygen content. Chemical symbol H 1 HYDROGEN N Atomic number 7 NITROGEN
O Chemical name 8 OXYGEN 7p 1p Number of e- in each energy level 1 Mg MAGNESIUM H C 6 8p N CARBON 2.5 O AT. (d) Digestion produces molecules small enough to be transported into the cytoplasm. poison) to denote this particular group of infectious agents. Aerobic rods Bacteroides, Fusobacterium (anaerobic wound and dental infections)
Family Pseudomonadaceae: Pseudomonadaceae: Pseudomonas (pneumonia, burn L. If we go by the constant discoveries of new organisms and new association probably exists somewhere on earth. A conidium budded from the mouth of a vase-shaped spore-bearing cell called a phialide or
sterigma, leaving a small collar. What are functional groups? Ionization of water leads to the release of hydrogen ions (H1) and hydroxyl (OH2) ions. How could multiplication be blocked? H. Atoms that differ in numbers of the protons, neutrons, and electrons are elements. a pond sample containing algae and protozoa 85 4. * medium (mee9-dee-um)
pl. Explain what is meant by the term protist, and outline the types of organisms belonging to this designation. Spongiform encephalopathies are chronic persistent neurological diseases caused by prions. Phylum Bacteriodetes These are widely distributed gram-negative anaerobic rods inhabiting soil, sediments, and water habitats, and frequently
found as normal residents of the intestinal tracts of animals. Simple Versus Differential Staining Positive staining methods are classified as simple, differential, or structural (figure 3.9). (a) Section through the vaccinia virus, a poxvirus, shows its internal components. Go there to search the scientific name of any species, and its taxonomy will be
shown in a box on the upper right portion of the first page. Protective layer against immune destruction Homing peptide DNA Lipid-soluble drug in bilayer (a) Diagram of a liposome is shown carrying drugs and displaying specific surface molecules to help in homing to the target and drug delivery.
Molecular biological methods have demonstrated that certain types 24 Chapter 1 The Main Themes of Microbiology of molecules in cells, called small ribosomal ribonucleic acid (rRNA), provide a "living record" of the evolutionary history of an organism. This remarkable motility may be observed on YouTube by searching for "type IV pili twitching"
motility." The Bacterial Surface Coating, or Glycocalyx The bacterial cells urface is frequently exposed to a highly parasitic existence inside other cells. They lack a nucleus or organelles. Knowledge and Comprehension,
and highlighted. Microbiologists have spent several decades concocting recipes for media and having great success in growing all kinds of environments. Members live in a variety of habitats, including the bodies of animals and protozoans, fresh and marine water, and even muddy swamps. (a) Electron micrograph section of
an interphase nucleus, showing its most prominent features. 7.5 Ecological Associations Among Microorganisms Expected Learning Tool taL22600_ch05_122-156.indd Page 156 10/9/13 9:21 PM f-w-166 Concept Mapping Three different types of concept mapping activities are used
throughout the text in the end-of-chapter material to help students learn and retain what they've read. Even eukaryotic mitochondria, considered bacterial in origin, function by means of a series of internal membranes (look ahead to 5.1 Making Connections). Stained vaginal smear reveals a large pink epithelial cell harboring gram- positive rods of
Lactobacillus, an important member of the normal microbiota that helps protect against infection. 25. The life cycle steps of an animal virus are adsorption, penetration, synthesis and assembly, and release from the host cell. Notice that for both the human and the protozoan, the categories become less inclusive and the individual members more
closely related and similar in overall appearance. Note the fine nanowires it makes to carry electrical impulses and communicate with other cell's biochemical and synthetic 102 Chapter 4 A Survey of Prokaryotic Cells and Microorganisms activities. In the
following sections, we focus primarily on the characteristics of bacterial growth that are generally representative of single-celled microorganisms. (c) Formation of the 1,2 bond between glucose and fructose to produce sucrose. (b) A diagram of a nerve cell to outline the stages in the conversion of normal cell proteins into prions and the formation of
prion fibers. Kay remained on the antibiotic regimen for 10 days and was released, fortunately without long-term damage. Quick Search Look for "What Are Malaria Protozoa" on YouTube to learn about the most dominant parasitic protozoan. MASS 35.45 19 15p 20p POTASSIUM K 2.88.1 AT. Identification is the process of determining and
recording the traits of organisms in order to trace their exact identity and placement in taxonomy. In fact, it was Beijerinck who first proposed the term virus (L. Reproduction involves the generation of offspring necessary to continue a species' line of evolution. Which of these is true of prions? Shown are the relative degrees of acidity and alkalinity
and the approximate pH readings for various substances. Internal details are revealed by positive staining of specific parts of the virus such as protein or nucleic acid. Flagella vary both in number and arrangement, the flagella are attached at one or both ends of the cell. Lactose is formed
when glucose and galactose connect by their number 1 and number 4 carbons. To a large extent, the structure, behavior, and unique gualities of each living thing are a consequence of the proteins they contain. Define nutrition and nutrients and their subcategories based on need and guantity. Most are free-living in a moist habitat (water, soil); feed
by engulfing other microorganisms and organic matter. They are complex in structure, with an icosahedral capsid head containing DNA, a central tube (surrounded by a sheath), collar, base plate, tail pins, and fibers (see figure 6.9b). As the substance's concentration increases, so does the rate of transport until the concentration of the transported
substance causes all of the transporters' binding sites to be occupied. ocular b. Thermophiles generally range in growth temperatures from 458C to 808C (1138F to 1768F). Agar, an indispensable polysaccharide in preparing solid culture media, is a natural component of certain seaweeds. Horizontal contrasting lines set off each entry, making them
easy to read. The normal residents, called microbiota, are so abundant that, cell-for-cell, they outnumber us by 10 times.* From this standpoint, one could argue that we are more microbial than human. genes would not have been maintained for thousands and even millions Although we do not know what these agents do to humans, some reof years if
they did not serve some function. Which of these two fats is an oil and which one is solid? This action folds the chain into local configurations called the α helix and β-pleated sheet. Although the capsides of all icosahedral viruses have this sort of symmetry, they can vary in the number of capsomers; for example, a poliovirus has 32 and an adenovirus
has 242 capsomers. Red cells are gram-negative (1,000). Simple stains require only a single dye and the counterstain, to distinguish between cell types or parts. This structure arises through additional intrachains 2.8 Nucleic Acids: A
Program for Genetics forces and bonds between various parts of the a helix and b-pleated sheets. Copyright © 2015 by McGraw-Hill Education. Chlorine has 17 electrons (2 in shell two, and 7 in shell three), making it 1 short of a complete outer shell. 89 4.2 Prokaryotic Profiles: The Bacteria and Archaea 90 The Structure of a
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CHAPTER 241 8.5 Biosynthesis and the Crossing Pathways of Metabolism The Frugality of the Cell—Waste Not, Want Not 244 Assembly of the Cell—Waste Not, Waste Not 244 Assembly of the Cell—Waste Not 244 Assembly of
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Fingerprints and Genetic Testing 313 DNA Fingerprinting: A Unique Picture of a Genome 313 CHAPTER 11 Physical and Chemical Agents for Microbial Control 322 Relative Resistance of Microbial Forms 322 Contents Terminology and Methods of Microbial
Control 324 What Is Microbial Death? These reservoirs serve not only as a source of these elements but can be replenished by the activities of organisms. Clarify what is involved in inoculation, growth, and contamination. Describe the protozoan adaptation for feeding. resolution 6. Answer available at chloroplasts are subjected to genetic analysis, it
turns out that they are close relatives of some of the oldest groups of cyanobacteria, and probably arose through endosymbiosis (see chapter 5). aden, gland. * thermophile (thur9-moh-fyl) Gr. therme, heat. Extreme Temperatures Some of the most extreme habitats are hot springs, geysers, volcanoes, and ocean vents, all of which support flourishing
microbial populations. The technical characteristics of microscopes and microscopy are a major focus of chapter 3. The influenza virus (an orthomyxovirus) is an example of this form. paper) 1. Microbiologists have found that this mechanism is every bit as complex and regulated as the flagellar mode of locomotion. Summarize the stages in processing
by the nucleus, endoplasmic reticulum, and Golgi apparatus involved in synthesis, packaging, and export. What events, discoveries, or inventions were probably the most significant in the development of microbiology and why? sarcina 14. Describe five different ways in which humans exploit microorganisms for our benefit. This virus first traveled
from Africa to the eastern United States in 1999, and is now established throughout the American continent and even the Hawaiian Islands. * diplococci (dih-plo-kok-seye) Gr. diplo, double. It employs components analogous to, but not 68 Chapter 3 Tools of the Laboratory necessarily the same as, those in light microscopy (table 3.3). A hydrogen atom
has only a single electron, but when two of them combine, each will bring its electron to orbit about both nuclei, thereby approaching a filled orbital (2 electrons) for both atoms and thus creating a single covalent bond (figure 2.4a). The bright-field microscope is a multipurpose instrument that can be used for both live, unstained material and
preserved, stained material. How could researchers have ever traced the stages of viral multiplication if they had been restricted to the natural host, especially in the case of human viruses? How do mold spores differ from bacterial endospores? Medium (a) can grow a wider number and spectrum X metabolizes a certain substance of colonies. The cell
 is central to the collective activities that are synonymous with being alive. Although they share the same name, eukaryotic flagella are much different from those of prokaryotes. * taxonomy (tacks-on0-uh-mee) Gr. taxis, arrangement, and nomos, name. In time, virology grew into a multifaceted discipline that promised to provide much information on
disease, genetics, and even life itself (6.1 Making Connections). 4.4 Glycolipid Integral proteins Phospholipids Transport protein Actin filaments 101 tively permeable structure with special carrier mechanisms for passage of most molecules (see chapter 7). Infections by Pseudomonas give rise to tenacious lung biofilms in some types of pneumonia. (b)
A and G purine bases are found in both DNA and RNA. Isolated colonies can be subcultured for further testing at this point. At the cellular level, however, a membrane is a thin sheet of molecules composed of phospholipids and sterols (averaging about 40% of membrane is a thin sheet of molecules composed of phospholipids and sterols (averaging about 40% of membrane is a thin sheet of molecules composed of phospholipids and sterols (averaging about 40% of membrane is a thin sheet of molecules composed of phospholipids and sterols (averaging about 40% of membrane content) and proteins (averaging about 60%). This pattern boundaries that
separate two closely redisplays the major Phyla within Domains Bacteria and Archaea. Common combinations are red and purple, red and green, or pink and blue. Describe the main categories of nutritional types among organisms. parasitic b. What researchers aimed to 20% of the analyzed genetic material could not be matched to any do with their
catch was to harness a powerful and known sort of microorganism. (h) Malaria shows multilevel parasitism. Some species will separate completely as shown here, while others will remain attached, forming chains or pairs, for example. bi 2 ca bo rb ra on x, at al e ka lin 10 e .5 so m ils ilk of m 11 ag .5 ne ho si us a eh 12 ol .4 d lim am e m w 13 on a .2
te ia r ov en cl 1 ea M ne po r ta ss iu m hy dr ox id e Chapter 2 pH 0 1 2 3 Acidic 4 5 6 [H+] 7 Neutral Increasing acidity Figure 2.13 TABLE 2.2 8 9 10 [OH-] 11 12 13 14 Basic (alkaline) Increasing acidity Figure 2.13 TABLE 2.2 8 9 10 [OH-] 17 Neutral Increasing acidity Figure 2.13 TABLE 2.2 8 9 10 [OH-] 17 Neutral Increasing acidity Figure 2.13 TABLE 2.2 8 9 10 [OH-] 17 Neutral Increasing acidity Figure 2.13 TABLE 2.2 8 9 10 [OH-] 18 Neutral Increasing acidity Figure 2.13 TABLE 2.2 8 9 10 [OH-] 18 Neutral Increasing acidity Figure 2.13 TABLE 2.2 8 9 10 [OH-] 18 Neutral Increasing acidity Figure 2.13 TABLE 2.2 8 9 10 [OH-] 18 Neutral Increasing acidity Figure 2.13 TABLE 2.2 8 9 10 [OH-] 18 Neutral Increasing acidity Figure 2.13 TABLE 2.2 8 9 10 [OH-] 18 Neutral Increasing acidity Figure 2.13 TABLE 2.2 8 9 10 [OH-] 18 Neutral Increasing acidity Figure 2.13 TABLE 2.2 8 9 10 [OH-] 18 Neutral Increasing acidity Figure 2.13 TABLE 2.2 8 9 10 [OH-] 18 Neutral Increasing acidity Figure 2.13 TABLE 2.2 8 9 10 [OH-] 18 Neutral Increasing acidity Figure 2.13 TABLE 2.2 8 9 10 [OH-] 18 Neutral Increasing acidity Figure 2.13 TABLE 2.2 8 9 10 [OH-] 18 Neutral Increasing acidity Figure 2.13 TABLE 2.2 8 9 10 [OH-] 18 Neutral Increasing acidity Figure 2.13 TABLE 2.2 8 9 10 [OH-] 18 Neutral Increasing acidity Figure 2.13 TABLE 2.2 8 9 10 [OH-] 18 Neutral Increasing acidity Figure 2.13 TABLE 2.2 8 9 10 [OH-] 18 Neutral Increasing acidity Figure 2.13 TABLE 2.2 8 9 10 [OH-] 18 Neutral Increasing acidity Figure 2.13 TABLE 2.2 8 9 10 [OH-] 18 Neutral Increasing acidity Figure 2.13 TABLE 2.2 8 9 10 [OH-] 18 Neutral Increasing acidity Figure 2.13 TABLE 2.2 8 9 10 [OH-] 18 Neutral Increasing acidity Figure 2.13 TABLE 2.2 8 9 10 [OH-] 18 Neutral Increasing acidity Figure 2.13 TABLE 2.2 8 9 10 [OH-] 18 Neutral Increasing acidity Figure 2.13 TABLE 2.2 8 9 10 [OH-] 18 Neutral Increasing acidity Figure 2.13 TABLE 2.2 8 9 10 [OH-] 18 Neutral Increasing acidity Figure 2.13 TABLE 2.2 8 9 10 [OH-] 18 Neutral Increasing acidity Figure 2.2 8 9 10 
and electron and To analyze the phenomenon, let us again reconverted to a converted to a converted to a view the production of NaCl but from a different positively negatively standpoint. hanging drop preparation b. Austin State University Delon Washo-Krupps, Arizona State University A Note to the Student How to Maximize Your Learning Curve There are clearly
many ways to go about assimilating information— Most of you are probably taking this course as a prerequisite to but mainly, you need to become involved in reading, writing, drawnursing, dental hygiene, medicine, pharmacy, optometry, physician ing simple diagrams, and discussion or study with others. A specialists, manuals, and computerized
programs. In the interest of space and ease in presentation, we have adopted a system of taxonomy that emphasizes natural groupings with the least complexity. For example, by coordinating the expression of genes that code for proteins, the biofilm can simultaneously produce large quantities of a digestive enzyme or toxin. Compared with the
growth rates of most other living things, bacteria are notoriously rapid. Although we correctly view the nucleus as the primary genetic center, it does not function in isolation. (b) A common protozoan, Paramecium caudatum. Special stains or electron microscope preparations must be used to see the arrangement, because flagella are too minute to be
seen in live preparations with a light microscope. ATP is a nucleotide containing adenine, ribose, and three phosphates rather to table 4.3), they are not as widespread as archaea in ultra extreme environments. SECTION 4.7 36. The phase-contrast
microscope is most useful for observing intracellular structures of eukaryotic cells. Best for observing live, unstained specimens; specimen is bright, field is black; provides outline of specimen with reduced internal cellular detail. groups of peptide bonds. Microbes
living in biofilms can create mixed infections, meaning that several microbes acting together invade the tissues and cause damage. chart. Other characteristics, and genetic makeup. C-carbohydrate helps prevent the bacterium from being
dissolved by the lysozyme of the host; fimbriae on the outer surface of the cell enhance adherence; and C5a protein helps the cell resist phagocytosis while also improving adherence; and C5a protein helps the cell enhance adherence of the bacterium; M-protein helps the cell resist phagocytosis while also improving adherence of the bacterium; M-protein helps the cell resist phagocytosis while also improving adherence of the bacterium; M-protein helps the cell resist phagocytosis while also improving adherence of the bacterium; M-protein helps the cell resist phagocytosis while also improving adherence of the bacterium; M-protein helps the cell resist phagocytosis while also improving adherence of the bacterium; M-protein helps the cell resist phagocytosis while also improving adherence of the bacterium; M-protein helps the cell resist phagocytosis while also improving adherence of the bacterium; M-protein helps the cell resist phagocytosis while also improving adherence of the bacterium; M-protein helps the cell resist phagocytosis while also improving adherence of the bacterium; M-protein helps the cell resist phagocytosis while also improving adherence of the cell resist phagocytosis while also improving adherence of the cell resist phagocytosis while also improving adherence of the cell resist phagocytosis while also improve a cell resist phagocytosis while a cell resist phagocytosis while also improve a cell resist phagocytosis while a cell resist phagocytosis while a cell resist phagocytosis while a cell resist
College Teresa Wilmoth, Baker College Port Huron, MI Symposium Attendees for Front Matter of Talaro 9e Dena Berg, Tarrant County College, SE Campus Erin Christensen,
Middlesex Community College Paula Curbo, Hill College Any Goode, Illinois Central College Any Goode, Illinois Central College Amy Goode, Illinois Central College Any Goode, Illinois Central College Susan Finazzo, Georgia Perimeter College Eunice
Kamunge, Ph.D., Essex County College Caroline McNutt, Schoolcraft College Elizabeth McPherson, University of Tennessee-Knoxville Tracey Mills, Ivy Tech Community College Elizabeth McPherson, University Marcia Pierce, Eastern Kentucky University Madhura Pradhan, Ohio State
University Todd Primm, Sam Houston State University Beverly Roe, Erie Community College Silvia Rossbach, Western Michigan University of Wisconsin-Oshkosh Sherry Stewart, Navarro College Steven Thurlow, Jackson Community College Silvia Rossbach, Western Michigan University of Wisconsin-Oshkosh Sherry Stewart, Navarro College Steven Thurlow, Jackson Community College Silvia Rossbach, Western Michigan University of Wisconsin-Oshkosh Sherry Stewart, Navarro College Silvia Rossbach, Western Michigan University Benjamin Rowley, University of Central Arkansas Mark Schneegurt, Wisconsin-Oshkosh Sherry Stewart, Navarro College Silvia Rossbach, Western Michigan University Office Silvia Rossbach,
College Stephen Wagner, Stephen F. As with the streak plate, cells are spread over separate areas on the surface so that they can form individual colonies (figure 3.11e, f). Trace the major parts of the microscope. These viruses are termed oncogenic, and
their effect on the cell is called transformation. The research now suggests that these microbes cannot be cultivated because they are so closely associated with humans that they have come to depend on us for survival. In this stain, hot carbol fuchsin dye becomes tenaciously attached (is held fast) to these cells so that an acid-alcohol solution will not
remove the dye. mucous membranes c. two hydrogen atoms b. These meand consequently can be amplified in mixed samples (figure 3.19a). on scientification or myth. Occasionally, protozoa are cultivated on artificial media or in laboratory animals for further identification or study. Notable
examples are the parvoviruses, which contain single-stranded DNA, and reoviruses (a cause of respiratory and intestinal tract infections), which contain double-stranded RNA. Spore-forming rods Family Bacillaceae: Bacillus (anthrax), Clostridium (tetanus, gas gangrene, botulism) Family Propionibacteriaceae: Propionibacterium (involved in acne)
Family Corynebacteriaceae: Corynebacteriaceae: Corynebacterium (diphtheria) Family Mycobacterium (diphtheria) Family Nocardiaceae: Mycobacterium (diphtheria) Family Nocardiac
glycocalyx varies among the several eukaryotic groups. Loop containing sample 1 2 3 4 (a) Steps in a Streak Plate; this one is a four-part or quadrant streak. A ripe ascus breaks Cup fungus open and releases the ascospores. CHAPTER 2 The Chemistry of Biology A highly magnified view of a 4-billionyear-old Martian meteorite uncovers tiny rods that
resemble earthly prokaryotes. Their organelles can be highly specialized for feeding, reproduction, and locomotion. Vibrio cholerae, the agent of cholera, and Clostridium botulinum, the cause of botulism. How are flagella and cilia similar? This is in contrast to the flagella of eukaryotic cells, which undulate back and forth. Name three groups of
obligate intracellular parasites. The majority also have a cell wall 4.2 Prokaryotic Profiles: The Bacteria and Archaea Figure 4.2 Structure of a typical bacteria cell. Methane may also contribute to the "greenhouse effect," which maintains the earth's temperature and can contribute to global warming. Carbon-Based Nutritional Types The element
carbon is so key to the structure and metabolism of all life forms that the source of carbon defines two basic nutritional groups: • A heterotroph* is an organism that must obtain its carbon in an organic form. Prokaryotes consist of two major groups, the bacteria and the archaea. Single-stranded RNA genomes that are ready for immediate translation
into proteins are called positive-strand RNA. commonly used to delineate two different groups of bacteria known as the gram-positive bacteria and the gram-negative bacteria but they generally benefit from it. But this view has had to be greatly revised (3.1 Secret World of
Microbes). Because microbiologists cannot rely as much as other scientists on senses other than sight, they are confronted by some unique problems. Differential stains can also pinpoint other characteristics, such as the size, shape, and arrangement of cells. 2.4 The Chemistry of Carbon and Organic Compounds A. The capacity to sterilize objects and
materials is an absolutely essential part of microbiology, medicine, dentistry, and some industries. If only the RNA of an influenza virus were injected into a cell by itself, could it cause a lytic infection? 1.3 Check Your Progress Human Use of Microorganisms 9 SECTIONS 1.11.2 1. pseudohyphae; Gr. pseudo, false, and hyphe. Cyanobacteria are very
diverse in distribution and morphology. Depending upon the conditions in the bacterial host, some special DNA viruses, called temperate* phages, undergo adsorption and penetration into the bacterial host but are not replicated or released immediately. In current usage, oxidation includes any reaction that causes an atom to lose electrons. Scientists
used Jenner's methods to develop vaccines for other pathogens. Agricultural Microbiology This branch is concerned with the relationships between microbes and domesticated plants and animals. 5.8 The Parasitic Helminths Includes three categories: roundworms, tapeworms, and flukes. Figure 1.14 Traditional Whittaker system of classification
Because viruses can exhibit host specificity, certain animals can propagate a given virus more readily than others. These elements are diatomic (two atoms), meaning that in their pure elements are diatomic (two atoms), meaning that in their pure elements are diatomic (two atoms), meaning that in their pure elements are diatomic (two atoms), meaning that in their pure elements are diatomic (two atoms), meaning that in their pure elements are diatomic (two atoms), meaning that in their pure elements are diatomic (two atoms), meaning that in their pure elements are diatomic (two atoms), meaning that in their pure elements are diatomic (two atoms), meaning that in their pure elements are diatomic (two atoms), meaning that in their pure elements are diatomic (two atoms), meaning that in their pure elements are diatomic (two atoms), meaning that in their pure elements are diatomic (two atoms), meaning that in their pure elements are diatomic (two atoms), meaning that in their pure elements are diatomic (two atoms), meaning that in their pure elements are diatomic (two atoms), meaning that in their pure elements are diatomic (two atoms), meaning that in their pure elements are diatomic (two atoms), meaning that in their pure elements are diatomic (two atoms).
sporangiospores. Both cells are relatively simple, with (a) showing chloroplast-like bodies like algae. Screening tests can detect specific antibodies that indicate signs of virus infection in a patient's blood. After numerous cell divisions, a macroscopic mound of cells, or a profiles can be extremely specific, even sufficolony, will be formed. Many textbook
 authors write the narrative of their book and call it a day. The structure of the lipid phase provides an impenetrable barrier that accounts for the selective permeability and transport of molecules. He invented pasteurization and completed some of the first studies showing that human diseases could arise from infection. Greater cellular detail can be
observed with phase-contrast or interference microscopy. 113 Free-Living Nonpathogenic Bacteria Photosynthetic Bacteria Photosyntheti Photosynthetic Bacteria Photosynthetic Bacteria Photosynthetic P
intravenous fluids to control infections. ubique, everywhere and ous, having. Using Bird Embryos An embryo is an early developmental stage of animals marked by rapid differentiation of cells. Which of the following is present in both gram-positive and gramnegative cell walls? Another concern is the possible release of infectious agents from cultures
into the environment, which is prevented by aseptic techniques. Using Live Animal Inoculation of chorioallantoic membrane Shell 177 Inoculation of yolk sac Albumin (b) Figure 6.20 Cultivating animal viruses in a developing bird embryo. Heidi is an active member of the American Society for Microbiology and has presented instructional
technology and best online and face-to-face teaching practices on numerous occasions at the annual conference for undergraduate educators. Having a larger genome allows cells to carry out the complex metabolic activity necessary for independent life. So the green color of a forest or a field of corn actually comes from these tiny bacteria that
became a part of photosynthetic eukaryotes billions of years ago. Show how the arrangements of bacilli occur, including palisades. Rather than trying to isolate microorganisms, the Martian soil and ice by measuring and assaying pH, salts,
and the basic chemical makeup of its geology and atmosphere. (a) The slime layer is a loose structure that is easily washed off. Name four categories that blood agar fits. Most victims first become infected as children and continue to harbor the parasite for years, even for a lifetime. (b) A sample taken from a saltern in Australia viewed by fluorescence
microscopy (1,0003). showed that this number represented only the tiniest "drop in the ocean." Some data revealed more than 20,000 different kinds *Dr. Venter was one of the main individuals behind the mapping of the human genome. * togavirus (toh0-guh-vy9-rus) L. Rickettsias Ricke
4.31). A number of bacterial pathogens fall into this group. This method is used by certain bacteria to transport sugars (glucose, fructose) while simultaneously adding phosphate molecules that activate them in preparation for a metabolic cycle. Zygospores* are sturdy diploid spores formed when hyphae of two opposite strains (called the plus and
minus strains) fuse and create a diploid zygote that swells and becomes covered by strong, spiny walls (figure 5.19). Oxygenic (oxygen-producing) photosynthesis can be summed up by the equation: Sunlight absorbed (CH2O)n 1 O2 CO2 1 H2O —
                                                                                                                                                                                                                                                                                                                                                                                                                                                            —n by chlorophyll in which (CH2O)n is shorthand for a carbohydrate. As some fecal bacteria
ferment lactose, they release acidic substances. In particular groups, such as the cestodes, reproduction is so dominant that the worms are reduced to little more than a series of flattened sacs filled with ovaries, testes, and eggs (figure 5.27a). 5 6 Chapter 1 The Main Themes of Microbiology Reproductive spores Bacteria: Mycobacterium tuberculosis
a rod-shaped cell (15,500x). The stages in this continuous process are shown in greater detail in figures 7.15 and 7.16. Differentiate between microscopic and macroscopic and macroscopic methods of observing microorganisms, citing a specific example of each method. A facultative anaerobe is an aerobe that does not require oxygen for its metabolism and is capable
of growth in the absence of it. Some inventive relatives of the Figure 3.8 Micrographs from two types of electron microscopes. Early microorganisms of this type dominated the earth's life forms for the Figure 3.8 Micrographs from two types of electron microscopes. Early microorganisms of this type dominated the earth's life forms for the first 2 billion years. It is the cause of "strep" throat and scarlet fever. Encapsulated bacteria that mutate to nonencapsulated forms usually lose their
pathogenicity. Substrates favorable to biofilm development have a moist, thin layer of organic material such as polysaccharides or glycoproteins deposited on their exposed surface. Early microbiology blossomed with the conceptual developments of sterilization, aseptic techniques, and the germ theory of disease. Plaques are essentially the * plaque
(plak) Fr. placke, patch or spot. Note the thick matrix of the biofilm caught in the fine fibers of the catheter. A small sac containing fluid. This type ply the results of tests to a selection process (figure 3.13b). Aerotolerant anaerobes do not utilize oxygen gas but can survive and grow in its presence. Examples include nutrient agar and broth, brain-
heart infusion, and trypticase soy agar (TSA). Microbes residing in these communities must associate physically and share the habitat, often establishing biofilms and other interrelationships. Water is the most common solvent in natural systems. As we show in the next three sections, it is closely tied to cytoplasmic organelles that perform elaborate
cell functions. coli, (280,0003). Application of alcohol in the third step dissolves lipids in the outer membrane of the gram-negative cells, which removes the dye from them. has more H1 than a solution with a pH of 8. Bottoms, Collin County Community College Pathogen Profiles Check Your Progress SECTION 13.1 1. The life cycles of protozoans vary
from simple to complex. Several studies with animals revealed that A fascinating aspect of the virus-host relachickens and mice infected with a human tionship is the extent to which viral geadenovirus (see figure) had larger fat denetic material becomes affixed to host posits and were heavier than uninfected chromosomes and is passed on, possibly
animals. Once in the body, the trypanosomes become established and multiply in muscle and white blood cells. The cell wall is usually found in which eukaryotes? Nucleic acid Capsomers (a) The Viral Capsid: The Protective Outer Shell When a virus particle is magnified several hundred thousand times, the capsid appears Quick Search as the most
prominent geometric feature Fun with viruses! Construct a virus (figure 6.4). Exosporium Spore coat Cortex Core Cell is septated into a sporangium and forespore. Although it is sometimes misused as a synonym for mutualism, be aware that the term does not refer only to mutually beneficial associations, as parasitism is also a form of symbiosis. The
presence of these high-energy bonds makes it possible for ATP to release and store energy for cellular chemical reactions. Nutritional and Other Requirements: Lack enzymes for processing food or generating energy; are tied entirely to the host cell for all needs (obligate intracellular parasites). (b) A sample of a key that uses test data (positive or
negative reactions) to guide identification of genera and species related to N. Embryonic, fetal, adult, and even cancerous tissues have served as sources of primary cultures. Apparently Jablot had been lucky; his infusions were sterile. (c) Even a dry lake in Antarctica, one of the coldest places on earth (2358C), can harbor microbes under its icy sheet
The structure of these early cells was so versatile that eukaryotic microorganisms soon spread out into available habitats and adopted greatly diverse styles of living. aureus Other Important Staphylococci Identification of Identification
Streptococci and Related Genera Beta-Hemolytic Streptococci: Streptococci and Group Strepto
Streptococcus pneumoniae: The Pneumococcus 18.3 The Family Neisseria gonorrhoeae: Gram-Negative Cocci Neisseria gonorrhoeae: The Gonococcus Neisseria gonorrhoeae: The Gonococcus Neisseria gonorrhoeae: The Gonococcus Neisseria gonorrhoeae: The Meningococcus Neisseria gonorrhoeae: The Meningococcus Neisseria gonorrhoeae: The Gonococcus 
 Importance 19.1 Medically Important Gram-Positive Bacilli 19.2 Gram-Positive Spore-Forming Bacilli General Characteristics of the Genus Bacilli An Emerging Food-Borne Pathogen: Listeria monocytogenes Erysipelothrix rhusiopathiae: A Zoonotic Pathogen 19.4 Gram-Positive Regular Non-Spore-Forming Bacilli An Emerging Food-Borne Positive Regular Non-Spore-Forming Regular Non-Spore-Forming Regular Non-Spore-Forming Regular Non-Spore-Forming Regular Non-Spore-Formi
Positive Irregular Non-Spore-Forming Bacilli Corynebacterium diphtheriae The Genus Propionibacterium tuberculosis: The Tubercle Bacilli Mycobacterium tuberculosis: The Tubercle Bacilli Mycobacterium diphtheriae The Leprosy Bacilli Mycobacterium tuberculosis: The Tubercle Bacilli Mycobacterium diphtheriae The Genus Propionibacterium diphtheriae The Leprosy Bacilli Mycobacterium diphtheriae The Leprosy Bacilli Mycobacterium diphtheriae The Genus Propionibacterium diphtheriae The Leprosy Bacilli Mycobacterium diphtheriae The Leprosy Bacilli Mycobacterium diphtheriae The Genus Propionibacterium diphtheriae The Genus Propionibacterium diphtheriae The Leprosy Bacilli Mycobacterium diphtheriae The Genus Propionibacterium diphtheriae The Leprosy Bacilli Mycobacterium diphtheriae The Genus Propionibacterium diphtheriae The Genus Propionibacter
NocardiosisCHAPTER 20 The Gram-Negative Aerobic Gram-Negative Aero
Differential Characteristics of Family Enterobacteriaceae Antigenic Structures and Virulence Factors 20.4 Coliform Organisms and Diseases Escherichia coli: The Most Prevalent Enteric Pathogens: Salmonella and
Shigella Nonenteric Yersinia pestis and Plague Oxidase-Positive Nonenteric Pathogens in Family Pasteurellaceae Haemophilus: The Blood-Loving BacilliCHAPTER 21 Miscellaneous Bacterial Agents of Disease 21.1 The Spirochetes Treponemes: Members of the Genus Treponemes Leptospirosis Borrelia: Arthropod-Borne Spirochetes
21.2 Curviform Gram-Negative Bacteria and Enteric Diseases The Biology of Vibrio cholerae Vibrio parahaemolyticus: Pathogen 21.3 Medically Important Bacteria of Unique Morphology and Biology Order Rickettsiales Specific
 Rickettsioses Emerging Rickettsioses Coxiella and Bartonella: Other Vector-Borne Pathogens Other Obligate Parasitic Bacteria: The Chlamydiaceae 21.4 Mollicutes and Other Cell-Walls 21.5 Bacteria in Dental Disease The Structure of Teeth and
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Borne Blood Parasites 23.4 Apicomplexan Parasites Plasmodium: The Agent of Malaria Coccidian Parasites Plasmodium: The Agent of Malaria Plasmodium: The Agent of Malaria Plasmodium: The Agent 
of Herpes Simplex The Spectrum of Herpes Infection and Disease The Biology of Varicella-Zoster Virus The Cytomegalovirus Group Epstein-Barr Virus Disease 24.5 Nonenveloped DNA Viruses The Adenoviruses Papilloma-and Polyomaviruses Nonenveloped
Paramyxoviruses Mumps: Epidemic Parotitis Measles: Morbillivirus Infection Respiratory Syncytial Viruses Coronaviruses Rubiviruses Rubivir
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Nutritional Flow in Ecosystems Ecological Interactions Between Organisms in a Community 26.3 The Natural Recycling of Bioelements Atmospheric Cycles Sedimentary Cycles 26.4 Terrestrial Microbiology: The Composition of the Lithosphere Living Activities in Soil 26.5 The Microbiology of the Hydrosphere The Hydrologic Cycle The Structure of
 Aquatic EcosystemsCHAPTER 27 Applied and Industrial Microbiology 27.1 Applied Microbiology Microorganisms in Water and Wastewater Treatment 27.2 The Microbiology of Food 27.3 Microbiology Products Bread Making Products B
Microorganisms as Food 27.4 Microbial Involvement in Food-Borne Diseases Prevention Measures for Food Poisoning and Spoilage 27.5 General Concepts in Industrial Microbial Factories to Industrial Factories Substance ProductionAPPENDIX B: Tests, Guidelines, Biosafety
LevelsAPPENDIX C: Bacterial Classification and TaxonomyAPPENDIX D: Keys to Multiple Choice QuestionsGlossary A B C D E F G H I J K L M N O P Q R S T U V W X Y Z Uploaded by [StormRG] Citation preview foundations in MICROBIOLOGY Ninth Edition Kathleen Park TALARO
 Barry CHESS FOUNDATIONS IN MICROBIOLOGY, NINTH EDITION Published by McGraw-Hill Education, 2 Penn Plaza, New York, NY 10121. As we shall see later, the enveloped viruses also differ from the naked viruses in the possible ways that they enter and leave a host cell. An alga and an amoeba living in fresh pond water are examples of cells
that live in constantly hypotonic conditions. During its division cycle, the cell has a mechanism for making a copy of its DNA by replication,* using the original strand as a pattern. Bacteria and Archaea (monerans) have prokaryotic cells and are unicellular. 6.3 How Viruses Are Classified and Named A. virions b. malariae Toxoplasmosis: Toxoplasmosis:
gondii Cryptosporidiosis: Cryptosporidiosis: Cryptosporidium Cyclospora cayetanensis Human/vector-borne Free-living/water and food Water/fresh products. Some cells are in the process of
 dividing. Define osmosis and describe varying osmotic conditions. Suggestions have ranged from distributing the protists among five new kingdoms to 25 kingdoms or more. Despite the reputation of viruses as destructive pathogens, there is another side to viruses—that of being benign and, in some cases, even beneficial. Do you think that all of the
VBNCs are really not culturable? Cellulomonas uses its enzymes to digest plant cellulose into glucose, but it cannot fix nitrogen. The yeast Saccharomyces produces the alcohol in beer and 5.6 Survey of Protists: Algae TABLE 5.4 Major Fungal Infections of Humans Degree of Tissue Involvement and Area Affected Name of Infection Name of Causative
Fungus 5.6 Survey of Protists: Algae Expected Learning Outcomes 27. Process Figure 7.14 Stages in biofilm formation, quorum sensing, induction and expression from left to right. We hop e you are inspired enough to embrace that k nowle dge throughout your lives . A number of species are pathogenic to field plants such as
corn and grain, and fungi also rot fresh produce during shipping and storage. Printed in the United States of America. Samples can also be screened for the presence of indicator molecules (antiqens) from the virus itself. Define polarity and explain what causes it. The U.S. Department of Agriculture has recently approved bacteriophage treatments to
prevent food infections. Enveloped viruses: With a helical nucleocapsid: (3) mumps virus (4) rhabdovirus With an icosahedral nucleocapsid: (5) herpesvirus (6) HIV (AIDS) (9) C. Fungi are involved in other medical conditions besides infections. Compartments and Connections of the Immune System 14.3 Second Line Defenses: Inflammation The
 Inflammatory Response: A Complex Concert of Reactions to Injury The Stages of Inflammation 14.4 Second Line Defenses: Phagocytosis, Interferon, and Complement: A Versatile Backup System Overall Stages in the Complement
Cascade An Outline of Major Host Defenses CHAPTER 15 Adaptive, Specific Immunity and Immunity: The Adaptive Line of Defense An Overview of Specific Immunity
Specific Events in T-Cell Maturation Characteristics of Antigens and Immunogens 15.3 Cooperation in Immune Reactions to Antigens The Role of Antigens The Role of Antigens The Role of Antigens and Immunity (CMI) 15.5 A Classification Scheme for Cells 15.4 T-Cell Responses Monoclonal Antibodies: Useful Products from Cancer Cells 15.4 T-Cell Responses Monoclonal Antibodies: Useful Products from Cancer Cells 15.4 T-Cell Responses Cell-Mediated Immunity (CMI) 15.5 A Classification Scheme for Cells 15.4 T-Cell Responses Monoclonal Antibodies: Useful Products from Cancer Cells 15.4 T-Cell Responses Monoclonal Antibodies: Useful Products from Cancer Cells 15.4 T-Cell Responses Monoclonal Antibodies: Useful Products from Cancer Cells 15.4 T-Cell Responses Monoclonal Antibodies: Useful Products from Cancer Cells 15.4 T-Cell Responses Monoclonal Antibodies: Useful Products from Cancer Cells 15.4 T-Cell Responses Monoclonal Antibodies: Useful Products from Cancer Cells 15.4 T-Cell Responses Monoclonal Antibodies: Useful Products from Cancer Cells 15.4 T-Cell Responses Monoclonal Antibodies: Useful Products from Cancer Cells 15.4 T-Cell Responses Monoclonal Antibodies: Useful Products from Cancer Cells 15.4 T-Cell Responses Monoclonal Antibodies: Useful Products from Cancer Cells 15.4 T-Cell Responses Monoclonal Antibodies: Useful Products from Cancer Cells 15.4 T-Cell Responses Monoclonal Antibodies: Useful Products from Cancer Cells 15.4 T-Cell Responses Monoclonal Antibodies: Useful Products from Cancer Cells 15.4 T-Cell Responses Monoclonal Antibodies: Useful Products from Cancer Cells 15.4 T-Cell Responses Monoclonal Antibodies: Useful Products from Cancer Cells 15.4 T-Cell Responses Monoclonal Antibodies: Useful Products from Cancer Cells 15.4 T-Cell Responses Monoclonal Antibodies: Useful Products from Cancer Cells 15.4 T-Cell Responses Monoclonal Antibodies: Useful Products from Cancer Cells 15.4 T-Cell Responses Monoclonal Antibodies: Useful Products from Cancer Cells 15.4 T-Cell Responses Monoclonal Antibodies: Us
 Specific, Acquired Immunities Defining Categories by Mode of Acquisition 15.6 Immunization Precipent of New Vaccines Routes of Administration and Side Effects of Vaccines To Vaccinate: Why, Whom, and When?
CHAPTER 16 Disorders in Immunity 16.1 The Immune Response: A Two-Sided Coin Overreactions to Antigens: Allergy/Hypersensitivity 16.2 Type I Allergic Reactions: Atopy and Anaphylaxis Modes of Contact with Allergens The Nature of Allergens and Their Portals of Entry Mechanisms of Type I Allergy: Sensitization and Provocation Cytokines
Target Organs, and Allergic Symptoms Specific Diseases Associated with IgE-and Mast-Cell-Mediated Allergy Treatment and Prevention of Alle
Antibodies Against A and B Antigens The Rh Factor and Its Clinical Importance Other RBC Antigens 16.4 Type III Hypersensitivities: Immune Complex Diseases Types of Immune Complex Diseases Types Diseases Types of Immune Complex Diseases Types Diseases D
Organ Transplantation Practical Examples in Transplantation 16.6 Autoimmune Disease The Origins of Autoimmune Disease Examples of Autoimmune Disease Secondary
Immunodeficiency Diseases 16.8 The Function of the Immune System in CancerCHAPTER 17 Procedures for Identifying Pathogens and Diagnosing Infectious Agent: Specimen Collection 17.2 Phenotypic Methods
Immediate Direct Examination of Specimen 17.3 Genotypic Methods DNA Analysis Using Genetic Probes Roles of the Polymerase Chain Reaction and Precipitation Reactions The Western Blot for Detecting
Proteins Complement Fixation Miscellaneous Serological Tests of Great Sensitivity Radioimmunoassays: Tests of Great Sensitivity Radioimmunoassay (RIA) Enzyme-Linked Immunoassays: Tests of Great Sensitivity Radioimmunoassays: Tests of Great Sensitivity Radioimmunoassay (RIA) Enzyme-Linked Immunoassays: Tests of Great Sensitivity Radioimmunoassays: Tests of Great Sensitivity Radioimmunoass
Cocci of Medical Importance 18.1 General Characteristics of Staphylococcus aureus The Scope of Staphylococcus aureus The 
 elemental oxygen exists as O2 and elemental hydrogen exists as H2. xv taL22600_ch05_122-156.indd Page 153 10/9/13 9:21 PM f-w-166 /202/MH0 T he Planning of an E xper tly Craf ted Learning Tool taL22600_ch05_122-156.indd Page 153 10/9/13 9:21 PM f-w-166 /202/MH0 T he Planning of an E xper tly Craf ted Learning Tool taL22600_ch05_122-156.indd Page 153 10/9/13 9:21 PM f-w-166 /202/MH0 T he Planning of an E xper tly Craf ted Learning Tool taL22600_ch05_122-156.indd Page 153 10/9/13 9:21 PM f-w-166 /202/MH0 T he Planning of an E xper tly Craf ted Learning Tool taL22600_ch05_122-156.indd Page 153 10/9/13 9:21 PM f-w-166 /202/MH0 T he Planning of an E xper tly Craf ted Learning Tool taL22600_ch05_122-156.indd Page 153 10/9/13 9:21 PM f-w-166 /202/MH0 T he Planning Tool taL22600_ch05_122-156.indd Page 153 10/9/13 9:21 PM f-w-166 /202/MH0 T he Planning Tool taL22600_ch05_122-156.indd Page 153 10/9/13 9:21 PM f-w-166 /202/MH0 T he Planning Tool taL22600_ch05_122-156.indd Page 153 10/9/13 9:21 PM f-w-166 /202/MH0 T he Planning Tool taL22600_ch05_122-156.indd Page 153 10/9/13 9:21 PM f-w-166 /202/MH0 T he Planning Tool taL22600_ch05_122-156.indd Page 153 10/9/13 9:21 PM f-w-166 /202/MH0 T he Planning Tool taL22600_ch05_122-156.indd Page 153 10/9/13 9:21 PM f-w-166 /202/MH0 T he Planning Tool taL22600_ch05_122-156.indd Page 153 10/9/13 9:21 PM f-w-166 /202/MH0 T he Planning Tool taL22600_ch05_122-156.indd Page 153 10/9/13 9:21 PM f-w-166 /202/MH0 T he Planning Tool taL22600_ch05_122-156.indd Page 153 10/9/13 9:21 PM f-w-166 /202/MH0 T he Planning Tool taL22600_ch05_122-156.indd Page 153 10/9/13 9:21 PM f-w-166 /202/MH0 T he Planning Tool taL22600_ch05_122-156.indd Page 153 10/9/13 9:21 PM f-w-166 /202/MH0 T he Planning Tool taL22600_ch05_122-156.indd Page 153 10/9/13 9:21 PM f-w-166 /202/MH0 T he Planning Tool taL22600_ch05_122-156.indd Page 153 10/9/13 9:21 PM f-w-166 /202/MH0 T he Planning Tool tall Page 153 10/9/13 9:21 PM f-w-166 /202/MH0 T he Planning Tool tall Page 153 10/9/13
designed for varied learning styles Chapter Summary with Key Terms The end-of-chapter material for the ninth edition has been carefully planned and updated to promote active learning styles and levels of Bloom's Taxonomy. Which structure is not a component of all cells? If we attempted to classify them on
the basis of Gram stain and shape alone, we could not assign them to a more specific level than Phylum! As a result, the newer classification schemes are incorporating more specific genetic and molecular data to increase accuracy. Many heat-adapted microbes are ancient archaea whose genetics and metabolism are extremely modified for this mode
of existence. Facilitated diffusion involves the attachment of a molecule to a specific protein carrier. Osmosis in living systems is similar to the model shown in figure 7.5. Living membranes generally block the entrance and exit of larger molecules and permit free diffusion of water. marcescens (red) made by subculturing isolated colonies. • An isotope
of the element. 2 Cells synthesize an adhesive matrix that holds them tightly to the substrate. Mold spores were introduced during filling of the vials, and because the medication lacked preservatives, they survived and grew. An average-size Escherichia coli cell can contain up to 200 new phage units at the end of this period. Provide some
explanations for why the eukaryotic parasites are so widespread and successful. Outline the stages in cell division and mitosis. Some viruses can actually carry away substances from their host cell. In addition to reactivity, the number of electrons in the outer shell also dictates the number of chemical bonds an atom can make. A mixed culture is a.
Differential media bring out visible variations in microbial growth. The nature of this expression varies, but generally it allows the biofilm to react as a unit. About 96% of the cell is composed of six elements (represented by CHONPS). This was the first indicator that prions of animals could cause infections in humans. How can one obtain 2,0003
magnification with a 1003 objective? refringere, to break apart. CHAPTER 6 An Introduction to Viruses Jumping hosts: The influenza virus can create new strains when it transfers among humans, birds, and pigs. Describe the basic process of biofilm formation. Our project manager Daryl Bruflodt has been an experienced and knowledgeable guide
through the intricacies of a digital-style revision. Robert Koch d. Genetic Engineering and Recombinant DNA Technology These interrelated fields involve deliberate alterations of the genetic makeup of organisms to create novel microbes, plants, and animals with unique behavior and physiology. The name is derived from the tendency of members to
glide over moist surfaces. Biofilms accumulate on damaged tissues (such as heart valves), hard tissues (teeth), and Quick Search foreign materials (catheters, intrauterine deFind "3D vices [IUDs], artificial hip joints). Beijerinck showed that a disease in tobacco was caused by a virus (tobacco mosaic virus). Cell wall Cell membrane Chromosome 1
Chromosome 2 Process Figure 7.15 Stages in the bacterial cell cycle and binary fission of a rod-shaped bacterium. If other languages such as English or French are used, the endings of these words are revised to have Latin endings. Organic debris (b) Enzymes are transported outside the wall. Escherichia coli O157:H7—a food-borne pathogen G.
Structure of Cell Walls The cell wall accounts for a number of important bacterial characteristics. Settling stimulates the cells to secrete a slimy or adhesive matrix, usually made of polysaccharide, that binds them to the substrate is essential to such activities as cell enlargement and discharge or secretion by cells. He developed minor symptoms but
remained healthy. MASS 39.10 2.8.5 2.8.6 AT. These nuclei are extruded through the top of the basidiospores. Maximum resolution TEM 5 0.5 nm. The nature of viruses 6.1 Overview of
Viruses Expected Learning Outcomes 1. Among these are Rocky Mountain spotted fever, caused by Rickettsia rickettsia (transmitted by ticks), and endemic typhus, caused by Figure 4.29 Photosynthetic bacteria. c How is it possible for the same influenza virus to be able to infect both swine and humans? Answer available at *On average, humans are
made up of 1013 cells and 1014 microbes, even though the microbes together weigh only about 2 to 5 pounds. For a short time, there was a sense that infectious diseases were going to be completely manageable. Prions are infectious diseases were going to be completely manageable.
one product. both b and c /202/MH02004/taL22600 disk1of1/0073522600/taL2 2. CLINICAL CONNECTIONS Our Microbial interrelationships obviously affect humans in many ways, but those having the most impact are microbes that naturally live on the body and parasites that attack the body. oil immersion lens to arrive at its
maximum resolving capacity, a drop of oil must be inserted between the tip of the lens and the specimen on the glass slide. At the scope, they were startled at what their nucleic acid becomes integrated into the host DNA. Phylum Euryarchaeota
The largest and best-studied group of archaea; 2 microns members' adaptations include methanogens), high A. Name two ways that pure, mixed, and contaminated cultures are culture (figure 3.12b) has had contaminants (unwanted microbes similar and two ways that they differ from each other. the types of viruses 1. The other
transmission and human-to-human transmission. adenine, phosphate, and ribose 18. We do not yet know everything they do, but it is likely they are vital components of the earth. What causes atoms to form chemical bonds? Embedded at numerous sites in this bilayer are
varioussized globular proteins (figure 2.20). seemingly deadly, the water Rather than being doomed to death, these kills any animals or plants that came in contact with it. The art program has been rendered in an enhanced, more colorful, and threedimensional style. Enveloped Viruses Helical Icosahedral (1) (3) (5) (2) (4) (6) C. common cold d.
Microbiology as a science is very dependent on a number of specialized laboratory techniques. d w r 5 sa ine 4. A simple model demonstrates how the wavelength influences the resolving power of a microscope. The cell walls of most bacteria gain their relative strength and stability from a unique macromolecule called peptidoglycan (PG). During the
final phase, the host's replication and synthesis machinery produces new RNA, proteins for the capsid, spikes, and viral enzymes. Differentiate between a hypothesis and a theory was Francesco Redi of Italy. If each of these released 2,000 and the capsid, spikes, and viral enzymes.
single spores and if every spore were able to germinate, we would soon find ourselves in a sea of mycelia. Chlorobi d. and to come back in a week. It contains a wide diversity of prominent bacteria, including photosynthesizers (cyanobacteria), thermophiles, radiation-resistant bacteria, halophiles, and sulfur metabolizers. plaques b. Nutritional
Mode/Distribution: All are heterotrophic. Replication requires the separation of the double strand into two single strands by an enzyme that helps to split the hydrogen bonds along the text with a hereditary molecule. DNA is a hereditary molecule that is composed of a. Some of the unsung heroes of authors are the readers who must sift through the text with a hereditary molecule.
 fine-tooth comb, checking for errors, grammatical usage, and consistency in style. Meiosis of diploid cells of the sporangium Sporangium strain Rhizoid Germinating zygospores (zy9-goh-sporz) Gr. zygon, yoke, to join. Probable origin of
universe. Summarize characteristics used to classify bacteria. The template for the leading strand (blue) is oriented 3' to 5'. Just remember that the most effective words. With this ninth edition, digital author Heidi Smith continues the journey of transformation into the digital era with us. The subunits are transported through the nuclear pores into the
cytoplasm for final assembly into ribosomes. Many infections are emerging, meaning that they are newly identified pathogens gaining greater prominence. Important genera are Treponema (figure 4.23e). The result is accurate, beautifully rendered art that helps difficult concepts come to life. (b) Figure 1.6 Microbes at
work. In contrast, intestinal pathogens such as * trophozoite (trof9-oh-zoh9-yte) Gr. trophonikos, to nourish, and zoon, animal. If a poll were taken to choose the most engrossing and vivid group of microorganisms, many biologists would choose the most engrossing and vivid group of microorganisms, many biologists would choose the most engrossing and vivid group of microorganisms, many biologists would choose the protozoa. Contamination during inoculation is a constant problem, so sterile techniques (media, transfer
equipment) help ensure that only microbes that came from the sample are present. After poring over 800 plus pages of text in a few months, they may feel like they've taken a crash course in microbiology. In general, a solvent will dissolve a solute only if it has similar electrical characteristics as indicated by the rule of solubility, expressed simply as
 "like dissolves like." For example, water is a polar molecule and will readily dissolve an ionic solute such as NaCl, yet a nonpolar solvent such as benzene will not dissolve NaCl. Water is the most common solvent in natural systems, having several characteristics that suit it to this role. The greater the difference in the composition of the two
substances the light passes between, the more pronounced is the refraction. Our agricultural practices can unearth microbes that were lying dormant or hidden. 4.6 Classification Systems of Prokaryotic Domains: Archaea and Bacteria Expected Learning Outcomes 24. At the other extreme are parasites (Plasmodium, Trypanosoma) that multiply in
(figure L). The filamentous diatom Chaetoceros is attacked by flagellated chytrids that dissolve and destroy their host (4003). Basic dyes carry a positively charged cell components (nucleic acids and proteins). An initial clarification comes from cultures made with reducing media that contain an
 oxygen-removing chemical such as thioglycollate. But these assumptions have turned out to be incorrect. A valid hypothesis will allow for experimentation and testing and can be shown to be false. * inoculation (in-ok0-yoo-lay9-shun) L. • Digital images, PowerPoint slides, and instructor resources are also available through Connect. Because methane
genetics (inheritance). One widely accepted theory suggests that the prion protein is an abnormal version of a normal protein. Coverslip Hanging drop containing specimen Vaseline Depression slide Negative stain of Bacillus anthracis Fixed, Stained
specimens. The folds on the inner membrane, called cristae,* vary in exact structure among eukaryotic cell types. Both should be italicized (or underlined if italics are not available), as follows: Histoplasma capsulatum or Hi
scientific name. Gr archaeo, ancient, and an, one. In other cases, they have been reassigned because genetic analysis indicated they belonged to an established phylum, usually to Ascomycota. Explain the differences between atomic number, and atomic weight. • From in-site tutorials, to tips and best practices, to live help from
colleagues and specialists - you're never left alone to maximize Connect's potential. Mauk, Gateway Community College Reza Marvdashti, Ph.D., CG, San Jacinto College Reza Marvdashti, Ph.D., CG, San Jacinto College Mandy Mitchell
Hinds Community College Anne Montgomery, Pikes Peak Community College Terence C. So prolific are the fungi that a single colony of mold can easily contain 5,000 spore-bearing structures. It is likely that every naturally occurring organic material on the earth can be attacked by some type of fungus. T an s oc y y l s t u a er ie io ut var rev M o icr
CASE STUDY Part 1 Life Will Find a Way C arved into a hillside near Butte, Montana, lies the Berkeley In 2018 the EPA will begin a more comprehensive cleanup program Pit, an industrial body of water that stretches about 1 mile to protect the watershed in the area. Wall usually prevents cell from bursting. LearnSmart, students often ask is: "How
can available within the Connect I learn this information to insite, is an excellent way to map crease my success in the course your own, individualized learning program. Because of their compactness and relatively light weight, fungal spores are dispersed widely through the environment by air, water, and living things. 3.4 Additional Features of the
Six "I's" Expected Learning Outcomes 14. Such organisms are remarkably resistant * halophiles (hay9-loh-fylz) to salt, even though they do not normally reside in high-salt environments. In parasitic helminths, the most * nematode (neem9-ah-tohd) Gr. nemato, thread, and eidos, form. Their survival is greatly dependent on symbiotic bacteria that form
an insulated coat on the worm's surface. * ubiquitous (yoo-bik9-wih-tis) L. Obtaining the overall clinical picture of the disease (specific signs) is often the environment to restore stability or to clean up toxic pollutants. Compare and contrast the
structure and function of inclusions and granules. b. Because autotrophs have the special capacity to convert CO2 into organic compounds, they are not nutritionally dependent on other living things. This classification scheme is partly based on this percentage. motile flagellated alga with an eyespot h. Describe the basic structure of an amino acid
 and the formation of called its secondary (28) structure. * magnification (mag9-nih-fih-kay0-shun) L. For example, if microbe appearance and numbers of colonies with the three media. In a sense, these living networks operate as "superorganisms" that influence such microbial activities as adaptation to a particular habitat, content of soil and water
nutrient cycling, and the course of infections. Dr. Jenner observed that cows had a form of pox similar to smallpox. The records of phylogeny are displayed in the form of a tree of life that shows organisms' relatedness. This staining method remains an important basis for bacterial classification and identification. genetic characteristics of a swine virus
but diagnoses, it took only six ithad By mid-April, nearly 1,000 Mexican cases also carried some genes from human and bird weeks for the influenza had been reported, with around 70 deaths. Without oil, some of the peripheral light that passes through the specimen is scattered into the air or onto the glass slide; this scattering decreases resolution.
But when the two are combined, they form sodium chloride4 (NaCl)—the familiar nontoxic table salt—a compound with properties quite different from either parent element (figure 2.6). It also contains tightly bound acidic polysaccharides, including teichoic acid directly attached to the peptidoglycan and lipoteichoic acid (figure 4.15). In most cases,
they are "out of sight and out of mind"—often living in remote rural areas far removed from medical facilities. —Kathy Talaro and Barry Chess xxii Reviewers Lanh Bloodworth, Florida State College at Jacksonville Carroll W. Some microbial ecologists suggest that future rises in sea temperature could increase the melting of these methane deposits.
The size of the individual cells ranges from 100 up to deposits in the ocean at temperatures up to 1708C. stained with dyes c. brown blotches on the skin b. The term complementary means that the nitrogen bases pair in matched sets according to this pattern: Adenine ordinarily pairs with thymine, and cytosine with quantine. —student, Triton College
McGraw-Hill Campus is an LMS integration service that offers instructors and students universal single sign-on, automatic registration, and gradebook synchronization bridges between a donor (upper cell) and two recipients (two lower cells). Viruses
that consist of only a nucleocapsid are considered naked viruses (figure 6.4a). Ribosomes: Sites of Protein Synthesis A bacterial cell contains thousands of ribosomes, which are made of RNA and protein. The large size and complex, three-dimensional shape of macromolecules enable them to function as structural components, molecular messengers,
energy sources, enzymes (biochemical catalysts), nutrient stores, and sources of genetic information. This term usually applies to the cultural level of study. * cestode (sess9-tohd) L. naked, icosahedral c. The bacteria are now so obligate that they have lost a large part of their genome and cannot survive outside the aphid. The Gram stain can also be a
practical aid in diagnosing infection and in guiding drug treatment. luteus, yellow. The management of energy in cells is almost exclusively dependent on chemical rather than physical reactions because most cells are far too delicate to operate with heat, radiation, and other more potent forms of energy. For this purpose, chemists use transfer of a
hydrogen atom (a proton and an electron) from one structural formulas illustrating the relationships of the atoms and compound to another. Synthesis Viral DNA or RNA replicated Viral components synthesis Viral DNA or RNA replicated
RNA replicated Viral components synthesized Viral Persistence Lysogeny Latency, chronic infection, cancer Release from Host Cell Cell lyses when viral enzymes weaken it. 174 Chapter 6 An Introduction to Viruses E. Because images produced by electrons lack color, electron micrograph is a photograph of a microscopic object) are
always TABLE 3.3 Comparison of Light Microscopes and shades of black, gray, and white. This newly identified species occurs in at least 20 forms, including spores, cysts, and amoebas, that can release potent toxins. Disaccharides such as lactose consist of two monosaccharides joined by glycosidic bonds. This multicellular bacterium goes through
several developmental stages in response to environmental signals. are not usually killed by mere boiling. Level I, titled Knowledge and Comprehension, is designed to assess recall and understanding; and Level II, titled Knowledge and Comprehension, is designed to assess recall and understanding; and Level II, titled Knowledge and Comprehension, is designed to assess recall and understanding; and Level II, titled Knowledge and Comprehension, is designed to assess recall and understanding; and Level II, titled Knowledge and Comprehension, is designed to assess recall and understanding; and Level II, titled Knowledge and Comprehension, is designed to assess recall and understanding; and Level II, titled Knowledge and Comprehension, is designed to assess recall and understanding; and Level II, titled Knowledge and Comprehension, is designed to assess recall and understanding; and Level II, titled Knowledge and Comprehension, is designed to assess recall and understanding; and Level II, titled Knowledge and Comprehension, is designed to assess recall and understanding; and Level II, titled Knowledge and Comprehension, is designed to assess recall and understanding; and Level II, titled Knowledge and Comprehension, is designed to assess recall and understanding; and Level II, titled Knowledge and Comprehension, is designed to assess the comprehension of the
The first substantial revelations about the unique characteristics of viruses occurred in the 1890s. The cell walls of algae are quite variety or the larger, more complex eukaryotic type that contain a nucleus and organelles. lack of
pigmentation in eukaryotes c. Most cases of chronic endocarditis are caused by biofilms on valves. The CDC estimates that at least 65% of chronic infections are caused by microbial biofilms on valves. The CDC estimates that at least 65% of chronic infections are caused by microbial biofilms on valves. The CDC estimates that at least 65% of chronic infections are caused by microbial biofilms.
moving molecules cannot travel very far without having collisions with other molecules and, therefore, will bounce off each other like millions of pool balls every second (figure 7.4). Also called saprotroph or saprophyte. positive, neutral, neutron d. The cycles of bacterial and animal viruses illustrate different patterns of viral multiplication, which are
summarized in table 6.4. Check Your Progress SECTION 6.5 21. The animal is exposed to the virus by injection of a viral preparation or specimen into the brain, blood, muscle, body cavity, skin, or footpads. the cause of amebic dysentery e. Throughout its long history, this deadly disease decimated many populations worldwide until 1977, when the
last case was reported. Define the glycocalyx for eukaryotic cells and list its basic functions. Consider Chagas disease, caused by the tropical and subtropical regions of Africa, India, Latin protozoan Trypanosoma cruzi, which over time lodges in the heart America, and Asia. Poxvirus 400 nm 3. In this section, we discuss some important physical
forces in cell transport. The total power of magnification of Binocular head Field of view Eye Virtual Image Principles of Light Microscopy The Microscopy T
source Base (a) (b) Figure 3.3 (a) The main parts of a microscope. Influenza viruses come in about 144 different subtypes and circulate within many vertebrate groups. Both giant viruses lack cellular structure and ribosomes, metabolic enzymes, and fission-style division. * phylum (fy9-lum) pl. Unfortunately, taken individually, these are not life signs.
Consider the scum that builds up in toilet bowls and shower stalls in a short time if they are not cleaned; or the algae that collect on the walls of swimming pools; and, more intimately, the constant deposition of plaque on teeth. Need a lab manual for your microbiology course? These nanobes and possibly to answer some questions about the origins of
life minute cells have been given the name nanobacteria or nanobes on earth and elsewhere in the universe. Using clay, demonstrate how cocci can divide in several planes and show the outcome of this division. Without these raw materials, metabolism would cease, (b) An enlarged view of the left replication fork to show the details of replication. This
category includes a wide variety of organisms that feed on other organisms: animals, protozoa, fungi, and many types of bacteria. they have found about 100,000 different gests that a chronic infection with the fragments of viral DNA. Those of algae and protozoa are tubular, fingerlike projections or flattened discs. All known methanogens are
archaea, and many of them are found in extreme habitats, ranging from hot springs and vents to the deepest, coldest parts of the ocean. nucleic acid 2. The porins are inserted in the upper layer of the ocean nucleic acid 2. The porins are inserted in the upper layer of the ocean nucleic acid 2. The porins are inserted in the upper layer of the ocean nucleic acid 2. The porins are inserted in the upper layer of the ocean nucleic acid 2. The porins are inserted in the upper layer of the ocean nucleic acid 2. The porins are inserted in the upper layer of the ocean nucleic acid 2. The porins are inserted in the upper layer of the ocean nucleic acid 2. The porins are inserted in the upper layer of the ocean nucleic acid 2. The porins are inserted in the upper layer of the ocean nucleic acid 2. The porins are inserted in the upper layer of the ocean nucleic acid 2. The porins are inserted in the upper layer of the ocean nucleic acid 2. The porins are inserted in the upper layer of the ocean nucleic acid 3. The porins are inserted in the upper layer of the ocean nucleic acid 3. The porins are inserted in the upper layer of the ocean nucleic acid 3. The porins are inserted in the upper layer of the ocean nucleic acid 3. The porins are inserted in the upper layer of the ocean nucleic acid 3. The porins are inserted in the upper layer of the ocean nucleic acid 3. The porins are inserted in the upper layer of the ocean nucleic acid 3. The porins are inserted in the upper layer of the ocean nucleic acid 3. The porins are inserted in the upper layer of the ocean nucleic acid 3. The porins are inserted in the upper layer of the ocean nucleic acid 3. The porins are inserted in the upper layer of the ocean nucleic acid 3. The porins are inserted in the upper layer of the ocean nucleic acid 3. The porins are inserted in the upper layer of the ocean nucleic acid 3. The porins are inserted in the upper layer of the ocean nucleic acid 3. The porins are inserted in the upper layer of the ocean nucleic acid 3. The porins are inserte
termed coevolution. Microscopes with visible light illumination Maximum effective magnification 5 1,0003 to 2,0003*. cteria. For example, thicker cell parts such as the cytoplasm, creating contrast. A type of nutrition that relies on an organic nutrient source.
Although chloroplasts resemble mitochondria, chloroplasts are larger, contain special pigments, and are much more varied in shape. face and other body parts. ". can neutralize the acidity of the uriner to colonize and infect the urinary system. When combined with a personalized learning plan, an unprepared or struggling student has all the tools they
need to quickly and effectively learn the foundational knowledge and skills necessary to be successful in a college level course. Explain the differences between facilitated diffusion and group translocation. As the study of microbiology became more scientific and the invisible was made visible, the fear of such mysterious vapors was
replaced by the knowledge and sometimes even the fear of "germs." About 130 years ago, the first studies by Robert Koch clearly linked a microscopic organism with a specific disease. This scenario also has the advantage of explaining the relationships among the major domains. Biotechnology applies the power of microbes toward the manufacture
of industrial products, foods, and drugs. NTDs are not given much priority for funding because they are not high-profile diseases with noticeable, acute symptoms requiring immediate medical care. Treating infections caused by gram-negative bacteria often requires different drugs than for gram-positive infections, because of the special requirement
that the drugs must cross the outer membrane. For instance, lactobacilli, which are common residents of the intestine, inactivate these compounds with manganese ions. Red dye stains the colorless cell. Tube 1 (far left): aerobic (Pseudomonas aeruginosa); Tube 2: facultative (Staphylococcus aureus); Tube 3: facultative (Escherichia coli); Tube 4:
obligate anaerobe (Clostridium butyricum). The location of growth in a tube of fluid thioglycollate medium is a fair indicator of an organism's adaptation to oxygen use (figure 7.11). Photoautotrophs and Photosynthesis Photoautotrophs are photoau
used in cell metabolism. A virus particle is composed of a nucleic acid core (DNA or RNA, not both) surrounded by a geometric protein shell, or capsid; the combination is called a nucleocapsid; a capsid is helical or icosahedral in configuration; many are covered by a membranous envelope containing viral protein spikes. When Frederick Twort and
Felix d'Herelle discovered these viruses in 1915, it first appeared that the bacterial host cells were being eaten by some unseen parasite; hence, the name bacteriophage was used. com, together, and mensa, table. Jenner wrote a paper detailing his experiment. The most important medical species is Mycoplasma pneumoniae (figure 4.16), which
adheres to the epithelial cells in the lung and causes an atypical form of pneumonia in humans. Fungi have enzymes for digesting an incredible array of substances, including feathers, hair, cellulose, petroleum products, wood, even rubber. Many of the examples covered in the section on functional categories of media contain agar. All of them were
used. What conditions are necessary to cultivate viruses in the laboratory? In cells with a wall, water loss causes shrinkage of the protoplast away from the wall, a condition called plasmolysis.* Although the whole cell does not collapse, this event can still damage and even kill many kinds of cells. Answer available at 6.2 The General Structure of
Viruses Expected Learning Outcomes 4. + Hypha - Hypha In general, spore formation follows the same pattern of two mating types coming together, fusing, and forming terminal Figure 5.20 Production of ascospores in a cup fungus. Compare and contrast the smooth ER, the rough ER, and the Golgi apparatus in structure and function. Even at that
time, however, many microbiologists were struck by several unique qualities of fungi that warranted placement into a separate kingdom. It catches readers' attention the same way people listen to the "news." The authors start from the scenarios to discussions, implications, and practical applications."—Lahn Bloodworth, Florida State College,
Jacksonville o icr CASE STUDY Part 2 Beginning with those first diagnoses, it took only 6 weeks for the influenza outbreak to explode into a pandemic. (0) (

| (a) Figure 3.14 Sample liquid media. Bacteria tend to stain more readily with cationic (positively charged) dyes because bacteria a. 1.3 Human Use of Microorganisms Microbes have been
called upon to solve environmental, agricultural, and medical problems. In one sentence, briefly define what is involved in each of the essential functions of proteins. As this process continues, the
infection spreads gradu- (a) Inoculation of amniotic cavity Inoculation of embryo Air sac Amnion Allantoic cavity ally and symmetrically from the original point of infection, causing the macroscopic appearance of round, clear spaces that correspond to areas of lysed cells. * Neisseria meningitidis (ny-serr9ee-uh men9-in-jih9-tih-dis) From the German
physician, Neisser, and Gr. meninx, a membrane. You will learn in chapter 9 that all proteins are made by "translating" the nucleic acid code on a single strand of RNA into an amino acid sequence. The term phylum is used for protozoa, animals, bacteria, and fungi. Many convert to a resistant, dormant stage called a cyst. At some point, evidence of
the accuracy and predictability of a theory is so compelling that the next level of confidence is reached, and the theory becomes a law, or principle. anaerobic, halophilic rod that of radiating fi laments that float habitats, such as hot springs and pools. Therein is the key to most success and sential concepts and terminology to memory. His contributions
to medical science so changed the practice of medicine that he is considered the "Father of Immunology." It is often said of Jenner that his discovery saved more lives than any other in history. Conditions within the endosome cause fusion of the vesicle membrane with the viral envelope, followed by release of the viral capsid and RNA into the
cytoplasm. Answer available at Some Special Requirements of Culturing Inherent in these practices are the implementation of sterile, aseptic, and pure culture2 techniques. MASS 15.99 11 Mg SODIUM C 2.8.2 2.4 Cl AT. Which characteristic(s) is/are not typical of protozoan cells? started about doomsday predictions supposedly found in
interpretations of an ancient Mayan calendar. There are millions of habitats on earth, of both natural and human origin. The Viral Envelope When enveloped viruses (mostly animal) are released from the host cell, they take with them a bit of its membrane system in the form of an envelope. Distinguish among the types of external cell appendages. As
we will learn in chapter 7, the microbes in these communities have "conversations" using a special chemical vocabulary, which greatly influences the actions of the biofilm. Describe the principal characteristics of algae that separate them from protozoa. Facultative rods and vibrios Family Anaplasmataceae: Ehrlichia (human ehrlichosis) Family
Enterobacteriaceae: Family Chlamydia Escherichia, Edwardsiella, (sexually transmitted infection) Citrobacter, Cat scratch disease) Serratia, Proteus, Yersinia (one species causes plague) III. Spores can be quite
variable in origin, form, and function. Nutritional and Habitat Range Protozoa are heterotrophic and usually require their food in a complex organic form. To further clarify that air and dust were the source of microbes, Pasteur filled flasks with broth and fashioned their openings into elongate, swan-neck-shaped tubes. Halobacteria living in the Great
Salt Lake and the Dead Sea actually absorb salt to make their cells isotonic with the environment; thus, they have a physiological need for a high-salt concentration in their habitats (see halophiles on page 202). The English surgeon Joseph Lister took notice of these observations and was the first to introduce aseptic* techniques aimed at reducing
microbes in a medical setting and preventing wound infections. He recorded: "In the said matter there were many very little living animalcules, very prettily a-moving. Membranes are made of are made of are made of Amino acids C NH2 R 2. T an s oc aly ers iety iou ut var rev M o icr CASE STUDY Part 2 There is much more to the story of neglected
diseases of poverty. E Armillaria E. The two main types of cytoskeletal elements are microfilaments and microtubules. an electrolyte 9. (b) A section through Aquaspirillum reveals a chain of tiny iron magnets (magnetosomes 5 MP). Generally, these reactions either synthesize new cell components or release energy that drives cellular activities. With
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further evolution, some of the cells within colonies became specialized, or adapted to perform a particular function advantageous to the whole colony, such as locomotion, feeding, or reproduction. In chapter 2, you learned that DNA usually exists as a doublestranded molecule and that RNA is single-stranded. from his earlier skin infection d
Microbiology is one of the largest and most complex of the biological sciences because it integrates subject matter from many diverse disciplines. pro, before, plus phage. Although these terms are used interchangeably, cell culture is probably a more accurate description. After all, inanimate objects can move and crystals can grow. The extent of the
differences between gram-positive and gram-negative bacteria is evident in the physical appearance of their cell envelopes (figure 4.13). How are the eukaryotic ribosomes and cell membranes different from those of prokaryotes? Note the plant itself and protect it against disease, presumably by secretto toxic diseases. Examples of algal forms are
shown in figure 5.22 and table 5.5. An algal cell exhibits most of the organelles (figure 5.22a). Industry has tapped the biochemical potential of fungi to produce large quantities of antibiotics, alcohol, organic acids, and vitamins. Facultative anaerobes usually possess catalase and superoxide dismutase. Most simple staining techniques take advantage
of the ready binding of bacterial cells to dyes like malachite green, crystal violet, basic fuchsin, and safranin. 152 Chapter 5 A Survey of Eukaryotic Cells and Microorganisms Copulatory spicule Anus Mouth Female Eggs Male Selfinfection to the anus to deposit eggs, which cause intense itchiness that is relieved by scratching. Most dyes form ions
when dissolved in a compatible solvent. Chemical composition of a medium may be completely chemically defined, thus synthetic. Cells exhibit extreme variation in shape due to the lack of a cell wall. Apicomplexans have many of the usual protozoan organelles but also contain an unusual body, the apical composition of a medium may be completely chemically defined, thus synthetic. Cells exhibit extreme variation in shape due to the lack of a cell wall. Apicomplexans have many of the usual protozoan organelles but also contain an unusual body, the apical composition of a medium may be completely chemically defined, thus synthetic.
of compounds classified as lipids are triglycerides, phospholipids, steroids, and waxes. With phagocytosis, solid particles are engulfed by flexible cell extensions or pseudopods (1,000X). Depending on the protein, this may be the final functional state. Tell how fungi obtain nutrients, and in what habitats one would expect to find them. Fungal Nutrition
All fungi are heterotrophic.* They acquire nutrients from a wide variety of organic sources or substrates (figure 5.16). Carrier-mediated active transport functions with specific membrane protein 1 Protein carrier 2 ATP 2 1 Transport molecule
Energy activator ATP ATP-binding site Intracellular (a) Carrier-mediated active transport molecules Intracellular Activated transport pumps can rapidly carry ions such as K1, Na1, and H1 across the membrane. Other examples are given in chapter 9. blastospore. To best explain the origin of the special properties and versatility
of proteins, we must examine their general structure. * spheroplast (sfer9-oh-plast) Gr. sphaira, sphere. Nigrosin (blue-black) and India ink (a black suspension of carbon particles) are the dyes most commonly used for negative staining. It has been well studied in a number of pathogenic bacteria. Which kinds of elements tend to make covalent bonds?
7.4 Environmental Factors That Influence Microbes isolates were unusual, very slow-growing forms, but others were similar to modern bacteria. These single-celled, simple organisms, called archaea, or archaeons, are considered a third cell type in a separate superkingdom (the Domain Archaea). An organic compound such as an amino acid,
nitrogenous base, or vitamin that cannot be synthesized by an organism and must be provided as a nutrient is a growth factor. It can be figured by percentage or molarity. (Not to scale.) (b) The cytoskeleton of a large eukaryotic cell is highlighted by fluorescent dyes. algae c. In a synthesis* reaction, the reactants bond together in a manner that
produces an entirely new molecule (reactant A plus reactant B yields product AB). selective medium chocolate agar b. Compare this outline to the one found on page 90 in chapter 4. Techniques with solid media in Petri dishes provide a means of separating individual microbes by producing isolated colonies. * pseudohypha (soo0-doh-hy9-fuh) pl.
sandwiched between them (figure 2.26). We further explore some important aspects of photosynthesis in chapters 7 and 8. Identification is accomplished through the use of keys, charts, and computer programs that analyze the data and arrive at a final conclusion. It is convenient to describe most bacteria by one of three general shapes as dictated by
the configuration of the cell wall (figure 4.23). Mammals appeared. Animal cells to survive. Emerging and Reemerging Diseases Among the more significant factors in the overall picture of infectious diseases are emerging and
reemerging diseases (1.1 Making Connections). It is a site for temporary storage of enzymes that have been released by the cell membrane. Describe 10 unique characteristics of viruses (can include structure, behavior, multiplication). Differentiate between transmission and scanning electron microsopes in image formation and appearance. Years of
experimentation were required to show that viruses were noncellular particles with a definite size, shape, and chemical composition. By this means, they can monitor the size of their own population. Chemists and biologists use shorthand to summarize the content of a reaction by means of a chemical equation. This case drives home several important to summarize the content of a reaction by means of a chemical equation.
facts about fungi: (1) They can grow rapidly even in low nutrient environments; (2) just a single spore introduced into a sterile environment, whether it is a vial of medicine or the human body, can easily multiply into millions of fungal cells; and (3) even supposedly "harmless" fungi are often opportunistic, meaning that they will infect tissues "if given
an opportunity." This case also emphasizes the need for zero tolerance for microbes of any kind in a drug that is being injected—such a procedure demands sterility. Other significant effects involve our expanding population and global food-growing practices. The rover's robotic arms are able to excavate soil, rock, and ice. All such tangible materials
that occupy space and have mass are called matter, discuss with others; 80% of what we experience personally; and 95% of what we teach to someone else. Other unique properties of viruses are summarized in table 6.1. The unusual structure and behavior of viruses have led to debates about their connection to the rest of the microbial world. These
are combined in various ways that assist in discussing the types of nutritional or ecological adaptations, as shown in the list below. * organelles (or-gan9-elz) Gr. organa, tool, and ella, little. neuraminidase spikes c. Note the elongate cylindrical morphology. As we will see in subsequent chapters, each group exhibits a distinct collection of biological
characteristics. Dyes are colored compounds carrying double-bonded groups such as CPO, CPN, and NPN. A nonworkable hypothesis would be that hemophilia is caused by a curse placed on the royal family of England. coli contains on the order of 5,000 different compounds, yet it needs to absorb only a few types of nutrients to synthesize this great
diversity. worsened with a longer wavelength of light. The top tube shows it as a solid. Even treatments with extreme high temperatures and concentrated chemicals are not always reliable methods to eliminate them. Release of energy from ATP drives the movement of the molecule through the protein carrier. Adverse impacts include: decomposition
of fruits and vegetables, and human infections, or mycoses; some produce substances that are toxic if eaten. There is (decolorizer) nothing specific in the reaction of gram-positive cells to the primary dye or in the reaction of gram-positive cells to the primary dye or in the reaction of gram-positive cells to the primary dye or in the reaction of gram-positive cells to the primary dye or in the reaction of gram-positive cells to the primary dye or in the reaction of gram-positive cells to the primary dye or in the reaction of gram-positive cells to the primary dye or in the reaction of gram-positive cells to the primary dye or in the reaction of gram-positive cells to the primary dye or in the reaction of gram-positive cells to the primary dye or in the reaction of gram-positive cells to the primary dye or in the reaction of gram-positive cells to the primary dye or in the reaction of gram-positive cells to the primary dye or in the reaction of gram-positive cells to the primary dye or in the reaction of gram-positive cells to the primary dye or in the reaction of gram-positive cells to the primary dye or in the reaction of gram-positive cells to the primary dye or in the reaction of gram-positive cells to the primary dye or in the reaction of gram-positive cells to the primary dye or in the reaction of gram-positive cells to the primary dye or in the primary dye or in the reaction of gram-positive cells to the primary dye or in the reaction of gram-positive cells to the primary dye or in th
Later, in a process called induction, the prophage in a lysogenic cell will be activated and progress directly into viral replication and the lytic cycle. See examples in figures A and 4.33. The ninth edition continues to meet these goals with the most digitally integrated, up-to-date, and pedagogically important revision yet. These reactions release simple
organic molecules and a modest amount of energy to drive the synthetic processes of the cell. none of these choices Explain your choice for question 16. Two flasks start out free of live cells (sterile) One flask is snapped off at the top; growth appears in broth. Visual Challenge Use the following pattern to construct an outline of the scientific reasoning.
that was involved in developing the germ theory of disease similar to figure 1.10. Most viruses with positive-strand RNA molecules already contain the correct message for translation into proteins. Others can be spread through bodily fluids and feces. For example, when equal molar solutions of hydrochloric acid (HCl) and sodium hydroxide (NaOH, a
base) are mixed, the reaction proceeds as follows: HCl 1 NaOH \rightarrow H2O 1 NaCl Here the acid and base ionize to H1 and OH2 ions, which form water, and other ions, Na1 and Cl2, which form sodium chloride. Although protozoa have adapted to a wide range of habitats, their main limiting factor is the availability of moisture. Next, the air-dried smear is
usually heated gently by a process called heat fixation that simultaneously kills the specimen and secures it to the slide. These molecules can also have drugs loaded into their cores and be directed toward specific cells or organs, but they are not broken down in the body and can remain in place significantly longer than traditional drug carriers. An
example is Desulfurobacterium (figure C). A simple microscope consists of a single magnifying lens, whereas a compound microscope relies on two lenses: the ocular lens and the objective lens. cell b. Release of Mature Viruses To complete the cycle, assembled viruses leave their host in one of two ways. He is thrilled and feels very fortunate to be
collaborating with Kathy Talaro, with whom he has worked in the classroom for more than a decade, on this ninth edition. Hospitals and clinics must take precautions to guard against the potential harmful effects of endospores in wounds. Such tests will provide specific information unique to a certain microbe. This binding changes the conformation
of the carrier proteins in a way that facilitates movement of the substance across the membrane. Probably the T-even phages are those of the intestinal bacterium Escherichia coli—especially the T-even phages are those of the intestinal bacterium Escherichia coli—especially the T-even phages are those of the intestinal bacterium Escherichia coli—especially the T-even phages are those of the intestinal bacterium Escherichia coli—especially the T-even phages are those of the intestinal bacterium Escherichia coli—especially the T-even phages are those of the intestinal bacterium Escherichia coli—especially the T-even phages are those of the intestinal bacterium Escherichia coli—especially the T-even phages are those of the intestinal bacterium Escherichia coli—especially the T-even phages are those of the intestinal bacterium Escherichia coli—especially the T-even phages are those of the intestinal bacterium Escherichia coli—especially the T-even phages are those of the intestinal bacterium Escherichia coli—especially the T-even phages are those of the intestinal bacterium Escherichia coli—especially the T-even phages are those of the intestinal bacterium Escherichia coli—especially the T-even phages are those of the intestinal bacterium Escherichia coli—especially the T-even phages are those of the intestinal bacterium Escherichia coli—especially the T-even phages are those of the intestinal bacterium Escherichia coli—especially the T-even phages are those of the intestinal bacterium Escherichia coli—especially the T-even phages are those of the intestinal bacterium Escherichia coli—especially the T-even phages are those of the intestinal bacterium Escherichia coli—especially the T-even phages are those of the intestinal bacterium Escherichia coli—especially the T-even phages are those of the intestinal bacterium Escherichia coli—especially the T-even phages are those of the intestinal bacterium Escherichia coli—especially the T-even phages are those of the intestinal bacterium Escherichia coli—especially the T-ev
microbes are sharing space and nutrient sources. Table 6.2 illustrates a system of classification for important viruses and the diseases they cause. The coiled spiral form is called the a molecule. For example, hexoses are composed of 6 carbons, and pentoses contain 5 carbons. Distinguish between emerging and reemerging infectious diseases and
explain what factors contribute to their development. d. During this process, the nucleocapsid binds to the membrane, which curves completely around it and forms a small pouch. simple stain c. They propose three distinct cell lines placed in superkingdoms called domains. Explain some of the ways the species level in bacteria is defined, and name at
least three ways bacteria are classified below the species level. ionic d. Cilia are found only in protozoa and animal cells. transport medium c. Describe pleomorphism, and give examples of bacteria with this trait. Eukaryotic cells are complex and compartmentalized into individual organelles. The acid-fast stain, like the Gram stain, is an important
diagnostic stain that differentiates acid-fast bacteria (pink) from nonacid-fast bacteria (blue). They are quite remarkable in being the only biologically active agent that lacks any sort of nucleic acid (DNA or RNA). Researchers are currently analyzing the effects of biofilms created by our own microbiota—
Protozoa: A protozoan, Oxytricha trifallax bearing tufts of cilia that function like tiny legs (3,500x). From these perspectives, we cannot overemphasize the importance of a working knowledge of the relationship between viruses and their host cells. How does this transformation occur? Chlorophyta c. On the basis of morphological form, the two major
groups of parasitic helminths are the flatworms (Phylum Platyhelminthes), with a very thin, often segmented body (figure 5.28). Defend your answer. (b) A disclike cell was recovered from a Chinese rock dating
590 million to 610 million years ago. 1 2 3 4 5 6 7 8 9 0 DOW/DOW 1 0 9 8 7 6 5 4 ISBN 978-0-07-352260-9 MHID 0-07-352260-9 MHI
the child was exposed twice to the pus from an active smallpox lesion. Osmotic Pressure Although most microbes exist under hypotonic or isotonic conditions, a few, called osmophiles, live in habitats with a high solute concentration. What does it mean to say that the human body is 90% prokaryotic? Agar is flexible and moldable, and it provides a
basic matrix to hold moisture and nutrients. Explain what causes the various levels of structure of a protein or fold into regular patterns. Multiplication Expected Learning Outcomes 11. 10. HIV attacks only specific types of human cells, such as certain
white blood cells and nerve cells. Viruses are not generally considered living or cells, and rely on host cells to replicate. * hydrolysis (hy-drol9-eye-sis) Gr. hydro, water, and lysis, to dissolve. All cells have one or more chromosomes containing DNA, ribosomes for protein synthesis, and they exhibit highly complex chemical reactions. During bacterial
reproduction, they are duplicated and passed on to offspring. Septum (b) (a) Figure 5.14 Macroscopic views of molds. This technique creates a vaccine that provides immunity but does not expose the person to the intact pathogen. With respect to oxygen requirements, several general categories are recognized. (a) Comparison of a
prokaryotic cell and a eukaryotic cell. • Major locomotor organelles are pseudopods, although some species have flagellated reproductive states. Both spacecraft were equipped with a one-ton roving science lab to analyze the Martian surface geology and soil. Define replication as it relates to viruses. This discovery was followed by Friedrich Loeffler
and Paul Frosch's isolation of the virus that causes foot-and-mouth disease in cattle. He regularly teaches courses in microbiology, and genetics, and works with students completing independent research projects in biology, and genetics, and works with students completing independent research projects in biology, and genetics, and works with students completing independent research projects in biology and microbiology, general biology, and genetics, and works with students completing independent research projects in biology and microbiology.
parts can interact with human tissues and contribute to disease. the little They also have gas vesicles that keep the cyanobacterium cells suspended high in the water column "Gloeocapsa, which to facilitate photosynthesis. cruzi Leishmaniasis: Leishmaniasis: Leishmania donovani, L. Because taxonomic schemes are to some extent artificial, certain groups of
organisms cannot be arranged in an exact eight-part taxonomic scheme. RNA viruses can be double-stranded but are more often single-stranded but are more often single-stranded. For example: • • • Helium (AN 5 2) has only a filled first shell of 2 electrons. (a) A cestode (beef tapeworm), showing the scolex; long, tapelike body; and magnified views of immature and mature proglottids
(body segments). For example, hepatitis B infects only liver cells of humans; the poliovirus infects primarily intestinal and nerve cells of most mammals. Draw the following molecules and determine which are polar: Cl2, NH3, CH4. A prominent feature of the
nucleoplasm in stained preparations is a network of dark fibers known as chromatin because of its attraction for dyes. It is also metabolically inactive and highly resistant to damage from further drying. taL22600_taL22600_taL22600_taL22600_pagefiles Host Cell
Cytoplasm Process Figures Many difficult microbiological concepts are best portrayed by breaking them down into stages that students will find easy to follow. Although the specific germination 4.5 Bacterial Shapes, Arrangements, and Sizes
Expected Learning Outcomes Although the majority of spore-forming bacteria are relatively harmless, several bacterial pathogens are sporeformers. High Salt, Acidity, and Alkalinity The growth of most microbial cells is inhibited by high amounts of salt; for this reason, salt is a common food preservative. At midpoint—pH 7 or neutrality—the
concentrations are exactly equal and neither predominates, this being the pH of pure water previously mentioned. X photograph h off Saccharomyces with a prominent nucleus (blue sphere) and bud (5,0003) Phylum III—Basidiomyceta (also Basidiomyceta) Many members are familiar macroscopic forms such as mushrooms and puffballs, but this
phylum also includes a number of microscopic plant pathogens called rusts and smuts that attack and destroy major crops, This has extensive impact on agriculture and global food production. This class of lipids has a hydropholic region that corresponds that attack and destroy major crops, This has extensive impact on agriculture and global food production. This class of lipids has a hydropholic region that corresponds that corresponds that corresponds that corresponds that attack and destroy major crops, This has extensive impact on agriculture and global food production.
to the long, uncharged "tail" (formed by the fatty acids). Lines of these early primitive cells gave rise to the Domains Bacteria and Archaea. Function requires cooperation and interaction among the system of organelles. Magnesium (AN 5 12) has a filled first shell, a filled second one, and a third shell that has only one orbital, so is nearly empty
Normal proteins 4 3 When this process creates large numbers of prions, they bind tightly together and form elongate chains. a capsule c. She blood cell count were ordered as backup. 483 490 16.1 The Immune Response: A Two-Sided Coin 491 Overreactions to Antigens: Allergy/Hypersensitivity CHAPTER 491 16.2 Type I Allergic Reactions: Atopy
and Anaphylaxis 492 Modes of Contact with Allergens 492 The Nature of Allergens and Their Portals of Entry 493 Mechanisms of Type I Allergy: Sensitization and Provocation 493 Cytokines, Target Organs, and Allergic Symptoms 495 Specific Diseases Associated with IgE- and Mast-Cell-Mediated Allergy 497 Anaphylaxis: A Powerful Systemic
Reaction to Allergens 498 Diagnosis of Allergy 499 Treatment and Prevention of Allergy
Phenotypic Methods 522 Genotypic Methods 522 Immunologic Methods 522 Immunologic Methods 522 Immunologic Methods 526 Immunologic Methods 527 In Disorders in Immunity 16.8 The Function of Specimen Cultivation of Specimen Cu
Scheme for Specific, Acquired Immunities 475 Defining Categories by Mode of Acquisition 476 CHAPTER 16.6 Autoimmune Disease 510 The Origins of Autoimmune Disease 510 Examples of Autoimmune Disease 510 The Origins Origi
Using Genetic Probes 529 Roles of the Polymerase Chain Reaction and Ribosomal RNA in Identification 520 The Western Blot for Detecting Proteins 530 General Features of Immune Testing 530 Agglutination and Precipitation Reactions 534 Fluorescent
Antibody and Immunofluorescent Testing 17.5 Immunoassays: Tests of Great Sensitivity 536 Radioimmunoassay (RIA) 536 Enzyme-Linked Immunosorbent Assay (ELISA) In Vivo Testing 538 17.6 Viruses as a Special Diagnostic Case 538 536 535 xxix Contents CHAPTER 18 CHAPTER The Gram-Positive and Gram-Negative Cocci of Medical Importance
543 18.1 General Characteristics of the Staphylococci 544 Growth and Physiological Characteristics of Staphylococcus aureus 544 The Scope of Staphylococcus aureus 546 Host Defenses Against S. The lysogenic phase is depicted in the green section of figure 6.16. This architecture ties in with its role in synthesis of proteins, which are collected in
the lumen (figure 5.7c) of the cisternae and processed for further transport to the Golgi apparatus (figure 5.7d). Characterize the four levels of protein structure and describe the pattern of folding. Figure 7.8 Active transport to the Golgi apparatus (figure 5.7d). Characterize the four levels of protein structure and describe the pattern of folding. Figure 7.8 Active transport to the Golgi apparatus (figure 5.7d).
that for successful cultivation, the microorganisms being cultured had to be provided with all of their required nutrients in an artificial medium. These include female infertility caused by Chlamydia infection and malignancies such as liver cancer (hepatitis viruses) and cervical cancer (human papillomavirus). These molecules appear to function in cell
wall maintenance, enlargement during cell division, and D-alanine -glycine Interbridge * glycan (gly9-kan) Gr., sugar. They can be photosynthetic (algae), or they can feed on other organisms (protozoa). The dominant substances in medium B are macromolecules that contain unknown (but potentially required) nutrients. Spirochetes that 16.
There are two replication forks where new DNA is being synthesized. The main structure is amylose bonded in a 1,4 pattern, with side branches of amylopectin bonded by 1,6 bonds. What are metachromatic granules, and what do they contain? botulinum, is the agent of botulism, a deadly form of food poisoning. By contrast, facultative* means not
being so restricted but adapting to a wider range of environmental conditions. Many have a stalk that they use to attach to substrates. Very common sources are body fluids, foods, water, soil, plants, and animals, but even places like icebergs, volcanoes, and rocks can be sampled. Review the types of chemical reactions and the general ways they can
be expressed in equations. In biology today, there are different methods for deciding on taxonomic categories, but they all rely on the history and relatedness of organisms. Lenses with higher NAs provide better resolving power because they increase the angle of refraction and widen the cone of light entering the lens. To see these microorganisms
arrayed more accurately to scale, look for them in figure 1.4. functions such as transport, feeding, energy release and use, and synthesis. Hydrogen is a unique element with the same atomic and mass number. Saprobes are free-living microbes
that feed primarily on organic detritis released by dead organisms, and symbionts* derive their organic nutrients from the bodies of living organisms. A U.S. Department of Agriculture technician observes tests for the presence of Escherichia coli in foods. "The Insight readings give the student some "geegolly-whiz" information that they think is just
interesting, but is also informative at the same time." —Carroll W. Division is for algae and plants. At a site where it borders on the Golgi apparatus, the endoplasmic reticulum buds off tiny membrane-bound packets of protein called transport vesicles that are picked up by the forming face of the Golgi apparatus. Because of the high water content of
cytoplasm, all cells require water from their environment to sustain growth and metabolism. Their size places them in the realm of the ultramicroscopic. (b) MacConkey agar differentiates between lactose-fermenting bacteria (indicated by an off-white colony)
with no dye reaction). crista, a comb. Chapter Summary with Key Terms 5.1 The History of Eukaryotes 5.2 and 5.3 Form and Function of the Eukaryotic Cell: Internal Structures Golgi complex Food particle Phagocyte detects food particle Lysosomes 131 Cristae (darker
lines) Nucleus 1 Matrix (lighter spaces) Engulfment of food 2 (a) Food vacuole Circular DNA strand 70S ribosome Merger of lysosome Merger of lysos
also alter their genetic Euryarchaeota makeup by a variety of mechanisms. disaccharide b. Growth takes place on two levels. Explain the importance of media for culturing microbes in the laboratory. Depending upon the circumstances, both views are defensible. A contaminated 17. The most adaptable configuration is the spheroid form called a
buckyball,* composed of 60 carbons (figure b). Viruses similar to it and Mexican patients to identify the strain of virus. Characteristics used for placement in a particular family include type of capsid, nucleic acid strand number, presence and type of envelope, overall viral size, and area of the host cell in which the virus multiplies. * lysis (ly9-sis) Gr.,
to loosen. At first, the idea of endosymbiosis was greeted with some controversy; howre rather ever, we now know that associations of this sort are Membrane forms ionships common in the microbial world. Briefly describe the effects of an oncogenic virus. have thick cell walls 13. Experts have postulated it is thought that they are essential to the
ecological cycling of H2S and that the minimum cell size to contain a functioning genome and reproother substances in this region, converting them to less toxic substances. Endoplasmic Reticulum: A Passageway and Production System for Eukaryotes The endoplasmic reticulum (ER) is an interconnected network of membranous, hollow sacs that
synthesize and transport cell substances (figure 5.7a). The number of atoms of each element must Expected Learning Outcomes be balanced on either side of the arrow. A generalized version of the fluid mosaic model of a cell membrane indicates a bilayer of lipids with proteins embedded to some degree in the lipid matrix.
MRSA mean, and what is its significance? Von Linné realized early on that a system for recognizing and defining the properties of living things would prevent chaos in scientific studies by providing each organism with a unique name and an exact "slot" in which to catalog it. Named for British bacteriologist J. Check Your Progress SECTION 7.1 1.
Although other bacteria require an intact cell wall to prevent the bursting of the cell, the mycoplasma cell membrane contains sterols that make it resistant to lysis. All protozoa, as well as numerous algae and fungi, are unicellular. • Sexual reproduction by means of basidiospores • Asexual spores: conidia • Incompletely septate hyphae
complaining of light-headedness. C P C. Answer for the opposite case as well. 206 Chapter 7 Microbial Nutrition, Ecology, and Growth undergo coevolution, and complete dependency of the parasite for the host is rather common. Learning Outcomes and Check Your Progress Every section in the book now opens with Expected Learning Outcomes and Check Your Progress Every section in the book now opens with Expected Learning Outcomes and Check Your Progress Every section in the book now opens with Expected Learning Outcomes and Check Your Progress Every section in the book now opens with Expected Learning Outcomes and Check Your Progress Every section in the book now opens with Expected Learning Outcomes and Check Your Progress Every section in the book now opens with Expected Learning Outcomes and Check Your Progress Every section in the book now opens with Expected Learning Outcomes and Check Your Progress Every section in the book now opens with Expected Learning Outcomes and Check Your Progress Every section in the book now opens with Expected Learning Outcomes and Check Your Progress Every section in the book now opens with Expected Learning Outcomes and Check Your Progress Every section in the book now opens with Expected Learning Outcomes and Check Your Progress Every section in the book now opens with Expected Learning Outcomes and Check Your Progress Every section in the Expected Learning Outcomes and Check Your Progress Every section in the Expected Learning Outcomes and Check Your Progress Every section in the Expected Learning Outcomes and Check Your Progress Every section in the Expected Learning Outcomes and Check Your Progress Every section in the Expected Learning Outcomes and Check Your Progress Every section in the Expected Learning Outcomes and Check Your Progress Every section in the Expected Learning Outcomes and Check Your Progress Every section in the Expected Learning Outcomes and Check Your Progress Every section in the Expected Learning Outcomes and Check Your Progress Every section in the Expect
closes with assessment questions (Check Your Progress). Inoculated tubes are then plated out A fluorescent micrograph of a biofilm of Vibrio cholerae (orange cells) taken from a water sample in India. When this medium is stabbed with an inoculum the appearance of growth around the stab line can be used to determine nonmotility (2) or motility (3)
Eleven of the 13 neglected disease pathogens are eukaryotic parasitic helminth worms or protozoans. (a) Cysts are eaten. In fact, many symbiotic and cooperative relationships are based on complex communication patterns among coexisting organisms. Because bacterial cells look two-dimensional and flat with traditional staining and
microscope techniques, they are best observed using a scanning electron microscope to emphasize their striking three-dimensional forms (figure 4.23). Metabolically, the archaea exhibit nearly incredible adaptations to what would be deadly conditions for other organisms. Media for gle step, the preliminary identification of a genus or even a species
called superoxide dismutase. (b) Tumbles. Several unique kinds of molecules are made of pure carbon alone. The fact that fungi are so widespread also means that they frequently share human living quarters, especially in locations that provide ample moisture and nutrients. This is the pattern in dental caries, periodontal disease, and gas gangrene.
Importance: Provide the basis of the food web in most aquatic habitats and are major producers of oxygen. fimbriae; L., a fringe. support b. Almost like reading a mystery novel, The Secret World of Microbes reveals little known and surprising facts about this hidden realm. In this chapter, we address these ideas and many others. Liquid 1. Bright-field
microscope Dark-field microscope Phase-contrast microscope Differential interference contrast microscope Common multipurpose microscope for live and preserved stained specimens; specimen is dark, field is white; provides fair cellular detail. (b) Longitudinal section through a cilium, showing the lengthwise orientation of the microtubules and the
basal body (bb) from which they arise. Basidia Fungal Classification It is often difficult for microbiologists to assign logical and useful classification schemes to microorganisms that also reflect their evolutionary relationships. Both flagella and cilia are found primarily in a. Amino acids are the basic building blocks of proteins. Includes many human
and plant pathogens, such as Pneumocystis (carinii) jiroveci, a pathogen of AIDS patients. Explain how prions and viroids are different from viruses. Eukaryotes are all placed in the Domain Eukarya. What is distinctive about isotopes of elements, and why are they important? (See figures J and K.) Clinical Connections Volume 5 This represents a mixed
assemblage of nine phyla, all of which are gram-negative but otherwise widely varied. Dyes impart a color to cells or cell parts by becoming affixed to them through a chemical reaction. Tap into other rightssecured third-party sources as well. Bacterial cells can also be categorized according to arrangement, or style of grouping. Among the
refinements that led to the development of today's compound (two-lens) microscope were the addition of a second magnifying lens system, a lamp in the base to give off visible light and illuminate* the specimen, and a special lens called the condenser that converges or focuses the rays of light to a single point on the object. bird embryos c. Bacteria
with no cell walls (Class Mollicutes) Family Mycoplasma (pneumonia), Ureaplasma (urinary infection) *Details of pathogens and diseases in later chapters. (c) Photomicrograph of a bacteriophage from cyanobacteria. See figures 5.15, 5.22, and 5.24 for examples of individual cell types. One group that seemed to be less susceptibles.
to H1N1 influenza virus were members of the population 60 years or older. One-third of the earth's inhabitants live on less than $1 per day, are malnourished, and are not fully immunized, and one-third of 7 billion humans have no access to drugs. 3.2 The Microscope: Window on an Invisible Realm Expected Learning Outcomes 3. The filaments curl
closely around the spirochete coils yet are free to contract and impart a twisting or flexing motion to the cell. Dyes that inhibit the growth of a certain microbe or microbes (call them such as methylene blue and crystal violet also inhibit the growth of a certain microbe or microbes (call them such as methylene blue and crystal violet also inhibit the growth of a certain microbe or microbes (call them such as methylene blue and crystal violet also inhibit the growth of a certain microbe or microbes (call them such as methylene blue and crystal violet also inhibit the growth of a certain microbe or microbes (call them such as methylene blue and crystal violet also inhibit the growth of a certain microbe or microbes (call them such as methylene blue and crystal violet also inhibit the growth of a certain microbe or microbes (call them such as methylene blue and crystal violet also inhibit the growth of a certain microbe or microbes (call them such as methylene blue and crystal violet also inhibit the growth of a certain microbe or microbes (call them such as methylene blue and crystal violet also inhibit the growth of a certain microbe or microbes (call them such as methylene blue and crystal violet also inhibit the growth of a certain microbe or microbes (call them such as methylene blue and crystal violet also inhibit the growth of a certain microbe or microbes (call them such as methylene blue and crystal violet also inhibit the growth of a certain microbe or microbes (call them such as methylene blue and crystal violet also inhibit the growth of a certain microbe or microbes (call them such as methylene blue and crystal violet also inhibit the growth of a certain microbe or microbes (call them such as methylene blue and crystal violet also inhibit the growth of a certain microbe or microbes (call them such as methylene blue and crystal violet also inhibit the growth of a certain microbe or microbes (call them such as methylene blue and crystal violet also inhibit them such as methylene blue and crystal viol
substances. The flasks' openings were freely open to the air but were curved so that gravity would cause any airborne dust particles to deposit in the lower part of the necks. We use T. They do not flow freely and have a soft, clotlike consistency. Samples subject to microbiological analysis can include nearly any natural material. Explain how
protozoans are identified and classified. They can permit, in a sinteria while permitting many gram-negative rods to grow. Although microbes require some carbon dioxide in their metabolism, capnophiles grow best at higher CO2 tensions (3%–10%) than are normally present in the atmosphere (0.033%). Many synthesis, decomposition, and transfer
reactions rely upon functional groups such as ROOH or RONH2. Chemical Analysis of Cell Contents To gain insight into a cell's nutritional makeup, it can be useful to analyze its chemical composition. a double membrane structure c. We explore some additional examples of the basic types of bonding in the following section. Most organic nutrients are
molecules that contain a basic framework of carbon and hydrogen. 13. The process, carried out in large bioreactors, could speed the clean up of hazardous nuclear waste deposits. 1.5 The Historical Foundations of Microbiology A. What are some of the functions of polysaccharides in cells? Macronutrients are required in relatively large quantities and
play principal roles in cell structure and metabolism. In contrast, an inorganic nutrient is composed of an element or elements other than carbon and hydrogen. Work out the following problems: a. The important concept of media will be covered in more detail in section 3.5. A past assumption has been that most microbes could be teased out of
samples and cultured, given the proper media. Complex Viruses B. During the incubation period (ranging from a few hours to several weeks), the microbe multiplies and produces a culture with macroscopically observable growth. Fluorescent stain of actin fibers appears as fine helical ribbons wound inside the cell. Nutrition is a process by which
chemical substances called nutrients are acquired from the environment and used in cellular activities such as metabolism and growth. hemagglutinin spikes d. To date, 118 elements have been described. Put simply, evolution states that living things change gradually through billions of years and that these evolvements result in various types of
structural and functional adaptations through many generations. Cell surface molecules that bind specifically with other molecules. Describe the structure of chloroplasts, and explain their importance and functions. Observe the water molecules that bind specifically with other molecules that bind specifically with other molecules.
hydrogen atoms, it will have a stronger attraction for the shared electrons are less attracted to the hydrogen orbitals, causing the positive charge of the hydrogen atoms. Expertise in final identification comes from cells. Look at figure 3.1 on page 61. The electrons are less attracted to the hydrogen orbitals, causing the positive charge of the hydrogen atoms.
key determinants in the last category, identification. The thick, white plaque that forms on teeth comes in part from the surface slimes produced by certain streptococci in the oral cavity. Often it is sufficient to know simply whether a bacterial species is motile. The first primitive eukaryotes were probably single-celled, independent microorganisms
but, over time, some forms began to cluster in permanent groupings called colonies. Eventually, it is either discarded or modified to fit the results of that characteristics of fungi allow them to spread into such a wide variety of habitats? * polymer (pahl9-ee-mur) Gr. poly, many; also the root for polysaccharide, polypeptide, and
polynucleotide. The Gram stain is the basis of several important bacterial cell wall structure, identification, and drug therapy. Cell Destruction Immediate or delayed Head Bacterial cell wall structure, identification, and drug therapy. Cell Destruction Immediate or delayed Head Bacterial cell wall structure, identification, and drug therapy.
It is solid at room temperature, and it melts (liquefies) at the needles, pipettes, and swabs. Functions of the eukaryotic organelles, the cell membrane provides a site for energy reactions, nutrient processing, and synthesis. Also ask your instructor about the resources available through ConnectPlus
including the media-rich eBook, interactive learning tools, and animations. 112 Chapter 4 TABLE 4.4 A Survey of Prokaryotic Cells and Microorganisms Important Families and Genera of Pathogenic Bacteria, with Notes on Some Diseases* I. For its part, the bacterial se of archaeal molecules metabolic relationship with the archaea, making use
Photosynthetic bacteria on. Encapsulated bacteria cells generally have greater pathogenicity because capsules protect the bacteria against white blood cells generally have greater pathogenicity because capsules protect the bacteria against white blood cells generally have greater pathogenicity because capsules protect the bacteria against white blood cells generally have greater pathogenicity because capsules protect the bacteria against white blood cells generally have greater pathogenicity because capsules protect the bacteria against white blood cells generally have greater pathogenicity because capsules protect the bacteria against white blood cells generally have greater pathogenicity because capsules protect the bacteria against white blood cells generally have greater pathogenicity because capsules protect the bacteria against white blood cells generally have greater pathogenicity because capsules protect the bacteria against white blood cells generally have greater pathogenicity because capsules protect the bacteria against white blood cells generally have greater pathogenicity because capsules protect the bacteria against white blood cells generally have greater pathogenicity because capsules protect the bacteria against white blood cells generally have greater pathogenicity because a greater pathogenic pathogen
here. ments and tests, special procedures have been developed to control 19. membrane. 32. Contaminated cultures can ruin correct analysis and study. Covalent bonds, with shared electrons. Outline the structure and functions of cell walls, and explain the role of peptidoglycan. One of the proposed alternate plans of classification is shown in figure and functions of cell walls, and explain the role of peptidoglycan.
5.13. In active transport mechanisms, energy is expended (ATP) to transport the molecule across the cell membrane. Because such an infection usually occurs when the host is compromised, the microbe is said to be an opportunistic pathogen. (a) Capsomers assemble into hollow discs. imperfect d. Cholesterol reinforces the structure of the cell
membrane in animal cells and in an unusual group of cell-wall-deficient bacteria called the mycoplasmas (see chapter 4). Certain algae produce neurotoxins that are harmful to humans and animals. If you were involved in developing an antiviral drug, what would be some important considerations? A spore produced by budding from a parent cell that
is a yeast or another conidium; also called a bud. Ultimately, the buildup of these converted proteins damages and kills the cell (figure 6.21b). This number represents the animal viruses were classified mainly on the basis of their
hosts and the kind of diseases they caused. In the case of certain pathosediment, a surface scum, or colored pigment. Nicolson, is called the fluid mosaic model. (see chapters 12 and 14). A desert-adapted green alga blooms during spring rains and survives by forming resistant spores (figure 5.22c, d). Types of Differential Stains An effective
differential stain uses dyes of contrasting color to clearly emphasize differences between two cell types or cell parts. Responsiveness is the capacity of cells to interact with external factors through irritability, communication, or movement. A cell that is cylindrical (longer than wide) is termed a rod, or bacillus.* There is also a genus named Bacillus.*
named for its rod shape. 5.5 The Kingdom of the Fungi Expected Learning Outcomes 21. (b) An artist's three-dimensional rendition of a chloroplast and its major features. (j) A dust mite lives in human settings and feeds off dead skin flakes. * basidiospores (bah-sid9-ee-oh-sporz) Gr. basidi, a pedestal. About 100,000 species are known, although
experts estimate a count much higher than this—perhaps even 1.5 million different types. Other intriguing evidence comes from fossilized cells discovered in shale deposits from China and Russia that are 600 million to nearly a billion years old. The immensity of this community has led one group of scientists to estimate that it comprises nearly one
third of all life on the planet! Evidence points to its extreme age: It has been embedded in the earth's crust for billions of years. Some viral infections can be treated with drugs that block viral replication. (gol9-jee) Named for C. This process takes, on average, about 10 hours. Microbiology as a science is about 300 years old. (c) Unusual flagella on
Aquaspirillum are amphitrichous and coil up into tight loops (7,5003). Natural organic molecules are nearly always the products of living things. (b) A fluorescent micrograph of Deinococcus radiodurans, showing its packet arrangement, cell walls (red), and chromosomes (green). By contrast, the crystals of dye tightly embedded in the gram-positive
bacteria are relatively inaccessible and resistant to removal. They are distributed in all areas of the world that support human life. The main determinants of a microbe's nutritional type are its sources of carbon and energy. This code is in the form of DNA in all cells and many viruses; a number of viruses are based on RNA alone. Outline the major
events in the history of microbiology, including the major contributors to the early development of microscopy, medical advances, aseptic techniques, and the germ theory of disease. Notice how much of the cell's space the chromosomes (light blue bodies) occupy. Recall that the members of symbiotic relationships are termed symbionts. The smooth
outer membrane completely covers an inner membrane folded into small, disclike sacs called thylakoids that are stacked upon one another into grana. Notice the location of the ba(cap) sidia along the gills in mushrooms, which are often dark from the spores they contain. Answer available at talaro9 (a) Biofilm matrix Capsule Cells of biofilm Fibrous
surface of catheter Cell bodies (b) Figure 4.11 Appearance of encapsulated bacteria. Life on earth would not be possible without them. To protect the fungi from other microbes, the ants also cultivate species of filamentous bacteria called actinomycetes that produce antibiotics. Fortunately, most organisms show consistent trends and can be
described by a few general categories (table 7.2) and a few selected terms (7.1 Making Connections). Enzymes hydrolyze the bonds on nutrients. The egg must be injected through the shell, necessitating rigorous sterile techniques to prevent contamination by bacteria and fungi from the air and the outer surface of the shell. NH4+
Cellulose degrader (Cellulomonas) Nitrogen fixer (Azotobacter) N2 Glucose (j) Dermatophagoides mite (1003) (i) Cycle of cross-feeding in two soil bacteria Amensalism One member of an association produces a substance that harms or kills another. Even viruses are no exception to this rule, but there is a significant difference. coli cells tightly
adheres by their fimbriae to the surface of an intestinal cell (12,0003). MASS 22.99 CALCIUM P 20 15 PHOSPHORUS S 16 Cl SULFUR 2 • 8 • 7 K AT. pili d. The septate hyphae develop small pores that allow communication between cells. from the surgery b. Construct a table that displays all microbial groups based on what kind of cells they have or do
not have. This process is repeated at intervals by each new daughter cell in turn; and with each successive round of division, the population increases. To integrate information from Internet sites, we placed "Quick Search" motifs within the chapters that direct readers to interesting enrichment topics, videos, or animations that can be quickly
accessed with a computer, smart phone, or tablet. Explain what it means for a virus to become persistent or latent, and how these events are important. Discuss the fundamentals of evolution, evidence used to verify evolutionary trends, and its use in studying organisms. The surfaces of microbes are negatively charged and attract basic dyes. Then
there is the matter of the incredible resistance of microbes. Microtubules are stained green, microfilaments are red, and the nucleus is blue. Electrons orbit the nucleus is blue. Electrons orbit the nucleus is blue. Electrons orbit the nucleus is blue.
bacterium carried in the intestine of domestic cattle, Escherichia coli O157:H7, the agent of a serious kidney disease, has been associated with hundreds of thousands of infections from food and water contaminated with hundreds of thousands of infections from food and water contaminated with hundreds of thousands of infections from food and water contaminated with hundreds of thousands of infections from food and water contaminated with hundreds of thousands of infections from food and water contaminated with hundreds of thousands of infections from food and water contaminated with hundreds of thousands of infections from food and water contaminated with hundreds of thousands of infections from food and water contaminated with hundreds of thousands of infections from food and water contaminated with hundreds of thousands of infections from food and water contaminated with hundreds of thousands of infections from food and water contaminated with hundreds of thousands of infections from food and water contaminated with hundreds of thousands of infections from food and water contaminated with hundreds of thousands of infections from food and water contaminated with hundreds of thousands of infections from food and water contaminated with hundreds of thousands of infections from food and water contaminated with hundreds of thousands of tho
conditions to grow such organisms in the lab. Nonpathogenic bacterial groups: The majority of bacterial groups: The majority of bacterial groups and not involved in disease. From this site, they can penetrate the lining of the intestine and invade the liver, lungs, and skin. Prions are a group of noncellular infectious agents that are not viruses and really belong in a
category all by themselves. The enlarged image is displayed on a viewing screen or photographed for further study rather than being observed directly through an eyepiece. 42 Chapter 2 TABLE 2.3 Representative Functional Groups and Organic Compounds That Contain Them Formula of Functional Group R* O The Chemistry of Biology H Name Can
Be Found in Hydroxyl Alcohols, carbohydrates Carboxyl Fatty acids, proteins, organic acids Amino Proteins, nucleic acids O R C OH H R C NH2 Check Your Progress H O R C O Ester Lipids Sulfhydryl Cysteine (amino acid), proteins Carbonyl, terminal end Aldehydes, polysaccharides R H R C these groups are assembled from smaller molecular
subunits, or building blocks, and because they are often very large compounds, they are termed macromolecules. This is the first organism on earth known to have established its own ecosystem and to sustain itself without the contributions of other organisms. Most are pathogens that alternate between a mammalian host and bloodsucking or the first organism on earth known to have established its own ecosystem and to sustain itself without the contributions of other organisms.
arthropods,7 such as fleas, lice, or ticks. General-purpose media are designed to grow a broad spectrum of microbes that do not have special growth requirements. (c) The ciliophoran Euplotes (8003) harbors unicellular green algae. Survey of Protists: Protozoa Amoebiasis: Entamoeba histolytica Brain infection: Naegleria, Acanthamoeba
Reservoir/Source Human/water and food Free-living in water Ciliated Protozoa Balantidiosis: Balantidiosis: Giardia lamblia Trichomoniasis: T. (i) Azotobacter releases NH4 that feeds Cellulomonas, and Cellulomonas degrades cellulose that feeds Azotobacter releases NH4 that feeds Cellulomonas, and Cellulomonas degrades cellulose that feeds Azotobacter releases NH4 that feeds Cellulomonas, and Cellulomonas, and Cellulomonas degrades cellulose that feeds Azotobacter releases NH4 that feeds Azotobacter releases NH4 that feeds Azotobacter releases NH4 that feeds Cellulomonas, and Cellulo
rates of pertussis in decades, even though children were being vaccinated. st notable is a protozoan the cell membrane of early eukaryotic cells. Define what is meant by emerging and reemerging diseases. A facultative halophile can grow with or without high-salt concentration. cid 0 b l r a in ac k co ffe 6. Explain why an isolated colony and a pure
culture are not the same thing. Even so-called harmless species found in the air and dust around us may be able to cause opportunistic infections in patients who already have AIDS, cancer, or diabetes. Peptone is a partially digested protein, rich in amino acids, that is often used as a carbon and nitrogen source. Powered by an intelligent diagnostic
and adaptive engine, SmartBook facilitates the reading process by identifying what content a student knows and doesn't know through adaptive assessments. Dozens of experimental trials are underway to develop potential cures for diseases, with mixed success (look ahead to chapter 10). She has been nurturing her love of microbiology since her
youth growing up on an Idaho farm where she was first fascinated by tiny creatures she could just barely see swimming in a pond. The most famous of these is gastric * zoonoses (zoh0-uh-noh9-seez) Gr. zoion, animal and nosos, disease. The end result of most viral infections is death of the host cell. This person becomes a host and a source of eggs,
and can spread them to others in addition to reinfesting himself. (a) Covalent bonds, both single and double. Pinching off the pouch releases the virus with its envelope (figure 6.14). Trophozoites are motile by cilia. (b) Herpes
simplex virus, a type of enveloped icosahedral virus (300,0003). In time, the cells evolved flexible outer envelope rickettsias, that can live into a single functioning entity, and the and folded internal intracellularly. Note the empty heads of "spent" phages lined up around the ruptured wall. These techniques are featured in several figures throughout
this chapter. A few species of algae, archaea, and bacteria can actually survive at a pH near that of concentrated hydrochloric acid near a pH of 0. Chemically, a ribosome is a combination of a special type of RNA called ribosomal RNA, or rRNA (about 60%), and protein (40%). Enveloped viruses bud off of the membrane, carrying away an envelope
with the spikes. One type of mesophile termed a psychrotroph is capable of growth at temperatures below 208C. reproductive bodies called spores, discussed next. Scanning electron microscope (SEM) View of a marine alga known as a coccolithophore, bearing an intricate cell wall 13,0003. We have added this new feature to enrich our coverage of
the latest research discoveries and applications in the field of microbiology. Both linear and ring models are given. The majority are harmless saprobes living off organic substrates such as dead animal and plant tissues. All living things are composed of cells, which are complex collections of macromolecules that carry out living processes. Capsid
Nucleic acid Viral Components: Capsids, Nucleic Acids, and Envelopes It is important to realize that viruses bear no real resemblance to cells and Archaea The Structure of a Generalized Bacterial Cell Extensions and Surface
Structures 4.3 The Cell Envelope: The Outer Boundary Layer of Bacteria Endospores: An Extremely Resistant Life Form 4.5 Bacterial Shapes,
Arrangements, and Sizes 4.6 Classification Systems of Prokaryotic Domains: Archaea and Bacteria Bacteria Unusual Forms of Medically Significant Bacteria Unusual Characteristics Free-Living Nonpathogenic Bacteria Unusual Forms of Medically Significant Bacteria Unusual Characteristics Free-Living Nonpathogenic Bacteria Unusual Characteristics Free-Living Nonpathogenic Bacteria Unusual Forms of Medically Significant Bacteria Unusual Characteristics Free-Living Nonpathogenic Bacteria Unusual Forms of Medically Significant Bacteria Unusual Characteristics Free-Living Nonpathogenic Bacteria Unusual Characteristics Free-Living No
Eukaryotic Cells and Microorganisms 5.1 The History of Eukaryotic Cell: External Structures 5.2 Form and Function of the Eukaryotic Cell: Internal Structures The Nucleus: The Control
Overview of Taxonomy 5.5 The Kingdom of the Fungi Fungal Identification Fungal Identific
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Multiplication Cycle in Bacteriophages Lysogeny: The Silent Virus Infection 6.6 Techniques using Embryos Using Live Animal Inoculation 6.7 Viral Infection, and Treatment 6.8 Prions and Other Nonviral Infectious ParticlesCHAPTER 7 Microbial
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Molecular Motion The Diffusion of Water: Osmosis Adaptations to Osmotic Variations in the Environment The Movement of Solutes Across Membranes Active Transport: Bringing in Molecules Against a Gradient Endocytosis: Eating and Drinking by Cells 7.4 Environmental Factors That Influence Microbes Adaptations to Temperature Gas
Requirements Effects of pH Osmotic Pressure Miscellaneous Environmental Factors 7.5 Ecological Associations Among Microorganisms 7.6 The Study of Microbial Crowth The Basis of Population Growth Other Methods of Analyzing
Population GrowthCHAPTER 8 An Introduction of Enzymes: Catalyzing the Chemical Reactions of Life 8.1 The Metabolism: The Chemical Reactions of Life 8.1 The Metabolism of Microbes Enzymes: Catalyzing the Chemical Reactions of Life 8.1 The Metabolism of Microbes Enzymes 8.2 The Pursuit and Utilization of Energy Cell Energetics 8.3 Pathways of Bioenergetics Catabolism
An Overview of Nutrient Breakdown and Energy Release Energy Strategies in Microorganisms Aerobic Respiration Pyruvic Acid—A Central Metabolite The Krebs Cycle—A Carbon and Energy Wheel The Respiration 8.4 The Importance of
Fermentation 8.5 Biosynthesis and the Crossing Pathways of Metabolism The Frugality of the Cell—Waste Not, Want Not Assembly of the Cell 8.6 Photosynthesis: The Earth's Lifeline Light-Dependent Reactions Other Mechanisms of Photosynthesis: The Earth's Lifeline Light-Dependent Reactions Other Mechanisms of Photosynthesis: The Earth's Lifeline Light-Dependent Reactions Other Mechanisms of Photosynthesis: The Earth's Lifeline Light-Dependent Reactions Other Mechanisms of Photosynthesis: The Earth's Lifeline Light-Dependent Reactions Other Mechanisms of Photosynthesis: The Earth's Lifeline Light-Dependent Reactions Other Mechanisms of Photosynthesis: The Earth's Lifeline Light-Dependent Reactions Other Mechanisms of Photosynthesis: The Earth's Lifeline Light-Dependent Reactions Other Mechanisms of Photosynthesis: The Earth's Lifeline Light-Dependent Reactions Other Mechanisms of Photosynthesis: The Earth's Lifeline Light-Dependent Reactions Other Mechanisms of Photosynthesis: The Earth's Lifeline Light-Dependent Reactions Other Mechanisms of Photosynthesis: The Earth's Lifeline Light-Dependent Reactions Other Mechanisms Other Mechanisms of Photosynthesis: The Earth's Lifeline Light-Dependent Reactions Other Mechanisms Other Mechani
 Genetics and Genes: Unlocking the Secrets of Heredity The Nature of the Genetic Material The Structure of DNA: A Double Helix with Its Own Language DNA Replication: Preserving the Code and Passing It On 9.2 Applications of the DNA Code: Transcription and Translation The Gene-Protein Connection The Major Participants in Transcription and
Translation Transcription: The First Stage of Gene Expression Translation: The Second Stage of Gene Expression Eukaryotic Transcription and Translation: Similar yet Different 9.3 Genetic Regulation in Bacteria A Repressible Operon Non-Operon
Control Mechanisms 9.4 Mutations: Changes in the Genetic Code Causes of Mutations Categories of Mutations Transmission of Genetic Material in Bacteria 9.6 The Genetics of Animal Viruses Replication Strategies in Animal
VirusesCHAPTER 10 Genetic Engineering: A Revolution in Molecular Biology 10.1 Basic Elements and Applications of Genetic Engineering Tools and Techniques of DNA Technology: How to Imitate Nature Technical Aspects of Recombinant DNA and Gene Cloning Construction of a Recombinant, Insertion into a
Cloning Host, and Genetic Expression Protein Products of Recombinant DNA Technology 10.3 Genetically Modified Organisms and Other Applications Recombinant Microbes: Modified Bacteria and Viruses Recombinant DNA Technology 10.4 Genome Analysis: Fingerprints and Genetic
Testing DNA Fingerprinting: A Unique Picture of a GenomeCHAPTER 11 Physical and Chemical Agents for Microbial Control Relative Resistance of Microbial Control What Is Microbial Control What Is Microbial Control What Is Microbial Control to flow
freely when the container is tilted. With inductive reasoning, one applies specific observations to develop a general explanation. replication c. Virulence Factors S. 4.4 Bacterial Internal Structures in bacteria: the chromosome(s) condensed in the nucleoid; ribosomes, which
serve as the sites of protein synthesis and are 70S in size; extra genetic information in the form of plasmids; storage structures known as inclusions; a cytoskeleton of bacterial actin, which helps give the bacterial acti
capsid is first laid down as an empty shell that will serve as a receptacle for the nucleic acid strand. The highly reactive superoxide ion (O22), peroxide (H2O2), and hydroxyl radicals (OH) are other destructive metabolic by-products of oxygen. By some estimates, archaea are the most common cells on the earth, and they have made major
contributions to the development of the earth itself. An imaginary molecular view of this area shows that sugar molecules are in a constant state of motion. Difficult, because we can't observe or analyze them without special techniques, especially the use of microscopes (see chapter 3). nomen, name, and clare, to call. A phospholipid contains a. N C C
N C C N C C The most important outcome of bonding and H O H OH H OH H O R3 R1 H H folding is that each different type of protein develops a unique shape, and its surface displays a Amino acid 1 Amino acid 2 Amino acid 3 Amino acid 4 distinctive pattern of pockets and bumps. Can you think of a simple test to determine if a child is
suffering from pinworms? Explain solutes, solvents, and hydration. Species that carry the greatest medical impact are Chlamydia trachomatis, the cause of both a severe eye infection (trachoma) that can lead to blindness and one of the most common sexually transmitted diseases, and Chlamydophila pneumoniae, an agent in lung infections. Describe
some possible benefits of having biofilms form in or on the human body. As with the prokaryotes, we begin on the outside and proceed inward through the cell. Economically beneficial as sources of antibiotics; used in making foods and in genetic studies. Though some of these early ideas seem quaint and ridiculous in light of modern knowledge, we
must remember that, at the time, mysteries in life were accepted and the scientific method was not widely practiced. One way to detect the growth of a virus in culture is to observe degeneration and lysis of infected cells in a monolayer of a cell culture (figure 16.19a). Their survival under such harsh conditions is due to several factors. Looking at
modern eukaryotic organisms, we find examples of many levels of cellular complexity (table 5.1). Describe the structure of the nucleus and its outstanding features. Only the open vessel developed microorganisms, which he presumed had entered in air laden with dust. (c) Steps in the loop dilution method and (d) the appearance of plate 3. The
Kingdom of the Fungi 135 (figure 5.15a). The medical and agricultural impact of fungi is extensive. Other microbes are not so limited the exact order, type, and number of amino acids. This textbook will largely follow the simpler system on the right, using Kingdoms, Divisions, and Phyla to separate the groups of eukaryotes. To maximize its resolving the simpler system on the right, using Kingdoms, Divisions, and Phyla to separate the groups of eukaryotes. To maximize its resolving the simpler system on the right, using Kingdoms, Divisions, and Phyla to separate the groups of eukaryotes.
power, an oil immersion lens (the one with highest magnification) must have a drop of oil placed at its tip. (a) The surface of an Alaskan glacier provides a perfect habitat for psychrophilic photosynthetic organisms such as Chlamydomonas nivalis. These enzymes digest the core to water. Mycobacterium tuberculosis— K M b t i t
b l i the bacillus that causes tuberculosis Volume 4 Phylum Actinobacteria This taxonomic category includes the high G 1 C (over 50%) gram-positive bacteria. Inspection begins with macroscopic characteristics of the culture and summarize their
importance to humans. Most prokaryotes are surrounded by a protective envelope that consists of the cell membrane. Molecules of Life: Proteins Amino Acid Structural Formul a H SECTIONS 2.52.6 25. (b) Figure 7.12 Culturing techniques for anaerobes. A significant factor in transmission of several parasites is the involvement of
arthropod vectors such as mosquitoes and flies. (see chapters 10 and 17). This is called a phenetic, or phenotypic, method of classification. Nutritional Mode/Distribution: Photosynthetic; freshwater and marine water habitats; main component of plankton. This is the main test for HIV infection (see figure 17.16). Once the student has mastered the
necessary basic skills and concepts, they engage in a highly realistic simulated lab experience that allows for mistakes and the execution of the scientific method. Compare and contrast prokaryotic cells, eukaryotic cells, and viruses. Microbiology is the study of bacteria, viruses, fungi, protozoa, and algae, which are collectively called microorganisms,
or microbes. *nano for nanometer, which is one-billionth of a meter in length, about 1/80,000 the diameter of a human hair. Adenovirus 75 nm 8. This taken during lecture can be rewritten or outlined to organize the means you must not only
function between molecules but may occur within different regions of the same large molecule. The fact that not all microbes exhibit capsules is a useful feature for identifying pathogens, conidium; Gr. konidion, a particle of dust. 36. All rights reserved. Describe a nucleotide and a polynucleotide, and compare and contrast the general structure of
DNA and RNA. Research into the fine structure of certain rod- and spiral-shaped bacteria has provided several new insights. The Origin and Evolution of Microorganisms 21 16. T an s oc y all ers iety iou ut var rev M o icr CASE STUDY Part 1 A view of the North Atlantic Ocean, a fitting place to mine for marine microbes. In fact, they can use their
senses of sight, smell, hearing, and even touch to detect and evaluate identifying characteristics and to keep track of growth and developmental changes. There are more infections than people acquire more than one infection. A great deal of new research is also being devoted to the development of nanoparticles to deliver drugs.
analyze DNA, and treat disease (look back at Clinical Connections, page 67). Viruses are infectious particles and locomotion of any kind; are large, complex molecules; and can be crystalline in form. The fastest ciliated protozoan ciliate movement can swim up to 2,500 mm/s—a meter and a on YouTube. We will touch on
this relationship in chapter 5. invaginations of the cell membrane c. * capsomer (kap9-soh-meer) L. What is a biofilm, and how did it form on the heart valve? This * aerobe (air9-ohb) Although the prefix means air, it is used in the sense of oxygen. falciparum, P. sheaths 3. 34. To-scale examples of each virus family are included. Chloroplasts:
Photosynthesis Machines Chloroplasts are remarkable organelles found in algae and plant cells that are capable of converting the energy of sunlight into chemical energy through photosynthesis. This organelle is always closely associated with the endoplasmic reticulum both in its location and function. Instead of painstakingly isolating and than there
are stars in the universe—an estimated nonillion (one folidentifying the individual microbes in the sample, as might have lowed by 30 zeros). A vibrio-shaped thermophile, Desulfovibrio, living in a pond biofilm 4.6 Classification Systems of Prokaryotic Domains: Archaea and Bacteria TABLE 4.3 111 (continued) Volume 3 Phylum Firmicutes This
collection of mostly gram-positive bacteria is characterized by having a low G 1 C content* (less than 50%). specimen holder b. It does not imply that an atom is getting smaller. One common type of osmophile such as Halobacterium and Halococcus inhabit
salt lakes, ponds, and other hypersaline habitats. As the student reads, the reading material constantly adapts to ensure the student is focused on the content he or she needs the most to close any knowledge gaps. This revised system can be represented as a six-kingdom system with Bacteria and Archaea serving as both Domain and Kingdom. Its role
as an endotoxin is described in chapter 13. Because they also have either an aldehyde or a ketone group, they are often designated as polyhydroxy aldehydes or ketones (figure 2.15). Placed under tremendous pressures, the methane it releases becomes frozen into crystals. Both of these viewpoints have some supportive evidence, and it is entirely
possible that viruses have originated in more than one way. To sum up the presence of microbes in one word, they are ubiquitous.* They are found in all natural habitats and most of those that have been created by humans. * picornavirus (py-kor0-nah-vy9-rus) Sp. pico, small, plus RNA. It is thought that magnetosomes direct these bacteria into
locations with favorable oxygen levels or nutrient-rich sediments. dysentery,* caused by Entamoeba histolytica. One of these is a very-long-chain fatty acid called mycolic acid, or cord factor, that contributes to the pathogenicity of this group. A microaerophile* does not grow at normal atmospheric concentrations of oxygen but requires a small amount
of it (1%-15%) in metabolism. This lays the groundwork for further research into the nature and roles of these microbes; it can also provide numerous applications in infection diagnosis, food safety, biotechnology, and microbial ecology. Even our modern laboratory microscopes are not greatly different in basic structure and function from those early
microscopes. (b) H + 8p H O + 1p (+) Figure 2.5 1p + H H (+) (+) Polar molecule. Phylum Planctomycetes This group lives in fresh and marine water habitats and reproduces by budding. To reflect these relationships, Carl Woese and George Fox have proposed a system that assigns all organisms to one of three domains, each described by a
different type of cell (see box below and figure 1.15). bacteria b. Prokaryotes perform similar functions, but they lack dedicated organelles to carry them out (figure 1.2). 27. Because of the damaging effects of very concentrated acids or bases, most cells operate best under neutral, weakly acidic, or weakly basic conditions (see chapter 7). It is worth
noting, in advance of chapter 5, that the mitochondrion, a eukaryotic organelle, is a close genetic relative to rickettsias, indicating an evolutionary link between them. 14 billion years ago 2 billion years ago 2 billion years ago 3 billion years ago 3 billion years ago 3 billion years ago 1 billion years ago 1 billion years ago 3 billion years ago 3 billion years ago 1 billion years ago 3 billion years ago 1 billion years ago 3 billion years ago 3 billion years ago 1 billion years ago 3 billion years ago 1 billion years ago 3 billion years ago 4 billion years ago 4 billion years ago 4 billion years ago 5 billion years ago 6 billion years ago 8 billion years ago 9 billion year
RNA synthesis and a collection area for ribosomal subunits. Phylum Thermotogae A phylum similar to Aquificae; includes thermophilic halophiles that live in deep-sea vents. Other highlights in this era of discovery are presented in later chapters on microbial control (see chapter 11) and vaccination (see chapter 15). Leeuwenhoek constructed more
than 250 small, powerful microscopes that could magnify up to 300 times (figure 1.9). DNA is the master code for a cell's life processes and must be transmitted to the offspring through replication. More information on these important processes and must be transmitted to the offspring through replication.
ribosomes, and are perhaps the first indisputable tiny cells that look like dwarf bacteria but are 10 times smaller than nanobes. * rhabdovirus (rab0-doh-vy9-rus) Gr. rhabdo, little rod. Differential stains require a primary dye and a contrasting counterstain in order to distinguish cell types or parts. nutrients dissolved in seawater b. How are infectious
diseases different from other diseases? Fungi and most algae have a thick, rigid cell wall surrounding a cell membrane. Many inorganic nutrients originate from nonliving environments such as air, water, and bedrock. What are vibrios and coccobacilli? What is the connection between viruses and cancer? 2.2 dominate. 3 Chromosome division and
septation The chromosomes affix to the cytoskeleton and are separated into the forming cells. Have both macronuclei; division by transverse fission Most have a definite mouth and feeding organelle. Describe inclusion bodies and granules, and explain their importance to cells. Fatty acids are a superior source of energy, yielding
twice as much per gram as other storage molecules (starch). Diffusion and Molecular Motion All atoms and molecules, regardless of being in a solid, liquid, or gas, are in continuous movement. Additional reactants coming from another reaction can also be indicated by arrows that enter or leave at the main arrow: CD XY C XYD Solutions:
Homogeneous Mixtures of Molecules A solution is a mixture of one or more substances called solutes uniformly dispersed in a dissolving medium called a solvent. This does not mean the results are invalid; it means the hypothesis may require reworking or additional tests. Explain what happens in negative staining that causes the final result. For
more background on MRSA and endocarditis, see chapter 18. A TEM of one virus particle reveals its unique geometric shape, dark DNA core, and fine surface fibrils (4,5003). Many organisms also display sexual reproduction, involving the union of sex cells from two parents. (d) Fungal hyphae (blue filaments—5003) growing in close contact with the
cells of a grass leaf. In some viruses, the vesicle membrane fuses with the virus, and in other cases, the vesicle membrane develops openings for the virus to leave. Curiosity* is designed to by googling "The monitor the methane content and possibly 7 Biggest Mysteries of Mars." determine if it is from a biological or nonbiological source. Kathy
continues to make microbiology a major focus of her life and is passionate about conveying the significance and practically anyone who shows interest. The Cytoplasmic (cell) membrane of eukaryotic cells is a typical bilayer of phospholipids in
which protein molecules are embedded (see figures 2.20 and 4.17). archaea c. One example is eosin, a red dye used to stain blood cells. 110 Chapter 4 TABLE 4.3 A Survey of Prokaryotic Cells and Microorganisms Overview of a Classification System for Prokaryotic Cells and Edition (See Appendix Table C.2 for a full outline.)
Volume 1 Domain Archaea Includes prokaryotes with unusual morphology, ecology, and modes of nutrition. The jagged lines and R symbol represent the hydrocarbon chains of the fatty acids, which are commonly very long. Researchers have discovered that prion or prionlike proteins are very common in the cell membranes of plants, yeasts, and
animals. The template for the lagging strand runs 5' to 3' (opposite to the leading strand), so to make the new strand in the 5' to 3' orientation, synthesis must proceed backward, away from the replication fork. As it turned out, the c What is the importance of a Gram stain in diagnosis of an infection cerebrospinal fluid (CSF) the technician extracted
appeared norlike this? Are there other ways (besides vaccines) to prevent any of these? He conducted a simple experiment in which he placed meat in a jar and covered it with fine gauze. In Multiple-Choice Questions negative staining, the microbe repels the dye and it stains the background. They are not considered medically important but are of
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ecological and potential economic importance. With this technique, the dye settles around the cell and creates a dark background. What kinds of cells are shown here? Good magnified image Contrast Magnification Wavelength Level II. * palisades (pal9-ih-saydz) L. In the ninth edition the Pathogen Profiles take on a new look. State several ways that
microbes are involved in the earth's ecosystems. Explain the species and subspecies levels for bacteria. Functions of the Viral Capsid/Envelope The outermost covering of a virus is indispensable to viral function because it protects the nucleic acid from the effects of various enzymes and chemicals when the virus is outside the host cell. fusion c. The
Rate of Population Growth The time required for a complete fission cycle—from parent cell to two new daughter cells—is called the generation, or doubling, 5. Hackett Brand Manager: Amy Reed Director of Development: Rose M. This method is often used in the early phases of evaluation and can formulate a generalization to be tested deductively. As
each organism in the biofilm carries out its specific niche, signaling among the members sustains the overall partnership. In general, solid fats (such as beef tallow) are more saturated, and oils (or liquid fats) are more unsaturated. Explain how microbes are classified into groups according to evolutionary relationships, provided with standard
scientific names, and identified by specific characteristics. Other viruses can vary in the number, types, and arrangement of capsomers. The Methanogens* are a unique type of chemoautotroph widely distributed in the earth's habitats. 35 Bonds and Molecules Sodium - Chloride (d) Figure 2.6 Ionic bonding between sodium and
chlorine. Describe the three major archaeal lifestyles and adaptations to extreme habitats. Is there such a thing as a "good virus"? Tolerance is another term that can be used to describe the capacity to survive a range of conditions. Keep in mind that all of the matoxidizing agent and a reducing agent, using examples. Algae occur in unicellular,
colonial, and filamentous forms, and the larger forms can possess tissues and simple organs. Although the best-studied biofilms involve just a single type of microorganism, most biofilms observed in nature are polymicrobial. The bug seeks a host and bites the mucous membranes, usually of the eye, nose, or lips, releasing the trypanosome in feces
near the bite. An easier way to calculate the size of a population over time is to use an equation such as: Nf 5 (Ni)2n In this equation, Nf is the exponent n denotes the generation number, and 2n represents the number of cells in that generation
Humans are the definitive hosts for many of the parasites, and in about half the diseases, they are also the sole biological reservoir. (b) Starch is also composed of glucose polymers, in this case a glucose. Strains of Staphylococcus aureus grow within the range of 68C to 468C (438F to 1148F), and the intestinal bacterium Enterococcus faecalis grows
within the range of 08C to 448C (328F to 1128F). When exposed to special stains or observed with an electron microscope, chromosomes have a granular or fibrous appearance (figure 4.18). Some strict parasites will not grow if the temperature varies more than a few degrees below or above the host's body temperature. One is to place a blue filter
over the microscope lamp, keeping the wavelength at the shortest possible value. Distinguish between the general reactions in covalent, ionic, and generated images (see figure 2.23, step 4). This net movement of Substances Across the Cell
Membrane How Molecules Diffuse in Aqueous Solutions Figure 7.4 Diffusion of molecules in aqueous solutions. Identify the groups of microorganisms included in the scope of microscope to improve resolution? Other valued members of our team who
have been instrumental in developing the text's visual elements are Carrie Burger, the content licensing specialist, Danny Meldung at Photo Affairs, and the designer Tara McDermott, who has produced another striking book and cover design. The Cytoskeleton: A Support Network All cells share a generalized region encased by the cell membrane
called the cytoplasm or, in eukaryotic cells, the cytoplasmic matrix. The basic structure of a simple carbohydrate monomer is a backbone of carbon bound to two or more hydroxyl groups. 7.2 Classification of Nutritional Types Expected Learning Outcomes 5. Adsorption and Host Range Invasion begins when the virus encounters a susceptible host cell
and adsorbs specifically to receptor sites on the cell membrane. Summarize the concepts of valence, polarity, and diatomic elements. (b1, 2) Simple models of hydrogen and carbon are not strictly accurate representations of atomic structure but are designed as a quick reference to the numbers and arrangements of shells and electrons, and the
numbers of protons and neutrons in the nucleus. a proton 12. Active photosynthesis and oxygen release are evident in surface bubbles. (a) A bacterial chromosome showing the overall pattern of replication. all of these 2. Go to figure 3.13 and trace what information was used to "key out" and identify the bacterial species that caused meningitis in the
Case Study. Over hundreds of millions of years, this combination evolved into a stable, beneficial partnership. * Micrococcus luteus (my0-kroh-kok9-us loo9-tee-us) Gr. micros, small, and kokkus, berry; L. As a result, several alternative taxonomic strategies are being proposed to deal with this changing picture. These protruding molecules, called
spikes or peplomers, are essential for the attachment of viruses to the (d) next host cell. Many of the discoveries in this science have resulted from the prior work of men and women who toiled long hours in dimly lit laboratories with the 12 Chapter 1 The Main Themes of Microbiology 1.1 MAKING CONNECTIONS The Changing Spectacle of
Infectious Diseases The middle of the last century was a time of great confidence in science and medicine. * Coryne, club, bacterion, little rod, and diphtheriae (kor-eye0-nee-bak-ter9-ee-yum dif9-theer-ee-eye) Gr. coryne, club, bacterion, little rod, and diphtheriae (kor-eye0-nee-bak-ter9-ee-yum dif9-theer-ee-eye) Gr. coryne, club, bacterion, little rod, and diphtheriae (kor-eye0-nee-bak-ter9-ee-yum dif9-theer-ee-eye) Gr. coryne, club, bacterion, little rod, and diphtheriae (kor-eye0-nee-bak-ter9-ee-yum dif9-theer-ee-eye) Gr. coryne, club, bacterion, little rod, and diphtheriae (kor-eye0-nee-bak-ter9-ee-yum dif9-theer-ee-eye) Gr. coryne, club, bacterion, little rod, and diphtheriae (kor-eye0-nee-bak-ter9-ee-yum dif9-theer-ee-eye) Gr. coryne, club, bacterion, little rod, and diphtheriae (kor-eye0-nee-bak-ter9-ee-yum dif9-theer-ee-eye) Gr. coryne, club, bacterion, little rod, and diphtheriae (kor-eye0-nee-bak-ter9-ee-yum dif9-theer-ee-eye) Gr. coryne, club, bacterion, little rod, and diphtheriae (kor-eye0-nee-bak-ter9-ee-yum dif9-theer-ee-eye0-nee-bak-ter9-ee-yum dif9-theer-ee-eye0-nee-bak-ter9-ee-yum dif9-theer-ee-eye0-nee-bak-ter9-ee-yum dif9-theer-ee-eye0-nee-bak-ter9-ee-yum dif9-theer-ee-eye0-nee-bak-ter9-ee-yum dif9-theer-ee-eye0-nee-bak-ter9-ee-yum dif9-theer-ee-eye0-nee-bak-ter9-ee-yum dif9-theer-ee-eye0-nee-bak-ter9-ee-yum dif9-theer-ee-yum dif9-theer
structures (750x). These infect the blood and are spread into organs, causing fever and other signs and symptoms, including the ones that were fatal. An atom that can donate electrons during a reaction is called a. We will assume that Ni is 10 (number of cells deposited in the sandwich while it was being prepared). The bacterial type discussed next is
also called an endospore, because it is produced inside a cell. What other correlation can we make from these data? * psychrophile (sy9-kroh-fyl) Gr. psychros, cold, and philos, to love. inoculation Crossinfection The helminths are classified according to their shape.
their size; the degree of development of various organs; the presence of hooks, suckers, or other special structures; the mode of reproduction; the kinds of hosts; and the appearance of eggs and larvae. Because of this balanced distribution, no part of the molecule has a greater attraction for the electrons. When a sodium atom reacts with chlorine and
loses 1 electron, the sodium is left with 1 more proton than electrons. TheoretiAquificae cally, it is a collection of bacterial cells, all Thermotogae Actinobacteria of which share an overall similar pattern Deinococcus-Thermus of traits, in contrast to other groups whose pattern differs significantly. Although the chromosome is the minimal genetic
requirement for bacterial survival, many bacteria contain other, nonessential pieces of DNA called plasmids. * deoxyribonucleic (dee-ox0-ee-ry0-boh-noo-klay9-ik). The secondary state arises from a peptide bond. Metabolism of urea is one way that Proteus spp. Basidiospores* are haploid sexual spores formed on the outside of a club-shaped cell called
a basidium (figure 5.21). Differentiate between hydropholic. Once in place, ribosomes synthesize proteins that are assembled by the RER into vesicles and moved to the nearby Golgi. An important component of rover design was to explore more thoroughly the idea that conditions conducive to life exist on Mars now or did in the past.
Describe the chemistry of carbon and the difference between inorganic and organic compounds. And though it is true tain information called the "pyramid of learning" has been proposed that mastering the subject matter in this textbook requires time and by Edgar Dale: We remember about 10% of what we read; 20% of effort, millions of students
will affirm how worthwhile it has been in what we hear; 50% of what we see and hear; 70% of what we their professions and everyday life. Over the past several years, Barry's interests have begun to focus on innovative methods of teaching that lead to greater student understanding. Note the fine detail of cilia and organelles. This complete virus or
virion is ready to infect another cell. Polysaccharides such as starch and peptidoglycan are chains of five or more monosaccharides. The flatworm group is subdivided into the cestodes,* or flukes, characterized by flat, ovoid bodies. Named in honor of T. (a)
Venenivibrio, an extremophilic bacterium that lives in acidic hot springs and derives energy by combining hydrogen gas with oxygen to form water and hydrogen peroxide. (a1) Root nodules on a legume; (a2) Bradyhizobium bacteria inside a nodule (3,0003) (b1) A Casseopeia jellyfish gets its color and nutrition from (b2) dinoflagellates (4003). Only
rarely is the optimum a single point. Using evidence from ancient sediments, paleontologists estimate that the earliest eukaryotic cells first evolved around 2 billion years ago. They are the ultimate survivors. (b) Biotechnology meets bioremediation. Much of the information gathered will help us understand the ecology of communities, how the
members interact, what kinds of nutrients they use or waste produce. Bradley, Hudson Valley Community College Marisa Cases, Manchester Cases, Manch
(separate) into unattached, charged particles called ions (figure 2.7). They may exist as singles, in pairs (diplococci*), in tetrads (groups of four), in irregular clusters (both staphylococci* and micrococci), or in chains of a few to hundreds of cells (streptococci). The reactions of the Gram stain are the result of these basic differences. Fixation also
preserves various cellular components in a natural state with minimal distortion. Some species have special feeding structures such as oral grooves, which carry food particles into a passageway or gullet that packages the captured food into vacuoles for digestion. Check Your Progress SECTION 7.4 13. * lophotrichous (lo0-foh-trik9-us) Gr. lopho, tuft
or ridge. The Check and Assess modules at the ends of each section have been changed to "Check Your Progress" questions to focus attention on retaining key information covered in that section. Such heat-loving microbes live in soil and water associated with volcanic activity, in compost piles, and in habitats directly exposed to the sun. complex
medium triple-sugar iron agar g. Soil community Aquatic microbes Complex communities of microbes exist in nearly every place on earth. They have a typical viral cycle, multiplying in the host cytoplasm in 6.2 The General Structure of Viruses 161 Surface fibrils DNA core (a) Capsid Figure 6.2 A monster virus—the megavirus. For now, let us briefly
consider the structure and some functions of DNA, RNA, and a close relative, adenosine triphosphate (ATP). 132 Chapter 5 A Survey of Eukaryotic Cells and Microfilaments Endoplasmic reticulum Micro
Figure 5.12 Circular DNA strand Granum Thylakoids (b) Figure 5.11 Details of an algal chloroplast. Some members of another group of very complex viruses, the bacteriophages,* have a polyhedral capsid head as well as a helical tail and fibers for attachment to the host cell. 84 Chapter 3 Tools of the Laboratory Check Your Progress SECTION 3.5 22.
septate hyphae and conidia. This essentially means that two different kinds of prokaryotes came together, merged, and formed a completely unique cell type. Other important pathogens are found in genera Staphylococcus and Streptococcus. A periplasmic flagellum is a type of internal flagellum that is enclosed in the space between the outer sheath
and the cell wall peptidoglycan (figure 4.7). Note that this medium can also differentiate among colonies by the types of hemolysis they display. (b) Lophotrichous flagella on Spirillum serpens, a widespread aquatic bacterium (9,0003). Although an individual species can grow between the extremes of 108C and 508C (508F and 1228F), the optimum
growth temperatures (optima) of most mesophiles fall into the range of 208C to 408C (688F to 1048F). In fact, they were responsible for changing the atmosphere of the earth from one without oxygen to one with oxygen to one with oxygen to one with oxygen to a constant of the earth from one without oxygen to oxygen t
harbor their own viral parasities! Many parasitic relationships also * commensalism (kuh-men9-sul-izm) L. We will use a simple system of four groups, based on method of motility, mode of reproduction, and stages in the life cycle. Describe three ways that animal viruses enter into a host cell. dia are designed for special microbial groups, and they
have extensive Bile salts, a component of feces, inhibit most gram-positive bacapplications in isolation and identification. The cells themselves do not stain because these dyes are negatively charged and are repelled by the negatively charged surface of the cells. A simple equation in the form of a fraction expresses the main mathematical factors that
influence the expression of resolving power. The primary life indicators are heredity, reproduction, growth, metabolism, responsiveness, and transport. A more satisfactory alternative is the hanging drop slide (below) made with a special concave (depression) slide, an adhesive or sealant, and a coverslip from which a small drop of sample is
suspended. The virus attaches to its host cell by specific binding of its spikes to cell receptors. The role of the photosynthetic pigments is to absorb and transform solar energy into chemical energy, which is then used during reactions in the stroma to synthesize carbohydrates. Many alternate between a trophozoite and a cyst stage, depending on the
conditions of the habitat. The light flow of water into the cell membrane fully extended and the cytoplasm full. NAM NAM peptidoglycan component of cell walls. When the flagellum reverses direction and rotates clockwise, the cell stops and tumbles. All organisms manifest asexual reproduction, with one cell simply dividing into two
new cells by fission or mitosis. These are formed in response to adverse conditions and are not reproductive (see chapter 4). Envelope spike Host cell membrane Receptor (a) (b) Figure 6.12 The mode by which animal viruses adsorb to the host cell membrane. From a larger perspective, the overall cycle of
life on this planet depends 7.1 Microbial Nutrition The atmosphere is a reservoir for gases (nitrogen, oxygen, and carbon dioxide) essential to living processes. What other elements present in earth microorganisms would one expect to find on Mars? The common symptoms are fever, muscle aches, and problems with breathing and coughing that clear
up in 1 or 2 weeks. In a few hours, a population of these bacteria can easily grow from a small number of cells to several million. Oxygen gas has a great impact on microbial adaptation of these bacteria can easily grow from a small number of cells to several million. Oxygen gas has a great impact on microbial adaptation. The effect of quorum sensing has also given greater insight into how pathogens invade their hosts and produce large quantities of substances that damage host
defenses. Some viruses can cause birth defects and cancer in humans and other animals. Before synthesis of the lagging strand can start, a primase adds an RNA primer to direct the DNA polymerase III. Singer and G. For enveloped viruses, these terms are interchangeable. Microscopic inset shows the brush arrangement of Penicillium phialospores
(2203), the asexual phase. The majority of medically significant microorganisms are mesophiles,* organisms that grow at intermediate temperatures is 378C or 988F). Because the electrons will spend more time near the oxygen, it will
express a partial negative charge. Major Groups: The four main phyla among the terrestrial fungi, given with sexual spore type, are Zygomycota (ascospores), Ascomycota (ascospores), Basidiomycota (basidiospores), and Chytridiomycota (ascospores), ascomycota (ascospores), and Chytridiomycota (ascospores), and Chytridiomycota (ascospores), ascomycota (ascospores), ascom
(see figure 6.16). Any simple eukaryotic cell that lacked multicellular structure or cell specialization has been placed into the Kingdom Protista generally as an alga (photosynthetic) or protozoan (nonphotosynthetic) um wa an te 0 s r 8. enveloped, helical b. Compare the major stages in multiplication of animal viruses and bacteriophages. This
microbe is being studied for its potential in bioremediation of radioactive waste and as a model organism for Mars studies. Describe the structures of nucleotides and list the nitrogen bases. Positively charged ions are termed cations,* and negatively charged ions are termed anions.* (A good mnemonic device is to think of the t in cation as a plus (1)
sign and the first n in anion as a negative (2) sign.) Substances such as salts, acids, and bases that release ions when dissolved in water are termed electrolytes because their charges enable them to conduct an electrical current. Trace the synthesis of cell products, their processing, and their packaging through the organelle network. A molecule of a
large protein (11) is included to indicate relative size of macromolecules. Plasmodium 26. A lysosome* is one type of vesicle originating from the Golgi apparatus that contains a variety of enzymes. The early earth is thought to have contained a hot, anaerobic "soup" with sulfuric gases and salts in abundance. Draw a simple figure to support your
answer. If you performed the quadrant streak plate method using a broth culture shown, which quadrant might you expect to yield isolated colonies? endotoxins, fever d. His technique consisted of timed, sequential applications of crystal violet (the primary dye), Gram's iodine (IKI, the Step
mordant), an alcohol rinse (decolorizer), and a con1 Crystal trasting counterstain—usually, the red dye, safranin. Microbes are involved in nutrient production and energy flow. Complex multicellular organisms evolved as individual cells in the organisms evolved as individual cells in the organism lost the ability to survive apart from the intact colony. Entry of the nucleic acid stops host cell DNA
replication and protein synthesis, and it soon prepares the cell machinery for viral replication and synthesis of viral protoplast (proh9-toh-plast) Gr. proto, first, and plastos, formed. Sterols are different from phospholipids in both structure
and behavior, as you may recall from chapter 2. Complexity ranges from single cell layers to thick microbial mats with dozens of dynamic interactive layers. Under the eukaryotic cell in mind, let us next examine the range of adaptations
that this cell type has undergone. What characteristics of viruses could be used to describe them as life forms? Table 1.2 arrays the most predominant infectious diseases on earth and their estimated yearly case numbers. Tegrity Campus indexes as it records your slideshow presentations and anything shown on your computer so students can use
keywords to find exactly what they want to study. This image was so detailed that the bonds between the carbon on a glucose bonds to the oxygen on the number 4 carbon on a second glucose. Dissociation of these compounds
leads to the formation of charged cations and anions. 162 Chapter 6 An Introduction to Viruses of 13 of the 20 families of animal viruses are enveloped, that is, they possess an additional covering external to the capsid called an envelope, which is usually a modified piece of the host's cell membrane (figure 6.4b). Two species of cyanobacteria alone—
Prochlorococcus and Trichodesmium—account for 30% to 40% of biomass formation and 50% of oxygen production through photosynthesis in the oceans. Most pathogens have relatively short doubling times. Left: uninoculated broth, pH 7; middle: growth with no change; right: positive, pH 8.0. (b) Presence-absence broth is for detecting the presence
of fecal bacteria in water samples. as eukaryotic c. The most extreme form is obligate intracellular parasitism, which means the microbe spends all or most of its life cycle inside the host cell, from which it derives essential nutrients and other types of support. A molecule with such an unequal distribution of charges is termed polar and shows polarity
-meaning it has positive and negative poles. These media, termed broths, milks, or infusions, are made by dissolving various solutes in distilled water. 7. (a) PF PC OS (b) Key Outer sheath (OS) Protoplasmic cylinder (PC) Tumble (T) Run (R) Tumble (T) Run (R) Tumble (T) Periplasmic flagella (PF) Peptidoglycan T T T T Cell membrane R (c) R Figure 4.7 The orientation
of periplasmic flagella on the (a) No attractant or repellent (b) Gradient of attractant concentration Figure 4.6 Chemotaxis in bacteria. This discovery led to immediate applications in medicine. carbon atom b. In fundamental ways, the electron microscope is similar to the optical microscope. First, D. Cytoplasmic membranes of eukaryotes are
functionally similar to those of prokaryotes, serving as selectively permeable barriers in transport. • The microbe invades and multiplies in the host, producing more parasites that can infect other suitable hosts. surface protein, neuraminidase (N), is an enzyme that breaks down c How do the receptor spikes on viruses play a role in infection?
Functional groups are small accessory molecules bonded to many organic compounds that impart unique characteristics. Some of the common reactions in organisms are syntheses, decompositions, and exchanges three cholesterol molecules bound to glycerol 5. For example, the germ theory of disease has been so thoroughly tested that it has clearly
passed into the realm of law. The glycocalyx of some bacteria is so highly adherent that it is responsible for harmful biofilms developing on nonliving materials such as plastic catheters, intrauterine devices, and metal pacemakers that are in common medical use (figure 4.12). * hypotonic (hy-poh-tahn9-ik) Gr. hypo, under, and tonos, tension. This 9th
edition is no exception. negative charges bonds. They have some * periplasmic (per0-ih-plaz9-mik) Gr. peri, around, and plastos, the fluid substances of a cell. The structure of the lipid phase provides an impenetrable barrier to many substances of a cell. The structure of the lipid phase provides an impenetrable barrier to many substances.
containing sessile colonization of surface cells 5. Even so, most eggs and larvae are vulnerable to Oral sucker Esophagus Pharynx Intestine Ventral sucker Simmature eggs (b) Excretory bladder Figure 5.27 Parasitic flatworms. Construct
your own concept map of macromolecules using table 2.4 as a guide. Comment on the sensational ways that some tabloid media portray the dangers of infectious diseases. It begins with species,* the smallest and most specific taxon. Most human parasites go
through three general stages: Amoeboid Protozoa There are numerous variations on this theme. It now appears that these criteria really do reflect accurate differences among these organisms and give rise to the same basic kingdoms as do genetic tests using ribosomal RNA (see figure 1.15). • Sporozoa produce special sporelike cells called
sporozoites* (figures G and H) following sexual reproduction, which are important in transmission of infections. killed b. 17. In fact, some aspects of the diseases they cause are related to the persistence and resistance of their spores. Nonsynthetic, or complex, media contain ingredients that are not completely definable. Biofilms are often cooperative
associations among several microbial groups (bacteria, fungi, algae, and protozoa) as well as plants and animals. Golgi apparatus d. Give examples of algae with medical importance. Gain seamless access to our full library of digital assets - 1,500 e-texts and instructor resources that let you build richer courses from within your chosen LMS! vii
Connec ting Instructors to Students- Connec tPlus Microbiology McGraw-Hill Connect Microbiology is a digital teaching and learning environment that saves students and instructors time while improving performance over a variety of critical outcomes. For the sake of comparison, we now turn to multiplication in bacterial viruses—the
bacteriophages. functional group or groups it carries. When exposed to an aqueous solution, the charged heads are attracted to the water phase, and the nonpolar tails are repelled from the water phase (figure 2.19b). I think that these give students examples of how scientists/ medical professionals must look at instances of disease and how they
occur and are spread. Agar is superior to gelatin as a solidifying agent because agar a. 192 Chapter 7 (a) Microbial Nutrition, Ecology, and Growth effects and may eventually evolve to a less harmful relationship with their host (see section 7.5). For example, a bird species may be called a yellow-bellied sapsucker, or a flowering plant, a sunflower. The
questions that directly follow Case Studies, Parts 1 and 2 challenge students to begin to think critically about relevant text references that will help them answer the questaL22600 ch06 157-184.indd Page 180 10/9/13 9:37 PM f-w-166 tions as they work through the chapter. 172 Chapter 6 An Introduction to Viruses are ultimately lethal to the cell
because of accumulated damage. hydrogen c. The fundamental parts of a modern compound light microscope are illustrated in figure 3.3a. (b) The appearance of athlete's foot, an infection caused by Trichophyton rubrum. 210 Chapter 7 Microbial Nutrition, Ecology, and Growth knowing the number of cells at the beginning and end of a growth
period. Three major types of RNA are important for protein synthesis. Gr. amphi, on both sides. Determining the exact origin of this virus has new cases, virologists immediately tested samples from American proved difficult, and it may never be known. Other bacteria that are made virulent by their prophages are 6.6 Techniques in Cultivating and
engulfed and uncoated, or virus surface fuses with cell membrane; nucleic acid is released. Note the fine fringe of flagella (1,500) Spore stain, showing spores (green) and cell membrane (red) (1,500) Use one dye to observe cells 71 Figure 3.9 Types of
sense of the word sterile, meaning completely free of all life forms including spores and viruses, had its beginnings here (see chapter 11). The vegetative cell is the metabolically active and growing phase. These layers are stacked together and often tightly bound into a unit like the outer husk and casings of a coconut. They mean the release of a virus
from an animal cell by enclosing it in a portion of membrane derived from the cell. The glycocalyx develops as a coating of macromolecules to protect the cell and, in some cases, help it adhere to its environment. One of the most profitable discoveries so far was a strict thermophile Thermus aquaticus, which produces an enzyme that can make copies
volume. diatom 18. vated white blood cell count. (a) General structure of a mastigophoran such as Peranema. In keeping with their special position in the biological spectrum, it is best to describe viruses as infectious particles (rather than organisms) and as either active or inactive (rather than alive or dead). In sections 4.6 and 4.7, we will cover
prokaryotic taxonomy, discuss the differences between bacteria and archaea, and introduce the major characteristics of animals. Structural differences give rise to gram-positive and gramnegative cells, as differentiated by the
The main taxa, or groups, in a classification scheme are organized into several descending ranks called a hierarchy. We revised the pedagogy of the end-of-chapter material, which now includes two major levels of questions and review assessments, based on Elements of Bloom's Taxonomy. Staining Reactions of Dyes Because many microbial cells lack
contrast, it is necessary to use dyes to observe their detailed structure and identify them. Note that in addition to differentiating two adjacent things, good resolution also means being able to observe an object with clarity. Each Na is surrounded by 6 Cls and vice versa. DNA, or deoxyribonucleic acid, the chemical substance that comprises the genetic
the broth and then incubated them. Their cell walls are also quite different, being composed of polysaccharide or protein and lacking peptidoglycan, and some lack cell walls are also quite different, being composed of polysaccharide or protein and lacking peptidoglycan, and some lack cell walls are also quite different, being composed of polysaccharide or protein and lacking peptidoglycan, and some lack cell walls are also quite different, being composed of polysaccharide or protein and lacking peptidoglycan, and some lack cell walls are also quite different, being composed of polysaccharide or protein and lacking peptidoglycan, and some lack cell walls are also quite different, being composed of polysaccharide or protein and lacking peptidoglycan, and some lack cell walls are also quite different, being composed of polysaccharide or protein and lacking peptidoglycan, and some lack cell walls are also quite different, being composed of polysaccharide or protein and lacking peptidoglycan, and some lack cell walls are also quite different.
also be included in the Mastigophora. TABLE 4.2 Spirilla Comparison of the Two Spiral-Shaped Bacteria Overall Appearance Mode of Locomotion Number of Helical Turns Gram Reaction (Cell Wall Type) Examples of Important Types Rigid helix Polar flagella; can
be in tufts Varies from 1 to 20 Gram-negative Most are nonpathogenic. MP (b) Figure 4.20 Bacterial inclusion bodies. Chemoautotrophs have adapted to the most stringent nutritional strategy on earth. Obligate or strict means being confined to a narrow niche or
habitat, such as an obligate thermophile that requires high temperatures to grow. R. F. In the background is a partial display of the periodic table of elements showing the position of these elements in the periodic table. Figure 7.16 shows some quantitative characteristics of growth: (1) The cell population size can be represented by the number 2 with
an exponent (21, 22, 23, 24); (2) the exponent increases by one in each generation; and (3) the number of the exponent also gives the number of the exponent increases by one in each generation. Pictured in (a) is the process of fusion between the envelope of the virus and the host cell membrane, with release of the number of the exponent increases by one in each generation.
of simple observations. Other examples of passive protein carriers found in a wide variety of cells are aquaporins, also known as water channels. Protozoa living in freshwater habitats regulate osmotic pressure by means of contractile vacuoles, which regularly expel excess water that has diffused into the cell (described later). The exceptional and
curious nature of viruses prompts numerous questions, including: • Basic structure consists of protein shell (capsid) surrounding nucleic acid core. They include materials such as rice grains (used to grow fungi), cooked meat media (good for anaerobes), and egg or serum media that are permanently coagulated or hardened by moist heat. What is the
ultimate way that microbes will, as Pasteur said, have the "last word"? What makes the mitochondrion and chloroplast unique among the organelles? Describe the concept of the atomic nucleus, electron orbitals, and shells. As a result of each collision, the directions of the colliding molecules are altered and the direction of any one molecule is
unpredictable and considered random. Which bacterium was probably used to write the name at the top? (a) Monotrichous flagellum on the pathogen Vibrio cholerae (10,0003). One of the questions that has plagued taxonomists is, What characteristics are reliable indicators of closeness in ancestry? respiration, an inflamed throat, and a stiff neck
Many of them are parasites of bacteria, which are also abundant in most ecosystems. As a rule, tiny, relatively soft organisms do not form fossils very readily. Early results show that the soil is salty and slightly acidic. all organisms of not form fossils very readily. Early results show that the soil is salty and slightly acidic. all organisms of not form fossils very readily. Early results show that the soil is salty and slightly acidic. all organisms of not form fossils very readily. Early results show that the soil is salty and slightly acidic. all organisms of not form fossils very readily. Early results show that the soil is salty and slightly acidic. all organisms of not form fossils very readily.
been recast as features titled "Making Connections", "Secret World of Microbes", and "Clinical Connections," Several of these boxes are new to this edition and many have been rewritten or updated. Know how to correctly write a scientific name. This is an oxygen-using process that extracts chemical energy contained in nutrient molecules and stores
it in the form of high-energy molecules, or ATP. a hydrogen atom and an oxygen atom d. called the glycocalyx,* functions in attachment to other cells or as a site for receptors—surface molecules that receive and respond to external stimuli. A conservative estimate places 50 million helminth infections in North America alone. The latest versions of
these microscopes have increased the resolving power to around 0.5 Å, which allowed technicians to image a pair of electrons! Such powerful tools for observing and positioning atoms have spawned a field called nanotechnology—the science of the "small." Scientists in this area use physics, chemistry, biology, and engineering to manipulate small
molecules and atoms. These methods produced a system with five major kingdoms: the monera, fungi, protists, plants, and animals. Even worse, common names are notorious for varying from region, even within the gram-negative group but are small
obligate intracellular parasites that replicate within cells of the hosts they invade. Differentiate between taxonomy, classification, and nomenclature. This has led to the speculation that they are similar to an ancestral form that gave rise to eukaryotes. A process of cell destruction, as occurs in bursting. These multiple forms occur naturally in certain
proportions. Pasteur's contemporary, Koch, established Koch's postulates, a series of proofs that verified the germ theory and could establish whether an organism was pathogenic and which disease it caused (see chapter 13). carried by an arthropod vector d. Our primary aim in introducing taxonomy is to present an organizational tool that helps you
keep track of the various microbial groups and recognize their major categories. To rule out a possible brain infection, a puncture of the spinal canal was performed. 7.4 Environmental Factors That Influence Microbes Expected Learning Outcomes 12. Because you are preparmeans reading alone will not gather the most important points from ing for
professions that involve interactions with patients, you will a chapter. 1. Figure 1.3 The six basic types of microorganisms. Humans and protozoa belong to the same domain (Eukarya) but are placed in different kingdoms. Two types of microorganisms. Humans and protozoa belong to the same domain (Eukarya) but are placed in different kingdoms. Two types of microorganisms. Humans and protozoa belong to the same domain (Eukarya) but are placed in different kingdoms. Two types of microorganisms.
cells. In addition to phospholipids, eukaryotic membranes also contain sterols of various kinds. Viruses that persist in the cell and cause recurrent disease are considered a. Cultures of animal cells usually exist in the primary or continuous form. Comparative sizes of typical cells are presented in figure 4.26. This alternate microscopic universe is
abiogenesis, but it did not convince many scientists of the day that simpler organisms could not arise in that way. There are 20 different R groups, which define the basic set of 20 amino acids, found in all life forms. If you find any of these or wish to make other comments, feel free to contact the publisher, sales representative, or authors
([email protected] and [email protected]) We hope that you enjoy your explorations in the microbial world and that this fascinating science will leave a lasting impression on you. The Position of Viruses are a unique group of biological entities known to infect
every type of cell, including bacteria, algae, fungi, protozoa, plants, and animals. Inoculation of media followed by incubation produces visible growth in the form of cultures. Describe the two main types of asexual fungal spores and how they are formed. At the same time that abiogenesis was being hotly debated, a few budding microbiologists began
to suspect that microorganisms could cause not only spoilage and decay but also infectious diseases. difficile is ordinarily present in low numbers, treatment with broad-spectrum antibiotics may disrupt the normal microbiota of the colon, leading to a C. A cell as "simple" as E. The points of separation are based on having a positive prefer the term
axenic, meaning that the culture is free of other or negative result for each test. pH 14 has an [H1] of 10214 moles (table 2.2). It grows swellings on its surface called buds, which then become separate cells * fungi (fun9-jy) sing. A single virus vi rus pa vir parr ticle particle Virus: Herpes simplex, the cause of cold sores (100,000x). Fatty acids are
long-chain unbranched hydrocarbon molecules with a carboxyl group (COOH) at one end that is free to bind to the glycerol. Be sure to use proper notation and endings. The polypeptide units form loose associations based on weak Shortly thereafter, they were also found in other parts of nucleated van der Waals and other forces. The name for this
type of microscopy is based on the use of certain dyes (acridine, fluorescein) and minerals that show fluorescence. The longevity of bacterial spores trom a fossilized bee that was 25 million years old. Note the pattern of ciliary movement evident on the left side of the cell
and the details of its internal structure. These frigid microhabitats harbor a microcosm of planktonic bacteria, algae, and predators that feed on them. Viruses are not considered living things because a. The chromosome is actually an extremely long molecule of DNA that is tightly coiled to fit inside the cell compartment. The archaea that thrive in this tightly coiled to fit inside the cell compartment.
warm, highly saline habitat produce brilliant red, pink, and orange pigments. Isotonic solutions are generally the most stable environments for cells, because they are already in an osmotic steady state with the cell. If several flagella are present, they become aligned and rotate (d) Figure 4.4 Electron micrographs depicting types of flagellar
arrangements. Other chromogenic agar is available for identifying Staphylococcus, Listeria, and pathogenic yeasts. The natural reservoirs of many inorganic compounds are mineral deposits in the soil, bodies of water, and the atmosphere. The shape is due to duplicated chromosomes attached at a central point, the centromere. A high concentration
of sugar exists in the cube at the bottom of the liquid. A CDC virologist examines cultures of influenza virus that are used in producing vaccines. What characteristics of carbon make it ideal for the formation of organic compounds? Shapes/Sizes: Icosahedral, helical, spherical, and cylindrical shaped. Resolution is a. the presence of twists d. The phase-
contrast microscope contains devices that transform the subtle changes in light waves passing through the specimen into differences in light intensity. Starting with the broadest category, the taxa are domain, kingdom, phylum (or division), class, order, family, genus, and species 3.2 The Microscope: Window on an Invisible Realm Not resolvable 65
Figure 3.6 Effect of resolution on image visibility. Bird embryo Streak plate Keys INFORMATION GATHERING SPECIMEN COLLECTION Microbiologists begin by sampling the object of their interest. Check Your Progress 117 (a) (b) Figure 4.32 Halophiles around the world. e e ra u 6 r t a 5. The Glycocalyx Most eukaryotic microbes have a
glycocalyx, an outermost boundary that comes into direct contact with the environment. Several newer forms of differential media contain artificial substrates called chromogens that release a wide variety of colors, each tied to a specific microbe. The French bacteriologist Louis Pasteur was certainly on the right track when he postulated that rabies
was caused by a "living thing" smaller than bacteria, and in 1884, he was able to develop the first vaccine for rabies. The binding of Na1 and Cl2 exists in three dimensions. Using an RNA virus (rubella virus), the major events are outlined, although other viruses will vary in exact details of the cycle. All together, government agencies are keeping track
of a total of 75 emerging and reemerging infectious diseases (see examples in figure).* The newer or emerging diseases usually erupt suddenly with no warning (SARS respiratory syndrome). Those at the edge of the cube diffuse from the concentrated area into more dilute regions. But the techniques for observing and cultivating these relatively large
microorganisms were useless for viruses. An infected person can travel around the world before showing any symptoms of infection. a scratchy throat. Golgi Apparatus: A Packaging Machine The Golgi3 apparatus, also called the Golgi complex or body, is the site in the cell that collects proteins and and packages them for transport to their final
destinations. Scanning probe microscopes operate with a minute needle tapered to a tip that can be as narrow as a single atom! This probe scans over the exposed surface of a material and records an image of its outer texture. By too much acid? In the previous example, induction might begin with the observation of a family in which several people
have hemophilia, and this may lead to the general idea that it is inheritable. species, genus, family, order, class, phylum, kingdom, domain d. Strict thermophiles are so heat tolerant that researchers may use a heatsterilizing device to isolate them in culture. (a) Na (b) 11p+ 12n0 17p+ 18n0 Sodium atom (Na) Chlorine atom (Cl) Na Cl + (c) Ionization
Instruc tors to Customize Lec ture Everything you need, in one location Enhanced Lecture Presentations contain lecture outlines, FlexArt, adjustable leader lines and labels, art, photos, tables, and animations embedded where appropriate. Examples of this type of microscope are a magnifying glass, a hand lens, and Leeuwenhoek's basic little tool
shown earlier in figure 1.9a. T an s oc y l a ers iety iou ut var rev M o icr CASE STUDY Part 2 Eventually, the studies in the marine environments of the earth led to the discovery of 20 million previously unknown genes and thousands of new species. membrane d. Here, specific proteins are synthesized from the RNA code and deposited in the lumen
(space) of the endoplasmic reticulum. With their cell walls incomplete or missing, such cells have very little protection from lysis.* Lysozyme, an enzyme contained in tears and saliva, provides a natural defense against certain bacteria by hydrolyzing the bonds in the glycan chains and causing the wall to break down. cleanup site. We also appreciate
the insights and contributions of brand manager Amy Reed and marketing manager Patrick Reidy. The smallest unit of matter with unique characteristics is a. Extracellular Solute-binding protein Solute Transporter protein 1 "Great illustrations, excellent support for the text." 2 —Peter Kourtev, Central Michigan University ATP ATP ATP-binding site
Intracellular (a) Carrier-mediated active transport. (a) A technician inoculates fertilized chicken eggs with viruses in the first stage of preparing vaccines. Discuss the collection of properties that are used to define life and the prokaryotic cell structures that are involved in carrying out these life processes. Some forms of referred to as the "bottom
billion," experience disability or death as leishmaniasis affect the skin and give rise to growths that deform the a result of 13 common diseases. chemicals containing a number of different types of bacteria are streaked onto these plates: (a) a generaland the ways that microbes react purpose nonselective
medium, (b) a selective medium, and (c) a differential medium. (b) Loop containing sample 1 2 3 (d) 1 2 3 (c) Steps in Loop Dilution; also called a pour plate or serial dilution "Hockey stick" 1 (e) Steps in a Spread Plate 2 (f) Figure 3.11 Methods for isolating bacteria. The Multiplication Cycle in Bacteriophages 173 So far as is known, all bacteria are
parasitized by various specific viruses. Classification is an orderly arrangement of organisms into groups that indicate evolutionary relationships and history. bioremediation 3. enzymes to digest materials outside the cell; and yet others are important in the enlargement and repair of the cell
This new edition's design incorporates specific icons and headings to highlight each distinct feature, producing a cleaner and less compartmented layout. Growing strictly anaerobic bacteria usually requires special media, methods of incubation, and handling chambers that exclude oxygen. To quote microbiologist Carl Zimmer, we live on "a planet of
lethal conditions are called toxophiles. To be successful, you must commit esknow and understand it. Students can view them anytime/anywhere via computer, iPod, or mobile device. The Framework of an Expertly Crafted Learning Tool 166 /202/MH02004/taL22600 disk1of1/0073522600/taL22600 pagefiles Pedagogy created to promote active
learning taL22600 ch05 122-156.indd Page 125 10/9/13 9:19 PM f-w-166 Cell wall* Page 127 Quick Search CLINICAL CONNECTIONS Look up "an interactive tour of the cell" at the National Science Foundation website to explore the dynamics of cell structure. As we will see in chapter 7, microbes have some incredible Quick Search "survival skills"
protons, neutrons, and electrons. Describe the process of Gram staining and how its results can aid the identification process. Lysosomes are involved in intracellular digestion of food particles and has yet to be disproved by serious scientific
inquiries. The Functions of Carbohydrates in Cells Carbohydrates in cells Carbohydrates are the most abundant biological molecules in nature. Some virus families are named for their microscopic appearance (shape and size). These bacteria have a two-phase life cycle that shifts between a vegetative cell (figure 4.22, step 1) and an endospore (figure 4.22, step 8). The
constructing the tree were based on structural similarities and differences, such as cellular organisms 1.7 The Origin and Evolution of Microorganisms 23 Kingdom Fungi Animalia Kingdom Protista DOMAIN BACTERIA Chlamydias Gram-positive Endospore Spirochetes bacteria producers
DOMAIN ARCHAEA Gram-negative Cyanobacteria bacteria Methane producers Prokaryotes that live in extreme heat DOMAIN EUKARYA Eukaryotes that live in extreme heat DOMAIN EUKARYA
present-day archaea occupy the remaining habitats on the earth that have some of the same extreme conditions. Most chytrids are saprobic and free-living in soil, water, and decaying matter. Furthermore, it furnishes several embryonic tissues that readily support viral multiplication. In the past, the classification scheme in this guide has been based
mostly on characteristics such as Gram stain and metabolic reactions. Expected Learning Outcomes 1. oncogenic c. Compare the methods and uses of cell culture, bird embryos, and live animals in growing viruses. This medium contains three sugars, phenol red dye to indicate pH changes (bright yellow is acid, various shades of red, basic), and iron
salt to show H2S gas production. (f1) Demodex mite lives in or around human hair follicles. The nature of the sample being cultured depends on the objectives of the analysis. The atomic mass or weight is equal to the average of the isotope mass numbers. As a result, a protein can react only with molecules that complement or fit its particular surface
features. orbitals d. Features of the nuclear envelope include a. Explain why bacterial viruses would be harmless to humans. Mutant forms of these pathogens that lack fimbriae are unable to cause infections. Contraction of the filaments imparts a spinning and undulating pattern of locomotion. Throughout the past few years, Heidi has had the
opportunity to collaborate with faculty all over the country in developing digital tools, such as LearnSmart, LearnSmart Labs, and Connect, to facilitate student learning a long growth period (yielding millions of cells) is based on a relatively simple concept. spore b
Pathogenic Neisseria and Yersinia species are often subultured on chocolate agar, which is made by heating blood agar and does not contain chocolate agar, which is made by heating blood agar and does not contain chocolate agar, which is made by heating blood agar and does not contain chocolate agar, which is made by heating blood agar and does not contain chocolate.
(thermophiles), and reduction of sulfur compounds. The early eukaryotes, probably similar to algae and protozoa, started lines of evolution that eventually gave rise to fungi, plants, and multicellular animals such as worms and insects. Electrons move around the nucleus of an atom in pathways called a. This tantalizing image bears a resemblance to
prokaryotic cells, Starting in 1976, a series of space explorations was launched to but there is still a controversy about whether these are ancient find evidence that could point to signs of life on Mars. This is given as the average mass numbers of all isotopic forms (table 2.1). Characterize elements and their isotopes. Knowledge and Comprehension
These questions require a working knowledge of the concepts pts in the chapter and the ability to recall and understand the information you u have studied. How is our understanding of microbiology enhanced by a knowledge of chemistry? Describe live media and the circumstances that require it. What is meant by diversity with respect to
organisms? In general, they are classified as basic (cationic) dyes, which have a positive charge, or acidic (anionic) dyes, which have a negative charge or acidic (anionic) dyes, which have a negative charge or acidic (anionic) dyes, which have a negative charge. Optical, or light, microscopy depends on lenses that refract light rays, drawing the rays to a focus to produce a magnified image. There is serious concern that water from the pit will polluted water?
 We include them in this chapter because they are prokaryotic in general structure and they do share many bacteria characteristics. Most eukaryotic forms cannot survive above 608C (1408F), but a few bacteria and archaea, called hyperthermophiles, grow at between 808C and 1218C (2508F, currently thought to be the highest temperature limit
endured by enzymes and cell structures). The maximum temperature at which growth and metabolism can proceed. of fatty acids is what gives fats and oils (liquid fats) their greasy, insoluble nature. All prokaryotes have a cell membrane, cytoplasm, ribosomes, and a chromosome. Specimen preparation in optical microscopy
varies according to the specimen, the purpose of the inspection, and the type of microscope being used. Bacteria and fungi were some of the first organisms to be genetically engineered, because their relatively simple genetic material is readily manipulated in the laboratory. Loop containing sample 1. More detailed functions of mitochondria are
covered in chapter 8. The cell walls of the fungi and algae are rigid and provide structural support and shape, but they are different in chemical composition from prokaryotic cell walls. The end result is two separate double strands with the same order of bases as the original molecule. Hook Outer membrane L ring Cell wall Basal body Rod
Periplasmic space Rings Rings Cell membrane (a) (a) 22 nm (b) (b) The presence of information used in the laboratory identification of various groups of bacteria. One possible circumstance is when a single animal becomes infected with strains of viruses from two different hosts. Artificial media allow the growth and isolation of
microorganisms in the laboratory and can be classified by their physical state, chemical composition, and functional types. When intertidal animals feed, their bodies accumulate toxins given off by the algae that can persist for several months. Like so many ideas of a biological nature, they turned to pondered about the possible existence of other life
forms in chemistry for answers. Differentiate between characteristics of yeasts and molds, and define fungal spores. Several of these types of vaccines are being tested. 20 40.08 Ca21 6 12.01 CO322 Calcium Ca Carbon Car
Hydrogen • Hydrogen Iodine Iodine • I 53 126.9 131.0 H1 I2 I-131 53 Iron Fe 26 55.84 Fe21, Fe31 Magnesium Mg 12 24.30 Mg21 Manganese Mn 25 54.93 Mn21, Mn31 Nitrogen N 7 14.0 NO32 (nitrate) Oxygen O 8 15.99 P 15 31.97 P-32 15 32 Potassium K 19 39.10 K1 Sodium Na 11 22.99 Na1 Sulfur S 16 32.06 SO422 (sulfate) Zinc Zn 30 65.38
Zn21 Phosphorus • The Major Elements of Life and Their Primary Characteristics 31 Phosphorus PO432 (phosphate) *Based on the Latin name of the element. Molecular evidence indicates that the Archaea started the branch that would eventually become the Domain Eukarya. This is the basis of positive staining. Examples of neurological diseases
include "mad cow disease" and Creutzfeldt-Jakob disease. The growth-limiting effect of hypertonic solutions on microbes is the principle behind using concentrated salt and sugar solutions as preservatives for food, such as in salted hams and fish. 24. (b) Structure of a buckyball indicates its "soccer ball" appearance of hexagonal carbons. There is a
well-developed periplasmic space above and below the peptidoglycan. McGraw-Hill offers several lab manuals for the microbiology course. For example, a medium such as brain-heart infusion is general purpose and enriched; manuals for the microbiology course.
of electrons Maximum effective magnification TEM 5 1,000,0003. More coverage can be found in section 4.7. Phylum Crenarchaeota Members depend on sulfur for growth and may inhabit hot and acidic sulfur pools and vents. The goal is a pure culture, in most cases, or a mixed culture. Cell responses to solutions of differing osmotic content. One
thing is for sure: The discovery of this viral baggage will So far, we have only small glimpses of the possible roles of these spur many years of research and provide greater understanding of the viruses. At the minimum, they must carry genes for synthesizing the viral capsid and genetic material, for regulating the actions of the host, and for packaging
the mature virus. The viral DNA is duplicated along with the regular genome and can provide adaptive genes for the host bacterium. This ancient idea, known as spontaneous generation, was continually reinforced as people observed that meat left out in the open soon "produced" maggots, that mushrooms appeared on rotting wood, that rats and
mice emerged from piles of litter, and that other magical phenomena occurred. Only certain eukaryotes are traditionally studied by microbiologists—primarily the protozoa, the microscopic algae and fungi, and animal parasites, or helminths. • As we observe the natural world, teeming with life, we cannot help but be struck by its beauty and
complexity. The vector is the reduviid* bug, an insect that is sometimes called the "kissing bug" because of its habit of biting its host at the corner of the mouth. What characteristics set the apicomplexa apart from the other protozoan groups? Viruses are known to infect a. The attachment of one thing onto the surface of another. Explain the
characteristics used in viral classification and the nature of viral families. (c) Cross section, indicating the position of the flagella with respect to other cell parts. Peripheral proteins are situated only at the surface and are readily removed. The structure of these two types of nanoparticles suits them well for carrying drugs to a precise location and
controlling their release. The other 70 or so elements are not critical to life, and a number of them, such as arsenic and uranium, can be highly toxic to cells. The tube on the right shows growth but neither acid nor gas. protein
synthesis d. Elements with partially filled outer orbitals are less stable and are more apt to form some sort of bond. (c) Even as the solution becomes diluted, there will still be osmosis into the sac. Discuss the origins, types, and functions of bioelements and nutrients. Figure 18.3 Cutaneous lesions of Staphylococcus aureus. One way that cells have
adapted to this limitation involves a process called facilitated diffusion (figure 7.7), • Asexual reproduction by fission • Mostly uninucleate; usually encyst • Most amoebas are free-living and Identifying Animal Viruses Figure 6.18 A weakened bacterial cell, crowded with viruses, "The six "I's",
algae d. This property of extreme variations in shape is a type of pleomorphism.* They can be grown on artificial media, although added sterols are required for the cell membranes of some species. Fossils from ancient deposits tell us that microbes have been making biofilms for billions of years. Phylum Actinobacteria d. Because cysts are more
resistant than ordinary cells to heat, drying, and chemicals, they can survive adverse periods. 200 Chapter 7 Microbial Nutrition, Ecology, and Growth Currently, there is intense interest in thermal microorganisms on the part of biotechnology companies. Transport media are important for conveying certain clinical specimens to the laboratory.
Differentiate between contamination, colonization, infection, and disease, and explain some possible outcomes in each. The cycle is completed in the infected human when certain trophozoites in the feces begin to form cysts, which then pass out of the body with fecal matter. (-) Mating strain (-) (+) Mating strain (+) Germination of mating strains
Figure 5.21 The cycle of sexual spore formation in basidiomycota. This behavior of light is evident if one looks through an everyday object such as a glass ball or a magnifying glass (figure 3.2). Identify the primary properties that define life and living things. These substances bind the cells to the substrate and begin the development of the biofilm
matrix. So far sible explanations for this association sugDoes this virus make us look fat? Because they emit detectable energy, they can be used to trace the position of key atoms or molecules in chemical reactions, they are tools in diagnosis and treatment, and they are even applied in sterilization procedures (see chapter 11). (a) A magnified view of
nerve cells infected with prion protein. Such data are obtained through actual testing by a method discussed in the following section. The phosphate-alcohol head lends a charge to one end of the molecule; its long, trailing hydrocarbon chain is uncharged. Because the cell usually expends energy to carry out this movement, it is also a form of active
transport. Often, theories develop and progress through decades of research and are added to and modified by new findings. Check Your Progress SECTION 6.1 1. Some viruses go into a latent, or lysogenic, phase in which they integrate into the DNA of the host cell and later may be active and produce a lytic infection. Two groups of bacteria—the
rickettsias and chlamydias—have adapted to life inside their host cells, where they are considered obligate intracellular parasites. This substance causes a sticky layer to develop on teeth that leads to plaque, described later in chapter 21. The benefits of agar are numeror Petri dishes, and they are inoculated by such tools as loops, ous. Their exact
composition varies, but most of them contain protein. These types of in vitro cultivation systems are termed cell culture or tissue culture. Microbes and their communities make up the been done in the past, they extracted the DNA
using state-of-the-art c In addition to bacteria, which other groups of microorganisms molecular techniques and computers.** When results from the would likely be found in the plankton? Tube 1 is a control that has not been inoculated, and tube 4 shows a black precipitate that occurs around the stab when H2S gas has been produced. (b) A row of E.
Chess, Barry. It occurred to these rugged individualists that even the human body itself was a source of infection. One conclusion of NASA scientists that has driven many of their searches is that any life on Mars, if it has c What characteristics of carbon make it the central building block existed at all, has been microbial. (a) A hydrogen molecule is
formed when two hydrogen atoms share their electrons and form a single bond. (b) TABLE 5.5 Summary of Algal Characteristics Division/Common Name Organization Cell Wall Pigmentation Ecology/Importance Euglenophyta (euglenids) Mainly unicellular, motile by flagella None, pellicle instead Chlorophyll, carotenoids, xanthophyll Some are close
relatives of Mastigophora Pyrrophyta (dinoflagellates) Unicellular, dual flagella Cellulose or atypical wall Chlorophyll, carotenoids Cause of "red tide" Chrysophyta (dinoflagellates) Unicellular, dual flagella Cellulose or atypical wall Chlorophyll, carotenoids Cause of "red tide" Chrysophyta (dinoflagellates) Unicellular, dual flagella Cellulose or atypical wall Chlorophyll, fucoxanthin Diatomaceous earth, major component of
plankton Phaeophyta (brown algae—kelps) Multicellular, vascular system, holdfasts Cellulose, alginic acid Chlorophyll, carotenoids, fucoxanthin Source of an emulsifier, alginate Rhodophyta (red seaweeds) Multicellular Cellulose Chlorophyll, carotenoids, fucoxanthin Source of an emulsifier, alginate Rhodophyta (green
algae, grouped with plants) Varies from unicellular, colonial, filamentous, to multicellular Cellulose Chlorophyll, carotenoids, xanthophyll Precursor of higher plants 5.7 Survey of Protists: Protozoa During particular seasons of the year, the overgrowth of these motile algae imparts a brilliant red color to the water, which is referred to as a "red tide"
(see figure 26.16). The mode of attachment varies between an acid and a base when they react to form water and a salt: HCl 1 NaOH → NaCl 1 H2O The reactions in biological systems can be reversible, meaning that reactants and products can be converted
back and forth. an archaeon Case Study Review 1. microscope hand-fashioned by Antonie van Leeuwenhoek, a Dutch linen merchant and Quick Search self-made microbiologist (figure 1.8). * conidia (koh-nid9-ee-uh) sing. Knowledge and Comprehension These questions require a working knowledge of the concepts in the chapter and the ability to
recall and understand the information you have studied. Genetic engineering is a newer area of biotechnology that manipulates the genetics of microbes, plants, and animals for the purpose of creating new products and genetically modified organisms. Name two main groups of obligate intracellular parasitic bacteria and explain why these groups
can't live independently. These fluorescent antibodies can be used to identify the causative agents in such diseases as syphilis, chlamydia, trichomoniasis, herpes, and influenza. ist nt u tr i e Mo nu s re, r es Early cyst wall formation to re d Mature cyst (dormant, resting stage) Figure 5.23 The general life cycle exhibited by many protozoa. This theory
states that eukaryotic cells arose when mitochondria are rickettsias, which are also obligate intracellular bacteria! a much larger prokaryotic cell engulfed smaller prokaryotic cells that began Explain some of the ways the early mitochondria and chloroplasts to live and reproduce inside the prokaryotic cell, rather than being destroyed. Cocci measure
anywhere from 0.5 to 3.0 mm in diameter; bacilli range from 0.5 to 2.0 mm in diameter and Bacteria. live mammals d. When buying a microscope, what features are most important to check for? An example of chemoheterotrophy is aerobic respiration, the
principal energy-yielding pathway in animals, most protozoa and fungi, and aerobic bacteria. Specifically, an inflammation of the meninges, the membranes that surround the brain. s ro g in ic he pal m t g of ua ted sin g ad ivid trac A u nnin x e d e DN tu b in e hey he ir s um t t he d n ea t, as zed **. magnification capability b. report symptoms that
range from skin rash, flulike reactions, sore throat, and The fungus acquires nutrients from its smaller partner and probably proheadaches to fatigue, diarrhea, allergies, and immune suppression. In 2012, NASA sent the Curiosity spacecraft on a 225 million-mile journey to Mars and landed it at a very precise time and place—an incredible
achievement that brought to bear vast knowledge of physics, engineering, and mathematics. Virulence Factors Enterotoxins that cause epithelial necrosis of the colon. Often their presence is harmless and limited to a film of mildew on shower stalls or in other moist environments. (a) Steps in a quadrant streak plate and (b) resulting isolated colonies
of bacteria. viewed directly 11. This includes fungi and protozoa and some of their internal structures, and most bacteria, and fluid are walled off by fibrin. It is a complex polymer of galactose and sulfur-containing carbohydrates. (d) Apicomplexan trophozoite
structure. Methane (CH4) Polarity in Molecules When atoms of different electronegativity3 form covalent bonds, the electrons will not be shared equally and are pulled more toward one atom than another. Atomic Structure and Elements 1. Explain what an isolated colony is and indicate how it forms. A newer type of microscope that overcomes this
impediment is called the scanning confocal microscope. Glycocalyces differ among bacteria in thickness, organization, and chemical composition. The pores are structured to serve as selective passageways for molecules to migrate between the nucleus and cytoplasm. Simple diffusion alone would be unable to transport these substances. (c) Closeup
of plaques, which consist of open spaces where cells have been disrupted by viral infection. More surprising still is that some bacteria and algae flourish in the sea ice of Antarctica. After you have studied the cells as presented in this chapter and chapte
eukaryotic cells. inactive dormant stage c. Using this guide, define obligate halophile, facultative psychrophile, and aerotolerant anaerobe. Histoplasma 20. Both occur in the blood during infection and are transmitted by blood-sucking vectors. When her condition appeared to be deteriorating rapidly, aching joints, sore throat, and a headache. In
general, logarithmic graphs are preferred because an accurate cell number is easier to read, especially during early growth phases. Common components of fats are fatty acids, elongate molecules with a carboxylic acid group. Helicobacter pylori, the agent of gastric ulcers, bores through the stomach lining, and Vibrio cholerae, the cause of cholera
penetrates the small intestine with the help of its flagellum. 146 Chapter 5 A Survey of Eukaryotic Cells and Microorganisms world. nonseptate c. This stain is used for other medically important mycobacteria such as the Hansen's disease (leprosy) bacillus and for Nocardia, an agent of lung or skin infections (see chapter 19). Most of the time our 1014
microbial passengers do more good than harm, but if they are displaced from their niche or are allowed to enter the sterile tissues, they become opportunistic pathogens and can cause infections. Fimbriae have an inherent tendency to stick to each other and to surfaces. Yeasts, a type of microscopic fungi, cause bread to rise and ferment sugar to
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make alcoholic beverages. Other algal habitats include the surface of soil, rocks, and plants; and several species are even hardy enough to live in hot springs or snowbanks. Several viruses that infect plants are of this type (figure 6.6b). He has written cases for the National Center for Case Study Teaching in Science and presented talks at national
meetings on the use of case studies in the classroom. The hook and its filament are free to rotate 3608—like a tiny propeller. Although the ice appears to be completely solid, it is honeycombed by various-size pores and tunnels filled with a solution that is Microbes are exposed to a wide variety of environmental factors that affect growth and survival
Figure 7.7 Facilitated diffusion. One can generalize that all spirilla, about half of the bacterial shapes are shown in figure 4.23). Appendages: Some bacterial shapes are shown in figure 4.23). Appendages: Some bacterial shapes are shown in figure 4.23.
yeast infections; and Stachybotrys is a toxic mold (see 5.1 Secret World of Microbes). The living world abounds with incredible, fascinating microbes that have yet to be discovered or completely understood. Perhaps the most remarkable cell granule is involved not in nutrition but rather in navigation. protozoa b. cyanobacteria 15. Up to 6 million bats
have been killed—as high as 95% of some cave populations. Look ahead to Clinical Connections on page 44 to see a type of this molecule, which is considered one of the most common molecules in the universe, and one that may have many earthly uses. Microscopes with ultraviolet illumination Maximum effective magnification 5 1,0003 to 2,0003*.
skin b. actin cytoskeleton 4. It is believed that attractant molecules inhibit tumbles, increase runs, and permit progress toward the stimulus (figure 4.6). Some viruses have glycoproteins on their surface for binding to and invading their host cells. Over the next few sections, we will glimpse other important milestones in the development of the
scientific method such as vaccination, germ theory, asepsis, and Koch's postulates. How did viruses originate? The rate of water diffusing across the cell membrane into the cytoplasm is rapid and constant, and the cells would die without a way to adapt. What is plankton? The methods he used to discount abiogenesis were simple yet brilliant. In
general, when a salt is formed, the ending of the name of the negatively charged ion is changed to -ide. 7 8 Chapter 1 The Main Themes of Microbiology of macroscopic organisms are usually given in centimeters (mm) and, sometimes, nanometers (nm)
and millimeters (mm). One problem hampering early animal virologists was their inability to propagate specific viruses routinely in pure culture and in sufficient quantities for their studies. Figure 4.22 illustrates some major physical and chemical events in this process. This viral DNA will be retained by the bacterial cell and copied during its normal
cell division so that the cell's progeny will also have the phage DNA. This capacity for multiplication, increasing the size of the population by cell division, has tremendous importance in microbial control, infectious disease, and biotechnology. Figure 7.3 Extracellular digestion in a saprobe with a cell wall (bacterium or fungus). RNA viruses are
replicated and assembled in the cytoplasm, with some exceptions. provides some of the most dramatic and Shows natural color Yes No realistic images in existence. Outline the basic steps in an infection cycle of a pathogenic protozoan and a helminth. One pathogen is Balantidium (figure F). In this habitat, they associate with a wide variety of other
organisms, from bacteria to animals to plants. 1 A parent cell at the beginning of the cell cycle What cannot be seen is the synthesis and activity gearing up for cell division. In the same way, internal components of a live, unstained cell also lack sufficient contrast to distinguish readily. If viruses that normally form envelopes were prevented from
budding, would they still be infectious? She has taught microbiology and major's biology courses at Pasadena City College for 30 years, during which time she developed new curricula and refined laboratory experiments. Nomenclature of viruses follows these conventions: Virus families are italicized and given the suffix -viridae, and virus genera are
likewise italicized and end in -virus. Under isotonic* conditions, the environment is equal in solute concentration to the cell's internal environment; and because diffusion of water proceeds at the same rate in both directions, there is no net change in cell volume. Newer systems for naming viruses also take into account the actual nature of the virus
particles themselves, with only partial emphasis on host and disease. Both fish and humans develop neurological symptoms and bloody skin lesions. Microbes can be engineered to synthesize desirable proteins such as drugs, hormones, and enzymes (see table 1.1C). Consequently, no taxa are permanent to any degree; they are constantly being
revised and refined as new information becomes available or new viewpoints become prevalent. This was the beginning of an avocation that she continues today—that of lending her artistic hand to interpretation of scientific concepts. 2 2. A. Other types of vacuoles are used in storing reserve food such as fats and glycogen. One exception is for
alcohol-based compounds, which can dissolve the lipids in the outer membrane and disturb its integrity. Discuss the adaptations of parasitic worms to their lifestyles, and explain why these adaptations are necessary or advantageous to the worms' survival. The electrons passing Image viewed Glass ocular Fluorescent screen through the specimen
travel to the fluorescent screen and display a through lens pattern or image. Capsule staining is a method of observing the microbial capsule, an unstructured protective layer surrounding the cells of some bacteria and fungi. Because bacteria contain large amounts of negatively charged substances, they stain readily with basic dyes such as methylene
blue, crystal violet, fuchsin, and safranin. the expenditure of additional cellular energy in the form of ATP-driven uptake. This is described by the primary structure (the chain of amino acids), the secondary structure (crosslinks, especially disulfide bonds
between secondary structures), and quaternary structure (formation of multisubunit proteins). latent, bacterial viruses b. Life Cycles and Reproduction Tapeworms, flukes, and roundworms are collectively called helminths, from the Greek word meaning "worm." Adult animals are usually large enough to be seen with the naked eye, and they range
from the longest tapeworms, measuring up to about 25 m in length, to roundworms less than 1 mm in length, to roundworms less t
Ionic Bonds: Electron Transfer Among Atoms In reactions that form ionic bonds, electrons are transferred completely from one atom to another and are not shared. That is the effect of adding oil to the immersion lens, which effectively increases the NA from 1.25 to 1.4 and improves the resolving power to 0.17 mm. In fact, epidemiologists analyzing
statistics on world cancer have estimated that one in six cancers can be associated with an infectious agent. The stabilizing effects of bacteria on the intestinal environment are the basis behind probiotic supplements and foods. These bacteria on the intestinal environment are the basis behind probiotic supplements and foods.
coloration. He can carry the infectious agent to many far-flung locations, exposing populations along the way, who in turn can infect their contacts. Each major discipline in microbiology contains numerous subdivisions or specialties that deal with a specific subject area or field (table 1.1). relationship became obligatory. TABLE 3.7 Examples of
Selective Media, Agents, and Functions Medium Selective Agent Used For Mannitol salt agar 7.5% NaCl Isolation of fecal enterococcus faecalis broth Sodium azide, tetrazolium Isolation of fecal enterococcus faecalis broth Sodium azide, tetrazolium Isolation of fecal enterococcus faecalis broth Sodium azide, tetrazolium Isolation of fecal enterococcus faecalis broth Sodium azide, tetrazolium Isolation of fecal enterococcus faecalis broth Sodium azide, tetrazolium Isolation of fecal enterococcus faecalis broth Sodium azide, tetrazolium Isolation of fecal enterococcus faecalis broth Sodium azide, tetrazolium Isolation of fecal enterococcus faecalis broth Sodium azide, tetrazolium Isolation of fecal enterococcus faecalis broth Sodium azide, tetrazolium Isolation of fecal enterococcus faecalis broth Sodium azide, tetrazolium Isolation of fecal enterococcus faecalis broth Sodium azide, tetrazolium Isolation of fecal enterococcus faecalis broth Sodium azide, tetrazolium Isolation of fecal enterococcus faecalis broth Sodium azide, tetrazolium Isolation of fecal enterococcus faecalis broth Sodium azide, tetrazolium Isolation of fecal enterococcus faecalis broth Sodium azide, tetrazolium Isolation of fecal enterococcus faecalis broth Sodium azide, tetrazolium Isolation of fecal enterococcus faecalis broth Sodium azide, tetrazolium Isolation of fecal enterococcus faecalis broth Sodium azide, tetrazolium Isolation of fecal enterococcus faecalis broth Sodium azide, tetrazolium Isolation of fecal enterococcus faecalis broth Sodium azide, tetrazolium Isolation of fecal enterococcus faecalis broth Sodium azide, tetrazolium Isolation of fecal enterococcus faecalis broth Sodium azide, tetrazolium Isolation of fecal enterococcus faecalis broth Sodium azide, tetrazolium Isolation of fecal enterococcus faecalis broth Sodium azide, tetrazolium Isolation of fecal enterococcus faecalis broth Sodium azide, tetrazolium Isolation azide, tetrazolium Isolation azide, tetrazolium azide, tetrazolium azide, tetrazolium azide, tetrazolium azide,
juice agar Tomato juice, acid Isolation of lactobacilli from saliva MacConkey agar (MAC) Bile, crystal violet Isolation of gram-negative enterics Eosin-methylene blue agar (EMB) Bile, dyes Isolation of Salmonella Sabouraud's agar (SAB)
pH of 5.6 (acid) inhibits bacteria Isolation of fungi 82 Chapter 3 Tools of the Laboratory TABLE 3.8 Examples of Differential Media Substances That Facilitate Differentiation Differentiation
enteric (HE) agar* Brom thymol blue, acid fuchsin, sucrose, salicin, thiosulfate, ferric ammonium citrate, and bile Salmonella, Shigella, and other lactose nonfermenters; H2S reactions are also observable MacConkey agar (MAC) Lactose, neutral red Bacteria that ferment lactose (lowering the pH) from those that do not Eosin-
methylene blue (EMB) Lactose, eosin, methylene blue Same as MacConkey agar Urea broth Urea, phenol red dye Fermentation of the ph Sulfur indole formation Triple-sugar iron agar (TSIA) Triple sugars, iron, and phenol red dye Fermentation of
sugars, H2S production XLD agar Lysine, xylose, iron, thiosulfate, phenol red Can differentiate Enterobacter, Escherichia, Proteus, Providencia, Salmonella, and Shigella Medium (a) (b) Figure 3.19 Examples of media that are both selective and differentiate Enterobacter, Escherichia, Proteus, Providencia, Salmonella, and Shigella Medium (a) (b) Figure 3.19 Examples of media that are both selective and differentiate Enterobacter, Escherichia, Proteus, Providencia, Salmonella, and Shigella Medium (a) (b) Figure 3.19 Examples of media that are both selective and differentiate Enterobacter, Escherichia, Proteus, Providencia, Salmonella, and Shigella Medium (a) (b) Figure 3.19 Examples of media that are both selective and differentiate Enterobacter, Escherichia, Proteus, Providencia, Salmonella, and Shigella Medium (a) (b) Figure 3.19 Examples of media that are both selective and differentiate Enterobacter, Escherichia, Proteus, Providencia, Salmonella, and Shigella Medium (a) (b) Figure 3.19 Examples of media that are both selective and differentiate Enterobacter, Escherichia, Proteus, Providencia, Proteus, 
based on genetic testing had become widely available. Transformed cells generally have an increased rate of growth, alterations in chromosomes, changes in the cell's surface molecules, and the capacity to divide for an indefinite period. This has a sticky texture that attracts primary colonists, usually bacteria. Although a multicellular organism is
composed of many cells, it is more than just a disorganized assemblage of cells like a colony. Gametangia Zygospore matures Fertilization Zygospore forms 140 Chapter 5 A Survey of Eukaryotic Cells and Microorganisms Zygote nuclei develop into sporangiospores. membranes. A true anaerobe (anaerobic microorganism) lacks the metabolic enzyme
systems for using oxygen gas in respiration. As might be expected, rods are also quite varied in their actual form. While there are increasing 6.8 numbers of antiviral drugs, most of them block virus replication by targeting the function of host cells. Varies from 3 to 70 Gram-negative Treponema pallidum, cause of syphilis; Borrelia and Leptospira,
important pathogens Spirilla Spirochetes Flexible helix Curved or spiral forms: Spirillum/Spirochete 106 Periplasmic flagella within sheath; cells flex; can swim by rotation or by creeping on surfaces; have 2 to 100 periplasmic flagella within sheath; cells flex; can swim by rotation or by creeping on surfaces; have 2 to 100 periplasmic flagella within sheath; cells flex; can swim by rotation or by creeping on surfaces; have 2 to 100 periplasmic flagella within sheath; cells flex; can swim by rotation or by creeping on surfaces; have 2 to 100 periplasmic flagella within sheath; cells flex; can swim by rotation or by creeping on surfaces; have 2 to 100 periplasmic flagella within sheath; cells flex; can swim by rotation or by creeping on surfaces; have 2 to 100 periplasmic flagella within sheath; cells flex; can swim by rotation or by creeping on surfaces; have 2 to 100 periplasmic flagella within sheath; cells flex; can swim by rotation or by creeping on surfaces; have 2 to 100 periplasmic flagella within sheath; cells flex; can swim by rotation or by creeping on surfaces; have 2 to 100 periplasmic flagella within sheath; cells flex; can swim by rotation or by creeping on surfaces; have 2 to 100 periplasmic flagella within sheath; cells flex; can swim by rotation or by creeping on surfaces; have 2 to 100 periplasmic flagella within sheath; cells flex; can swim by rotation or by creeping on surfaces; have 2 to 100 periplasmic flagella within sheath; cells flex; can swim by rotation or by creeping 
cells) Streptococci (variable number of cocci in chains) (b) Division in two perpendicular planes Tetrad (cocci in packets of four) Sarcina (packet of 8-64 cells) (c) Division in several planes Irregular clusters (number of cells varies) Palisades arrangement Metachromatic granules Palisades arrangement Pleomorphism Figure 4.24 Pleomorphism and
other morphological features of Corynebacterium. * archaea (ar9-kee-uh) sing, archaeon. Phylum Proteobacteria This phylum contains five classes representing an extremely varied cross section of over 2,000 identified species of bacteria. A major stimulus to the rise of microbiology in the late 1800s was the development of techniques for growing
microbes out of their natural habitats and in pure form in the laboratory. A protein has a natural tendency to the native state, and if it is disrupted by some means, the protein is assume more complex levels of organization, called the secondary, said to be denatured. Explain the ways that mitochondria resemble rickettsias and chloroplasts resemble
cyanobacteria. Differentiate between mono-, di-, and polysaccharides, and give examples of each. The Parasitic Helminths 151 developed organs are those of the reproductive tract, with some degree of reduction in the digestive, excretory, nervous, and muscular systems. Incubation is carried out in a CO2 incubator that provides the correct range of
CO2 (figure 7.12b). *The 2,0003 maximum is achieved through the use of a 203 ocular or 23 annulus. CLINICAL CONNECTIONS Persistent Viral Infections As a general rule, a virus infection kills its host cell, but some cells escape destruction by harboring the virus in some form. prions 7. One advantage of this original plan is that it continues to use
most of the original taxa at the phylum, division, and lower levels, especially as they relate to medically significant microbial groups. acid, base c. Single nucleus Sexual reproduction, when present, by syngamy; division by longitudinal fission by longitudinal fission Several parasitic forms lack mitochondria and Golgi apparatus. What general type of multicellular parasite is
composed primarily of thin sacs of reproductive organs? These were the techniques that Venter's team applied to ocean samples (see Case Study, page 1). Hyphae can also be classified according to their particular function. Whatever the direction, transport occurs across the cell membrane, the structure specialized for this role. Bacteria with a
significant difference in G 1 C percentage are less likely to be genetically related. When a gram-positive cell is exposed to either of these two chemicals, it will lose the cell wall completely and become a protoplast,* a fragile cell bounded only by a membrane that is highly susceptible to lysis. See critical thinking question 1. Outline the main
differential stains and how they are used. environmental signals, it forms an endospore by a process termed sporulation. Each viral type is limited in its host receptors. It is hard for us to believe, but as recently as the late 1800s, surgeons wore street
clothes in the operating room and had little idea that hand washing was important. SECTION 1.5 10. How are algae important? As technology advanced in the profile at least chemically. Define dyes and describe the basic chemistry behind the process of staining. But even with this new technology, it is highly unlikely that microbiologists will abandon
culturing, simply because it provides a constant source of microbes for detailed study, research, and diagnosis. 46 Chapter 2 The Chemistry of Biology 6 CH2OH O H H 4 1 H OH O H OH H H H O CH2OH O H H H A OH I H H O CH2OH O H H H A OH I H H O CH2OH O H H H A OH I H H O CH2OH O H H H A OH I H H O CH2OH O H H H A OH I H H O CH2OH O H H H A OH I H H O CH2OH O H H H A OH I H H O CH2OH O H H H A OH I H H O CH2OH O H H H A OH I H H O CH2OH O H H H A OH I H H O CH2OH O H H H A OH I H H O CH2OH O H H H A OH I H H O CH2OH O H H H A OH I H H O CH2OH O H H H A OH I H H O CH2OH O H H H A OH I H H O CH2OH O H H H A OH I H H O CH2OH O H H A I H O CH2OH O H H H A OH I H H O CH2OH O H H H A OH I H H O CH2OH O H H H A OH I H H O CH2OH O H H A I H O CH2OH O H H H A OH I H H O CH2OH O H H H A OH I H H O CH2OH O H H H A OH I H H O CH2OH O H H H A OH I H H O CH2OH O H H H A OH I H H O CH2OH O H H H A OH I H H O CH2OH O H H H A OH I H H O CH2OH O H H H A OH I H H O CH2OH O H H H A OH I H H O CH2OH O H H H A OH I H H O CH2OH O H H A I H O CH2OH O H H H A OH I H H O CH2OH O H H H A OH I H H O CH2OH O H H H A OH I H H O CH2OH O H H H A OH I H H O CH2OH O H H H A OH I H H O CH2OH O H H H A OH I H H O CH2OH O H H H A OH I H H O CH2OH O H H H A OH I H H O CH2OH O H H H A OH I H H O CH2OH O H H H A OH I H H O CH2OH O H H H A OH I H H O CH2OH O H H H A OH I H H O CH2OH O H H H A OH I H H O CH2OH O H H H A OH I H H O CH2OH O H H H A OH I H H O CH2OH O H H H A OH I H H O CH2OH O H H H A OH I H H O CH2OH O H H A OH I H H O CH2OH O H H A OH I H A OH
HHHHHHHHHHA1 a 4 1 a 4 1 a 4 1 a 4 1 a 4 1 a 6 O O O O HHOHOHH 3 H 2 OH 3 H 2 OH 3 H 2 OH 6 CH2OHO HHHH 4 1 O O OHHH 5 H bonds 3 H (a) Cellulose 2 OH (b) Starch Figure 2.17 Polysaccharides. Glucose (Greek for sweet) is the most common and universally important hexose;
fructose is named for fruit (one of its sources); and xylose, a pentose, derives its name from the Greek word for wood. Complex, multipartner mutualism is especially striking in termites, which harbor 250 or more specialized microbes inside their gut. What correlation can be made between the geographic location of a parasite and its vector? both b
and c 2. Thus the seeds of medical microbiology were sown in the middle to latter half of the nineteenth century with the introduction of the first practical vaccine, the germ theory of disease, and the resulting use of sterile, aseptic, and pure culture techniques. In general, all living things have an absolute need for the bioelements, traditionally listed
as carbon, hydrogen, oxygen, phosphorus, potassium, nitrogen, sulfur, calcium, iron, sodium, chlorine, magnesium, and certain other elements. 1 Beyond these basic requirements, microbes have significant differences in the source, chemical form, and amount of the elements they use. Magnification of the object or specimen by a compound
microscope occurs in two phases. 4 As the chains build up, they form fibers within the cell's function and destroy it. transport c. Describe the life cycle of endospore-forming bacteria, including the formation and destroy it.
body and do not cause infections. Other types of glycocalyces can be important in formation of biofilm infections (see 4.1 Making Connections). Glycocalyx Page 126 External structures Glycocalyx Page 126 Ex
membrane Nucleus Nuclear envelope Nucleolus Chromosomes Organelles Endoplasmic reticulum Golgi complex Mitochondria Chloroplasts Locomotor organelles Flagella Cilia Ribosomes Cytoskeleton Microtubules Microtubules Microtubules Microtubules Microtubules Microtubules Microtubules Microtubules Cilium Cell membrane (c) Whips back and
forth and pushes in snakelike pattern bb (a) (b) Twiddles the tip Lashes, grabs the substrate, and pulls Figure 5.3 The structure of cilia and flagella. To understand how solutions become acidic or basic, we must look again at the behavior of water molecules. Is the germ theory of disease really a law, and why? Briefly outline the processes and
purposes of the six types of procedures that are used in handling, maintaining, and studying microorganisms. The proton and neutron have almost exactly the same mass, which is about 1.66 3 10224 grams, a unit of measurement known as a Dalton (Da) or unified atomic mass unit (U). ribosomes c. Although a parasite is usually defined as an
organism that obtains food and other requirements at the expense of a host, the term parasite is also used to denote protozoan and helminth pathogens. Another system classifies them according to their energy source as phototrophs or chemotrophs. The glycocalyx may be a slime layer or a capsule. Polypeptides ordinarily will contain both types of
configurations. objective c. The most drastic outcome was the deaths of 39 patients from complications of meningitis. One species, Spirillum minor, causes rat bite fever. The atomic nucleus is surrounded by electrons that travel within orbitals and occur in energy levels called shells. Together, the capsid and the nucleic acid are referred to as the
nucleocapsid. In both cases, the medium is stabbed carefully in the center with an inoculating needle and later observed for the pattern of growth around the stab line. They replicate in the nucleus c. The later blood cultures
grew a strain of Staphylococcus aureus* known as MRSA. Despite this limit, small improvements to resolution are possible. This microbe is widely distributed in the world, from northern zones to the tropics, and is nearly always associated with humans. Microtubules are long, hollow tubes that maintain the shape of eukaryotic cells such as protozoa
that lack cell walls. So far, our main focus has been on the characteristics of atoms, ions, and small, simple substances that play diverse roles in the external surface of the cell is required for the diffusion of nutrients and wastes. Oxygen comprises about 20% of the atmosphere
and CO2 about 0.03%. recombinant DNA 4. that are advantageous to at least one of the members. re 3. Outline the general body areas that are sterile and those regions that harbor normal resident microbiota. Weight is a measurement of the gravitational pull on the mass of a particle, atom, or object. Classification systems serve both practical and
academic purposes. Distinguish between a single and a double bond. Certainly some are commensals that make a living on the body without harm or benefit, but a greater number are probably mutualistic, providing some form of nutrition or protection. The first microscopes were simple, meaning they contained just a single magnifying lens and a few
working parts. Lister's concept of asepsis was much more limited than our modern precautions. A Rickettsia k rickettsia; Neisseria; enterics such as Escherichia coli and Salmonella; Vibrio species; and other bacteria that live in the intestinal tracts of animals. The
medical importance of these novel infectious agents has led to a great deal of research into how they function. As it moves along the surface, any deflection of the metal probe is detected by a sensitive device that relays the information to an imager. Bacteria exhibit considerable variety in shape, size, and colonial arrangement. As it leaves, each ion
becomes hydrated, which means that it is surrounded by a sphere of water molecules (figure 2.12). Kathy Talaro's experiences as a teacher, microbiologist, and illustrations. Compare and contrast the main phases
in the lytic multiplication cycle in bacteriophages and animal viruses. This type of bonding is usually represented in molecular models with a dotted line. mitosis Writing Challenge 14. Relate the characteristics of other types of cell walls and wall-free cells. fructose c. Comparisons are given as average sizes. cestus, a belt, and ode, like. One important
finding was the essential functions these residents can have in protective immunities. Structures inside cells that perform specific functions. The complete life cycle of helminths includes the fertilized egg (embryo), larval, and adult stages. * autotroph (aw9-toh-trohf) Gr. auto, self, and troph, to feed. 1.5 The Historical Foundations of Microbiology
Expected Learning Outcomes 9. Some of the institutions charged with this task are the U.S. Public Health Service (USPHS) and the Centers for Disease Control and Prevention (CDC). Incubator ISOLATION Some inoculation techniques can separate microbes to create isolated colonies that each contain a single type of microbe. Instead, they populate
some of the coldest places on earth, including Extreme thermophile Minimum -15 -10 -5 0 Maximum 5 10 15 20 25 30 35 40 45 50 55 60 65 70 75 80 85 90 95 100 105 110 115 120 125 130 Temperature °C Figure 7.9 Ecological groups by temperature of adaptation. Among living things, fur, feathers, fruits, leaves, human skin, and insect exoskeletons
are naturally waterproofed with a coating of wax. The trypanosome trophozoite multiplies in the intestinal tract of the reduviid bug and is harbored in the feces. colony growing beneath the media surface b. These vials were sent to 23 states and used to inject the drug into the spinal column or joints of around 14,000 patients. Chemical traits of fungal
cells include the possession of a polysaccharide, chitin, in their cell walls and the sterol, ergosterol, in their cell membranes. diatoms b. Acidic dyes such as nigrosin and India ink can still be used successfully on bacteria using the negative stain method (table 3.4). General purpose Types of Media Most media discussed here are designed for bacteria
and fungi, though algae and some protozoa can be propagated in media. After months of investigation, the CDC isolated a black mold, Exserohilum rostratum, from both the patients and drug vials. In the usual sense, it means an increase in size of a population through reproduction. an outer membrane c. Differentiate between habitat and niche. An
inflammation of the lining of the lining of the lining of the heart and its valves usually caused by infection. Note that this reaction is complementary to photosynthesis. categories based upon color reaction and shape: gram-positive rods, gram-positive rods, gram-positive rods, gram-positive rods, and gram-positive rods, gr
cells in parallel array (inset). protozoa d. In general, fungi derive nutrients through a. Tracing the origins of and evolutionary relationships among bacteria has not been an easy task. Flagellar stain of Proteus vulgaris. This process is described in more detail in chapter 9. These extremely tiny bacteria range from 0.1 to 0.5 mm in size. Active 2 ATP ATP
Bulk transport transported. Because gram-negative bacteria are colorless after decolorization, their presence is demonstrated by applying the counterstain safranin in the final step. Pili are appendages in bacteria that serve as a means of a. This fluidity is essential to such activities as engulfment of food and discharge or secretion by cells. Explain
why penicillin can be an effective drug to treat grampositive bacterial infections but is ineffective against most gramnegative bacteria. Molecules, such as benzene, that repel water are considered hydrophobic.* A third class of molecules, such as the
phospholipids in cell membranes, are considered amphipathic* because they have both hydrophobic properties. What do you suppose the world would be like if there were cures for all infectious diseases and a means to destroy all microbes? As we learned in chapter 1, all cells discovered thus far are classified into one of two
fundamentally different groups: the small, seemingly simple prokaryotic cells and the larger, structurally more complicated eukaryotic cells. Eventually, the host cell becomes so packed with viruses that it undergoes lysis and splits open, thereby releasing the mature virions (figure 6.18). Microbiologists exploring acid mines in Calilower limits of
bacterial size. The scientific name is always a combination of the generic (genus) name followed by the species name. Ribosomes: Protein Synthesizers In an electron micrograph of a eukaryotic cell, ribosomes are numerous, tiny particles that give a "dotted" appearance to the cytoplasm. Prominent members include the branching filamentous
Actinomycetes, the spore-bearing Streptomycetes, Corynebacterium (see figure 4.23a). a gram-positive cell b. As long as the flask remained intact, the broth remained sterile, but if the neck was broken off so that dust fell directly down into the container, microbial growth immediately commenced
These beautiful algae have silicate cell walls and golden pigment in their chloroplasts. In general, an atom will be most stable if it fills its outer shell of 8 electrons. During the formation of the nucleocapsid, these discs link together and form a continuous helix into which the nucleocapsid the first stable if it fills its outer shell of 8 electrons. During the formation of the nucleocapsid, these discs link together and form a continuous helix into which the nucleocapsid, these discs link together and form a continuous helix into which the nucleocapsid the first stable if it fills its outer shell of 8 electrons.
swallowed may be absorbed in unpredictable amounts, and it may not reliably reach the site of action; or it may not be specific to the target cells and cause harm to healthy tissues. These findings have spurred a great deal of speculation on the possible involvement of viruses in cancers whose cause is still unknown, serine 7. Only smallpox has been
sucrose or lactose Neisseria meningitidis Ferments sucrose; does not ferment lactose; does not ferment sucrose Neisseria gonorrhoeae Reduces nitrite Branhamella catarrhalis (b) 3.5 Media: The Foundations of Culturing Does not ferment sucrose Neisseria gonorrhoeae Reduces nitrite Branhamella catarrhalis (b) 3.5 Media: The Foundations of Culturing Does not ferment sucrose; does not ferment sucrose Neisseria sucrose; does not ferment sucrose; does not ferment
nitrite Moraxella spp. They are composed of a nitrogen base, a pentose sugar, and a phosphate. These then developed a protective coating and a capacity to reenter a cell and use its machinery to reproduce. framework involved in support and shape. Cooking does not destroy the toxin, and there is no antidote. Describe some of the ways that
organisms use lysosomes. Protozoan cells often receive growth factors from symbiotic bacteria and algae that are mutually nurtured by the protozoan cell. Hint: Clear adhesive tape is involved. It is common for cells of a single species to show pleomorphism* (figure 4.24). Here, they lay down a glycocalyx consisting of fimbriae, pili, slime layers, or
capsules. Several early scientists fashioned magnifying lenses and microscopes, but these lacked the optical clarity needed for examining bacteria and other small, single-celled organisms. synthetic medium b. e. This means that the dyes give off visible light when bombarded by shorter ultraviolet rays. cruzi to illustrate the phases of a trypanosomal
life cycle and to demonstrate the complexity of parasitic relationships. Like the phase-contrast microscope, the differential interference contrast (DIC) microscope provides a detailed view of unstained, live specimens by manipulating the light. Describe the nutritional strategy of two types of chemoautotrophs described in the chapter. The eukaryotic
cell can be compared with the prokaryotic cell in structure, size, metabolism, motility, and shape. A large The accompanying figure shows a possible sequence If a smaller bacterial cell. * microbe (my9-krohb) Gr. mikros, small, and bios, life. This interest in the microbial world led to a biology major at Idaho State University, where she worked as a
teaching assistant and scientific illustrator for one of her professors. Why would chronic infections be more likely to be associated with diseases like cancer? Areas that look smooth and flat with the light microscope display intriguing surface features with the SEM (figure 3.8b). Entamoeba 25. Although they are somewhat typical in morphology, they
middle. Both are composed of large and small subunits of ribonucleoprotein (see figure 5.7). Define what is meant by the term "microorganism" and outline the important contributions microorganisms make to the earth's ecosystems. The degree of resolution allows magnification to be extremely high—usually between 5,0003 and 1,000,0003 for
biological specimens and up to 5,000,0003 in some applications. What qualities of this bacterium make it such a serious concern? The trypanosome of Chagas disease relies on the close relationship of a warm-blooded mammal and an insect that feeds on mammalian blood. Evaluate the following preparations in terms of providing information on
microbial size, shape, motility, and differentiation: spore stain, negative stain, simple stain, hanging drop slide, and Gram stain. The Learning Outcomes are tightly correlated to digital material. They move their slender, twisted cells by means of periplasmic flagella. How are polymers formed? Describe the properties of nonviral infectious particles.
100 Chapter 4 A Survey of Prokaryotic Cells and Microorganisms CLINICAL CONNECTIONS The Cell Wall and Infections Variations in cell wall anatomy contribute to several differences between the two cell types besides staining reactions. Following attachment of the virus to host cell receptors, the lipids within the adjacent membranes become
rearranged so that the nucleocapsid can be translocated into the cytoplasm for the bacteria. Other examples include fungi that grow within plant tissues and protect the plant from drought and insects while being
harbored (11) Antibiosis by an actinomycete against a pathogenic fungus; (12) micrograph of actinomycete (8003) and fed (figure 7.13d). Taken together, NTDs rank second only to HIV/AIDS in their medical, social, and economic impact. aureus"? + - Keep in mind that because electrons are being added during reduction, the atom that receives Na 28
1 Cl 28 7 Na 28 Cl 28 8 them will become more negative; and that is the meaning of reduction in this context. three fatty acids bound to glycerol b. This species causes tick-borne Mediterranean fever. Most fungi and protozoa, as well as many bacteria (genera Micrococcus and Bacillus), have strict requirements for oxygen in their metabolism. A yeast
cell is distinguished by its round to oval shape and by its mode of asexual reproduction. Ribonucleic acid (RNA) is a polymer of nucleotides where the sugar is ribose and uracil is the replacement base for thymine. This was a new strain of virus first observed in 2009. At ordinary room temperature, semisolid media exhibit a clotlike consistency (figure
3.15) because they contain an amount of solidifying agent (agar or gelatin) that thickens them but does not produce a firm substrate. Because of this widespread distribu- tion, they are huge contributors to worldwide productivity. Multiplication Cycle: Animal Cells 1. But many substances that cells require are * turgid (ter9-jid) A condition of being
swollen or congested. OH OH *The R designation on a molecule is shorthand for remainder, and its placement in a formula indicates that what is attached at that site varies from one compound to another. He called his technique vaccination, from the Latin vacca for cow. The incredible diversity and versatility seen in microbes make them excellent
candidates for solving human problems. Will an H bond form between H3C—CH55O and H2O? Others include anaerobic (reducing), assay, and enumeration media. The results of the experiment must be published and repeated by other investigators. Can you explain why a virus can enter some types of human cells but not others? T an s oc y all ers
iety iou ut var rev M o icr CASE STUDY Part 1 A view of Mars' Mount Sharp reveals stratified rock layers reminiscent of those on earth that could hold signs of ancient organisms. Some animal viruses enter their host cell and permanently alter its genetic material, in many cases leading to cancer. Medium (b) produces only one or two types of colonies on earth that could hold signs of ancient organisms.
that look very similar. Microbes are essential to the maintenance of the air, soil, and water. (c) Elongation of the nucleocapsid progresses from both ends, as the nucleic acid is wound "within" the lengthening helix. Describe interactions between humans and their microbiota. Note the variations in structure of this reactive component. If even one
component of a given medium is not chemically definable, the medium is a nonsynthetic, or complex,4 medium (table 3.6B). A subculture is a a. As we will see, the chemical properties of an element are controlled mainly by the distribution of electrons in the outermost shell. Figure 2.21 provides examples of several common amino acids. After
consulting table 6.1 on page 158, what additional statements can you make about viruses, especially as compared with cells? Euglenophyta d. Answer available at *This term and fullerene were chosen in honor of Buckminster Fuller, who designed the geodesic dome, an architectural structure that is constructed on the same plan as these tiny
molecules. (a) Because a water molecule is released at each ester bond, this is another form of dehydration synthesis. Answer available at * virion (vir9-ee-on) Gr. iso, poison. Parasites range from viruses to helminth worms, and they can live on the body (ectoparasites), in the organs and tissues (endoparasites), or even within cells (intracellular
parasites, the most extreme type). Answer available at 3.3 Preparing Specimens for Optical Microscopes Expected Learning Outcomes 9. This milestone enabled the close examination of a microbe and its morphology, physiology, and genetics. become 10,000 times more acidic than normal c What types of microbes would one expect to be living in
such fresh water. The last cases occurred in 1977, and in 1979 the disease was declared eradicated. taL22600_ch19_574-603.indd Page 11/6/13 are 7:55covered PM f-w-166 Most strains of583 S. Nucleus of cell Archaea: The Other Prokaryotes Figure 4.31 Transmission electron micrograph of Rickettsia conorii inside its host cell (100,000X). 61 62
Chapter 3 TABLE 3.1 Tools of the Laboratory An Overview of Microbiology Technique Process Involves Purpose and Outcome See Pages Inoculation Placing a sample into a container of medium that supplies nutrients for growth and is the first stage in culturing To increase visibility; makes it possible to handle and manage microbes in an
artificial environment and begin to analyze what the sample may contain Incubation Exposing the inoculated medium to optimal growth conditions, generally for a few hours to days To promote multiplication and produce the actual culture. Saprobic Microorganisms The primary niche of saprobes is as decomposers of plant litter, animal matter, and
dead microbes. Specific Mechanisms of Drug Resistance 12.5 Interactions and Alteration of the Microbiota by Antimicrobials 12.6 Considerations in Selecting an Antimicrobial Drug Resistance Natural Selection and Drug Resistance 12.5 Interactions Between Drugs and Hosts Toxicity to Organs Alteration of the Microbiota by Antimicrobials 12.6 Considerations in Selecting an Antimicrobial Drug Resistance Natural Selection and Drug Resistance Natural Selection Natural Selecti
Susceptibility of Microorganisms The MIC and the Therapeutic Index Patient Factors in Choosing an Antimicrobiota DrugCHAPTER 13 Microbe-Human Interaction, Disease Resident Microbiota: The Human as a Habitat Indigenous Microbiota of Specific
Regions Colonizers of the Human Skin Microbial Residents of the Gastrointestinal Tract Inhabitants of the Genitourinary Tract Microbial Residents of the Genitourinary Tract 13.2 Major Factors in the Development of an Infectious Dose Attaching to the Host: Phase Two
Invading the Host and Becoming Established: Phase Three 13.3 The Outcomes of Infection and Disease The Portal of Exit: Vacating the Host The Persistence of Microbes and Pathologic Conditions 13.4 Epidemiology: The Study of Disease in
Populations Origins and Transmission Patterns of Infectious Microbes The Acquisition and Transmission of Infectious Agents 13.5 The Work of Epidemiologists: Investigation and Surveillance Epidemiologists: Investigation and
dimensions Macroscopic Range of eye Flea Roundworm* 2m mm 1 mm Fungus sporangium µ 200 µm Range of light microscope Metric Chart Symbol Log No. Multiplier kilometer decimeter decimeter decimeter millimeter micrometer nanometer Angstrom picometer km hm dam dm cm mm µm nm Å pm 103 102 101 10-1 10-2 10-3 10-6
be described by an exact chemical formula. Nucleolus Ribosome parts Rough endoplasmic reticulum Nucleus Transport vesicles Golgi apparatus Condensing vesicles Cell membrane Secretion by exocytosis Secretory vesicle Figure 5.8 The synthesis and transport machine. transport medium SIM medium Case Study Review 1. Peritrichous flagella also
reverse direction and cause the cell to lose coordination and stop. The Cellular Organization of Microorganisms As a general rule, prokaryotic cells, and in addition to lacking a nucleus, as previously mentioned, they lack organelles, which are structures in cells bound by one or more membranes. To continue the Case
Study, go to page 180. Even extremes in temperature and pH are not a barrier to their existence; hardy species are found in hot springs, ice, and habitats with low or high pH. What is meant by the term virion? (2) An unsaturated fatty acid has at least one double bond and cannot pack densely due to the bends in the long chain caused by the double
bonds. It was readily transmitted from human to human. Functional types of media serve different purposes, often allowing biochemical tests to be performed at the same time. 122 c What can you conclude about the total number of NTD cases, given that everyone in the bottom billion has at least one infection? Name an acid-fast bacterium and
explain what characteristics make this bacterium different from other gram-positive bacteria. Periodically, these parasitized cells rupture, releasing large numbers of new trophozoites into the blood. Add your own content quickly and easily. From interviewing Mr. Jones, he learned that condition, saying he was probably tired from working in his
garden an artificial valve had been implanted in his heart 10 years before, a and suffering one of his regular allergy attacks. The reason for this phenomenon can be explained by their valences. By the time any problems were reported, several hundred cases of infection had occurred, half of which settled in the meninges. The other is intended for use
on processed meats and poultry to control Listeria monocytogenes, another prominent food-borne pathogen. Describe the properties of atoms and identify the relationships of the particles that they contain. Several major virus families have capsids arranged in an icosahedron*—a three-dimensional, 20-sided figure with 12 evenly spaced corners.
Green and Purple Sulfur Bacteria The green and purple bacteria are also photosynthetic and contain pigments. A ill i (h (honey)) mushrooms, h sprouting i from the base of a tree, arose from a vast underground mycelium that covers 2,200 acres and stretches 3.5 miles across. Mass transport of large particles, cells, and liquids by engulfment and
vesicle formation Alternate system for transporting nutrients (sugars, amino acids) early Energy expenditure is required. We rely on the review process to uncover errors, check content, clarify points, and get feedback on accuracy, order, depth, organization, and readability. During the bacterial growth." sion cycle, the parent cell
enlarges, duplicates its chromosome, and forms a central transverse septum that divides the cell into two daughter cells. * sporozoite (spor0-oh-zoh9-yte) Gr. sporos, seed, and zoon, animal. This definition does not work for bacteria primarily because they do not exCrenarchaeota Proteobacteria hibit a typical mode of sexual reproducNanoarchaeota
tion. Cockroaches, termites appeared. Select the description that best fits the word in the left column. Hyphae are characteristic of the filamentous fungi called molds. Even 199 parched zones in sand dunes and deserts harbor a hardy brand
of microbes; and thriving bacterial populations can be found in petroleum, coal, and mineral deposits containing copper, zinc, gold, and uranium. Any product other than water that arises when acids and bases react is called a salt. Take the case of malaria, caused by a microorganism transmitted by mosquitoes, which kills 1 to 2 million people every
year worldwide. locomotor organelle c. This space in gram-negative bacteria is a site of many metabolic reactions related to synthesis and transport of proteins, actions of enyzmes, and energy release. The gradient goes from the outer container (higher concentration of H2O) to the sac (lower concentration of H2O). The primary purposes of viral
cultivation are (1) to isolate and identify viruses in clinical specimens; (2) to prepare viruses for vaccines; and (3) to do detailed research on viral structure, multiplication cycles, genetics, and effects on host cells. Because the envelope is more supple than the capsid, enveloped viruses are pleomorphic and range from spherical to filamentous in shape
In chapter 5, we will similarly survey the eukaryotic world. Nuclear envelope with pores Pages 127, 128 Nucleus Page 127 Lysosome Page 121 Nucleolus Pages 131, 132 Centrioles* Page 128 *Structure not present in all cell types Figure 5.2
Overview of composite eukaryotic cell. For example: • • Earth's temperature is regulated by "greenhouse gases," such as carbon dioxide and methane, that create an insulation layer in the atmosphere and help retain heat. Which kingdoms of the five-kingdom system contain eukaryotic microorganisms? 5. Many syntrophic associations occur in
aquatic habitats and soils within biofilms and are related to nutrient and bioelement recycling. (-) (a) (-) O The Nature of Diatomic Elements You will notice that hydrogen, oxygen, nitrogen, chlorine, and iodine are often shown in notation with a 2 subscript—H2 or O2. (b) www.mcgrawhillconnect.com Enhance your study of this chapter with study
characteristics of life Three Clinical Connections features on bacterial structures that play an important role in infections Revised biofilm figure and box Revised biofilm figure and bo
Archaea Chapter 5 Chapter 1 • • • • • • Redesigned microbial size and measurement figure, with new images A reconfigured table covering the fields in microbiology with new photographs and examples A chart mapping emerging diseases A new figure to illustrate applications of the scientific
method using vaccination as a topic A new figure and table showing disease statistics to replace the original taxonomic trees have been refreshed; photographs of examples of major groups were added to the Domain-based tree Chapter 2 • • • • The
figure of atoms was enhanced to look more dynamic and closer to its real structure. Nearly 2,000 microbes are pathogens that cause infectious diseases that result in high levels of mortality and morbidity (illness). Viruses vary in the exact mechanisms of these processes, but we will use a simple animal virus to illustrate the major events (figure 6.11)
will cause a visible change in the medium and Y will not. Analysis of this molecule in prokaryotic cells indicates that certain unusual cells exist
only in a yeast form and others occur primarily as hyphae, a few, called dimorphic,* can take either form, depending upon growth conditions, such as changing temperature. Different Types of Atoms: Elements and Their Properties All atoms share the same fundamental structure. They play numerous roles in cell structure, adhesion, and metabolism.
These are large polymers of simple sugars. (a) Triple sugar iron agar (TSIA) inoculated on the surface and stabbed into the thicker region at the bottom (butt). The number of orbitals and how completely they are filled depend on the numbers of electrons, so that each element will have a unique pattern. Integral proteins extend fully through
the entire membrane and are often fixed in place. Another useful property is that it is not readily digestible and thus not a nutrient for most applications. Characterize the bacterial ribosomes and cytoskeleton. Chemical Content of
Media Media with a chemically defined composition are termed synthetic. *Some diseases are named by adding the suffix -iasis to the name of the organism that causes it. The nucleic acid of a virus is a. Spore completes maturation; sporangium starts to disintegrate. Answer available at agent varies among species, it is generally a small organic
molecule such as an amino acid or an inorganic salt. Summarize the two major ways that animal viruses leave their host cells. Although the majority of fungi are either unicellular or colonial, a few complex forms such as mushrooms and puffballs are considered multicellular. What makes the amino acids distinctive, and how many of them are there? It
is important to remind you that the large majority of microorganisms are relatively harmless and highly beneficial and essential. Many of them are retrovidoes not prove causation, but it certainly warrants additional research. With this construction, the cytoplasm and organelles move freely from one region to another, and each hyphal element can
have several nuclei (see figure 5.14c). reticulum (SER). First, they adsorb to host bacteria using specific receptors on the bacterial surface. The R designation on a molecule is shorthand for remainder, and its placement in a formula indicates that the group attached at that site varies from one compound to another. Pseudopods are active in both
movement and feeding. Rickettsias Poxvirus Range of electromicroscope Herpesvirus* 200 nm Poliovirus 100 nm 10 nm 2n nm Most viruses fall between 200 and 10 nm in size. Your efforts in exploring microbes will be more meaningful if you understand some essentials of microscopy* and specimen preparation. How are they different? Which
of the following is not one of the six "I's"? They are real cells, complete with a tiny genome and a light microscopes. (Are they caused by an infection? Nonseptate hyphae consist of one long, continuous cell not divided into individual compartments by cross walls. Rabies 125 nm 5. He developed two vaccines (rabies and anthrax) and clarified the
actions of microbes in wine and beer fermentation. In all of these conditions, the brain progressively deteriorates and the patient loses motor coordination, along with sensory and cognitive abilities. These DNA be used to isolate single cells. Because the use of standardized species names has not been widely accepted, the genus or common English
vernacular names (for example, poliovirus and rabies virus) predominate in discussions of specific viruses in this text. Superficial (not deeply invasive) Outer epidermis, hair, Dermatophytosis, and dermis can also called tinea be attacked or ringworm of the scalp, body, feet (athlete's foot), toenails Mucous Candidiasis, or
(torulosis) Lung, skin Paracoccidioidomycosis (South American blastomycosis) Coccidioides immitis Blastomyces dermatitidis Histoplasma capsulatum Cryptococcus neoformans Paracoccidioides brasiliensis *This fungus can cause severe, invasive systemic infections in patients with cancer, AIDS, or other debilitating diseases. They do not have
flagella. • An autotroph* is an organism that uses inorganic CO2 as its carbon source. These changes generally involve the breaking 11. The hook is anchored to the cell by the basal body, a stack of rings firmly anchored through the cell wall to the cell membrane. tropica, L. A fully formed, extracellular virus particle that is virulent and able to
establish infection in a host is called a virion.* The number of virions released by infected cells is variable, controlled by factors such as the size of the virus and the health of the host cell. Why is the hydrophilic end of phospholipids attracted to water? (3)-(4) By metaphase, the chromosomes are fully visible as X-shaped structures. As the biofilm
evolves, it undergoes specific adaptations to the habitat in which it forms. The nucleic acid of animal viruses enters the host cell through a. These spores are initially enclosed but are released when the sporangium ruptures. 39. The domain has great ecological importance due to its actions in biogeochemical cycling. Inoculations have to be done in a
cold room because ordinary room temperature can be lethal to these organisms. About 1875, Koch used this experimental system to show that anthrax was caused by a bacterium called Bacillus anthracis. Define carbohydrate and know the functional groups that characterize carbohydrates. It is than could be covered in one semester or quarter, your
instructor far more effective to spend an hour or so each day for two weeks will select what he/she wants to emphasize and construct a reading than a marathon cramming session on one weekend. Plants have eukaryotic cells, are multicellular, have cell walls, and are photosynthetic. Because of the scarcity of cells in the early stages of growth, some
samples can give a zero reading even if there are viable cells in the culture. When atoms bind together in molecules, they lose the properties of the atom and take on the properties of the combined substance. For example, parasites that invade and live on the human body derive all essential nutrients from host tissues, tissue fluids, secretions, and
wastes. Some are even found in the oral cavity and large intestine of humans. The model describes a membrane as a continuous bilayer formed by lipids with the polar heads oriented toward the outside and the nonpolar tails toward the center of the membrane. What other applications could grow out of this use of such tiny delivery systems? c What
appear to be the most important facts in this case? protists d. One way to detect motility is to stab a (a) tiny mass of cells into a soft (semisolid) medium in a test tube (see figure 3.15). both c and d 3. Describe the three main techniques for cultivating viruses. taL22600_ch18_543-573.indd Page 547 11/5/13 7:48 PM f-w-166 Spongy bone Metaphysis
Combination Figures Artery Line drawings combined with photos give students two perspectives: the realism of photos and the explanatory clarity of illustrations. Proteins can function as a. Describe the virus-host relationship. archaea 120 Chapter 4 A Survey of Prokaryotic Cells and Microorganisms 11. (2) A microfossil of a billion-year-old filament
found in Siberian fossils. Here we provide a brief overview of the process, using an RNA virus as a model. Modifier terms are also used to specify the nature of an organism's adaptations. Confirmation of their status by genetic testing eliminated any question that they belong in a kingdom of their own. Psychrophiles can grant the confirmation of their status by genetic testing eliminated any question that they belong in a kingdom of their own. Psychrophiles can grant the confirmation of their status by genetic testing eliminated any question that they belong in a kingdom of their own. Psychrophiles can grant the confirmation of their status by genetic testing eliminated any question that they belong in a kingdom of their own. Psychrophiles can grant the confirmation of their status by genetic testing eliminated any question that they belong in a kingdom of their own. Psychrophiles can grant the confirmation of their status by genetic testing eliminated any question that they belong in a kingdom of their own.
an optimum below 158C. The one thing that has remained constant and unchanging over these years is the outstanding collaboration we enjoy with the editorial and production staff at McGraw-Hill Education. These of microbial types of microbial
with selective and differential media. 23. What is the difference between the use of the shape bacillus? have circulated in the United States in the recent past, but Major features used to identify the influenza virus are protein this one also displayed characteristics of European and Asian swine molecules on the surface of the
virus called receptors or spikes. Check Your Progress SECTION 3.1 1. mately involved in forming the human placenta, leading microbiologists Using information you have learned about viruses, explain how to conclude that some viruses have become an essential factor in evoluviruses could become a permanent component of an organism's tion and
development. Differentiate between flagella and periplasmic flagella and periplasmic flagella. This group includes free-living protozoa, most fungi, and a variety of bacteria. The Structure and Functions of Membranes The word membrane appears frequently in descriptions of cells in chapters 4 and 5. Some biologists refer to viruses as parasitic particles; others consider An
adenovirus them to be very primitive organisms, and making of bonds and the rearrangement of atoms, 7.5 are so prevalent that they dominate the structure of most natural environments on earth. B. Scanning electron micrograph of a biofilm formed by a gram-negative backerium. Alkaligenes, on a central venous catheter, ADP can be converted back
to ATP when the third phosphate is restored, thereby serving as an energy depot. The sample is placed into a container of medium that will support its growth. Bacteria living deep in a swamp on a diet of inorganic sulfur or protozoa digesting wood in a termite's intestine seem to show radical adaptations, but even these organisms require a constant
influx of certain substances from their habitat. ter in any reaction is retained in some form, and the same types and numbers of atoms going into the reaction will be present in the products. A General Comparison of Prokaryotic Cells Viruses**
Genetics Nucleic acids True nucleus Nuclear envelope Nucleoid 1 2 2 1 1 1 1 2 1 2 2 Reproduction Mitosis Production Mitosis Production Mitosis Production of sex cells Binary fission 2 1/2 1 1 1 1 2 2 2 Respiration Enzymes Mitochondria 1 2 1 1 2 2 Photosynthesis Pigments
Chloroplasts 1/2 2 1/2 1/2 2 2 Motility/locomotor structures Flagella Cilia 1/2*** 2 1/2 1/2 2 Shape/protection Cell membrane Cell wall Capsule 1 1/2*** 2 1/2 1/2 2 (have capsids instead) 2 0.5-3 mm**** 2-100 mm, 0.2 mm Size (in general) *1 means most members of the group exhibit this characteristic; 2 means most lack it; 1/2 means some
members have it and some do not. Fungal spores function not only in multiplication but also in survival, providing genetic variation, and dissemination. Finally, a way to quickly and easily create the course materials you've always wanted. This procedure is repeated at evenly spaced intervals (i.e., every hour for 24 hours) (figure 7.17). 6.5 TABLE 6.3
Cytopathic Changes in Selected Virus-Infected Animal Cells Virus Response in Animal Cells Virus Response in Cytopathic Changes in Selected Virus-Infected Animal Cells Virus Response in Cytopathic Changes in Selected Virus-Infected Animal Cells Virus Response in Cytopathic Changes in Selected Virus-Infected Animal Cells Virus Response in Cytopathic Changes in Cytopathic Changes in Selected Virus-Infected Animal Cells Virus Response in Cytopathic Changes in Cytopathic Cytopathic Changes in Cytopathic Cy
in cytoplasm Cells round up; no inclusions No change in cell shape; cytoplasmic inclusions (Negri bodies) Syncytia form (multinucleate) Adenovirus Poliovirus Reovirus Influenza virus Rabies virus Measles virus of multiple host cells into single large cells containing multiple nuclei. The eBook is now even viewable on an iPad! And, when you are done
you will receive a free PDF review copy in just minutes! Visit McGraw-Hill Create—www.mcgrawhillcreate.com— today and begin building your perfect book. Explain the two principal functions of dyes in media. This growth pattern is termed exponential. Fungus Zone with no growth where antibiotic inhibits undesirable fungus Actinomycete colony
that produces antibiotic (k) Leaf cutting ants gathering food for a fungus garden that is their source of food. They live in sulfur springs, freshwater lakes, and swamps that are deep enough for the anaerobic conditions they require yet where their pigment can still absorb wavelengths of light (figure 4.29). action are called the reactants. This
calculation comes out to 12, so 2n is equal to 212. Check Your Progress SECTION 1.7 18. One very common CPE is the fusion Why would the integration of viral genes into a human chromosome cause cancer? Theobald Executive Marketing Manager: Patrick E. capsa, box. The general phases of this cycle are presented in figure 5.25. 5 Cells secrete
their enzymes in unison to digest food particles. We added over 120 new or significantly revised figures and 180 new and replacement photographs. So far in our introduction to the bacterial world, we have covered a rich variety of members with exceptional modes of living and behaving. (c) Division in several planes produces irregular clusters.
Chemically, a wax is an ester formed between a long-chain alcohol and a saturated fatty acid. The Double Helix of DNA DNA is a huge molecule formed by two very long polynucleotide (meaning that it consists of many nucleotides joined together) strands linked along their length by hydrogen bonds between complementary pairs of nitrogen bases. A
fungus that causes Ohio Valley fever. The majority of fungi produce sexual spores at some point. magnus, great, and ficere, to make. Examine figure 3.11a, b. Discuss the major characteristics of algae, and explain how they are classified. lens d. Organisms are assigned binomial scientific names consisting of their genus and species names.
Chemoautotrophs play an important part in recycling inorganic nutrients and elements. The ants spread the chemical in their gardens to protect the fungi from invasion by parasites. LearnSmart also predicts when a student will forget concepts and introduces remedial content to prevent this. * monotrichous (mah0-noh-trik9-us) Gr. mono, one, and
tricho, hair. Summarize the basic characteristics of archaea. In these locations, microbes signal each other as well as human cells in ways that shape the conditions there. Some of these are DNA viruses such as papillomavirus, which is a sociated with cervical cancer, and herpesviruses such as Epstein-Barr virus, which is a cofactor in Burkitt's
lymphoma in geneticallypredisposed individuals. gram-negative, genetic exchange d. Moreover, the other animalcules were in such enormous numbers, that all the water . (b1) Nucleus Shell 2 Nucleus Shell 3 Nu
electron Orbitals Figure 2.1 Models of atomic structure. (a) An electron micrograph of a longitudinal section, Identify the differences between covalent, ionic, and hydrogen bonds. What constitutes a micronutrient can vary from one microbe to another and
often must * adaptation L. not changed d. What is the pH of a solution with a concentration of 0.00001 moles/ml (M) of OH2? It can be used only on preserved material. For practical purposes, mycologists divide the fungi into two groups: the macroscopic fungi (mushrooms, puffballs, gill fungi) and the microscopic fungi (molds, yeasts). Although
details of this process are too complex to discuss here, it involves expenditure of energy and a coordinating mechanism in the cell membrane. Define growth factors and metallic ions with examples, and explain their functions in cells. (d) A negative stain of this virus highlights its texture and fibers that have fallen off. What is the structure of
carbohydrates and glycosidic bonds? Vaccines that stimulate immunity are an extremely valuable for only a limited number of viral diseases (see chapter 15). When we say that microbes are too small to be seen with the unaided eye, what sorts of dimensions are we talking about? * replication (rep-lih-kay9-shun) L. Cilia are very
similar in overall architecture to flagella, but they are shorter and more numerous (some cells have several thousand). 4.7 Survey of Prokaryotic Groups with Unusual Characteristics Expected Learning Outcomes 28. Ascaris is a genus of parasitic intestinal roundworms. Gas bubble
Outline of Durham tube Cloudiness indicating growth Figure 3.21 Carbohydrate fermentation in broths. Each of these cells becomes a basidthe cup-shaped fruiting body that houses the asci. and can be inhibited by drugs that affect only bacteria. peptidoglycan d. (a) Cellulose is composed of b glucose bonded in 1,4 bonds that produce linear, lengthy
chains of polysaccharides that are H-bonded along their length. In the following sections, we cover the microscopic structure and functions of the eukaryotic cell. Life Cycles and Reproduction Most protozoa are recognized by a motile feeding stage called the trophozoite* that requires ample food and moisture to remain active. Chitin (ky-tun), a
polymer of glucosamine (a sugar with an amino functional group), is a major compound in the cell walls of fungi and the exoskeletons of insects. In general, photosynthesis relies on special pigments to collect the light and uses the energy to convert CO2 into simple organic compounds. Here we see a red cyanobacterium, Nostoc (3,0003), that has
probably been frozen in suspended animation there for 3,000 years. By definition, a parasite is a microbe that invades the body of a host, uses it as a habitat and source of nutrients and, in the process, harms the host to some degree. Through a series of adaptive questions, LearnSmart Labs identifies a student's knowledge gaps and provides resources
to quickly and efficiently close those gaps. (a) Molecular formulas provide a brief summary of the elements in a compound. A Diagnostic Scheme for Medical Use Many medical use Many medical use formulas provide a brief summary of the elements in a compound. A Diagnostic Scheme for Medical Use Many medical use Many medical use Many medical use formulas provide a brief summary of the elements in a compound. A Diagnostic Scheme for Medical Use Many medical use Many
this chapter are microbial adaptiveness and ubiquity. Cellular microbes Nucleus No nucleus No nucleus Noncellular microbes Nucleus No nucleus N
isotopes and delivering antiviral drugs into infected cells. Proteins are the most prevalent organic compound. gram-positive, genetic exchange b. water molecule 2. Explain what happens in positive staining to cause the reaction in the cell. In most cells, triglycerides are stored in long-term concentrated form as droplets or globules. Differential media
grow several types of microorganisms but are designed to bring out visible differences among those microorganisms in these settings 7.5 Ecological Associations Among Microorganisms 203 7.2 Secret World of Microbes A Mutual Attraction A tremendous
variety of mutualistic symbioses occur in nature. 18 Chapter 1 The Main Themes of Microbiology the air with strong antiseptic chemicals, such as phenol, prior to surgery. A newer classification scheme for living things is based on the genetic structure of their ribosomes. Its distribution is worldwide among all socioeconomic groups, but it seems to
attack younger people more frequently than older ones. This was first confirmed by environmental researchers, who came to believe that only about 1% (and in some environments could be grown in laboratories by the usual methods and, therefore, were unknown and
unstudied. infective, RNA viruses c. They then added an enzyme that would transcribe the DNA sequence into the RNA genome used by poliovirus. Inclusions, or Granules: Storage Bodies Most bacteria are exposed to severe shifts in the availability of food. Important subsciences include immunology, epidemiology, and public health, food, dairy,
aquatic, and industrial microbiology. Describe the evolutionary history of eukaryotic ribosomes, described in chapter 4. For our purposes, we adopt a classification scheme with a medical mycology emphasis, in which the Kingdom Eumycota is subdivided into several
phyla based upon the type of sexual reproduction, hyphal structure, and genetic profile. The scale includes macroscopic, microscopic, and atomic dimensions. Data from a cross section of such tests can produce a unique profile of each species. This virus has a well-developed enveloped enveloped enveloped enveloped enveloped enveloped enveloped enveloped.
showed growth, indicating that the bacteria had entered her bloodstream. Unfortunately, they also tend to occur in the poorest rural victims of harsh ostracizing by their communities. In most cases, these microbes first attacked and killed millions of
fish and later people whose occupations exposed them to fish and contaminated water. * heterotrophic (het-ur-oh-tro9-fik) Gr. hetero, other, and troph, to feed. Quaternary structure occurrence of nucleic acids in all known cells and viruses emphasizes their important roles as informational molecules. This begins the process of laying down memory.
Describe the three main types of sexual spores, and construct a simple diagram to show how each is formed. The data from a growing bacterial population are graphed by plotting the number of cells as a function of time. They require neither light nor organic nutrients in any form, and they derive energy in diverse and some-times surprising ways.
The following series of experiments were among the most important in finally tipping the balance. They are small RNA viruses. Dyes are effective differential agents because many of them are pH indicators that change color in response to the production of an acid or a base. These growth factors are organic compounds such as vitamins and amino
acids that the microbes cannot synthesize themselves. We see this in Buchnera endosymbionts of certain aphids. engulfed entirely into a vesicle called an endosome after its initial attachment. Membranes are also components of eukaryotic organelles such as nuclei, mitochondria, and chloroplasts, and they appear in internal pockets of certain
prokaryotic cells. It was transmitted from Mexico to the United States. Green algae Flagellates PROTISTS PROKARYOTES EUKARYOTES Brown algae Kingdom Protista Amoebas Diatoms Apicomplexans Dinoflagellates Early eukaryotic cells appeared ±2 billion years ago. (a) The peptidoglycan of a cell wall is a huge, three-
dimensional latticework that is actually one giant molecule to surround and support the cell. 88 4.1 Basic Characteristics of Cells and Life Forms Expected Learning Outcomes 1. In 2009, his laboratory manual, Laboratory Applications in Microbiology: A Case Study Approach, was published. Order the
following items by size, using numbers: 1 5 smallest and 8 5 largest. Embryonic fluids and tissues can be prepared for direct examination with an electron microscope. Since classification was first initiated around 200 years ago, several thousand species of bacteria and archaea have been identified, named, and catalogued. These are fully functioning
cells marine microbiologist discovered an even larger species of the right? Details of this process are covered in chapter 9. yeasts that produce human hormones, pigs that prod
is a Formulas, Models, and Equations reducing agent. Reproductive Mode: Includes embryo, larval, and adult stages. In this case, the MRSA bacteria in the patient's skin infection must have entered the circulation and colonized the artificial valve over several weeks to months. Agar and gelatin media are illustrated in figure 3.16. lem spr 4 o in 3. The
species category has created a lot of controversy within the virology community. We are becoming more susceptible to infectious disease precisely because of advances in medicine. So useful were his postulates that the causative agents of 20 other diseases were discovered between 1875 and 1900, and even today, they serve as a basic premise for
establishing a pathogen-disease link. Despite this slight disagreement, the impact of viruses is undeniable. Note that the lenses reverse the image and flip it upside down. When an unsupported idea is dismissed as being "just a theory," this is an incorrect use of the term as far as science is concerned. Figure 4.12 Magnified view of a biofilm. It was
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slightly elevated at 1008F. This enzyme—Taq polymerase—is now an essential component of the polymerase chain reaction or PCR, a process used in many areas of medicine, forensics, and biotechnology (see chapter 10). • Cryptosporidium is an emerging intestinal pathogen transmitted by contaminated water (see figure G). 1 ic M ac hy id dr oc 2.
The flowing action of the pseudopods results in amoeboid motion, and pseudopods also serve as feeding structures in many amoebas. Consult table 6.2, page 167, right-hand column to determine which viral diseases you have had and which ones you have been vaccinated against. It is still undergoing analysis, and it somewhat complicates the
presentation of some organisms by disposing of some traditional groups, although three of the five original kingdoms (animals, plants, fungi) still work within this framework. bacteria, viruses, and other microorganisms. The primary concerns of taxonomy are classification, nomenclature, and identification. xiii T he Purpose of an E xper tly Craf ted
Learning Tool taL22600 ch06 157-184.indd Page 178 10/9/13 9:37 PM f-w-166 /202/MH02004/taL22600 disk1of1/0073522600/taL22600 pagefiles NEW! Secret World of Microbes 6.1 Secret World of Microbes Seeking Your Inner Viruses Would you be alarmed to be told that your Evidence is mounting that certain vicells carry around bits and pieces
of fossil ruses may contribute to human obesity. II. A parasite lives in or on the body of a larger organism called the host and derives most of its sustenance from that host. (a2) Carbon has four orbitals and two shells. are localized to one site in the body b. A monosaccharide is a simple polyhydroxy aldehyde or ketone molecule containing from 3 to 7
carbons; a disaccharide is a combination of two monosaccharides; and a polysaccharide is a polymer of five or more monosaccharides bound in linear or branched chain patterns (figure 2.15). The nature of the septa varies from solid partitions with no communication between the compartments to partial walls with small pores that * mycelium (my9-
see-lee-yum) pl. phrenia. These findings have given support to the endosymbiotic theory of their evolutionary origins discussed in 5.1 Making Connections. Electronegativity—the ability of an atom or molecule to attract electrons. glycosidic d. cell membrane c. Helminths: Roundworms of Trichinella spiralis coiled in the muscle of a host (250x).
vesicles, ribosomes d. In fact, over 8% of the DNA in human chrovirus allows its DNA to regulate cellular differentiation of stem cells into mosomes comes from viruses! fat cells. For example, there are pigmented and nonpigmented and nonpigment
Since 1969, at least 26 novel infectious agents have arisen within the human population. Some examples of scientific names, pronunciations, and origins are: • • • • Histoplasma capsulatum (hiss0-toh-plaz9 -mah cap0-soo-lay9-tum)
Gr. histo, tissue, plasm, to form, and L. Adsorption 6 Penetration Lysis of weakened cell Lytic Cycle DNA splits Spliced viral genome 3 Viral DNA molecule Capsid The lysogenic state in bacteria. spikes c. Mitochondria (along with chloroplasts) are
unique among organelles in that they divide independently of the cell, contain circular strands of DNA, and have prokaryote-sized 70S ribosomes. (2) In a peritrichous* arrangement, flagella are dispersed randomly over the surface of the cell (figure 4.4). The third shell with nine orbitals can hold up to 18 electrons. This term means that most of them
are so minute (, 0.2 mm) that an electron microscope is necessary to detect them or to examine their fine structure. Stuart's and Amie's transport media contain buffers and Control tube (b) absorbants to prevent cell destruction but will not support growth. Synthetic (chemically 1. An important characteristic of a solution is that the solute cannot be
separated by filtration or ordinary settling. Most elements do not exist naturally in pure, uncombined form but are bound together as molecules and compounds. Biochemical tests are discussed in more depth in chapter 17 and chapters that cover identification of pathogens. The general structure of nucleic acids. Once absorbed, nutrients are
processed and transformed into the chemicals of the cell. A transmission electron microscope (TEM) projects the electrons through prepared sections of the specimen, providing detailed structural images of cells, cell parts, and viruses. Because many of these nutritional patterns are also ecological in nature, they will be given fuller coverage in
section 7.5. In this section, we introduce saprobes and parasites as they relate to nutrition. The general steps in a viral multiplication cycle are a. In an informal and general way, we have already begun classifying viruses—as animal, plant, or bacterial viruses; enveloped or naked viruses; DNA or RNA viruses; and helical or icosahedral viruses. Many
fungi and bacteria are adapted to this survival strategy. reproduction c. Branches of Microbiology Branch Bacteriology Chapter 4 Involved in the Study of: The bacteria—small single-celled prokaryotic organisms Mycology 5, 22 The fungi, a group of eukaryotes that includes both microscopic eukaryotes (molds and yeasts) and larger organisms
(mushrooms, puffballs) Protozoology 5, 23 The protozoology 5, 23 The protozoo—animal-like and mostly single-celled eukaryotes Virology Parasitology Phycology or Algology Morphology 6, 24, 25 5, 23 5 4, 5, 6 Physiology 7, 8 Taxonomy 1, 4, 5, 17 Viruses—minute, noncellular particles that parasitize cells Parasitize and parasitic organisms—traditionally including
pathogenic protozoa, helminth worms, and certain insects Simple photosynthetic eukaryotes, the algae, ranging from single-celled forms to large seaweeds The detailed structure of microorganisms Microbial Genetics,
Molecular Biology 9, 10 The function of genetic material and biochemical reactions that make up a cell's metabolism Microbial Ecology 7, 26 Interrelationships between microbes and the environment; the roles of microorganisms in the nutrient cycles and natural ecosystems A medical microbiologist tests specimens for evidence of antibodies to the
human immunodeficiency virus (HIV). These categories are not absolute, in that some saprobes can adapt to living organisms, and some symbionts can obtain nutrients from a nonliving source. Each of the subsequent whole-number readings in the scale reduces the [H1] by tenfold: • • • pH 1 contains [0.1 moles H1/L]. But there are many salt lovers,
including rich communities of bacteria and algae living in oceans, salt lakes, and inland seas, some of which are saturated with salt (30%). (b) Nutrient gelatin contains enough gelatin (12%) to take on a solid consistency. Bacteria that decompose urine create alkaline conditions, because ammonium (NH41) can be produced when urea (a component of
urine) is digested. She has also served as a coauthor with Kelly Cowan on the first two editions of Microbiology: A Systems Approach. * matrix (may9-triks) L. Figure 1.12 Photograph of Robert Koch looking through a microscope with colleague Richard Pfeiffer looking on. What kind of ion would you expect magnesium to make on the basis of its
valence? 430 Compartments and Connections of the Immune System 431 14.3 Second Line Defenses: Inflammation 440 The Stages of Inflammation 440 14.4 Second Line Defenses: Phagocytosis, Interferon, and Complement 445 Phagocytosis: Partner to Inflammation
and Immunity 445 xxviii Contents Interferon: Antiviral Cytokines and Immune Stimulants Complement: A Versatile Backup System 448 Overall Stages in the Complement Cascade 450 An Outline of Major Host Defenses 450 CHAPTER 447 Antibodies Against A and B Antigens 504 The Rh Factor and Its Clinical Importance 502 Other RBC Antigens 504
16.4 Type III Hypersensitivities: Immune Complex Disease 505 Types of Immune Complex Disease 505 Types III Hypersensitivities: Immune Complex Disease 505 Types of Immune Complex Disease 505 Types III Hypersensitivities: Immune Complex Disease 505 Types III Hypersensitivities:
Practical Examples in Transplantation 509 15.1 Specific Immunity: The Adaptive Line of Defense 456 An Overview of Specific Events in T-Cell Maturation 462 Specific Immune Response System 456 15.2 Lymphocyte Maturation 462 Specific Events in T-Cell Maturation 462 Specific Immunity: The Adaptive Line of Defense 456 An Overview of Specific Immunity: The Adaptive Line of Defense 456 An Overview of Specific Immunity: The Adaptive Line of Defense 456 An Overview of Specific Immunity: The Adaptive Line of Defense 456 An Overview of Specific Immunity: The Adaptive Line of Defense 456 An Overview of Specific Immunity: The Adaptive Line of Defense 456 An Overview of Specific Immunity: The Adaptive Line of Defense 456 An Overview of Specific Immunity: The Adaptive Line of Defense 456 An Overview of Specific Immunity: The Adaptive Line of Defense 456 An Overview of Specific Immunity: The Adaptive Line of Defense 456 An Overview of Specific Immunity: The Adaptive Line of Defense 456 An Overview of Specific Immunity: The Adaptive Line of Defense 456 An Overview of Specific Immunity: The Adaptive Line of Defense 456 An Overview of Specific Immunity: The Adaptive Line of Defense 456 An Overview of Specific Immunity: The Adaptive Line of Defense 456 An Overview of Specific Immunity: The Adaptive Line of Defense 456 An Overview of Specific Immunity: The Adaptive Line of Defense 456 An Overview of Specific Immunity: The Adaptive Line of Defense 456 An Overview of Specific Immunity: The Adaptive Line of Defense 456 An Overview of Specific Immunity: The Adaptive Line of Defense 456 An Overview of Specific Immunity: The Adaptive Line of Defense 456 An Overview of Specific Immunity: The Adaptive Line of Defense 456 An Overview of Specific Immunity: The Adaptive Line of Defense 456 An Overview of Specific Immunity Line of Defense 456 An Overview of Specific Immunity Line of Defense 456 An Overview of D
Characteristics of Antigens and Immunogens 462 462 15.3 Cooperation in Immune Reactions to Antigen Processing and Presentation 464 B-Cell Responses 471 Cell-Mediated Immunity (CMI) 16.7 Immunodeficiency Diseases: Compromised
Immune Responses 512 Primary Immunodeficiency Diseases 513 Secondary Immunity: Vaccinetion 478 Development of New Vaccines 480 Routes of Administration and Side
Effects of Vaccines 482 To Vaccinate: Why, Whom, and When? Other cytoskeletal elements appear to be active in cell division. The clawing and wasting are chiefly due to nerve damage that interferes with musculoskeletal activity. Propose another function of flagella besides locomotion. Characteristics to consider in identification include the shape
and size of the cell; the type, number, and distribution of locomotor structures; the presence of special organelles or cysts; and the number of nuclei. Common groups of photosynthetic microbes (see figure 4.32). 15.
Anatomical or geographic areas have also been used in naming. Humans are host to similar chronic diseases, including Creutzfeldt-Jakob Disease (CJD), kuru, fatal familial insomnia, and others. Several types of drugs used to treat infection (penicillin, cephalosporins) are effective because they target the peptide cross-links in the peptidoglycan,
thereby disrupting its integrity. Three-dimensional models of hydrogen and carbon that approximate their actual structure. Red dashed lines indicate H bonds. Some ancillaries, including electronic and print components, may not be available to customers outside the United States. Indicate how the resolving power is determined and how resolution
affects image visibility. Identify several arrangements of bacteria and how they are formed. xi T he Ar t of an E xper tly Craf ted Learning Tool Author's and talent transforms difficult concepts A utthor's experience experie Truly instructional artwork has always been a hallmark feature of Foundations in Microbiology. What is embedded in rough
endoplasmic reticulum? Indicate how viruses were discovered and characteristic symptoms. Firmicutes b. Examples of reactions are detected by direct examination of specimens, genetic tests, testing patients' blood, and characteristic symptoms. Firmicutes b. Examples of reactions
are synthesis and decomposition. Proteobacteria c. Outline the most significant discoveries and events in microscopy, culture techniques, and other methods of handling or controlling microbes. human immunodeficiency virus HIV protozoan rickettsia protein worm coccus-shaped bacterium spirochete atom 15. In many cases, the disease has an
extended course and can cause death. The Nucleus: The Control Center The nucleus is a compact sphere that is the most prominent organille of eukaryotic cells. A major action of the cell membrane is to regulate transport, that is, the passage of nutrients into the cell membrane is to regulate transport, that is, the passage of nutrients into the cell membrane is to regulate transport, that is, the passage of nutrients into the cell membrane is to regulate transport, that is, the passage of nutrients into the cell membrane is to regulate transport, that is, the passage of nutrients into the cell membrane is to regulate transport, that is, the passage of nutrients into the cell membrane is to regulate transport, that is, the passage of nutrients into the cell membrane is to regulate transport, that is, the passage of nutrients into the cell membrane is to regulate transport, that is, the passage of nutrients into the cell membrane is to regulate transport, that is, the passage of nutrients into the cell membrane is to regulate transport, that is, the passage of nutrients into the cell membrane is to regulate transport, that is, the passage of nutrients into the cell membrane is to regulate transport, that is, the passage of nutrients into the cell membrane is to regulate transport.
of the cytoplasm, often made evident by the streaming of organelles around the cell in a cyclic pattern. Protons and neutrons form the nucleus of the atom. (See figures H and I.) H. Cell wall acts as a barrier. Fluid thioglycollate is a slightly viscous broth used for determining patterns of growth in oxygen (see figure 7.11). Symbiotic microbes
Photoheterotroph Example Photosynthetic organisms, such as algae, plants, cyanobacteria Only certain bacteria, animals Fungi, bacteria, some protozoa (decomposers) Parasites, commensals, mutualistic microbes Purple and green photosynthetic bacteria
thesize are phototrophs, and those that gain energy from chemical compounds are chemotrophs. How does the precise structure of the cell walls differ between gram-positive and gram-negative bacteria? Biologists have estimated that these two Domains together still account for at least half of the total mass of life forms on earth. The Structure of
an E xper tly Craf ted Learning Tool Chapter Opening Case Studies Each chapter opens with a Case Study Part 1, which helps the students appreciate and understand how microbiology impacts their lives. What is uncoating? Viral spikes leading to Virus transmission Adsorption leads to via a process called and uncoating e b ay hm ic wh Other RNA
RNA dsDNA which must be transcribed into before replication 184 Chapter 6 An Introduction to Viruses Level II. Several endospore-forming species cause food spoilage or poisoning. Name four differential reactions that TSIA shows. In the loop dilution, or pour plate, technique, the sample is inoculated, also with a loop, into a series of cooled but still
liquid agar tubes so as to dilute the number of cells in each successive tube in the series (figure 3.11c, d). Easy, because they reproduce so rapidly and can usually be grown in large numbers in the laboratory. The Viable Plate Count: Batch Culture Method A growing population is established by inoculating a known quantity of sterile
liquid medium with a few cells of a pure culture. Robert Koch won the Nobel Prize for Physiology or Medicine in 1905 for his work on Mycobacterium tuberculosis. on earth are single-celled chrysophyta called diatoms (figure 5.22b). Answer available at As the smaller cells took up permanent residence, they came to perform specialized functions for
the larger cell, such as food synthesis and oxygen utilizaA larger prokaryotic cell, possibly an A smaller prokaryotic tion, that enhanced the cell's versatility archaea, containing a cell, related to modern and survival. This process * culture (kul9-chur) Gr. cultus, to tend or cultivate. 160oF (71oC). Among the most remarkable are giant and dwarf
bacteria. 19. Another viewpoint proposes that even though viruses do not exhibit most of the life processes of cells (look back at section 4.1), they can direct them and thus are certainly more than inert and lifeless molecules. negative stain 18. Telescopes have allowed closer glimpses of celessome of the same chemical substances on earth would likely
exist on tial bodies, but they have never been able to show the details Mars, then Martian life forms would be expected to have a similar needed to verify the presence of life. Parasitic species live on this list would be a self-contained
and highly organized unit to carry out the activities of life, namely a cell. More often they cling together in complex masses called biofilms. The cytoplasm also holds larger, discrete bodies such as the chromosome, ribosomes, granules, and actin strands. Other inclusions, also called granules, contain crystals 4. Groups of large, complex viruses that
are parasites inside cells of ocean-dwelling amoebas. This increase in fat cells adds adipose tissue, more fat producThese researchers are doing the work of molecular fossil hunters, tion and storage, and greater body fat. Enveloped helical virus (influenza virus): (c) a schematic view and (d) a colorized micrograph featuring a positive stain of the
influenza virus (300,0003). Scientists don't agree about whether viruses are living or not. Describe some of the ecological benefits of mutualism. 7.4 Environmental Factors That Influence Microbes type of organism metabolism such as
fermentation. In the first step, crystal violet stains cells in a smear all the same purple color. A future mission to Mars is planned that will return samples to earth for more detailed analysis. Most proteins have both types of secondary structures. These so-called persistent infections can last from a few weeks to years and even for the life of the host
The smear technique, developed by Robert Koch more than 100 years ago, consists of spreading a thin film made from a liquid suspension of cells on a slide and air-drying it. This molecule provides the main source of structural support to the bacterial cell wall. 16. As evolutionary microbiologist Isolation Techniques Certain isolation techniques are
based on the concept that if an individual bacterial cell is separated from other cells and provided adequate space on a nutrient surface, it will grow into a discrete mound of cells called a colony (figure 3.10). micrococcus c. The pathways taken by electrons are called orbitals, which are not actual objects or exact locations but represent volumes of
three-dimensional space in which an electron is likely to be found. Their metabolism is adapted to producing methane gas (CH4 or "swamp gas") by reducing carbon dioxide, using hydrogen gas under anaerobic conditions, summarized as: 4H2 1 CO2 n CH4 1 2H2O * methanogen (meth-an0oh-gen9) From methane, a colorless, odorless gas, and
gennan, to produce. across and contains a volume of close to 40 billion gallons. In addition to being beautifully colored and diverse in appearance, they vary in length from a few micrometers to 100 meters. Individuals in a later phase of the /202/MH02004/taL22600_pagefiles disease can lose their fingers. It contains a volume of close to 40 billion gallons. In addition to being beautifully colored and diverse in appearance, they vary in length from a few micrometers to 100 meters. Individuals in a later phase of the /202/MH02004/taL22600_pagefiles disease can lose their fingers.
7.5% sodium chloride, an amount of salt that is inhibitory to most bacteria and molds found in humans. All protozoa reproduce by relatively simple, asexual methods, usually mitotic cell division. c. Lipids contain long hydrocarbon chains and are not soluble in polar solvents such as water due to their nonpolar, hydrophobic character. These openings in
the membrane facilitate passive transport of water molecules following an existing osmotic gradient. bench in the back of his shop, grinding glass lenses to ever-finer specifications. See Appendix A for a table that shows all 20. In many ways, the mitochondrion of eukaryotic host's cytoplasm; it multiplies and is passed on during cell dent division,
contains a a tiny cell within a cell. Unusual groups include photosynthetic bacteria such as cyanobacteria, which provide oxygen to the environment, and the green and purple bacteria. They may be grouped with related Phyla Fibrobacteres and Chlorobi. stiff neck c. An oxidation is a loss of electrons and a reduction is a gain electrons. Reptiles
appeared. Why are intestinal bacteria able to grow on media containing bile? Explain why sterols like cholesterol can add "stiffness" to membranes that contain them. The spindle fibers that play an essential role in mitosis are actually microtubules that attach to chromosomes and separate them into daughter cells. adjacent to each other. Oxygen is a
significant element in organic compounds and inorganic compounds (see water, sulfates, phosphates, nitrates, carbon dioxide). diplococcus d. When a polar flagellum rotates in a counterclockwise direction, the cell swims forward in runs. We want you to be awed by these tinies t creatures and the tremendous impact they have on all of the ear th's
natural ac tivities. In general, an atom derives its properties from a combination of subatomic particles called protons (p1), which are positively charged; neutrons (n0), which have no charge (are neutral); and electrons (e2), which are positively charged; neutrons (no), which are negatively charged; neutrons (no), which are positively charged.
for experimentation and must be taken on faith, they can never be subjected to the rigors of the scientific method. It is most often used on fluorescently stained specimens, but it can also be used to visualize live unstained cells and tissues (table 3.2). More recent studies have found that this space serves as the major site for peptidoglycan synthesis.
outer membrane b. Cryptococcus neoformans—f a yeast that causes cryptococcosis (4003). Parts of cells and macromolecules do not show these characteristics independently. It is common to note inclusion bodies, or compacted masses of viruses or damaged cell organelles, in the nucleus and cytoplasm (figure 6.15b). The amount and exact
composition of peptidoglycan vary among the major bacterial groups. 2.6 Molecules of Life: Lipids Expected Learning Outcomes 22. * microscopic (my0-kroh-skaw9-pik) Gr. mikros, small, and scopein, to see. The poxviruses (including the 164 Chapter 6 An Introduction to Viruses 240 - 300 nm Core membrane 200 nm Nucleic acid Outer envelope
Soluble protein antigens Capsomers Lateral body (a) (a) Envelope Capsid DNA core Nucleic acid Capsid head Collar Tail fibers Sheath (b) Figure 6.8 Two types of icosahedral viruses, highly magnified. Outside of their host, they lack most other features of life we just described, and are inactive and inert. Host cell membrane Virus spikes Free RNA
Receptors Uncoating of nucleic acid (RNA) Irreversible attachment (a) Entry of nucleic acid (RNA) Irreversible attachment (b) Virus in vesicle Vesicle, envelope, and capsid break down Free DNA Engulfment Capsid RNA
Nucleic acid Receptor (c) Adhesion of virus to host receptors Engulfment into vesicle Viral RNA is released from vesicle Process Figure 6.13 Modes of virus penetration. Give examples of each type. Describe several ways that algae are important microorganisms. Check Your Progress SECTION 6.8 30. Motility is best observed with a a. The examples
are more or less to scale within a size zone but not between size zones. 6.7 Viral Infection, Detection, and Treatment macroscopic manifestation of cytopathic effects (CPEs), discussed in section 6.4. This same technique is used to detect and count bacteriophages, because they also produce plaques when grown in soft agar cultures of their host cells.
Visual Challenge Concept Mapping 87 An Introduction to Concept Mapping found at provides guidance for working with concept maps. storage 13. List the eukaryotic groups and their body plans. As diffusion continues, the sugar will spread evenly throughout the aqueous phase, and eventually there will be no gradient. This process requires the
highest levels of sterile and aseptic precautions. Some parasites are spread by direct contact with an infected person, some burrow into the skin, and others are ingested in contaminated soil or water. Fungal Identification and Cultivation Fungi are identified in medical specimens by first being isolated on special types of media and then being
observed macroscopically and microscopic appearance can be valu- separating bacteria in a mixed sample. Fungal toxins may cause disease in humans, and airborne fungi are a frequent cause of allergies and other medical
conditions (5.1 Secret World of Microbes). (a) A test system for common gram-negative cocci uses 8 small wells of media to be inoculated with a pure culture and incubated. Any changes in partner A exert a selective pressure on partner B to adapt to these changes, and vice versa. What are the main differences between saprobes and parasites?
heterotrophs can use the same organic carbon sources. cept for one—that the atmosphere contained Mars has a profile somewhat similar to earth and is one of the closer high levels of carbon dioxide gas. The size of most protozoan cells falls within the range of 3 to 300 mm. Soon viruses. Birds undergo their embryonic period within the closed
protective case of an egg, which makes an incubating bird egg a nearly perfect system for viral propagation. The envelope of an animal virus is derived from the host cell. Media companies have developed selective-differential media for numerous common pathogens, which makes an incubating bird egg a nearly perfect system for viral propagation. The envelope of an animal virus is derived from the host cell.
viruses in figures 6.7d, 6.9c, and 6.10. Draw simple structural molecules of triglycerides and phospholipids to compare their differences and similarities. A particularly hardy sugar-loving or saccharophilic yeast withstands the high sugar concentration of honey and candy. Dissolution occurs because Na1 is attracted to the negative pole of the water
molecule and Cl2 is attracted to the positive poles. Objective lens Oil Air Slide Figure 3.5 Workings of an oil immersion lens. Algae and certain bacteria trap the sun's energy to produce food through photosynthesis. Name and define the primary areas included in microbiological studies. Carbohydrates formed by the reaction can be used by the cell to
synthesize other cell components. They exist in the saltiest places on the earth—inland seas, salt lakes, and salt mines. body. In the example, the bacteria were streaked so as to spell their own names. One of the most eye-opening discoveries has been that many diseases once considered noninfectious probably do involve microbial infection. Most
bacteria are unicellular and are found in a great variety of shapes, arrangements, and sizes. Syedberg, the Swedish chemist who developed the ultracentrifuge in 1926. Fungi also interact with animals in Starting in 2007, wildlife personnel and others began reporting mass their habitats, most notably with small roundworms, called nematodes, deaths
of bats in caves throughout the Northeast and some parts of the and insects. Some notable exceptions are giant amoebas and ciliates that are large enough (3-4 mm in length) to be seen swimming in pond water. A cutaway gives a view of RNA strands (green). D X-ray D. For the most part, bacteria function as independent single-celled, or unicellular
organisms. *Note that the left scale is logarithmic, and the right scale is arithmetic. Not only is the pathogen featured in a micrograph, along with a description of the microscopic morphology, identification descriptions, habitat information, and virulence factors, the primary infections/disease, as
/202/MH02004/taL22600 disk1of1/0073522600/taL22600 pagefiles well as the organs and systems primarily impacted are displayed in new artwork within the profile as well. Sometimes spelled procaryotic and eucaryotic. Other examples are blood, serum, meat extracts, infusions, milk, soybean digests, and peptone. The spread plate method evenly
great deal to be desired. What is probably true of a $20 microscope that claims to magnify 1,0003? Many of the known members are adapted to a habitat with extremes of temperature (hyperthermophiles), acidity (acidophiles), acidophiles), acidophiles, acidophiles, acidophiles, acidophiles, acidophiles, acidophiles, acidophiles, acidophiles, aci
carbon for Azotobacter, and the ammonium supplies Cellulomonas with usable nitrogen. Certainly, viruses are the most common cause of acute infections that do not result in hospitalization, especially when one considers widespread diseases 178 Chapter 6 An Introduction to Viruses 6.1 Secret World of Microbes Seeking Your Inner Viruses Would
you be alarmed to be told that your Evidence is mounting that certain vicells carry around bits and pieces of fossil ruses may contribute to human obesity. Concept Mapping 27 Case Study Review 2. Jenner deduced that the cowpox was closely related to smallpox and could possibly be used on patients to provide protection similar to that of the
milkmaids he had seen. • What would cause a local infection to spread into a pandemic so rapidly? For example, a carrier protein that transports sodium will not bind glucose. During this time, the entire text and art program are inspected at least six times by the authors and team members. Metabolism encompasses the thousands of chemical
pathogen that would otherwise be overlooked because of its low numbers in a specimen. The first living cells on earth would most likely resemble which of these? Describe three basic techniques for isolation, including tools, media, incubation, and outcome. Fungi can also be parasites on the bodies of living animals or plants, although very few fung
absolutely require a living host. The color-bearing ion, termed a chromophore, 3.3 (a) Simple and Negative Stains (b) Differential Stains Preparing Specimens for Optical Microscopes (c) Structural Stains Use two dyes to distinguish between cell types Special stains used to enhance cell details Methylene blue stain of Corynebacterium (1,000) Gram
stain Purple cells are gram-positive. One method of characterizing ribosomes is by S, or Svedberg, 4 units, which rate the molecular sizes of various cell parts that have been spun down and separated by molecular sizes of various cell parts that have been spun down and separated by molecular sizes of various cell parts that have been spun down and separated by molecular sizes of various cell parts that have been spun down and separated by molecular sizes of various cell parts that have been spun down and separated by molecular sizes of various cell parts that have been spun down and separated by molecular sizes of various cell parts that have been spun down and separated by molecular sizes of various cell parts that have been spun down and separated by molecular sizes of various cell parts that have been spun down and separated by molecular sizes of various cell parts that have been spun down and separated by molecular sizes of various cell parts that have been spun down and separated by molecular sizes of various cell parts that have been spun down and separated by molecular sizes of various cell parts that have been spun down and separated by molecular sizes of various cell parts that have been spun down and separated by molecular sizes of various cell parts that have been spun down and separated by molecular sizes of various cell parts that have been spun down and separated by molecular sizes of various cell parts that have been spun down and separated by molecular sizes of various cell parts that have been spun down and separated by molecular sizes of various cell parts that have been spun down and separated by molecular sizes of various cell parts that have been spun down and separated by molecular sizes of various cell parts that have been spun down and separated by molecular sizes of various cell parts that have been spun down and separated by molecular sizes of various cell parts that have been spun down and separated by molecular sizes of various cell parts that have been spun down and separated by mol
fungi, and plant pathogens (rusts and smuts) • The one human pathogen, the yeast Cryptococcus neoformans, causes an invasive systemic infection in several organs, including the skin, brain, and lungs (figure F). The membranes of bacteria are an important site for a number of metabolic activities. F 1 2 Chapter 1 The Main Themes of Microbiology
Among the specialty professions of microbiology are: 1.1 The Scope of Microbiology Expected Learning Outcomes • • 1. One such bond is a hydrogen bond, a weak electrostatic force that forms between a hydrogen covalently bonded to one molecule and an oxygen or nitrogen atom on the same molecule or on a different molecule. Identified by
Results of a catalase test are used to distinguish Streptococcus (positive). lactose 4. enriched medium broth e. (a) A simple model and (b) a threedimensional model of a water molecule indicate the polarity, or unequal distribution, of electrical charge, which is caused by the pull of the shared electrons toward the
oxygen side of the molecule. Simple stains use just one dye and highlight cell morphology. karyotes. 40. 3.5 Media: The Foundations of Culturing A. Acidic [H+] Neutral Acid [OH-] The temperature of habitats ranges significantly throughout the biosphere, and microorganisms can be found living all along this wide temperature scale.
geomicrobiologists, who focus on the roles of microbes in the development of earth's crust (table 1.1B); marine microbiologists, who study the oceans and its smallest inhabitants; medical technologists, who do the tests that help diagnose pathogenic microbes and their diseases; nurse epidemiologists, who analyze the occurrence of infectious diseases
specimens in a particular way, as described in the next sections and summarized in table 3.2. Refer back to figure 1.4 for size comparisons of microbes and molecules. This classification would then serve as a means for future identification of that same organism and permit workers in many biological fields to know if they were indeed discussing the
same organism. Staphylococcus and staphylococcus? Epidemiology: Developing countries in the tropics are hardest hit by helminth infectious stages. known as diffusion. Some animal viruses cause chronic and persistent infections, antibodies d. can donate an can accept an donated
an accepted the electron. L forms arise naturally from a mutation in the wall-forming genes, or they can be induced artificially by treatment with a chemical such as lysozyme or penicillin that disrupts the cell wall. The light source for optical microscopes consists of a band of colored wavelengths in the visible spectrum. But influenza viruses are also
notorious for altering the shapes of their spikes so that they can invade more than one host. Some of the small cells trapped inside these evolving cells became organelles* that are the distinguishing feature of eukaryotic cells. pyogenes infection involves limiting contact between carriers of the bacterium and immunocompromised potential hosts. This
includes carrying nutrients and water from the external environment into the cell's interior. chemically defined nutrient broth (synthetic) medium brain-heart infusion d. Recently, bacteria were isolated from an undersea lake in Antarctica that were living at 2158C (58F). How are the poxviruses different from other animal viruses? Supply your own
linking words or phrases in the concept map, and provide the missing concepts in the empty boxes. Bacteriophages go through similar stages as the animal viruses described earlier (figure 6.16). His work marked the beginning of an era of great scientific achievement—one that produced some of the most far-reaching developments in microbiology
and medicine. The signs of viral growth include death of the embryo, defects in embryonic development, and localized areas of damage in the membranes, resulting in discrete, opaque spots called pocks (a variant of pox). Although these appearances seem abrupt, hundreds of millions of years of earth's history passed while they were evolving to these
(1O2) is an extremely reactive molecule produced by both living and nonliving processes. Using a corkscrew and a spring to compare the flexibility and locomotion of spirilla and spirochetes, explain which cell type is represented by each object. (a) DNA contains deoxyribose, and RNA contains ribose. Sexual reproduction occurs when two mating
strains of hyphae grow together, fuse, and form a mature diploid zygospore. They are not particularly common in the ocean because the salt content is not high enough to support them. The delivery tool is usually a loop, needle, swab, or syringe. The process of "developing" a smear to create contrast and make inconspicuous features stand out
requires staining. Regardless of the exact genetic makeup, both cells and viruses can continue to exist only if they can duplicate their genetic makeup, both cells and viruses can continue to exist only if they can duplicate their genetic makeup, both cells and viruses can continue to exist only if they can duplicate their genetic makeup, both cells and viruses can continue to exist only if they can duplicate their genetic makeup, both cells and viruses can continue to exist only if they can duplicate their genetic makeup, both cells and viruses can continue to exist only if they can duplicate their genetic makeup, both cells and viruses can continue to exist only if they can duplicate their genetic makeup, both cells and viruses can continue to exist only if they can duplicate their genetic makeup, both cells and viruses can continue to exist only if they can duplicate their genetic makeup, both cells and viruses can continue to exist only if they can duplicate their genetic makeup, both cells and viruses can continue to exist only if they can duplicate their genetic makeup, both cells and viruses can continue to exist only if they can duplicate their genetic makeup, both cells and viruses can continue to exist only if they can duplicate their genetic makeup.
detailed structure of cells and viruses. Richard Pfeiffer discovered Haemophilus influenzae and was a pioneer in typhoid vaccination. (2) Once a binding protein attaches to a special channel in the permease. As the host cell produces new phage
parts, the parts spontaneously assemble into bacteriophages. The two general types of photosynthetic bacteria are those that produce oxygen during photosynthesis and those that produce some other substance, such as sulfur granules or sulfates. Pinocytosis Phagocytosis 5 4 Pseudopods 3 Microvilli Liquid enclosed by microvilli Oil droplet 2
Vacuoles 1 Section of cell Vesicle with liquid (c) Endocytosis. • Entamoeba is a parasite of humans (figure D). The virtual 63 image is the one that will be received by the eye and converted to a retinal and visual image. contaminated drinking water c. (b) Closeup of a normal, uninfected region of cultured cells. Thi off Giardia Gi di lamblia—a
widespread intestinal pathogen (2,0003) The Sarcodina* (Amoebas) • Cell form is primarily an amoeba (see figure 5.24b). You may to you—and mastering it will use the exam questions in the require time, motivation, and —Teresa Wilmoth, Baker College Port Huron text, on the Connect website, or preparation. condenser 6. This condition, in which
the host chromosome carries bacteriophage DNA, is termed lysogeny.* Because viral particles are not produced, the bacterial cells carrying temperate phages do not lyse and they appear entirely normal. Intrachain means within the chain; interchain would be between two chains. We can still find remnants of these early cells in fossil biofilms called
stromatolites (figure 4.28b1,2). This would pave the way for specific experiments that test for the influence of genetics. To survive these controlled a smear
Commensalism The members have an unequal relationship. Examples of organelles include the mitochondria and Golgi complexes, and several others, which perform specific (b) Examples of viruses (a) Basic cell types Prokaryotic cell showing selected organelles Nucleus Envelope Chromosome Ribosomes Capsid Ribosomes
Cell membrane Nucleic acid An enveloped virus (HIV) Cell wall Cell membrane Mitochondria Flagellum A complex virus (bacteriophage) Figure 1.2 Basic structure of cells and viruses. Continuing in the same manner up to pH 14, which contains [0.0000000000000 moles H1/L]. Endospore Formation and Resistance The major stimulus for endospore
formation is the depletion of nutrients, especially amino acids. What are the ecological roles of psychrophiles and thermophiles? Note that not all components are found in all cells. In very simple terms, they remove electrons from inorganic
substances such as carbon dioxide, oxygen, and hydrogen. (b) Figure 6.3 The crystalline nature of viruses. If provided with moisture and nutrients, a cyst breaks open and releases the active trophozoite. The bonds that carbon forms are linear, branched, or ringed, and it can form four single bonds, two double bonds, or one triple bond (figure 2.14).
What is the capsid, and what is its function; how are the two types of capsids constructed? Other specializations of hyphae are illustrated in figure 5.17. In general, microorganisms are microscopic and, unlike macroscopic organisms, which are readily visible, they require magnification to be adequately observed or studied. class, phylum c. How are
the concepts of an atom and an element related? 180 Chapter 6 An Introduction to Viruses bovine spongiform encephalopathy (mad cow disease) in cattle, and wasting disease in elk, deer, and mink. They afflict billions of humans. Major exceptions to this description are the membranes of mycoplasmas, which contain high amounts of sterols—rigid
lipids that stabilize and reinforce the membrane—and the membrane end the membrane are without charge, and electrons are positively (1) charged, neutrons are without charge, and electrons are without charge, and electrons are positively (1) charged, neutrons are without charge, and electrons are megatively (2) charged. 153 b. Check Your Progress SECTION 7.5 18. Many of the diseases that we currently think of
as noninfectious will likely be found to have an infectious cause once we continue to look for VBNCs. Look ahead to chapter 13, we will explore some of the findings from the Human Microbiome Project, which recently did a comprehensive study of the microbial content of several body sites. The specific fluorescent antibodies that attach only to the
pathogen and fluoresce a bright green make it a valuable diagnostic stain. Additional interactions can be important factors in the ecology and adaptations of organisms. It also contains the framework of support in cells lacking walls. helminth worm involved in pinworm infection g. Eventually, it will die out or mutate into a line of cells that can grow by
continuous subculture in fresh nutrient medium. Recombinant DNA technology has unlimited potential in terms of medical microbiologists because they can make the bacteria they infect more virulent for humans. Smallest infectious forms
range from the largest poxvirus (0.45 mm or 450 nm) to the smallest viruses (0.02 mm or 20 nm). Shewan and Lake Oneida, New York, where it was discovered. Below each shape is a micrograph of a representative example. appearance, are all complex nonsynthetic media. The contours of the specimens resolved with scanning electron micrography
are very revealing and often surprising. Wall structure gives rise to differences in staining, toxicity, and effects of drugs and disinfectants. Differentiate among mutual, commensal, and parasitic associations, providing examples. In cellular metabolism, electrons are lactose also share it. Peptidoglycan* is one special class of compounds in which
polysaccharides (glycans) are linked to peptide fragments (a short chain of amino acids). When these methods were used to sample various environments, they revealed a vast "jungle" of new species that had never before been cultured. Slight hypotonicity is tolerated quite well by most bacteria because of their rigid cell walls. Each element is a pure
substance that has a characteristic atomic structure and predictable chemical behavior. The aphids too have come to require the bacteria for survival. Relate the stages in the multiplication cycle of animal viruses, and summarize what is happening in each stage. Get Tegrity. Some ciliates and flagellates5 even have organelles that work somewhat like
a primitive nervous system to coordinate movement. * An extremophile (ex-tree9-moh-fyl0) is a microbe that can live in very severe conditions that would be harmful to other organisms. Note the difference in the to them. 54 Chapter 2 The Chemistry of Biology sugar instead of deoxyribose and uracil instead of thymine (see figure 2.24). These archaea
have significant modifications in their cell walls and membranes, and will lyse in hypotonic habitats. 5 New RNA 6 Release. either DNA or RNA 12. atomic force b. Some structure of an atom, the exact composition of atoms
has been well (a1) Hydrogen established by extensive physical analysis using sophisticated instruments. b for a useful mnemonic device to recall the essential elements. One example is Cryptococcus, which causes a serious fungal meningitis in AIDS patients (figure 3.9c). DNA viruses that cause respiratory infections in humans. 3.5 Media: The
Foundations of Culturing 81 microbe D and allows it to grow by itself. How are bacterial endospores and cysts of protozoa alike? Working at these dimensions, researchers are currently creating tiny molecular tools to miniaturize computers and other electronic devices. (b) AIDS viruses (HIV) leave their host T cell by budding off its surface. The
empty capsid remains attached to the cell surface. When * literally "to feed with light." Stromatolite (a1) (a2) (b1) Ribosomes Nucleoid Thylakoids (b2) (c) Figure 4.28 Cyanobacterial characteristics. Such rigorous conditions will ensure that the food is sterile and free from viable bacteria.
continued to have a fever, and his antibiotics. A flagellum is a long, sheathed cylinder containing regularly spaced hollow tubules—that extend along its entire length (figure 5.3b). More comthe oxidizing partner receives the electrons and is reduced.5 plex molecules such as glucose (C6H12O6) can also be symbolized Redox reactions and is reduced.5 plex molecules such as glucose (C6H12O6) can also be symbolized Redox reactions.
are essential to many of the biochemical prothis way, but this formula is not unique, because fructose and gacesses discussed in chapter 8. Improved technology has continued to refine electron microscopes and to develop (b) (a) variations on the basic plan. (e) Tiny colonies of Haemophilus absorb required growth factors given off by Staphylococcus.
Like nutrient broth, it contains beef extract and peptone, as well as 1.5% agar by weight. With dwindling clean freshwater supplies worldwide, it will become even more important to find ways to reclaim polluted water. Covalent bonding also occurs in oxygen gas (O2), but with a difference. Complete transformation of a vegetative cell into a
sporangium and then into an endospore requires 6 to 12 hours in most spore-forming species. seemed to be alive." Leeuwenhoek started sending his observations to the Royal Society of London, and eventually he was recognized as a scientist of great merit. number) on adjacent sugar units are bonded to the same oxygen atom like links in a chain
(figure 2.16). Some microbes are spread from human to human by means of vectors,* defined as animals such as insects that carry diseases. sibilities of extraterrestrial life. Superkingdom Prokaryotae Kingdom Prokaryotae Kingdom Prokaryotae Kingdom Animalia *also known as
Kingdom Myceteae acquire nutrition. The vast majority of life forms require only about 20 of the 94 naturally occurring elements. Immunofluorescence techniques or direct examination with an electron microscope are often used for this (see figure 6.8). Although all trees are artificial and tend to simplify relationships, they still can provide a basic
picture of phylogeny that we need to organize our study. This strengthening feature is extremely important in cells that lack a cell wall. to receptors found on mammalian nerve cells, and the human immunodeficiency virus (HIV) attaches to the CD4 protein on certain white blood cells. Explain this statement: Microorganisms—we need to live with
 them because we can't live without them. Where Do the Viruses Fit? This change has redefined our presentation of their classification, so that prokaryotes are now placed in five major subgroups and 25 different phyla instead of two domains split into 4.6 Classification Systems of Prokaryotic Domains: Archaea and Bacteria Fungi Animals Slime molds
109 would be required to separate closely related genera and species. Stanford University scientists applied these techniques to subgingival plaque harvested from one of their own mouths. (b) Multiple bonding of carbons can give rise to long chains, branched compounds, and ringed compounds, many of which are extraordinarily large and complex.
These trophozoites migrate to the large intestine and begin to feed and grow. The biofilm varies in thickness and complexity, depending upon where it occurs and how long it keeps developing. Assay media are used by technologists to test the effectiveness of antimicrobial drugs (see chapter 12) and by drug manufacturers to assess the effect of
disinfectants, antiseptics, cosmetics, and preservatives on the growth of microorganisms. This bonding causes the whole chain to coil 31. It includes industrial microbiology, which uses microbes to produce and harvest large quantities of such substances as vaccines, vitamins, drugs, and enzymes (see chapters 10 and 27). DNA viruses can have single
stranded (ss) or doublestranded (ds) DNA; the dsDNA can be arranged linearly or in circles. The micrograph has been colorized to indicate the periplasmic flagella (yellow), the outer sheath (blue), and the protoplasmic cylinder (pink). hl 0 or ic 2. Because of the polarity of water molecules, the negatively charged oxygen end of one water molecule is
weakly attracted to the positively charged hydrogen end of an adjacent water molecule. One type is designed to spray on livestock to reduce the incidence of pathogenic Escherichia coli. They live in volcanic waters and soils and submarine vents, and are often salt- and acid-tolerant as well (figure 4.33). enriched medium 15. In general, the capsid of
any capsid from virus is constructed from a number of ideninstructions in "paper tical protein subunits called capsomers.* virus models" and The capsomers can spontaneously selflook for images of a assemble into the finished capsid. Older or reemerging diseases demonstrate just how difficult it is to eradicate microbes and the diseases they cause,
even though we are very aware of them and often have drugs and vaccines to combat them. Systems for Presenting a Universal Tree of Life The first trees of life were constructed on the basis of just two kingdoms (plants and animals). The breaking of dormancy, or germination, happens in the presence of water and a specific germination agent
Trypanosoma brucei occurs in Africa, where it causes an estimated 50,000 new cases of sleeping sickness each year. Two organisms belonging to Domain Eukarya, traced through their taxonomic series. The NAG stands for N-acetyl glucosamine, and the NAM stands for N-acetyl muramic acid. an oxidizing agent c. Inset shows cells with diploid nuclei
Streptococcus species are the initial colonists on teeth surfaces leading to dental plaque (see figure 21.30). One type of endogenous retrovirus has been shown to be intihuman genome and its tiny passengers. (b) In response to a usable substrate, the cell synthesizes enzymes that are transported across the wall into the extracellular environment.
They may also serve as an alternative transport system for molecules. techoic acid, inflammation b. The result is a complex, 30. Other types of vesicles include vacuoles,* which are membranebound sacs containing fluids or solid particles to be digested, excreted, or stored. A parasite specialist examines leaf litter for the presence of black-legged ticks.
—the carriers of Lyme disease. Examples of varied nutritional patterns include grazers, scavengers, and predators, but the dominant chemoheterotrophic microorganisms fit the description of saprobes or symbionts. Describe the basic factors in diffusion and passive transport systems. www.mcgrawhillconnect.com Enhance your study of this chapter
Leeuwenhoek discovered organisms he called animalcules. That same year, rumors (b) Figure 1.9 Leeuwenhoek's microscope. phosphates, lysis 15. Several modern diagnostic tools that anaFigure 3.10 Isolation technique. The first lens in this system (the one closest to the specimen) is the objective lens, and the second (the one closest to the eye) is
the ocular lens, or eyepiece (figure 3.3b). Vegetative hyphae (mycelia) are responsible for the visible mass of growth that appears on the surface of a food source and penetrates it to digest and absorb nutrients. Carbon, for example, exists primarily as carbon 12 with 6 neutrons (MN 5 12); but a small amount (about 1%) consists of carbon 13 with 7 carbon, for example, exists primarily as carbon 12 with 6 neutrons (MN 5 12); but a small amount (about 1%) consists of carbon 13 with 7 carbon, for example, exists primarily as carbon 12 with 6 neutrons (MN 5 12); but a small amount (about 1%) consists of carbon 13 with 7 carbon, for example, exists primarily as carbon 12 with 6 neutrons (MN 5 12); but a small amount (about 1%) consists of carbon 13 with 7 carbon 14 with 6 neutrons (MN 5 12); but a small amount (about 1%) consists of carbon 13 with 7 carbon 15 with 7 carbon 15 with 7 carbon 15 with 7 carbon 16 with 7 carbon 16 with 7 carbon 16 with 7 carbon 17 with 7 carbon 17 with 7 carbon 18 with 8 carbon 18 with 7 carbon 18 with 8 carbon 18 with 7 carbon 18 with 8 carbon 18 with 
neutrons and carbon 14 with 8 neutrons. Important preventive measures include sewage treatment, curtailing the use of human feces as fertilizer, and adequate sanitation of food and water. Such parasitic microbes that grow inside sterile tissues, cause damage, and even death are also termed pathogens. Which parts of an element do not vary in
number? Attention was turned to substances that are 1970s, the National Aeronautics and Space Administration (NASA) part of all life on earth: mainly water and carbon-based chemicals. A prophage is a/an a. Which stain is used to distinguish differences between the cell walls of medically important bacteria? * valence (vay9-lents) L. Describe the
basic characteristics of prokaryotic cells and eukaryotic cells and their evolutionary origins. condenser d. In (a), the longer waves are too large to penetrate between the finer spaces and produce a fuzzy, undetailed image. Figure 7.1 Environmental conditions that influence microbial adaptations. The human immunodeficiency virus (HIV) comes
equipped with reverse transcriptase for synthesizing DNA from RNA. This type of photosynthesis occurs in plants, algae, and cyanobacteria and uses 190 Chapter 7 Microbial Nutrition, Ecology, and Growth 7.1 MAKING CONNECTIONS A Guide to Terminology Much of the vocabulary for describing microbial adaptations is based on some common
root words. Differentiate between a monomer and a polymer. Much of the time, they form cohesive communities with other organisms, sharing habitat and nutrients. Substances commonly found among various algal groups are cellulose, pectin,1 mannans,2 and minerals such as silicon dioxide and calcium carbonate. "Conan the Bacterium" A tiny
gram-positive coccus, Deinococcus radiodurans, (see photo b), has been called "Conan the bacterium" because of its capacity to survive extreme drying and very high levels of radiation. It also explains why viruses usually Look up "Flu have tissue specification and very high levels of radiation. It also explains why viruses usually Look up "Flu have tissue specification and very high levels of radiation. It also explains why viruses usually Look up "Flu have tissue specification and very high levels of radiation. It also explains why viruses usually Look up "Flu have tissue specification and very high levels of radiation."
off dead skin and secretions, but do not usually cause harm (figure 7.13f1, 2). * bacillus (bah-sil9-lus) pl. 6. They used small, known fragments of DNA or probes that can highlight microbes in specimens. Bordetella pertussis (bor0-duh-tel9-uh purtuss9-iss) After Jules Bordet, a Belgian microbiologist who discovered this bacterium, and L. family, genus fragments of DNA or probes that can highlight microbes in specimens.
d. It is common for the terms polypeptide and protein to be used interchangeably, though not all polypeptides are large enough to be considered proteins. Yeasts are fungi, and molds are a. Molecules, including those in cells, are constantly involved in 9. Several groups of bacteria have unusual adaptations and life cycles. Facilitated diffusion
 Extracellular High Concentration Figure 7.6 Intracellular 195 196 Chapter 7 Microbial Nutrition, Ecology, and Growth Features inherent in active transport systems are: 1. Growth of cells, 4. (c) An abscess on the knee caused by methicillin-resistant Staphylococcus aureus (MRSA). They exist deep beneath the polar ice caps, in the ocean to a depth of
7 miles, in hot springs and thermal vents, in toxic waste dumps, and even in the clouds. Most organisms in this category live in a habitat such as soil, water, or the human body that provides small amounts of oxygen but is not directly exposed to the atmosphere. Domain Archaea c. This passive transport mechanism utilizes a carrier protein in the
membrane that will bind a specific substance. Endospore destruction is a particular concern of the food-canning industry. SECTION 3.4 A mixed culture (figure 3.12a) is a container that holds two or more easily differentiated species of microorganisms, not unlike 16. coli 2 µm Red blood cell 12 µm Staphylococcus 1 µm Ebola virus 1.2 µm Rhinovirus
0.03 µm (30 nm) Figure 4.26 The dimensions of bacteria. cysteine b. The leading parasitic worm infections are ascariasis, and the leading protozoan infections are Chagas disease, African trypanosomiasis, and leishmaniasis. A few are parasites, living on the tissues of other organisms, but none is
obligate. Hydrogen Bonding Some types of bonding do not involve sharing, losing, or gaining electrons but instead are due to attractive forces between nearby molecules or atoms. Most gingival infections consist of similar mixtures of oral bacteria that have invaded damaged gum tissues. In asexual reproduction, spores are formed through budding,
partitioning of a hypha, or in special sporogenous structures; examples are conidia and sporangiospores. This slime protects them from being dislodged from the teeth and provides a niche for persistent colonization that, can lead to dental disease. As a consequence of his findings and the rise of the scientific method, the notion of spontaneous
generation, or abiogenesis, was eventually abandoned for biogenesis. 29. Organisms are not shown at the same magnifications; approximate magnifications; approximate magnifications; approximate magnifications; approximate magnifications; approximate magnifications.
(undulant fever), and Streptococcus pneumoniae. More extensive hydrogen bonding is partly responsible for the structure and stability of proteins and nucleic acids, as you will see later on. The process of evolution has accumulated such a significant body of knowledge over hundreds of years that scientists from all disciplines consider it to be a fact.
ck, lang nts rie ut of n Dr yi Excystment Encystment Encystment Cyst wall breaks open. 75, 77 72, 73 74 *Observable to the unaided or naked eye. tics. This topic is covered in more depth in chapter 8. These groupings are based on virus structure, chemical composition, and genetic makeup. Syntrophy Microbes sharing a habitat feed off substances released by
other organisms. colored versus black-and-white images c. cruzi. This black mold (4003) is A little brown bat suffering from called endophytes. spira, a coil. chemical reactions, leading to changes in the composition of the 10. A slightly more complex pattern of covalent bonding is shown for methane gas (CH4) in figure 2.4c. When biologists began to
focus on the possible origins of these cells, they turned to an analysis of modern cells, and from these studies emerged convincing evidence that eukaryotic cells evolved from prokaryotic cells through a process of intracellular symbiosis* (5.1 Making Connections). Oxygen O2 gas Oxides H 2O Air (20%*), a major product of photosynthesis Soil Oxygen
gas is necessary for the metabolism of nutrients by aerobes. This is the cause of pertussis, or whooping cough. Researchers sampling sulfur vents in the deep ocean discovered thermophilic archaea growing prolifically at this high
temperature, but they were also living at 265 atmospheres of pressure. Refer to table 4.2 for a "Motile Spirilla" comparison of other features of the two heon YouTube. protein synthesis b. A psychrophile* is a microorganism (bacterium, archaea, fungus, or alga) with an optimum temperature below 158C (598F) but generally can grow at 08C (328F).
As indicated earlier, microtubules are also responsible for the movement of cilia and flagella. Additional information on prion diseases can be found in chapter 25. The earth's limitless habitats and microbial adaptations are matched by an elaborate menu of microbial nutritional schemes. Case Study Review 1. This pathogen appears to remain dormant
in water where it can serve as a source of cholera infection for people drinking the water. 3 When biofilm grows to a certain density (quorum), the cells release inducer molecules that elongate into hyphae that produce
an extensive mycelium. Figure 3.13a proMicrobes become visible as isolated Macroscopic view vides an example of a multiple-test, miniaturized colonies containing Colony level system for obtaining physiological characterismillions of cells. The microbial existence is indeed another world, but it would remain largely uncharted without an essential
tool: the microscope. Two remarkable examples are the adeno-associated virus (AAV), which can replicate only in the presence of the hepatitis B virus and can worsen the severity of liver damage. Briefly outline the pH scale. The new techniques come
from molecular biology and include a study of genes—both their structure and function—at the molecular level. RNA molecular level. RNA molecular level. RNA molecular level. and function—at the individual genes exist in separate RNA molecular level.
chapters. This form (a) Runs. Once the substance is transported, the carrier protein resumes its original shape and is ready to transport again. differential medium 16. Viruses are genetic and metabolic parasites; and apicomplexan protozoans like Plasmodium (cause of malaria)
are hemoglobin parasites (figure 7.13h1, 2). LearnSmart is the only adaptive learning program proven to effectively assess a student's knowledge of basic course content and help them master it. The protozoan trophozoite is the a. Weak molecular interactions similar to hydrogen bonds that play major roles in the shape and function of biological
molecules are van der Waals forces. Molecules are pumped into or out of the cell by specialized receptors; driven by ATP or other highenergy molecules are pumped into or out of the cell by specialized receptors; driven by ATP or other highenergy molecules are pumped into or out of the cell by specialized receptors; driven by ATP or other highenergy molecules are pumped into or out of the cell by specialized receptors; driven by ATP or other highenergy molecules are pumped into or out of the cell by specialized receptors; driven by ATP or other highenergy molecules are pumped into or out of the cell by specialized receptors; driven by ATP or other highenergy molecules are pumped into or out of the cell by specialized receptors; driven by ATP or other highenergy molecules are pumped into or out of the cell by specialized receptors; driven by ATP or other highenergy molecules are pumped into or out of the cell by specialized receptors; driven by ATP or other highenergy molecules are pumped into or out of the cell by specialized receptors; driven by ATP or other highenergy molecules are pumped into or out of the cell by specialized receptors; driven by ATP or other highenergy molecules are pumped into or out of the cell by specialized receptors; driven by ATP or other highenergy molecules are pumped into or out of the cell by specialized receptors.
translocation Molecule is moved across membrane and simultaneously converted to a metabolically useful substance. Their relative rigidity confers stability on eukaryotic membranes and become unevenly distributed. Describe the pH
scale and how it was derived; define acid, base, and neutral levels. Adaptations to Temperature of their natural habitats. In spite of the hostile bottom of the pit lay a massive deposit of mining waste that was like conditions that were seemingly deadly, the
water turned out to be an accident waiting to happen. Most can propagate by the simple outward growth of existing hyphae or by fragmentation, in which a separated piece of mycelium can generate a whole new colony. Blood agar is both enriched and differential. (a) Penicillium notatum mold, a very common Nucleus (c) Bud scars Pseudohyphae
Figure 5.15 Microscopic morphology of yeasts. The earth's habitats provide a constant supply of energy, nutrients, and gases; maintain a certain pH and temperature; and establish communities of interactive organisms. You will need to understand how the imnot just rote memorize words mune system interacts with
mi"This text is the best one on the market to help but understand the ideas and croorganisms and the effects of students understand holistic microbiology be able to apply them later. per, severe, and tussis, cough. Phylum Chlamydiae Another group of obligate intracellular parasites that reproduce inside host cells. latent b. From this emerges a stable
three-dimensional molecule. When a hypothesis has been thoroughly supported by long-term study and data, it is considered a. What is the principal effect of the prion agent of Creutzfeldt-Jakob disease? This complex area houses the organelles and sustains major metabolic and synthetic activities. (b) Simple model of ionic bonding. Medical
specimens taken from blood, sputum, cerebrospinal fluid, feces, or the vagina are smeared directly onto a slide and observed with or without special stains. (k) Ants have complex symbiotic relationships that involve mutualism and bacteria. H H H N N N R P Figure 2.24 N (b) Purine bases P D (b) In DNA,
the polymer is composed of alternating deoxyribose (D) and phosphate (P) with nitrogen bases (A,T,C,G) attached to the deoxyribose. Endospore-forming genera include Bacillus and Clostridium. A better analogy may be a spiral staircase. Prokaryotic cells but are
still complex in their structure and function. What kind of substances will be expected to be hydrophilic and hydrophobic, and what makes them so? Plates of agar inoculated with the CSF grew typical off-white, smooth isolated colonies that tested out as N. One excepSome of the cleverest and most inventive media recipes belong to the tion is the
genus Staphylococcus, which grows well in this medium categories of selective and differential media (figure 3.18). Few microbiology. 14,000 Total Deaths (000) 7. all of these 20. It may be a surprise to discover that the fleshy part of a mushroom is actually a
fruiting body Young Gill designed to protect and help disseminate its mushroom (button) sexual spores. The diphtheria toxin responsible for the severe nature of the disease is a bacteriophage product. These studies, supported by the work of other scientists, became known as the germ theory of disease. By a genetic disorder?) 8. The Discovery of
Pathogens and the Germ Theory of Disease Two ingenious founders of microbiology, Louis Pasteur of France (figure 1.11) and Robert Koch of Germany (figure 1.12), introduced techniques that are still used today. (See also figure 2.12.) In this solution, Cl2 ions are attracted to the hydrogen component of water, and Na1 ions are attracted to the
oxygen (box). (b) The capsule is a thick, structured layer that is not readily removed. Momentarily setting aside a strictly scientific and objective tone, it is tempting to think of these extraordinary viruses as minute spacecrafts docking on an alien planet, ready to unload their genetic cargo. A covalent bond called a peptide bond forms between the
amino group on one amino acid and the carboxyl group on another amino acid. Depending on the particular experiment, tests can be performed on adult, juvenile, or newborn animals. The starting event probably occurred when a larger prokaryotic cell engulfed smaller prokaryotic cells and kept them alive. By escaping phagocytosis, the bacteria are
free to multiply and infect body tissues. To understand how organisms originate, we must understand some fundamentals of evolution. Then, in the mid-1800s, the acclaimed microbiologist Louis Pasteur entered the arena. Inducer molecule stimulates expression of a particular gene and synthesis of a protein product, such as an enzyme. Bright-Field
Microscopy The bright-field microscope is the most widely used type of light microscope. vitros, glass. Immunology This branch studies the complex web of protective substances and reactions caused by invading microbes and other harmful entities. (b) Plotting the logarithm of the cells produces a straight line indicative of exponential growth,
whereas plotting the cell numbers arithmetically gives a curved slope. M Mycobacterium tuberculosis—K b t i t b l i the bacillus that causes tuberculosis Volume 4 Phylum Actinobacteria This taxonomic category includes the high G 1 C (over 50%) gram-positive bacteria. Because there is so "Microbes rule the earth." much still to be learned about all
earthly habitats, very different way to examine the living world. Using super adaptive technology, the program identifies what a student doesn't know, and then provides "teachable moments" designed to mimic the office hour experience. Figure 2.27 summarizes the main steps in this process in cells. difficile in fecal samples. Contrast
chemoautotrophs and chemoheterotrophs as to carbon and energy sources and other unique strategies they may have. Japanese scientists isolated this kill the cell. Large subunit (30S) and large (50S) subunits, both separate and joined. Specialized techniques
were developed to culture them in the laboratory. (7)-(8) Telophase completes chromosomal separation and division of the cell proper into daughter cells. Some forms of Staphylococcus aureus (MRSA) and Mycobacterium tuberculosis are resistant to so many drugs that there are few, and sometimes no, choices left. The fourth shell with 16 orbitals
contains up to 32 electrons. Looking back over the previous 8 editions, the authors are struck by the extensive discoveries and new developments in the science of microbiology that are reflected in the changing content and character of this book. Pilus Page 94 Inclusion body Pages 102, 103 Flagellum Pages 91–93 Flagella—Bacterial Propellers The
prokaryotic flagellum* is an appendage of phenomenal construction and is certainly unique in the biological world. the general functions of the essential bioelements in the cell. Parasitic chytrid fungi. This allows a cell to swim freely through an aqueous habitat. Inset is a high magnification (10,0003) cross section of
a single spore showing the dense protective layers that surround the core with its chromosome. charged ion. TABLE 5.1 Unicellular, Fungi Algae Multicellular Except Reproductive Stages Helminths (parasitic worms) Arthropods
(animal vectors of diseases) 5.2 Form and Function of the Eukaryotic Cell: External Structures Expected Learning Outcomes 4. How must a non-cyst-forming pathogenic protozoan be transmitted? T an s oc y y l s t u a er ie io ut var rev M o icr CASE STUDY Part 1 Palate Battling a Brain Infection O ne Saturday evening in 2007, a 50-year-old woman
named not find a pulse and noticed dark brown spots developing on Kay Peterson began to suffer flulike symptoms, with fever, her legs. Compare and contrast passive and active forms of transport, using examples of what is being transported and the requirements for each. Because these populations often contain very large numbers of cells, it is
useful to express them by means of exponents or logarithms (see "Exponents" found at . Feces Figure 5.26 Stages in the infection and transmission of amebic dysentery. These anaerobes are not harmed by oxygen, and some of them possess alternate mechanisms for breaking down peroxide and superoxide. Rarer infections include streptococcal toxic
shock syndrome, S. Several large outbreaks of salmonellosis, shigellosis, and listeriosis have been traced to contaminated dairy and poultry products, and vegetables. Note the suckers that attach to host tissue and the dominance of reproductive and digestive organs. 2.7 Membranes are dynamic and constantly changing because the lipid phase is in
motion and many proteins can migrate freely about. These forces can hold even large molecules together because of the cumulative effects of numerous sites of interaction. They flourish in every type of aquatic environment, whether ocean, hot springs, or Antarctic ice, and they can also survive in a wide range of terrestrial habitats. The most visible
organelle is the nucleus, a roughly ballshaped mass surrounded by a double membrane that contains the DNA of the cell. What kinds of data are collected during information gathering? 114 Chapter 4 A Survey of Prokaryotic Cells and Microorganisms 4.1 Secret World of Microbes Redefining Bacterial Size Microbiologists keep being reminded how
far we are from having a complete assessment of the bacterial world, mostly because the world is so large and bacteria are so small. Separation techniques such as streaking can crobes based on their DNA. 92 Chapter 4 A Survey of Prokaryotic Cells and Microorganisms Figure 4.3 Details of the Filament flagellar basal body and its position in the cell
wall. These early researchers found that when infectious even though they could not see the infectious agent with a microscope. Refer to table 7.1 to see an overview of the major bioelements, compounds, their sources, and their
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importance to microorganisms. spirilla; L. Check Your Progress SECTION 3.2 3. If it were not for multitudes of bacteria and fungi, many chemical elements would become locked up and unavailable to organisms. Historical records show that households in ancient Egypt kept moldy loaves of bread to apply directly to wounds and lesions, which was
probably the first use of penicillin! The manipulation of microorganisms to make products in an industrial setting is called biotechnology.* One newer application of this process uses farmed algae to extract a form of oil (biodiesel) to be used in place of petroleum products (figure 1.6a). Scheme for Differentating Gram-Negative Cocci and Coccobacilli
Gram-negative cocci and coccobacilli (a) Oxidase + Oxidase - Acinetobacter spp. the viral capsid b. Streptomyces species—common i soil bacteria; often the source of antibiotics K. lungs d. (c) Tubes containing pure cultures of E. The spore exists in an inert, resting condition that is capable of extreme resistance and very long-term survival. The type
of bond is dictated by the electron makeup of the outer orbitals (valence) of the atoms. The introduction of antibiotics in the 1940s and a lengthening list of vaccines for preventing numerous diseases caused many medical experts to declare a victory. *lentivirus (len0-tee-vy9-rus) Gr. lente, slow. One of the first things that often comes to mind is the
ability to move or to grow. The pond also harbors a mixed population of algae (green clumps). Receptors Cell membrane Spikes 1 Adsorption. * pleonorphism (plee0-oh-mor9-fizm) Gr. Pleon, more, and morph, form or shape. Domain Bacteria b. agent of smallpox) are very large DNA viruses that lack a typical capsid and are covered by a dense layer of
lipoproteins and coarse fibrils on their outer surface. You must attend lecture and laboratory sessions to listen be concerned with infection control and precautions, which in turn to your instructors or teaching assistants explain the material. Instead, the viral DNA enters an inactive prophage* state, during which it is usually inserted into the bacterial
chromosome. In enveloped forms such as influenza virus and HIV, glycoprotein spikes bind to the cell membrane receptors. The universal Bond forming Check Your Progress 8. A microorganism's habitat provides necessary substances—some abundant, others scarce—that must still be taken into the cell. Indeed, most plans are in a state of flux as new
information and methods of analysis become available. The Structure of a Generalized Bacterial cell prokaryotic cells appear featureless and two-dimensional when viewed with an ordinary microscope, but this is only because of their small size. Bacterial cell membranes contain primarily phospholipids (making up about 30%-40% of the membrane
mass) and proteins (contributing 60%-70%). formula (no coefficient means one). The bond that forms between the OCOOH is defined as an ester bond (figure 2.18a). CLINICAL CONNECTIONS An Outbreak of Fungal Meningitis Most fungi are not invasive and do not ordinarily cause serious infections unless a patient's immune
system is compromised or the fungus is accidentally introduced into sterile tissues. Although a distinction is made between the type of carbon compounds involved in the normal structure and metabolism of all cells are organic. The animals apparently became infected in
the winter, and by spring, they were already dead or sick and dying. pili; L., hair. A unique ecosystem based on hydrogen sulfide-oxidizing bacteria exists in the hydrothermal vents lying along deep oceanic ridges. It has alternating glycans (NAG and NAM) bound together in long strands. Scientists at Pacific Northwest National Laboratories (PNNL)
test the capacity of two newly discovered bacteria—Shewanella (green) and Synechococcus (yellow) (1,0003)—to reduce and detoxify radioactive waste. These three areas are interrelated and play a vital role in keeping a dynamic inventory of the extensive array of living things. Following the pathway that fits the living things except for the one being
studied. Confocal Microscopes Optical microscopes may be unable to form a clear image at higher magnifications, because samples are often too thick for conventional lenses to focus all levels of cells simultaneously. The order of taxa between the top and bottom levels is, in descending order: domain, kingdom, phylum* or division, 4 class, order,
family, genus,* and species. Such a degree of specificity can provide the funcH R2 H R4 H O O H H tional diversity required for many thousands of 3H2O + N C C N C
fungal, and protozoan diseases. Although in most instances the inhabitants are archaea and bacteria, certain fungi, protozoans, algae, and even viruses are also capable of living in severe habitats. Enterobiasis occurs most often among families and in other close living situations. 22 Chapter 1 The Main Themes of Microbiology PLANTS FUNGI
ANIMALS Kingdom Plantae Kingdom Myceteae Kingdom Animalia Chordates Angiosperms Arthropods Basidiomycetes Annelids Gymnosperms Echinoderms Mollusks Mosses Zygomycetes and ed Se Ferns Nematodes Ascomycetes Cnidarians Sponges Ciliates Red algae Flatworms First multicellular organisms appeared 0.6 billion years ago. See
table 3.1 for a brief description of each procedure, its purpose, and intended outcome. Viruses are microbes but not cells. Because hypertonicity will force water to diffuse out of a cell, it is said to create high osmotic pressure or potential. The polypeptides in proteins with cells, in cells with no nuclei (bacteria), and in viruses. On the basis of the
formula for resolving power, explain why a smaller RP value is preferred to a larger one and explain what it means in practical terms if the resolving power is 1.0 mm. Explain the concept of the cell envelope, and describe its structure. The length of a multiplication cycle, from adsorption to lysis, varies to some extent, but it is usually measured in
hours. croscope and atomic force micro(b) SEM image of Shewanella, an unusual bacterium that derives energy from uranium and other radioactive scope (3.1 Making Connections). This is then stained using dyes to permit visualization of cells or cell parts. In this example, a sodium cation attracts the negatively charged region of water molecules.
and a chloride anion attracts the positively charged region of water molecules. * pilus (py9-lus) pl. When exposed to certain 104 Chapter 4 A Survey of Prokaryotic Cells and Microorganisms Exosporium Core Spore coats 1 Vegetative cell Chromosome Cortex 9 During germination, the spore swells and releases a vegetative cell. 7.3 Transport:
Movement of Substances Across the Cell Membrane Cells with cell walls Isotonic Solution Hypotonic Hy
took! The bacteria preceded even the earliest animals by about 3 billion years. For a and b, explain your choice. For instance, the microbe can invade more than one host species (alternate hosts) and undergo several changes as it cycles through these hosts, such as sexual reproduction or encystment. Describe the plan of a basic eukaryotic cell and
organelles, and indicate the structures all cells possess and those found only in some groups. It is increasingly evident that this enormous underground community of microbes is a major force in weathering, mineral extraction, and soil formation. This type of capsid is found in several enveloped human viruses, including those of influenza, measles,
and rabies. Entamoeba histolytica and Giardia lamblia form cysts and are readily transmitted in contaminated water and foods. What properties of water make it an effective biological solvent, and how does a molecule like NaCl become dissolved in it? Describe the structure of a flagellum and how it operates. 7.2 Classification of Nutritional Types 1916.
Heterotrophs and Their Energy Sources The majority of heterotrophic microorganisms are chemoorganisms are chemoorganisms are chemoorganisms are chemoorganisms are still present with this system (see figure 1.14). When a beam
or ray of light transmitted through air strikes and passes through the convex surface of glass, it experiences some degree of refraction, * defined as the bending * microscopy (mye-kraw9-skuh-pee) Gr. The science that studies microscopy (mye-kraw9-skuh-pee) Gr. The science tha
ad ivid trac A u nnin d ex N tu be n D i e hey he ir s um t t he d n ea t, as zed **. This can occur in either direction. Another serious issue with prions is their extreme resistance. Since viruses lack metabolic enzymes, how can they synthesize necessary components? both DNA and RNA d. The structure of lipid bilayers confers characteristics on
membranes such as selective permeability and fluid nature. Although C. This is a good indication that humans are not likely to, nor should we try to, eliminate microorganisms from our environment. What processes are involved in bacteriophage assembly? The total power of magnification is calculated from the product of the ocular and objective
magnifying powers. Microbiology. The Development of Aseptic Techniques From earliest history, humans experienced a vague sense that "unseen forces" or "poisonous vapors" emanating from decomposing matter could cause disease. Biologists studying large organisms such as animals and plants can, for the most part, immediately see and
differentiate their experimental subjects from the surrounding environment and from one another, amino acid 17. Membrane proteins function in receiving molecular signals (receptors), in binding and transporting nutrients, and as enzymes, topics to be discussed in chapters 7 and 8. Chytrid cells Diatom cell 10.0 µm * chytrid (kit9-rid) Gr. chytridion
little pot. In time the Archaea line branched off and gave rise to the Eukarya. Microbiologists have termed such remarkable organisms extremophiles. But there is little disagreement that they have been in existence for billions of years, probably ever since the early history of cells. Name several inorganic compounds. These microbes are termed viable
but nonculturable, or VBNC. (a) Modern humans, Homo sapiens. Perhaps the most definitive evidence has been that deposits of ice were shown to be frozen water. Organelles also partition the eukaryotic cell into smaller compartments. You
will notice that this number may not come out even, because most elements have several isotopes and differing proportions of them. (G 5 glycocalyx) of locomotion must be seen in live spirochetes to be truly appreciated (see Quick Search, page 105). Additional coverage on cell types and microorganisms appears in chapters 4 and 5. Explain the stages
in the population growth curve and its practical importance. The inclusion of a website does not indicate an endorsement by the authors or McGraw-Hill Education, and McGraw-Hill Education does not guarantee the accuracy of the information presented at these sites. 6.8 Prions and Other Nonviral Infectious Particles A. Other equipment can break
up and vaporize rocks and perform detailed chemical analyses on the contents. See chapter 25 for additional details on influenza and track the latest information on flu outbreaks at www.cdc.gov/flu/. Enterobius a. It permits differentiation of four major is called inoculation.* The observable growth that later appears in or on the medium is known as a
culture. Since the first edition, the goals of this book have been to explain complex topics clearly and vividly, and to present the material in a straightforward way that students can understand. For example, Escherichia coli colonizes the intestine and behavior of
biofilms is termed quorum Quick Search sensing. Some species have adapted to cold habitats. A hydrogen bond can form between a. The power of the ocular usually remains constant for a given microscope. The smaller and larger conidia formed by the same fungus under varying conditions. These reversible reactions are symbolized with a double
arrow, each pointing in opposite directions, as in the exchange reaction shown earlier. Any medium containing 1% to 5% agar usually has the word agar in its name. Rapid methods of identification use monoclonal antibodies to detect the C-carbohydrate found on the cell surface of S. aci 3 d ac id 2. 5.7 Survey of Protists: Protozoa Expected Learning
Outcomes 29. An example is Gloeotrichia (figure D; see section 4.7 for more coverage). Because they are reversibly solid, they can be liquefied with heat, poured into a different container, and resolution for most biological applications is
approximately 0.5 nm. Here an outline of a hand represents the object being illuminated, and two different-size beads represent the wavelengths of light. Earliest eukaryotic cells appeared. coughing. A remarkable feeding adaptation can be seen in the ciliate Didinium (see table 5.6, figure E), which can easily devour another microbe that is nearly its
size. Enzymes serve as the catalysts for all chemical reactions in cells, and O O H H H R3 R1 H H nearly every reaction or wild guess. Which of the following has not been an objective of Mars exploration? bacteria d. Gradually, many species were found to
make sexual spores, and they were assigned to the taxonomic grouping that best fit those spores. The scanning tunneling microscopes. In a very real sense, viruses are genetic parasites because they cannot multiply until their nucleic acid has reached their haven inside the host cell. TABLE 5.3 A Survey of
Fungal Groups, Characteristics, and Representative Members Phylum I—Zygomycota (also Zygomycetes) • • • • Sexual spores: zygospores Asexual zygospores Zygospores Asexual zygospores Zy
described in 4.1 Making Connections. Rickettsia typhi (transmitted by lice). All matter in the universe is composed of minute particles called atoms—the simplest form of matter not divisible into a simpler substance by chemical means. In a solution of NaCl and water, NaCl is the the . Microbial Dimensions: How Small Is Small? They are smaller in size
and infect their prokaryotic or eukaryotic or eukaryotic hosts in order to reproduce themselves. The following list is a brief summary of some nutritional patterns in the intestinal bacterium Escherichia coli. 3.2 The Microscope: Window on an Invisible Realm INOCULATION One goal of these procedures is to attach a name or identity to the
microbe, using information gathered from inspection and investigation. So, even microbes that use carbon dioxide as their primary source of carbon will convert this CO2 into organic compounds once it gets into the cell. state in many cases. 21. Protists have eukaryotic cells and are mostly unicellular. Some bacteria that ordinarily have a cell wall can
lose it during part of their life cycle. Several species of molds prey upon or parasitize nematodes. molecules responsible for carrying out DNA's instructions, definitive diagnosis requires cell culture, embryos, or animals, but this method can be
Characteristic Bacteria Archaea Eukarya Cell type Prokaryotic Prokaryotic Eukaryotic Euk
similar to Eukarya 2 1 Presence of peptidoglycan in cell wall 1 2 2 Cell membrane lipids Fatty acids with ester linkages Sterols in membrane 2 (some exceptions) 2 1 4.7 Survey of Prokaryotic Groups with Unusual Characteristics Many of these hardy microbes are
living in severe combinations of extremes as well—for instance, high acidity and high temperature, high salt and alkalinity, low temperature and high pressure. Visual Challenge c. • Most form thick-walled zygotes called oocysts; entire group is parasitic.. Importance: Fungi are essential decomposers of plant and animal detritis in the environment.
One difference between this and the streak plate method is that in this technique, some of the colonies will develop deep in the medium itself and not just on the surface. India ink capsule stain of Cryptococcus neoformans (500) Acid-fast stain Red cells are acid-fast. Laboratory work with true
psychrophiles can be a real challenge. confocal d. The last type of symbiotic interrelationship is parasitism, first introduced in section 7.2. This is the one type of symbiotic interrelationship is parasitism, first introduced in section 7.2. This is the one type of symbiotic interrelationship is parasitism, first introduced in section 7.2. This is the one type of symbiotic interrelationship is parasitism, first introduced in section 7.2. This is the one type of symbiotic interrelationship is parasitism, first introduced in section 7.2. This is the one type of symbiotic interrelationship is parasitism, first introduced in section 7.2. This is the one type of symbiotic interrelationship is parasitism, first introduced in section 7.2. This is the one type of symbiotic interrelationship is parasitism, first introduced in section 7.2. This is the one type of symbiotic interrelationship is parasitism, first introduced in section 7.2. This is the one type of symbiotic interrelationship is parasitism, first introduced in section 7.2. This is the one type of symbiotic interrelationship is parasitism, first introduced in section 7.2. This is the one type of symbiotic interrelationship is parasitism, first introduced in section 7.2. This is the one type of symbiotic interrelationship is parasitism.
 which is calculated from the sum of all of the atomic masses of the atomic masses of the atoms it contains. A fastidious organism must be grown on what type of medium? Prominent scientists from this period include Robert Koch, Louis Pasteur, and Joseph Lister. Endospores are dormant bodies produced by Bacillus, Clostridium, and several other bacterial genera
Discuss this possibility based on the known domains and their evolutionary history. A few of them such as oxygen (O2) consist of the same element (see the Nature of Diatomic Elements on page 34). the presence of specific membrane proteins (permeases and pumps; figure 7.8a), and Extracellular 3. CLINICAL CONNECTIONS Are Microbes a Hidden
Cause of Diseases? During the hours or days of this process, a culture develops as the visible growth of the microbes in the container of medium. Other variations include coccobacilli, vibrios, and filamentous forms. (f1 and 2) Human commensals associated with the epidermis make a living off flakes and excretions, generally with neutral effects. Some
species form a pseudohypha,* a chain of yeasts formed when buds remain attached in a row (figure 5.15c). H SSporozoite H. Nonphotosynthetic organisms power their cells by extracting energy from chemical reactions. A comparison of two possible systems for presenting the taxonomy of major eukaryotic groups. The substances that result from the
14. 3. Although their primary photosynthetic pigments 4.7 Survey of Prokaryotic Groups with Unusual Characteristics include green chlorophyll b and the bluish pigments. vivos, life. (b) A rotting tomato being invaded by a fuzzy forest of mold. (5)-(6) Spindle
fibers attach to these and facilitate the separation of individual chromosomes during anaphase. Electron ative images and shadow casts of whole Microscope Specimen requires Depends Yes microbes (see figure 6.3). Nitrogen N2 gas NO32 (nitrate) NO22 (nitrate) NO32 (nitrate) NO3
Soil and water Soil and water Soil and water Organisms Nitrogen gas is available only to certain microbes that fix it into other inorganic nitrogen compounds—nitrates, and ammonium— the primary sources of nitrogen gas is available only to certain microbes that fix it into other inorganic nitrogen gas is available only to certain microbes that fix it into other inorganic nitrogen gas is available only to certain microbes that fix it into other inorganic nitrogen gas is available only to certain microbes that fix it into other inorganic nitrogen gas is available only to certain microbes that fix it into other inorganic nitrogen gas is available only to certain microbes that fix it into other inorganic nitrogen gas is available only to certain microbes that fix it into other inorganic nitrogen gas is available only to certain microbes that fix it into other inorganic nitrogen gas is available only to certain microbes that fix it into other inorganic nitrogen gas is available only to certain microbes that fix it into other inorganic nitrogen gas is available only to certain microbes that fix it into other inorganic nitrogen gas is available only to certain microbes that fix it into other inorganic nitrogen gas is available only to certain microbes that fix it into other inorganic nitrogen gas is available only to certain microbes and the microbes and the microbes are also as a second nitrogen gas in a 
acids and nucleic acids. All prokaryotes are microorganisms and include the bacteria and archaea (see figure 1.14). Nanobacteria-like forms were first isolated from blood and serum What are some of the adaptations that a giant Thiomargarita would resamples. A biofilm is a complex network of microbes and their secretions that form in most natural
environments, discussed further in chapter 4. The relatively larger protons and neutrons make up a central core, or atomic nucleus, 1 that is surrounded by 1 or more electrons (figure 2.1). They can be dispersed by air currents and may even be an important factor in the spread of diseases such as amebic dysentery. sliced into thin sections d. Bacterial
Endospores: An Extremely Resistant Life Form Ample evidence indicates that the anatomy of bacteria with pili participate in a mating process termed conjugation, 2 which uses the pilus (also called a sex pilus) as a connector for transferring DNA from a donor cell to a recipient (figure 4.9). A
newer class of HIV drugs, the protease inhibitors, disrupts the final assembly phase Quick Search of the viral life cycle. A strand of viral nucleic acid is inserted during capsid formation. fibers b. parasitology c. To conclude this Case Study, go to Perspectives on the Connect website. Which of the following prokaryotes lacks cell walls? Explain what
factors could cause opportunistic mycoses to be a growing medical problem. When covalent bonds are formed between atoms that have the same or similar electronegativity, the electrons are shared equally between the two atoms. Of several moleculesized systems under development, two that look very promising are liposomes and fullerenes.
Endocytosis: Eating and Drinking by Cells Some cells can transport large molecules, particles, liquids, or even other cells across the cell membrane. Types include general-purpose, enriched, selective, and differential media. (a) Division in one plane produces diplococci and streptococci. Some photosynthetic bacteria exhibit phototaxis, a type of
movement in response to light rather than chemicals. Demonstration of the magnification and image-forming capacity of clear glass "lenses." Given a proper source of illumination, a magnifying glass can deliver 2 to 10 times magnification. L. Every substance in medium A is known to a very precise degree. If we were to adopt common names such as
the "little yellow coccus" (for Micrococcus luteus*) or the "club-shaped diphtheria bacterium" (for Corynebacterium diphtheriae*), the terminology would become even more cumbersome and challenging than scientific names. a garden plot containing both carrots and onions. Although these exceptional forms can stain positive or negative in the Gram
stain, examination of their fine structure and chemistry shows that they do not fit the descriptions for typical gram-negative or gram-positive cells. By convention, the host in which larval development occurs is the intermediate (secondary) host, and adulthood and mating occur in the definitive (final) host. Invertebrates or nonhuman primates are
occasionally used as well. (c) Three-dimensional models of triglycerides containing saturated (1) and unsaturated fatty acids (2). The offspring from such a union can have slight variations in form and function that are potentially advantageous to the adaptation and evolution of their species. Gliding, Fruiting Bacteria The gliding bacteria are a mixed
collection of gram-negative bacteria in Phylum Proteobacteria that live in water and soil. The cell or cytoplasm. The Significant Events in Microbiology Table found at summarizes some of the pivotal events in microbiology from its earliest beginnings to the present. It is composed of two
main layers: the cell wall and the cell membrane. Higher magnification reveals that a mitochondrion consists of a smooth, continuous outer membrane that forms the external contour and an inner, folded membrane nestled neatly within the outer membrane that forms the external contour and an inner, folded membrane are inner, folded membrane nestled neatly within the outer membrane (figure 5.10b). Compare the way that the image is formed in the TEM and SEM. Some
nutrients are absorbed in a ready-to-use form, and others must be synthesized by the cell from simple compounds: • • • • • Water content is the highest of all components (70%). connecting the phosphates represent bonds that release large amounts of energy when broken. The larger gold, white, and blue cells are a type of algae called diatoms, and
the tiny white and blue cells are unknown prokaryotes. Two very recent events dramatically contrast the differences between scientific reasoning. Define what is meant by the term evolution. - Ninth edition. It was transmitted from pigs to humans. 303 10. What are the functions of RNA? Abiogenesis refers to the a. pili c. Once
inside the small intestine, the cyst germinates into a large multinucleate amoeba that subsequently divides to form small amoebas (the trophozoite stage). Note that the extremes of the ranges can overlap to an extent. Reproductive Strategies and Spore Formation Fungi have many complex and successful reproductive strategies. The Development of
the Microscope: "Seeing Is Believing" It is likely that from the very earliest history, humans noticed that when certain foods spoiled, they became inedible or caused illness and yet other "spoiled" foods did no harm and even had enhanced diagnosed in Mexico in March 2009, it spread around the world in 6 short weeks! Within 6 months, it had caused
millions of cases and thousands of deaths and had been reported in at least 200 countries. It is now evident that many of them possess an internal network of protein polymers associated with the wall. Because of their tiny size and obligately parasitic lifestyle, they were at one time considered a type of virus (see Table 4.3L). They play many roles in
the functioning of the earth's ecosystems. This process of sexual recombination yields new and different genetic combinations that can be advantageous in evolution. has more OH2 d. Alcohols are hydrocarbons containing an OOH functional group. (b) Cilia beat in coordinated waves, driving the cell forward and backward. Additional studies are
needed to test this curious question of mycoplasmas and 100 times smaller than the average bacterial cell. A strain or variety of bacteria is a culture The major categories of this revised taxonomic scheme are derived from a single parent that differs in structure or metabolism presented in table 4.3, which provides a brief survey of characterfrom
yourself. All viruses have a protein capsid,* or shell, that surrounds the nucleic acid in the central core. E. Some microbes effectively compete by using up a vital nutrient to grow faster and dominate the habitat. This is the optimum condition for the many processes occurring in and on the membrane. (a) Structural formula: The wavy lines Chapter
of the pinworm, a roundworm. Bottoms, Ph.D., Collin College Laurie M. Algae are widespread inhabitants of fresh and marine waters. Habitat A fairly strict parasite, S. During the development of a fungal colony, the vegetative mycelium. After adsorption
the phage plate becomes embedded in the cell wall, and the sheath contracts, pushing the tube through the cell wall and membrane and releasing the nucleic acid into the interior of the cell wall, and the sheath contracts, pushing the tube through the cell wall and membrane and releasing the nucleic acid into the interior of the cell wall, and the sheath contracts, pushing the tube through the cell wall and membrane and releasing the nucleic acid into the interior of the cell wall, and the sheath contracts, pushing the tube through the cell wall, and the sheath contracts, pushing the tube through the cell wall and membrane and releasing the nucleic acid into the interior of the cell wall and membrane and releasing the nucleic acid into the interior of the cell wall and membrane and releasing the nucleic acid into the interior of the cell wall and membrane and releasing the nucleic acid into the interior of the cell wall and membrane and releasing the nucleic acid into the interior of the cell wall and membrane and releasing the nucleic acid into the interior of the cell wall and membrane and releasing the nucleic acid into the interior of the cell wall and membrane and releasing the nucleic acid into the interior of the cell wall and membrane and releasing the nucleic acid into the interior of the cell wall and membrane and releasing the nucleic acid into the interior of the cell wall and membrane and releasing the nucleic acid into the interior of the cell wall and membrane and releasing the nucleic acid into the interior of the cell wall and membrane and releasing the nucleic acid into the interior of the cell wall and membrane and releasing the nucleic acid into the interior of the cell wall and membrane and releasing the nucleic acid into the interior of the cell wall and membrane and releasing the nucleic acid into the interior of the cell wall and membrane and releasing the nucleic acid into the nu
RNA virus. In that case, additional levels can be imposed immediately above (super) or below (sub) a taxon, giving us such categories as superphylum and subclass. The technology featured in this Case Quick Search Study is also focused on "mining" the Go to "Exploring microbial diversity of habitats such as soil, an Icy Invisible icebergs, hot springs
deep-ocean sediments, Realm in Antarctica" on and even the human body. The following is a selected Found throughout each chapter, current, real-world readings allow students to fit together the interconnections between, microbe, classification, cause and effect, and treatment, just like pieces of a puzzle. Other contributions they have made to
eukaryotic evolution include the chloroplasts of algae and plants. A standard procedure for many viruses is the polymerase chain reaction (PCR), which can detect and amplify even minute amounts of viral DNA or RNA in a sample. Resolution is improved with shorter wavelengths of illumination and with a higher numerical aperture of the lens. 52
Chapter 2 The Chemistry of Biology HOCH2 O N base Pentose sugar H H Phosphate (a) A nucleotide, composed of a phosphate, a pentose sugar, and a nitrogen base (either A,T,C,G, or U) is the monomer of both DNA and RNA. a reducing agent d. Why are some covalent molecules polar and others nonpolar? mucus and helps the virus invade
respiratory tissues. adsorption, penetration, synthesis, assembly, and release b. (1) (200X) (2) www.mcgrawhillconnect.com Enhance your study of this chapter with study tools and practice tests. SECTION 5.3 In what ways does the nucleus function like the "brain" of the cell number can be represented logarithmi- cally or arithmetically or arithmetically
reactants trade portions between each other and release products that are combinations of the two. Gramnegative cell walls are thinner, and the crystal violet is relatively easy to remove with the decolorizer. a molecule b. Major Groups: Protozoa are subdivided into four groups based upon mode of locomotion and type of reproduction: Mastigophora
the flagellates, motile by flagella; Sarcodina, the amoebas, motile by pseudopods; Ciliophora, the ciliates, motile by cilia; Apicomplexa, motile by flagellates, motile by flagella; Sarcodina, the amoebas, motile by pseudopods; Ciliophora, the ciliates, motile by flagellates, motile by flagella; Sarcodina, the amoebas, motile by pseudopods; Ciliophora, the ciliates, motile by flagellates, motile by flagellates
techniques revolve around keeping species in the pure culture form for further study, identification, or biotechnology applications. Many are also attached to the cell membrane. From there they may be secreted (as here) or act internally. Student success is a strategic priority at FRCC and a personal passion of Heidi's, and she continually works to
develop professionally in ways that help her do a better job of reaching this important goal. The cells tend to fold (snap) back upon each other, forming a row of cells oriented side by side (see figure 4.24). But not all steps are always performed, nor do they necessarily proceed exactly in this order, studies were published, even seasoned
microbiologists were stunned at the variety and numbers of marine microbes they had c What fields of microbiology would be involved in the further study discovered. * cysteine (sis9-tuh-yeen) Gr. Kystis, sac. to analyze elements in soil b. The cristae membranes hold the enzymes and electron carriers of aerobic respiration. Microbiology is a
specialized area of biology that deals with tiny life forms that are not readily observed without magnification, which is to say they are microscopic.* These microscopic organisms are collectively referred to as microorganisms, microbes,* or several other terms, depending upon the purpose. As ecosystems. Indicate the size ranges in bacteria in
comparison to other organisms. This illustration organizes the common measurements used in microbiology along with examples of organisms or items that fall into these measurement ranges. In this capacity, they play Oil" on the Science an essential role in the aquatic food web Channel to learn and contribute significantly to the oxygen about a new
content of the atmosphere through photosource of "green" synthesis. the host cell, so they are not living things but are more akin to large, infectious molecules. Golgi apparatus chloroplasts cytoplasm endoplasmic reticulum ribosomes flagella nucleolus cell membrane Level II. Describe electron orbitals and energy shells and how they are filled. f. One
classification scheme is based on a five-kingdom organization developed by Whittaker that includes: 1. receptors c. A section of graphene recently analyzed by the atomic force microscope, which clearly shows the carbon atoms that make up its structure. A gram-negative cell exposed to these same substances loses its peptidoglycan but retains its
outer membrane, leaving a less fragile but nevertheless weakened spheroplast.* Evidence points to a role for L forms in certain chronic infections. Other microfilaments are active in amoeboid motion, a type of movement typical of cells such as amoebas and phagocytes that produces extensions of the cell membrane (pseudopods) into which the
cytoplasm flows. Incidentally, although pHs are given here in even whole numbers, more often, a pH reading exists in decimal form; for example, pH 4.5 or 6.8 (acidic) and pH 7.4 or 10.2 (basic). mushroom 2. Answer available at 67 Figure 3.7 Fluorescent staining of a sample of Treponema pallidum, the causative agent of syphilis. spontaneous
generation of organisms from nonliving matter b. Aqueous solutions containing both acids and bases may be involved in neutralization reactions, which give rise to water and other neutral by-products. Coevolving symbionts remain in very close contact and must evolve together to sustain 204 Chapter 7 Figure 7.13 Microbial Nutrition, Ecology, and
Growth Part 1—Symbiosis: A shared existence. In chapter 1, we introduced the two major types of prokaryotic cells: the bacteria and the archaea. blood agar 6. What is the third cell type? A geomicrobiologist from NASA collects samples from Mono Lake as part of an environmental study determining survival strategies of extreme bacteria.
taL22600_ch05_122-156.indd Page 154 10/9/13 9:21 PM f-w-166 Writing Challenge These questions are suggested as a writing experience. The latter represent an important source of building blocks for nucleic acid and ATP synthesis. Transport may occur against a concentration gradient. Medium (c) shows not used by organism Y, then X more
variety than (b), and colonies are differentiated by a varying color reaction. This property occurs because the substances we call lipids contain relatively long or complex COH (hydrocarbon) chains that are nonpolar and thus * glycocalyx (gly0-koh-kay9-lix) Gr. glycos, sweet and calyx, covering. In general, eukaryotic microbial cells have a cytoplasmicol for the substances we call lipids contain relatively long or complex COH (hydrocarbon) chains that are nonpolar and thus * glycocalyx (gly0-koh-kay9-lix) Gr. glycos, sweet and calyx, covering. In general, eukaryotic microbial cells have a cytoplasmicol for the substances we call lipids contain relatively long or complex COH (hydrocarbon) chains that are nonpolar and thus * glycocalyx (gly0-koh-kay9-lix) Gr. glycos, sweet and calyx, covering color for the substances we call lipids contain relatively long or complex COH (hydrocarbon) chains that are nonpolar and thus * glycocalyx (gly0-koh-kay9-lix) Gr. glycos, sweet and calyx, covering color for the substances we call lipids contain relatively long or complex COH (hydrocarbon) chains that are nonpolar and thus * glycocalyx (gly0-koh-kay9-lix) Gr. glycos, sweet and calyx, covering color for the substances we call lipids contain relatively long or complex COH (hydrocarbon) chains the substances we call lipids contain relatively long or complex COH (hydrocarbon) chains the substances we call lipids contain relatively long or complex COH (hydrocarbon) chains the substances we call lipids contain relatively long or complex COH (hydrocarbon) chains the substances we call lipids contain relatively long or complex COH (hydrocarbon) chains the substances we call lipids contain relatively long or complex COH (hydrocarbon) chains the substances we call lipids contain relatively long or complex COH (hydrocarbon) chains the substances we call lipids contain relatively long or complex COH (hydrocarbon) chains the substances we call lipids contain relatively lipids contain relatively lipids contain relatively lipids (hydrocarb
membrane, nucleus, mitochondria, endoplasmic reticulum, Golgi apparatus, vacuoles, cytoskeleton, and glycocalyx. 108 Chapter 4 A Survey of Prokaryotic Cells and Microorganisms 200X Human hair Ragweed pollen 2,000X Lymphocyte Yeast cell Ragweed pollen 20,000X E. * meningitis (men9-in-jy9-tis) Gr. meninx, a membrane, and itis, an
all over the world were convinced that the world would come to an end on December 21, 2012. This is especially true of bacteria, although fungi and other microorganisms can participate in these activities. (d) Smaller molecules are transported across the wall and cell membrane into the cytoplasm. As hard as we may try to manage microbes, we
keep coming up against a potent reality, a sentiment summed up by the renowned microbiologist Louis Pasteur over 130 years ago when he declared: "Microbes will have the last word." Why do you think it is unlikely that infectious diseases can ever be completely eradicated? Any progress in controlling these NTDs will require a global partnership
that brings together resources from many countries. The relationship between income and rate of death from infectious diseases is most evident in this comparison. In fact, many areas of this science have become so specialized that it is not uncommon for a microbiologist to spend an entire career concentrating on a single group or type of microbe and rate of death from infectious diseases is most evident in this comparison. In fact, many areas of this science have become so specialized that it is not uncommon for a microbiologist to spend an entire career concentrating on a single group or type of microbe.
biochemical process, or disease. The spikes are assigned numbers to keep track of the several different forms, and from this practice comes the shorthand method of naming strains of virus. In some areas of the world, farmers knowingly or unknowingly use fecally contaminated water and fertilizer on fresh produce that will be on your table the next
 week. The heat resistance of spores has been linked to their high content of calcium and dipicolinic acid, although the exact role of these chemicals is not yet clear. Percentage is the ratio of solute in solution expressed as some combination of weight or volume. Check Your Progress 105 SECTION 4.4 20. Biochemicals are organic compounds produced
by (or components of) living things, and they include four main families: carbohydrates, lipids, proteins, and nucleic acids (table 2.4). The amount of internal detail visible by this method is greater than by either bright-field or dark-field methods (table 2.2). (b) Microscopic views of this snow alga, actually classified as a "green" alga although a red
pigment dominates at this stage of its life cycle (6003). The cause of the epidemic has been traced to nutrient-rich agricultural runoff water that promoted the sudden "bloom" of Pfiesteria. The wall is relatively rigid due to peptidoglycan. In adone of these diseases." tuberculosis, and they have been largely dition to medical effects, people often lose
 their ignored by the medical establishment in many abilities to go to school and work, and become countries. Bacteria with gram-positive cell wall structure (Phyla Firmicutes and Actinobacteria) A. These granules occur in a variety of bacteria living in oceans and swamps. The fungi exhibit such a marked diversity in spores that they are largely
classified and identified by their spores and spore-forming structures. vesicles 5. tain phenol red dye that also changes color with pH: it is yellow in acid and red in neutral and basic conditions. 20. Microbes form the basis of genetic engineering and recombinant DNA technology, which alter genetic material to produce new products and modified life
forms. Identify a nucleic acid and differentiate between DNA and RNA. Psychrophile Psychrotroph Optimum Mesophile Rate of Growth Another way to express temperature adaptation is to describe whether an organism grows optimally in a cold, moderate, or hot temperature range. Explain how a supposedly harmless, airborne mold
could get all the way into the brain and cause meningitis. The exact tissue inoculated is guided by the type of virus being cultivated and the goals of the experiment (figure 6.20). The majority of the molecules associated with living things are composed of single and double covalent bonds between the most common biological elements (carbon,
hydrogen, oxygen, nitrogen, sulfur, and phosphorus), which are discussed in more depth in chapter 7. (b) Phospholipids in water-based solutions become arranged (1) in single layers called micelles, with the charged head oriented toward the water phase and the hydrophobic nonpolar tail buried away from the water phase, or (2) in double-layered
systems with the hydrophobic tails sandwiched between two hydrophilic layers. 4 Completion of cell compartments The septum is synthesized completely through the center, and the cell membrane patches itself so that there are two separate cell chambers. At that point, the system is said to be in equilibrium. New cases quickly appeared in Canada
Central and South America, Europe, Asia, and eventually in more than 200 countries. The position of an electron at any one instant is dictated by its energy electrons in the outer shells. Adenosine triphosphate (ATP) is a nucleotide with 3
phosphates that serves as the energy molecule in cells. Note that direction of synthesis refers to prevention of infection; pure culture refers to growth of a single species of microbe. taL22600 ch06 157-184.indd Page 158 10/9/13 9:37 PM f-w
 166 3. Even among those fungi that are pathogenic, most human infection occurs through accidental contact with an environmental source such as soil, water, or dust. Now that we know more about these microbes, we will use chapter 7) followed by
 metabolism (chapter 8), and ending with genetics (chapter 9). Proteins attached to the outer portion of the cell wall of several gram-positive species, including Corynebacterium diphtheriae (the agent of diphtheria) and Streptococcus pyogenes (the cause of strep throat), also have toxic properties. (c) Figure 6.9 Detailed structure of complex viruses.
When the Centers for Disease Control 2009 H1N1 type A influenza rather than swine and Prevention (CDC) received reports of these flu. (b) An enveloped virus is composed of a nucleocapsid surrounded by a flexible membrane called an envelope. 17 90 Countries reporting smallpox (1950-1980) 80 70 1965: Vaccine campaign 60 50 40 1979: Smallpox
eradicated 30 20 10 0 19 8 0 19 7 19 6 19 5 0 0 0 Number of Countries Reporting Cases 1.5 The Historical Foundations of Microbiology Reproducibility of results; other medical testing Vaccination theory becomes widespread. 4 Phagosome Digestive vacuole 5 Figure 5.9 The functions of lysosomes during phagocytosis.
The amino acid that accounts for disulfide bonds in the tertiary structure of proteins is a. Some of them have been associated with a specific location (Ebola fever virus), whereas others have become pandemics, meaning they spread across continents (human immunodeficiency virus—HIV). For example, Gram staining a fresh urine or throat specimen
can point to a preliminary cause of infection, and in some cases, it is possible to begin drug therapy on the basis of this stain. As we will see in the case file to continue, it is a critical step in diagnosing meningitis. An example of a workable hypothesis based on deduction might speculate that a disease such as hemophilia is an inheritable condition. An
atom that can receive extra electrons and thereby The atomic content of molecules can be represented by a few oxidize another molecule is an oxidizing agent. lipid metabolism b. If it continues to rise beyond that point, the enzymes and nucleic acids will eventually become permanently inactivated—a condition known as denaturation—and the cell
will die. Specially bred strains of white mice, rats, hamsters, guinea pigs, and rabbits are the usual choices for animal cultivation of viruses. The rate of transport proteins. Explain how elements make chemical bonds to form molecules and compounds. MicrobiologyBytes Between
customers, he retired to the workon YouTube. It includes such diverse areas as blood testing, vaccination, and allergy (see chapters 15, 16, and 17). Because the width of bacterial flagella lies beyond the resolving power of the filament and then
staining it. everyone in the bottom billion has at least one of these diseases," said Dr. Peter Hotez, a parasitologist and medical doctor at George Washington University. It all started when a small compounding pharmacy in Massachusetts unknowingly sent out hundreds of mold-contaminated medical facilities for injections to
control pain. In fact, viruses exhibit variety in how their RNA or DNA is configured. + He-He-H2 (a) e-1p+ HH CH H 8p+ 8n0 1p+ H Molecular oxygen (O2) 6p+ 6n0 1p+ C 1p+ HH OOH 1p+ Double bond Covalent Bonds: Molecules with
Shared Electrons Covalent (cooperative valence) bonds form between atoms with valences that suit them to sharing electrons rather than to donating or receiving them. Data from an entire growth (log) phase, the stationary phase, and
the death phase (figure 7.18). How are spirochetes and spirilla different? 2. Because the endospore very dehydrated, it is less vulnerable to the effects of heat. The substances transported do not pass physically through the membrane but are carried into the cell by
endocytosis. This worm causes a very common infestation of the large amounts of alkaline substances b. (a) A model of a single molecule of a phospholipid. develop within the liver 155 Multiple Matching. gram-positive, attachment c. A major contributing factor is our increased mobility and travel, especially by air
It has been estimated that as much as 40% of the yearly fruit crop is consumed not by humans but by fungi. Compare the domain system with the five-kingdom system, adenoviruses have usually been involved While searching through the genome sein respiratory and eye infections, they can quences, virologists began to find DNA also infect adipose
cells. 1.6 Taxonomy: Organizing, Classifying, and Naming Microorganisms is very much like learning a new language, and occasionally its demands may be a bit overwhelming. This merged structure is called a phagosome (figure 5.9). Table 2.4 will also be a useful reference when you study metabolism in chapter 8. I. In this system, kingdoms are
based on cell structure and type, the nature of body organization, and nutritional type. Some tenaciously clung to the idea of abiogenesis* which embraced spontaneous generation phyla (fye9-luh) Gr. phylon, race. This is a remarkable species that can bioremediate radioactive metals in contaminated waste sites. It can outline the organism's shape
and permit rapid recognition of swimming cells that may appear in fresh specimens, but it does not reveal fine internal details. A valid question make up your own. Check Your Progress Figure 1.11 Photograph of Louis Pasteur (1822-1895), the father of microbiology. The one feature that most characterizes them is the presence of special flagellated
responsible for converting the atmosphere from anaerobic to aerobic through their production of oxygen, which made it possible for the evolution of aerobic eukaryotes. Changes in structure and function that improve an organism's survival in a given environment. The optimum temperature covers a small range, intermediate between the minimum
and maximum, which promotes the fastest rate of growth and metabolism. T and so caly ers iety iou ut var rev Mo icr CASE STUDY Part 2 Beginning with those first diagnoses, it took only 6 weeks for the influenza outbreak to explode into a pandemic. Media are extremely varied in nutriboiling temperature of water (1008C or 2128F). The range of
revealed a thick biofilm coating containing that same bacterium. Where do superoxide ions and hydrogen peroxide originate? Typical examples include Gram, acid-fast, and endospore stains. (b) Cutaway three-dimensional view of the relationships of the nuclear envelope, pores, and endospore stains.
earth's sediments, where they play essential roles in recycling elements, leaching minerals, and forming soil. spirochete cell. In final assembly, the prefabricated components fit together into whole parts and finally into the finished viruses. Styles of Locomotion Except for one group (the Apicomplexa), protozoa are motile by means of pseudopodssin.
("false foot"), flagella, or cilia. * prophage (pro9-fayj) L. Characterize viruses according to size range. Unfortunately, his experiments were done before the realization that heat-resistant microbes * abiogenesis (ah-bee0-oh-jen9-uh-sis) L. Another variety, the atomic force microscope (AFM), gently forces a diamond and metal probe down onto the
surface of a specimen like a needle on a record. culture made from an isolated colony 7. broken free. Were it not for the structural support of the peptidoglycan in the cell wall, they would rupture from internal pressure. An intracellular framework of fibers and tubules that bind and support eukaryotic cells. fimbriae d. ix T he Prof ile of an E xper tly
Craf ted Learning Tool Art and organization of content make this book unique taL22600 ch09 256-292.indd Page 263 11/27/13 3:27 PM f-w-166 /202/MH02004/taL22600 disk1of1/0073522600/taL22600 pagefiles 4. Lichens occur in most habitats on earth, but they are especially important as early Bat Populations Decimated by Fungal Infections
 invaders of rock and in soil formation. The hydrogen bonds between pairs can be disrupted when DNA is being copied, and the fixed complementary base pairing is essential to maintain the genetic code. What do you automatically know about that bacterium's structure? sugar, proteins, and thymine d. In what ways is biological "dark matter" simila
to the dark matter of the universe? presence of a cell wall in prokaryotes 5. The main features of the 6 "I's" are laid out in figure 3.1 and table 3.1. Depending on the purposes of the major tools of the microbiologist's trade. In
peritrichous forms, all flagella sweep toward one end of the cell and rotate as a single group. Science and its hypotheses and theories must progress along with technology. Effects of pH Microbial growth and survival are also influenced by the pH of the habitat. Over very long periods, the mutualists can become completely interdependent. Bacterial
endospores function in a. The solid waste disposal industry is focusing on methods for degrading the tons of garbage in landfills, especially plastics and paper products. But when these subatomic particles come together in specific, varied 1. Breakage of the bond of the terminal phosphate releases energy to do cellular work and also generates
 adenosine diphosphate (ADP). Answer available at . They are sensory appendages that can detect and respond to environmental signals. In fact, as we shall see in chapter 26, the framework of microbial nutrition underlies the nutrient cycles of all life on earth. wine and the gas that causes bread to rise. The size range of most microbes extends from
the smallest viruses, measuring around 10 nm and actually not much bigger than a large molecule, to protozoans measuring 3 to 4 mm and visible with the naked eye. Name two parasites that are transmitted in the cyst form. This being an introducon the basis of their unique ribosomal RNA profiles. These bacteria are found in such large numbers in
the sediments that Microbiologists have been more skeptical. It is this quality that gives rise to the unlimited diversity in protein form and function. Fungi pose an ever-present economic hindrance to the agricultural industry. Lethal damages include a permanent shutdown of metabolism and genetic expression, destruction of cell membrane and
organelles, toxicity of virus components, and release of lysosomes. mhhe.com/talaro9 16 Chapter 1 The Main Themes of Microbiology Observations/ information gathering Formation of Jenner's hypothesis, experiment I Testing the hypothesis, experiment II 1. Because our understanding of the phylogenetic relationships is still in
 development, there is not yet a single official system of taxonomy for presenting all of the eukaryotes. Both members can survive apart from their mutualistic habit but have a well-developed affinity for each other. Phylum Nanoarchaeota A newly discovered group of extremely small archaea found in salt mines and caves (see 4.1 Secret World of
Microbes). • The microbe leaves the host in large numbers by a specific means and must enter a new host to survive. Anaerobic coccu (involved in wound infections) D. Pasteur made enormous contributions to our understanding of the roles of microorganisms
in many aspects of medicine and industry. Longterm complications of S. Discuss the range of associations among microorganisms and their basic qualities. Describe the types of eukaryotic locomotor appendages. Discuss the importance of fungi in ecology, agriculture, commerce, and medicine. At one extreme are the so-called "good" parasites, which
occupy their host with little harm. they are not cells b. The stop blocks all light from entering the objective lens except peripheral light that is reflected off the specimen itself. It is remarkable how much they resemble modern-day algae or protozoa (figure 5.1). (c) An electron micrograph of a single cell (10,0003) reveals layers of thylakoids.
that are the sites of photosynthesis. Use the magnification as your gauge. * peritrichous (per0-ee-trik9-us) Gr. peri, around. We are especially indebted to the thorough and Technical College, Lahn Bloodworth of Florida State College-
Jacksonville, Jason Gee of East Carolina University, Mark Farinha of Anne Arundel Community College, Robin Hulbert of California State Polytechnic Institute, and Michelle Milner, Itawamba Community College, Robin Hulbert of California State Polytechnic Institute, and Michelle Milner, Itawamba Community College, Robin Hulbert of California State Polytechnic Institute, and Michelle Milner, Itawamba Community College, Robin Hulbert of California State Polytechnic Institute, and Michelle Milner, Itawamba Community College, Robin Hulbert of California State Polytechnic Institute, and Michelle Milner, Itawamba Community College, Robin Hulbert of California State Polytechnic Institute, and Michelle Milner, Itawamba Community College, Robin Hulbert of California State Polytechnic Institute, and Michelle Milner, Itawamba Community College, Robin Hulbert of California State Polytechnic Institute, and Michelle Milner, Itawamba Community College, Robin Hulbert of California State Polytechnic Institute, and Michelle Milner, Itawamba Community College, Robin Hulbert of California State Polytechnic Institute, and Michelle Milner, Itawamba Community College, Robin Hulbert of California State Polytechnic Institute, and Michelle Milner, Itawamba Community College, Robin Hulbert of California State Polytechnic Institute, and Michelle Milner, Itawamba Community College, Robin Hulbert of California State Polytechnic Institute, and Michelle Milner, Itawamba Community College, Robin Hulbert of California State Polytechnic Institute, and Michelle Milner, Itawamba Community College, Robin Hulbert of California State Polytechnic Institute, and Michelle Milner, Itawamba Community College, Robin Hulbert of California State Polytechnic Institute, and Michelle Milner, Itawamba Community College, Robin Hulbert of California State Polytechnic Institute, and Michelle Milner, Itawamba Community College, Robin Hulbert of California State Polytechnic Institute, and Milner Institute, and Milner Institute, and Milner Institute, and Milner Institute
proper form for translation are called negative-strand RNA. The cell wall of gram-negative bacteria also contains lipopolysaccharide, a complex of lipid and polysaccharide responsible for symptoms such as fever and shock (see chapters 4 and 13). A related technology uses fluorescent nucleic acid probes to differentiate between live and dead cells in
mixtures or detect uncultured cells (see 3.1 Secret World of Microbes). This is true even in organisms with cell walls (bacteria, algae, and fungi), because the cell wall is usually only a partial, nonselective barrier. These waves are 100,000 times shorter than the waves of visible light. Define lipid, triglyceride, phospholipid, fatty acid, and cholesterol.
the viral envelope 2. Carbohydrates exist in a great variety of configurations. In sexual reproduction, spores are formed following fusion of male and female strains and the formation of a sexual structure; sexual spores are one basis for classification. The general phases in the life cycle of animal viruses are adsorption,* penetration, synthesis,
assembly, and release from the host cell. A unique feature is having a membrane around their DNA and special compartments enclosed in membranes. Describe the fundamental characteristics of cells. decomposer of citrus fruit, is known for its velvety texture and typical blue-green color. Electron micrographs taken during this time show cells with
masses of viruses, often enclosed in packets (see figure 6.15a). Semisolid 3. Liposomes are being considered for treating tumors and viral infections, delivering antibiotics to infected tissues and organs, vaccine delivery, and even some types of genetic therapies.
sketching out what she envisions in precise detail, with accompanying instructions to the illustrator. Eventually, the element is recycled to the inorganisms for thousands of years to improve life and even to further human progress. Where did
the MRSA pathogen likely originate? Classify types of fungal spores and explain their functions. Microbes have adapted to pHs all along this scale. Bacteroides B t id species—may i through a fluorescent microscope cause intestinal infections (note the large blue nucleoid) *G 1 C base composition The overall percentage of guanine and cytosine in DNA
is a general indicator of relatedness because it is a trait that does not change rapidly. time. active feeding stage b. Manifestations of the resultant disease range from mild to very severe and include fever, inflammation, and heart and brain damage. T an s oc y l a ers iety iou ut var rev M o icr CASE STUDY Part 2 A Gram stain is one of the key tests for
getting quick feedback on the kind of microbes that might be present in a sample. Type IV pili found in Pseudomonas bacteria carry out a remarkable sort of twitching motility. receptors of its 11. /202/MH02004/taL22600 disk1of1/0073522600/taL22600 disk1of1/00735200/taL22600 disk1of1/00735200 disk1of1/0073500 disk1of1/0073500 disk1of1/0073500 disk1of1/0073500 disk1of1/0073500 disk1of1/0073500 disk1of1/0073500 disk1of1/0073500 disk1of1/0073500 disk1of1/007
ir s um t t he d n ea t, as zed **. We know, for instance, that heat destroys cells by inactivating proteins and DNA and that this process requires a certain amount of water in the protoplasm. The dye does not stick to the specimen but dries around its outer boundary, forming a silhouette. Explain the bases for classification, taxonomy, and
nomenclature. Briefly outline the characteristics of the four protozoan groups and name important pathogens in each group. Although most viral infections do not result in death, some, such as rabies, HIV, and Ebola, have very high mortality rates, and others can lead to long-term debility (polio, hepatitis). (a) Light microscope magnification (1,2003)
of purified poliovirus crystals. The gliding property evidently involves rotation of filaments or fibers just under the outer membrane of the cell wall. A lengthy process of experimentation, analysis, and testing eventually leads to conclusions that either support or refute the hypothesis. To allay unfounded fears about acquira few cases of this same type
of flu cropped up in outbreak to explode into a ing this disease from swine, public health groups the United States, primarily in California and Archaea 95 4.1 MAKING CONNECTIONS Biofilms—The Glue of Life Microbes rarely live in
isolation. If this is the case, how can we account for such differences in the damage that viruses do? solute, solvent b. People exposed to these houses or buildings bines with a photosynthetic microbe, either an alga or cyanobacterium. A notable example of the need for growth factors occurs in Haemophilus influenzae, a bacterium that causes
meningitis and respiratory infections in humans. What other microbial groups besides bacteria have prokaryotic cells? Because immersion oil has the same optical qualities as glass, it prevents refractive loss that normally occurs as peripheral light passes from the slide into the air; this property effectively increases the numerical aperture (figure 3.5).
Temperatures in these regions range from 508C (1228F) to well above the boiling point of water, with some ocean vents even approaching 3508C (6628F). Images" for a special stains on technique The scanning electron microscope unique visual or treatment. Male and female worms mate, and the female migrates out 7. Deinococcus can be seen in
reduces sulfur compounds in lakes and ponds figure 4.18. Title. identification e. Although they lack a cell wall entirely, mycoplasmas (see figure 4.17) have been placed with the Firmicutes because of their genetic relatedness. refraction of light rays d. Nucleus, Endoplasmic Reticulum, and Golgi Apparatus: Nature's Assembly Line As the keeper of the
eukaryotic genetic code, the nucleus ultimately governs and regulates all cell activities. molecula, little mass. Multiple-Choice Questions 4.5 Bacterial Shapes, Arrangements, and Sizes A. Cells of the microscopic fungi exist in two basic morphological types: hyphae and yeasts. It is an intracellular parasite with a complex cycle alternating between
humans and mosquitoes (figure H). This event exposes the base code and makes it available for copying. ***The prokaryotic type is structurally very different. View celll Vi off an infected if d host h revealing a vacuale containing Chlamydia cells in various stages of development M. * amphipathic (am9-fy-path9-ik) Gr. amphi, both. Scientific knowledge
is accumulative, and it must have built-in flexibility to accommodate new findings. Polysaccharides are usually stored by cells in the form of glucose polymers such as starch (figure 2.17b) or glycogen that are readily tapped as a source of energy and other metabolic needs. Describe the steps of the Gram stain, and explain how it can be an important
diagnostic tool for infections. The mordant causes the dye to form large crystals that get trapped by the meshwork of the cell wall. 198 Chapter 7 Microbial Nutrition, Ecology, and Growth 7.1 Secret World of Microbes Life in the Extremes Any extreme habitat—whether hot, cold, salty, acidic, alkaline, high pressure, arid, oxygen-free, or toxic—is likely
to harbor microorganisms with special adaptations to these conditions. Describe the structures of peptides and how their bonds form, a yeast that infects the lungs i. The population size at any point in the growth chamber and plating it out on a
solid medium to develop isolated colonies. So far, genomic studies of various body habitats have revealed thousands of new kinds of microbes, most of them inhabiting the mouth and intestinal tract. mensa, table. The virus is engulfed by the cell membrane into a vesicle or endosome and transported internally. The hepatitis B virus Virus Invades Your
Body" on the targets the liver, and the mumps virus targets internet. Exactly what causes the charges to form on atoms in ionic bonds? Which viruses would more likely be possible oncoviruses and why would this be the case? A staining technique with fluorescent dyes is commonly used to detect Mycobacterium tuberculosis (the agent of tuberculosis)
in patients' specimens (see figure 19.20). The majority of bacteria with gram-negative cell wall structure (Phyla Proteobacteria, Bacteriodetes, Fusobacterium, Spirochaetes, Chlamydiae) F. archaeon b. Budding of enveloped viruses causes
them to be shed gradually, without the sudden destruction of the cell. early, poxviruses d. Archaea adapted to growth at very low temperatures are hyperthermophilic (loving very high temperatures); those growing at very high temperatures are described as psychrophilic (loving very high temperatures).
organized, thorough without being overwhelming, visually appealing (fonts, illustrations, colors, etc.), accurate and interesting. Treponema pallidum— T llid spirochetes that cause syphilis N. All subjects remained protected from smallpox. It is evident that the organelles impart much greater complexity and compartmentalization compared to a
prokaryotic cell. What are the primary problems in treating viral infections with drugs? What term is used to describe a single species exhibiting both cell types shown below, and which types of organisms would most likely have this trait? Some scientists assumed that microscopic beings were an early stage in the development of more complex ones.
Didinium idi i ((predator, d right)—preparing i h) to attack and engulf Paramecium (prey, left) in an age-old ciliate struggle (1,2003) F. 2.2 Bonds and Molecules Expected Learning Outcomes 6. He worked out the concept of safely conferring artificial immunity long before there was any understanding of the immune system (look ahead to 15.2 Making
Connections). Animal specialists work with infectious diseases and other interactions between animals and microorganisms. It also divides the bacteria into gram-positive, gram-negative, and those without cell walls and then subgroups them according to cell shape, arrangement, and certain physiological traits such as oxygen usage: Aerobic bacteria
use oxygen in metabolism; anaerobic bacteria do not use oxygen in metabolism; and facultative bacteria may or may not use oxygen. * staphylococci (staf0-ih-loh-kok9-seve) Gr. staphylococci (staf0-i
of this group are harmless, free-living inhabitants of water and soil, a few species are malnourished children. Even in a science dealing with very small things, an atom's minute size is striking; for example, an oxygen atom is only
0.0000000013 mm (0.0013 nm) in diameter, and 1 million of them in a cluster would barely be visible to the naked eye. You may wish to review this stain, described in 3.2 Making Connections. Maher, Ivy Tech Community College Luis Materon, University of
Texas-Pan American Dr. Craighton S. Gradually, the abiogenesis hypothesis was abandoned, as convincing evidence for biogenesis strictly on dead organic matter in environmental reservoirs such as soil and water, and are unable to adapt to the body of a live host. As long as the concentrations of the solutions
differ, one side will experience a net loss of water and the other a net gain of water until equilibrium is reached and the rate of diffusion is equalized. ing this reaction, sodium is oxidized because it contains a dye (phenol red) that
changes color under variations in pH, and mannitol, a sugar that can be converted to acid. Describe the main purposes of media, and compare the three categories based on physical state, chemical composition, and usage. With respect to nutrition, microbes are not really so different from humans. Visual Challenge 1. This is the description of
antibiosis—the release of natural chemicals or antibiotics—that inhibit or kill microbes (look ahead to chapter 12). Biofilms associated with plant roots promote the mutual exchange of nutrients between the microbes and roots. Fimbriae function in adhering to the environment; pili can be involved in adhesion, movement, and genetic exchange.
Environmental factors with the greatest impact on microorganisms are nutrient and energy sources, temperature, gas content, water, salt, pH, radiation, and other organisms (figure 7.1). A fluorescence microscope can be handy for locating specific microbes in complex mixtures because only those cells targeted by the technique will fluoresce. After
an attempt to culture these bacteria over 495 days, a few cells enlarged, but most remained inactive. Active Transport: Bringing in Molecules Against a Gradient Free-living microbes exist under relatively nutrient-starved conditions and cannot rely completely on slow and rather inefficient passive transport mechanisms. The incredible variation in
shapes is the basis for the diverse roles proteins play as enzymes, antibodies, receptors, and structural components. The process that most accounts for several observations made about microbial activities. cell membrane d. Fundamentally, then, cells must have a supply of atoms that can
gain or lose electrons if they are to carry out life processes. glycocalyx b. Parasites living in host tissues are most likely to be living in isotonic habitats. Fullerenes represent an unusual group of molecules that consist only of carbon double-bonded to other carbons, forming a lattice network that can assume a number of configurations. Following
mating between parental hyphae underground, the mycelium gives rise to the fruiting body that we commonly identify as a mushroom. By contrast, however, the ribosomes of eukaryotes (except in the mitochondria and * stroma, mattress or bed. Selected representatives of the Domains are included. Viruses that alter host
genetic material may cause oncogenic effects. Early bacteriologists found it convenient to classify bacteria according to shape, variations in arrangement, growth characteristics, and habitat. (b) A culture of Yersinia pestis on chocolate agar, which gets its brownish color from cooked blood and does not produce hemolysis. It is for these reasons that
 scientists do not take a stance that theories or even laws are absolutely proved. However, a few bacteria and most viruses are far too small to be resolved by the optical microscope and the atomic number, it is possible to determine the
numbers of neutrons by subtraction. 

Some microbiologists analyzing the results of these studies have proposed that we are likely to uncover totally new domains of organisms. Visual Challenge visual Challenge questions take images and concepts learned in other chapters and ask students to apply that knowledge to concepts covered in the current
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chapter. This section summarizes the prominent discoveries made in the past 300 years: microscopy, the rise of the scientific method, and the development of medical microbiology, including the germ theory and the origins of modern microbiology.

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and toxicity (figure C). Define contaminant. We value the capable and diligent efforts of Heidi Smith to develop and improve the digital assets for the Connect website. In the long-term scheme of things, microorganisms are the main forces that drive the structure and content of the soil, water, and atmosphere. People are living longer. media), which
provides an environment in which they multiply. How would you describe the types of scientific reasoning in the various experiments for supporting and denying spontaneous generation? Selenite and brilliant green dye are used in media to isolate Salmonella from feces, and sodium azide is used to isolate enterococci from water and food. The top of
culture is most frequently used for laboratory study, because it of the key provides a general category from which to begin a seallows the precise examination and control of one microorganism ries of branching points, usually into two pathways at each new by itself. Part 3, Perspectives, has been moved to the Connect website. These topics are
further explored in chapters 7 and 13. Overall Morphology: At the cellular (microscopic) level, fungi are typical eukaryotic cells, with thick cell walls. Hyphae* are long, threadlike cells that make up the bodies of filamentous fungi, or molds (figure 5.14). Another comes from maximizing the numerical aperture. Neck of second flask remains intact; no
growth occurs. Locomotion by means of flagella is common in protozoa, algae, and a few fungal and animal cells. An illustration of the organs and systems that are affected by a pathogen has been added to each Pathogen Profile; additional Pathogens Profile; additional Pathogens Profiles have been added to several phyla within this kingdom, humans are
in the Phylum Chordata, but even a phylum is rather all-inclusive, considering that humans share it with other vertebrates as well as with creatures called sea squirts. 4.2 Prokaryotic Profiles: The Bacteria and Archaea A. Relate the techniques and tools used to detect and count cells in culture. Such animals can be an indispensable aid for studying,
growing, and identifying microorganisms. Certain viruses can also be detected by their ability to agglutinate red blood cells (form big clumps) or by their reaction with an antibody of known specificity that will affix to its corresponding virus, if it is present. Some arthropods such as fleas and ticks may also be carriers of infectious diseases. Thus,
survival is largely a matter of whether the enzyme systems of microorganisms can continue to function even in a changing environment. Sporozoite of Cryptosporidium—a common water-borne pathogen • Toxoplasma gondii causes an acute infection (toxoplasmosis) in humans, which is acquired from cats and other animals (see figure 23.16).
Regardless of their evolutionary history, all species presently residing on the earth are modern, but some have arisen more recently in evolutionary history than others. h l a common inhabitant of soil and plants (4003) B. This is a rapidly expanding field that often complements biotechnology (see chapter 10). Solid media may be liquefiable, containing
a solidifying agent such as agar or gelatin. Growth occurs throughout the container and can then present a dispersed, cloudy, or flaky appearance. Find "Hydrothermal Instead, this ecosystem is based on a massive Vents" or "Black Smokers" on chemoautotrophic bacterial population that YouTube to watch oxidizes the abundant hydrogen sulfide
(H2S) videos of these gas given off by the volcanic activity there. (c) The enzymes hydrolyze the bonds in the debris molecules. This difference favors, or selects, positive bacteria. Humans are generally quite resistant to fungal infection, except for two main types of fungal pathogens: the primary pathogens, which can infect even healthy persons, and
the opportunistic pathogens, which attack persons who are already weakened in some way. Conidia* (conidiospores) are free spores not enclosed by a spore-bearing sac (figure 5.18b). Autotrophs and Their Energy Sources Autotrophs derive energy from one of two possible nonliving sources: sunlight and chemical reactions involving simple
chemicals. 2.7 Molecules of Life: Proteins A. For the chapters on pathogens 18-25, we created Systems Profiles tables that correlate important species with the major body systems they infect. DNA molecules are usually extremely long, a feature that satisfies a requirement for storing genetic information in the sequence of base pairs the molecules
contains. Other studies of the ocean have documented the presence of 10 million viruses per milliliter of water—10 times the number of cellular microbes. Some sporangiospores are the end result of the sexual phase of the life cycle as seen in figure 5.19. vention was truly a matter of life or death." Realizing this was more than just the flu, her
hus Because Kay's symptoms pointed to a posband rushed her immediately to the nearest sible infection of the central nervous system, a "Our intervention was truly second spinal puncture was performed. Does the newer system change the basic idea of prokaryotes? Mitochondria: Energy Generators of the Cell None of the cellular
 activities of the genetic assembly line could proceed without a constant supply of energy, the bulk of which is generated in most eukaryotes by mitochondria.* When viewed with light microscopy, mitochondria appear as tiny round or elongated particles scattered throughout the cytoplasm. In another case, it refers to the enlargement of a single
organism during maturation. Many identification systems are automated and computerized to process data and provide a "best fit" identification. An older therapy getting a second look involves use of bacterial infections (phage therapy). Obligate and facultative intracellular bacterial infections (phage therapy).
Rickettsiaceae: Rickettsia (Rocky Mountain spotted fever) J. The specimen, being denser and more opaque than its surroundings, absorbs some of this light, and the rest of phospholipids makes them essential components of cell
membranes? It is now evident that microbes show a well-developed capacity to communicate and cooperate in the formation and function of biofilms. resistant 5. The placement and number of flagella can be useful in identifying flagellated protozoa and certain algae. "true" nucleus. Foundations in Microbiology's art program combines vivid colors
multidimensionality, and self-contained narrative to help students study the challenging concepts of microbiology. Note its highly textured glycocalyx. * saprobe (sap9-rohb) Gr. sapros, rotten, and bios, to live. This appearance arises when the DNA becomes highly condensed by forming coils and supercoils around the histones to prevent the
chromosomes from tangling as they are separated into new cells. Food Microbiologists These scientists are concerned with the impact of microbes on the food supply, including such areas as food spoilage, food-borne diseases, and production. sarcina, a packet. Such common air contaminants as Aspergillus, Cladosporium, and Stachybotrys all have
the capacity to give off airborne spores and toxins that, when inhaled, cause a whole spectrum of symptoms sometimes referred to as "sick that they have a soft, uniform texture and appearance. neutral, negative, electron 3. These archaea are common inhabitants of anaerobic mud and the bottom sediments of lakes and oceans. Molecules need not capacity to give off airborne spores and toxins that, when inhaled, cause a whole spectrum of symptoms sometimes referred to as "sick that they have a soft, uniform texture and appearance. neutral, negative, electron 3. These archaea are common inhabitants of anaerobic mud and the bottom sediments of lakes and oceans.
exist in a gradient. Dr. Oliver Wendell Holmes, an American physician, observed that mothers who gave birth at home experienced fewer infections than did mothers who gave birth in the hospital, and the Hungarian Dr. Ignaz Semmelweis showed quite clearly that women became infected in the maternity ward after examinations by physicians
coming directly from the autopsy room. Describe the adaptations of viruses that do not immediately kill the host cell and explain what their functions may be. Several parasitic species, including the agents of malaria and toxoplasmosis, reproduce asexually inside a host cell by multiple fission. Multiple Matching. Discuss major functions of lipids in
cells. The reason that these microbes had never been previously sampled or identified arises from our inability to grow them in the laboratory. Both the sporangia and the that undergo meiosis Ascospores sporangia and the that undergo meiosis as the third that the that undergo meiosis as the third that the thir
arose from the union of two separate fungal parents, they are not genetically identical. Older and sicker people have heightened susceptibility to what we might call "garden-variety" microbes. If septate, the septa are complete Most species are free-living saprobes; some are animal parasites Can be obnoxious contaminants in the laboratory, food
spoilage agents, and destructive to crops • Examples of common molds: Rhizopus, a black bread mold; Mucor; Absidia; Circinella (figure A, Syncephalastrum, A. The colonies of yeasts are much like those of bacteria in 5.5 The Kingdom of the Fungi 137 5.1 Secret World of Microbes Fungi: A Force of bacteria in 5.5 The Kingdom of the Fungi 137 5.1 Secret World of Microbes Fungi: A Force of bacteria in 5.5 The Kingdom of the Fungi 137 5.1 Secret World of Microbes Fungi: A Force of bacteria in 5.5 The Kingdom of the Fungi 137 5.1 Secret World of Microbes Fungi: A Force of bacteria in 5.5 The Kingdom of the Fungi 137 5.1 Secret World of Microbes Fungi: A Force of bacteria in 5.5 The Kingdom of the Fungi 137 5.1 Secret World of Microbes Fungi: A Force of bacteria in 5.5 The Kingdom of the Fungi 137 5.1 Secret World of Microbes Fungi: A Force of bacteria in 5.5 The Kingdom of the Fungi 137 5.1 Secret World of Microbes Fungi: A Force of bacteria in 5.5 The Kingdom of the Fungi 137 5.1 Secret World of Microbes Fungi 137 5.1 Secr
Nature Life in the Fungal Jungle Fungi are among the most prolific microbes on earth. Is it not curious that the human cell welcomes a virus in and hospitably removes its coat as if it were an old acquaintance? A saturated fatty acid has all of the carbons in the chain bonded to hydrogens with single bonds. Second, to maintain and keep track of such
small research subjects, microbiologists usually will need to grow them under artificial conditions. Billions of doses given over a decade reduced smallpox to zero. Acidity, Alkalinity, and the pH Scale Another factor with far-reaching impact on living things is the concentration of acidic or basic solutions in their environment. It is a multifunctional
structure involved in transport, synthesis, and energy reactions (a) General scheme in the formation of the intestine accompanied by bloody stools. The pH scale expresses the concentration of H1 such that a pH of less than 7.0 is
considered acidic, and a pH of more than that, indicating fewer H1, is considered basic (alkaline). Primary cell cultures are prepared by placing freshly isolated animal tissue in a growth medium. pores that allow communication with the cytoplasm Multiple-Choice M l i l Ch i Questions Q i End-of-Chapter Questions Students can assess their knowledge.
of basic concepts by answering these questions and looking up the correct answers in appendix D. * illuminate (ill-oo9-mih-nayt) L. Biotechnology This branch is defined by any process that harnesses the actions of living things to derive a desired product, ranging from beer to stem cells. Deaths were particularly high among young children and
pregnant women whose treatment had been delayed. Examples include the natural partnerships that are found in symbiosis and biofilms. Some microbes have adapted to a non-free-living lifestyle called parasitism. The three classes in the phylum display significant diversity, and a number of the members are pathogenic. For each type of medium
select all descriptions that fit. These introductory categories are certainly useful in organization and description, but the study of specific viruses requires a more standardized method of nomenclature. An important taxonomic system is standardized by Bergey's Manual of Systemic Bacteriology, which presents the prokaryotes in five major groups, as
organized by volume. It could be nearly any thing or place on earth. Viruses typically possess only the genes needed to invade host cells and redirect their synthetic machinery to make new viruses. pages cm ISBN 978-0-07-352260-9 — ISBN 0-07-352260-9 (hard copy: alk. (1) A sectioned stromatolite displays layers of a cyanobacterial biofilm laid
down over a billion years ago. Selective and Differential Media Mannitol salt agar (MSA) contains a high concentration of NaCl (7.5%) that is quite inhibitory to most human pathogens. She is gratified by the many supportive notes and letters she has received over the years from devotees of microbiology and users of her book. A solution with a pH of
2 a. A Helminth Cycle: The Pinworm To illustrate a helminth cycle in humans, we use the example of a roundworm, Enterobius vermicularis, the pinworm or seatworm. The configuration of the inner and outer sides of the membrane can be quite different because of the yeariations in protein shape and position. Instead of the term pure culture, some
microbiologists junction. These relationships vary in the degree of interaction and its outcome. A single medium can be classified in more than one category depending on the ingredients it contains. The greatest variety in arrangement occurs in cocci (figure 4.25). Its capacity for magnification and resolution makes the EM an invaluable tool for
seeing the finest structure of cells and viruses. The brightfield image is compared with that of other microscopes in table 3.2. Dark-Field Microscope by adding a special disc called a stop to the condenser. T an s oc ty alyy ers ie i viou r t u va re M "I very much enjoyed these case
studies in the chapters. Because it does not form cysts, it is more delicate and must be transmitted by intimate contact between sexual partners. Some worms are restricted to a given geographic region, and many have a higher incidence in tropical areas. Because the fungi are classified into general groups by the presence and type of sexual spores, it is more delicate and must be transmitted by intimate contact between sexual partners.
would seem logical to identify them in the same way, but sexual spores are rarely if ever demonstrated in the laboratory setting. This text follows the American Society for Microbiology style, which calls for capitalization of the terms Gram staining and lowercase treatment of gram-negative and gram-positive, except in headings. The
nucleus makes up the larger mass (weight) of the atom, whereas the electron region, sometimes called the "electron cloud," accounts for the greater volume. Research in extreme habitats in Antarctica uncovered a surprisingly rich diversity of viruses inhabiting a frigid lake. Figure 3.2 Effects of magnification. Other well-studied examples of obligate
mutualism can be found in termites, corals, root nodules, tube worms, and ants (figure 7.13 a1, 2, b1, 2 and 7.2 Secret World of Microbes). Protozoan Form and Function Most protozoan cells are single cells containing the major eukaryotic organelles except chloroplasts. macroscopic, media c. Both A and B will satisfactorily grow the bacteria. The
most general subdivision is based on the way the spores arise. In the deductive reasoning approach, a scientist uses general observations of some phenomenon—that is, they deduce the facts that can account for what they have observed. Because strict, or obligate, anaerobes also lack the enzymes
for processing toxic oxygen, they cannot tolerate any free oxygen in the immediate environment and will die if exposed to it. Sometimes it may seem that prokaryotes are the microbial "havenots" because, for the sake of comparison, they are described by what they lack. Any substance, whether an element or compound, that must be provided to an
organism is called an essential nutrient. Explain or illustrate exactly what will happen to the cell wall if the synthesis of the interbridge is blocked by penicillin. Examples of macronutrients are compounds such as sugars and amino acids that contain carbon, hydrogen, and oxygen. Specific structures that are found in some, but not all, bacteria are
flagella, pili, fimbriae, capsules, slime layers, inclusions, an actin cytoskeleton, and endospores. species, family, class, order, phylum, kingdom 12. For example, the flagellate Trichomonas vaginalis causes a common sexually transmitted infection. Name the notable features of microorganisms that have created a need for the specialized tools of
microbiology. Animal viruses range in size from the small 160 Chapter 6 An Introduction to Viruses 1. As scientists continue to explore remote and unusual environments, the one entity they always find is microbes. s ro g in ic he palm t g
of ua ted sin g ad ivid trac A u nnin d ex N tu be D in e hey he ir s um t t he d n ea t, as zed **. * refract, refraction (ree-frak9-shun) L. protons b. germ theory of disease 7. It is a discrete organelle consisting of layers of flattened, disc-shaped sacs also called cisternae, giving an appearance of a stack of pita breads. (g) All viruses are
parasites that invade cells and take over their function. As a group, mesophiles can grow between 108C and 508C, but their optima usually fall between 208C and 408C. For many years, biologists regarded most single-celled microbes as simple individuals without comparable properties, other than to cling together in colonies. larger size of
prokaryotes b. Phylum IV—Chytridimycota Members of this phylum are unusual, primitive fungi commonly called chytrids.* Their cellular morphology ranges from single cells to clusters and toxins) are secreted by the membrane into the
extracellular environment. 0_ch21_633-665.indd Page 637 17/10/13 2:46 PM user-f467 /202/MH02004/taL22600_pagefiles Color photos of individuals affected by disease provide students with a real-life, clinical view of how microorganisms manifest themselves in the human body. Supply your own linking words or
phrases in this concept map, and provide the missing concepts in the empty boxes. The organization of matter—whether air, rocks, or bacteria—begins with individual building blocks called atoms. The most complex proteins assume a quaternary (48) structure, The nucleic acids, deoxyribonucleic* acid (DNA) and ribonucleic* in which two or more
polypeptides interact to form a large, multiunit acid (RNA), were originally isolated from the cell nucleus. Aerobic cocci J. 6.2 (a) Capsomers Vertex Fiber Nucleic acid (c) (b) Figure 6.7 The structure and formation of an icosahedral virus (adenovirus is the model). 4.3 The Cell
 Envelope: The Outer Boundary Layer of Bacteria Gram-Positive 99 Gram-Negative Lipoteichoic acid Lipopolysaccharides Wall teichoic acid Porin proteins Periplasmic space Membrane protein Key Phospholipid Porin
Membrane proteins Lipoprotein Peptidoglycan Teichoic acid Lipopolysaccharide Figure 4.15 A comparison of the detailed structure of gram-positive and gram-negative cell envelopes and walls. Describe the major groups of helminths and their basic morphology and classification. To ensure a constant supply of nutrients and other required and gram-negative cell envelopes and walls.
substances, microbes must capture those that are in low concentrations and actively transport them into the cell. Infective Amoebas: Entamoeba Several species of amoebas cause disease in humans, but probably the most common disease is amoebiasis, or amebic * reduviid (ree-doo9-vee-id) A member of a large family of flying insects with sucking
beaklike mouths. • Molecules on virus surface impart high specificity for attachment to host cell. This collaborative experience and these tools have revolutionized her approach to teaching and dramatically affected student performance in her courses, especially microbiology hybrid courses where content is delivered partially online. If not for the
work of decomposers, the earth would gradually fill up with organic material and the nutrients it contains would not be recycled. What is an enveloped virus, and how does the envelope arise? As our knowledge of biofilm patterns grows, it will likely lead to greater understanding of their involvement in infections and their contributions to disinfectant
and drug resistance (see chapter 12). The main criteria presently used to group viruses are structure, chemical composition, and similarities in genetic makeup, which indicate evolutionary relatedness. In the following section and in later chapters, we consider numerous concepts relating to the roles of macromolecules in cells. Questions throughout
the chapters have been modified and compressed; new questions have been written for the Case Study Reviews. If not for electron microscopes, our understanding of biological structure and function would still be in its early theoretical stages. Check Your Progress SECTIONS 6.6 AND 6.7 26. 141 142 Chapter 5 A Survey of Eukaryotic Cells and
Microorganisms Fungi That Produce Only Asexual Spores (Imperfect) From the beginnings of fungal classification, any fungus that lacked a sexual state was called "imperfect" and was placed in a catchall category, the Fungi Imperfect. This early explanation is considered a hypothesis, and however tentative it may start out, it is still based 1.5 The
Historical Foundations of Microbiology 15 1.2 MAKING CONNECTIONS The Fall of Superstition and the Rise of Microbiology For thousands of years, people believed that certain living things arose from vital forces present in nonliving or decomposing matter. Briefly describe the manner of nutrition and body plan (unicellular, colonial, filamentous, or
multicellular) for each group. These recep- I tors are genetically controlled and subject to frequent changes in structure. vectur, one who carries effectiveness wears off and may
require additional inoculations to create adequate protection. For example, Mycobacterium leprae, the cause of Hansen's disease, has a generation time of 10 to 30 days—as long as some animals. The two types of endoplasmic reticulum Nuclear pore
Chromatin Endoplasmic reticulum Nuclear envelope Nucleolus Nuclear envelope Nucleolus Nuclear envelope Nucleolus (b) Figure 5.5 The nucleus. But evidence is accumulating that they are actually more closely related to Domain Eukarya than to bacteria. Many older diseases are also reemerging. (a) An anaerobic environmental chamber is equipped with
ports for handling strict anaerobes without exposing them to air. Nonseptate hyphae lack septa and are single, long multinucleate cells and viruses are
ultimately programmed by a master code composed of nucleic acids. Biofilms on heart valves can give rise to infections in other areas of the body. Biofilms are known to be a rich ground for genetic transfers among neighboring cells that involve conjugation and transformation (see chapter 9). (b) Structural models of two kinds of fatty acids. Infected
people may become involved in an ongoing cycle that continues to produce more parasites and increase their survival and transmission. In fact, reduction often results in a greater complexity of Reducing agent Oxidized cation Reduced anion the molecule. Cytopathic* effects (CPEs) are defined as virus-induced damage to the cell that
 alters its microscopic appearance. This technology makes it possible to deliberately alter DNA2 and to switch genetic material from one organisms in milk, water, food, soil, and other samples. flagellated protozoan genus that
causes an STD j. Three polysaccharide—glucose, and glycogen) are structurally and biochemically distinct, even though all are polymers of the same monosaccharide—glucose. Note that many of these infections are treatable with vaccines. (d) The flattened layers of the Golgi apparatus receive protein-carrying
transport vesicles from the RER, process their contents, and transport condensing vesicles to sites of various cellular functions. Symbioses can be obligatory, involve animals, plants, and other microbes, and can include complex multipartner interactions. The terms mass and weight are often used interchangeably in biology, even
though they apply to two different but related aspects of matter. The feeder microbe grows around its partner as tiny colonies, while the passive partner is not harmed or helped (figure 7.13e). TABLE 5.6 Selected Taxonomy of Protozoa, with Group Characteristics and Examples The Mastigophora (Also Called Zoomastigophora) • • • • • Motility is
primarily by flagella alone or by both flagellar and amoeboid motion. Usually, evolution progresses toward greater complexity, and evolutionary stages range from simple, less evolved forms that are close to an ancestral organism to more complex, evolved forms that have advanced beyond the ancestral forms. Some investigators go right from
sampling to microscopic inspection or from sampling to DNA testing. disulfide bonds. Parasitism is widespread throughout nature. This image is observed in the field of view by the eye and perceived by the brain. (a) Structure of Chlamydomonas, a motile green alga, indicating major organelles. Most procedures involve a positive stain, in which the
dye actually sticks to cells and gives them color. The most effective use of dark-field microscopy is to visualize living or heat, or cannot be stained with the usual methods. Indicate the characteristics used in identifying and naming viruses. a nucleoid d. helix, and the folded, accordion form is called the b-pleated
sheet. T2 bacteriophage 65 nm 9. They are highly successful and adaptable single-cell life forms. Domain Eukarya Kingdom Plantae Kingdom Plant
that developed in the conditions of the hot early earth. Although isotopes have virtually the same chemical properties, some of them have unstable nuclei that spontaneously release energy in the form of radiation, water, terrestrial 8, ductive and synthetic machinery is approximately 0.14 mm, which means that some of the nanobes could be artifacts
or bits of larger cells that have Miniature Microbes—Are They for Real? The factor that most limits the clarity of a microscope's image is its resolving power. The kinds of harm that parasites do to their hosts varies from superficial damage (ringworm on the skin from a fungal infection) to death (rabies virus). Most ell lla. (a) Sporangiospores: (1)
Absidia, (2) Syncephalastrum, (table 5.3), (a) phialospores (e.g., Coccidioides), (b) Conidia: (1) arthrospores (e.g., Aspergillus, table 5.3), (a) macroconidia and microconidia and microconidia (e.g., Aspergillus, table 5.3), (b) Conidia: (1) arthrospores (e.g., Aspergillus, table 5.3), (a) macroconidia and microconidia and microconidia (e.g., Aspergillus, table 5.3), (b) Conidia: (1) arthrospores (e.g., Aspergillus, table 5.3), (a) macroconidia and microconidia and microconidia (e.g., Aspergillus, table 5.3), (b) Conidia: (1) arthrospores (e.g., Aspergillus, table 5.3), (a) macroconidia and microconidia and microconidia (e.g., Aspergillus, table 5.3), (a) macroconidia (e.g., Aspergillus, table 5.3), (b) Conidia: (1) arthrospores (e.g., Aspergillus, table 5.3), (a) macroconidia and microconidia and microconidia (e.g., Aspergillus, table 5.3), (b) Conidia: (1) arthrospores (e.g., Aspergillus, table 5.3), (a) macroconidia and microconidia and microconidia and microconidia (e.g., Aspergillus, table 5.3), (b) Conidia: (c.g., Aspergillus, table 5.3), (b) Conidia: (c.g., Aspergillus, table 5.3), (c.g., Aspergillus, table 5.3), (c.g., Aspergillus, table 5.3), (d) macroconidia and microconidia and mic
OPDPOOTATCGGATGCCTwo double strands ATATCGCGADOTCCADOTCCADOTCCADOTCCADOTCCADOTCCATAGOTCCADOTCCADOTCCADOTCCADOTCCADOTCCADOTCCADOTCCADOTCCADOTCCATAGOTCCADOTCC
4. The medium may be solid or liquid, and held in tubes, plates, flasks, and even eggs. The lytic cycle (1-7) involves full completion of viral infection through lysis and release of virions. Examination of the compounding facility uncovered negligence and poor quality control, along with dirty preparation rooms. They penetrate by injecting their nucleic
 acid and are released as virulent phages upon lysis of the cell. Because all redox reactions occur in pairs, it follows that reduction is the result of a 2.3 Chemical Reactions, Solutions, and pH 37 different atom gaining these same electrons. Nonsynthetic (complex; not chemically defined) 2. But this microscope has additional refinements that can add
contrasting colors to the image. Go back to page 6 and observe the six micrographs in figure 1.3. See if you can tell what kind of microscope was used to make the photograph based on magnification and appearance. Polysaccharides typically contribute to structural support and protection and serve as nutrient and energy stores. Because they are
genetically-different, these basidiospores produce different parental hyphae that begin the cycle again. Pentose sugars may be deoxyribose or ribose, depending on the type of nucleic acid. SECTION 4.5 Classify bacteria according to their basic shapes. Some proteins are situated only at the surface; others extend fully through the entire membrane
endoplasmic reticulum, nucleolus c. The original Kingdom Protista may also be represented as a collection of protozoa and algae in several separate taxons discussed in chapter 5. A microscope that has a total magnification of 1,5003 when using the oil immersion objective has an ocular of what power? T an s oc aly ers iety iou ut var rev M o icr CASE
STUDY Part 2 Needing to move from speculation to scientific facts, NASA started a series of missions in 2002 that could perform more detailed investigations. size . Various fungal types thrive in substrates with higher salt, sugar, or acid content, at relatively high temperatures, and even in snow and glaciers. The use of biological agents to remedy
environmental problems. 2022 1 2H1 ———n H2O2 (hydrogen peroxide) 1 O2 Step 2. Supply the linking words between each pair of concepts. * in vivo (in vee9-voh) L. When this type of membrane is placed between solutions of * osmosis (oz-moh9-sis) Gr. osmos, impulsion, and osis, a process. Nutrient agar is a common one. Bacteria that cause
tuberculosis and leprosy produce a wax (wax D) that contributes to their pathogenicity. b and c e. The fact that you are reading this textbook absolutely verifies which of these approaches is more reliable and predictive. The chromosomes in the nucleus of nondividing cells are not readily visible because they are long, linear DNA molecules bound in
varying degrees to histone proteins, and they are far too fine to be resolved as distinct structures without extremely high magnification. Explain the process of coevolution and how it influences the development of microorganisms. Among the common organic molecules that can satisfy this requirement are proteins, carbohydrates, lipids, and nucleic
acids. Lab results from the Gram stain and culture were conclusive: Kay Peterson was infected by the meningococcus, Neisseria meningitidis,* which is an agent of both meningitidis,* which is an agent of both meningitidis, and septicemia.* The microscopic examination yielded the classic appearance of tiny pairs of red cocci (diplococci) and white blood cells carrying the same cocci inside.
Typeface: 10/12 Times New Roman Printer: R. Figure 2.11 Three-dimensional, or space-filling, models of (a) water, (b) carbon dioxide, and (c) glucose. as an archaeon d. Direction of net water movement. tetrad b. Other noncellular infectious agents include satellite viruses and viroids. Table 5.3 outlines the major phyla, their characteristics, and
typical members. * ribonucleic (ry0-boh-noo-klay9-ik) It is easy to see why the abbreviations are used! 2.8 Nucleic Acids: A Program for Genetics 51 Amino acids bound in a chain. Highly acidic or alkaline habitats such as acidic bogs and streams or alkaline soils and ponds can provide numerous
 habitats for specialized microbial communities. Note: This method works best if the spreading tool (usually an inoculating loop) is resterilized (flamed) after each of steps 1-3. (b) Division in two planes at right angles produces tetrads and packets. Microbes are ubiquitous. Imagine Leeuwenhoek's excitement and wonder when he first viewed a drop of
rainwater and glimpsed an amazing microscopic world teeming with unearthly creatures. The condition they cause, enterobiasis, is usually a simple, uncomplicated infection that does not spread beyond the intestine. These are terms, like protist, that
provide a shorthand label for certain eukaryotes. As in plants and animals, a union of genes from two parents creates offspring with combinations of genes different from that of either parent. In time, as each hypothesis is supported by a growing body of data and survives rigorous scrutiny, it moves to the next level of acceptance—the theory. an
endospore former d. The diseases associated with prions are known as transmissible spongiform encephalopathies (TSEs). G. If the temperature rises slightly above maximum, growth will stop. Dental carries are partly due to the complex actions of aerobic and anaerobic bacteria in plaque. 6.4 Modes of Viral Multiplication A. Most fungi are saprobes,
meaning that they obtain these substrates from the remnants of dead plants and animals in soil or aquatic habitats. List the major elements that are associated with life. (b) 3.5 Media: The Foundations of Culturing 79 (a) (a) (b) 1 2 3 4 Figure 3.15 Sample semisolid media. Electron microscopy depends on electromagnets that serve as lenses to focus
electron beams. Robert Whittaker built on this work and during the period of 1959 through 1969 added a fifth kingdom for fungi. What is lysogeny? Diseases as disparate as multiple sclerosis, obsessive compulsive disorder, and coronary artery disease have been linked to chronic infections with microorganisms. In this way, they are drawn away from
the crystal separately into solution. Both nucleic acids are polymers of repeating units called nucleotides,* each of which is composed of three smaller units: a nitrogen base, a pentose (5-carbon) sugar, and a phosphate (figure 2.24a). She continued her education at Arizona State University, Occidental College, California Institute of Technology, and
California State University. All new species are the products of preexisting species, and their ancestry may be traced by examining fossils, morphology, genetics, and their ancestry may be traced by examining fossils, morphology, genetics, and their ancestry may be traced by examining fossils, morphology, genetics, and their ancestry may be traced by examining fossils, morphology, genetics, and their ancestry may be traced by examining fossils, morphology, genetics, and their ancestry may be traced by examining fossils, morphology, genetics, and their ancestry may be traced by examining fossils, morphology, genetics, and their ancestry may be traced by examining fossils, morphology, genetics, and their ancestry may be traced by examining fossils, morphology, genetics, and their ancestry may be traced by examining fossils, morphology, genetics, and their ancestry may be traced by examining fossils, morphology, genetics, and their ancestry may be traced by examining fossils, morphology, genetics, and their ancestry may be traced by examining fossils, morphology, genetics, and their ancestry may be traced by examining fossils, morphology, genetics, and their ancestry may be traced by examining fossils, morphology, genetics, and their ancestry may be traced by examining fossils, morphology, genetics, and their ancestry may be traced by examining fossils, and their ancestry may be traced by examining fossils, and their ancestry may be traced by examining fossils, and their ancestry may be traced by examining fossils, and the construction of the 
500 different types of media are used in culturing and identifying 78 Chapter 3 Tools of the Laboratory microorganisms. Chemical elements are needed in the overall scheme of cell growth, but most of them are available to the cell as compounds and not as pure elements. Processing these organic molecules by respiration or fermentation releases
energy in the form of ATP. The CDC collects information and statistics on diseases from around the United States and publishes it in a newsletter, The Morbidity and Mortality Weekly Report (see chapter 13). The cultured cells grow in the form of a monolayer, a single, confluent sheet of cells that supports viral multiplication and permits close
inspection of the culture for signs of infection (figure 6.19). Whenever she can, she visits her family in Idaho. For example, it was recently shown that HIV depends on the expression of 250 human genes to complete its multiplication cycle. The bottom layer of the outer membrane is similar to the cell membrane in its overall structure and is composed
of phospholipids and lipoproteins. Some of the oldest pressed as three cardinal temperatures. Several protozoan groups exist only in the trophozoite state. Diseasecausing agents. Van der Waals forces are a significant factor in protein folding and stability (see figure 2.23, steps 3 and 4). This difference in staining quality is due to structural variations
found in the cell walls of bacteria (look ahead to chapter 4). As the core rehydrates and takes up nutrients, it begins to grow out of the endospore coats. Hydrogens and oxygen tend to remain bonded by covalent bonds, but under certain conditions, a single hydrogen can break away as an ionic H1, or hydrogen ion, leaving the remainder of the
molecule in the form of an OH2, or hydroxide ion. In time, a critical number of cells, termed a quorum,* accumulates and this ensures that there will be sufficient quantities of inducer molecules. a speculation c. Elements with a filled outer orbital are relatively nonreactive because they have no extra electrons to share with or donate to other atoms.
6.5 The Multiplication Cycle in Bacteriophages A. Arrows show the route of infection; insets show the appearance of Entamoeba histolytica. 144 Chapter 5 A Survey of Eukaryotic Cells and Microorganisms Ribosomes Flagellum Mitochondrion Nucleus Nucleolus Chlorophages A. Arrows show the appearance of Entamoeba histolytica. 144 Chapter 5 A Survey of Eukaryotic Cells and Microorganisms Ribosomes Flagellum Mitochondrion Nucleus Nucleolus Chlorophages A. Arrows show the appearance of Entamoeba histolytica. 144 Chapter 5 A Survey of Eukaryotic Cells and Microorganisms Ribosomes Flagellum Mitochondrion Nucleus Nucleolus Chlorophages A. Arrows show the appearance of Entamoeba histolytica. 144 Chapter 5 A Survey of Eukaryotic Cells and Microorganisms Ribosomes Flagellum Mitochondrion Nucleus Nucleolus Chlorophages A. Arrows show the appearance of Entamoeba histolytica. 144 Chapter 5 A Survey of Eukaryotic Cells and Microorganisms Ribosomes Flagellum Mitochondrion Nucleus Nucleolus Chlorophages A. Arrows show the appearance of Entamoeba histolytica. 144 Chapter 5 A Survey of Eukaryotic Cells and Microorganisms Ribosomes Flagellum Mitochondrion Nucleus Nucleolus Chlorophages A. Arrows show the appearance of Entamoeba histolytica. 144 Chapter 5 A Survey of Eukaryotic Cells and Microorganisms Ribosomes Flagellum Mitochondrion Nucleus Nucleolus Chlorophages A. Arrows Show the Arrows 
Algal Cell (d) Figure 5.22 Representative microscopic algae. Some viruses bud off the cell membrane; others leave via the nuclear envelope or the endoplasmic reticulum. Doing justice to such incredible diversity would require more space than we can set aside in an introductory textbook, but in this section we have selected some of the more
prominent and unusual groups to present. Final number (Nf) 5 10 3 4,096 5 40,960 bacterial cells in the sandwich This same equation, with modifications, is used to determine the generation time, a more complex calculation that requires 6. Describe the stages in the multiplication cycle of bacteriophages. Globular protein CH2 CH HCH HCH C CH
Cholesterol HCH Cholesterol HO H CH CH3 CH3 Figure 2.20 Cutaway view of a membrane with its bilayer of lipids. Explain the classification scheme used for viruses. difficile superinfection. Provides very detailed, highly contrasting, threedimensional images of live specimens. The average generation time is 30 to 60 minutes under optimum
conditions. Explain how the levels of a taxonomic scheme relate to each other. When these two atoms, called the recharged ion. One powerful technique for designing new organisms is termed recombinant DNA. To illustrate what imparts a charge to ions, let us look again at the reaction between sodium and chlorine. ue 2 b rk 4. Mr. Jones was sent
home with lost consciousness. pyogenes with a capsule composed of hyaluronic acid (HA) identical to the HA found in host cells, preventing an immune response by the host. Some inclusion bodies contain condensed, energy-rich organic substances, such as glycogen and poly b-hydroxybutyrate (PHB), within special single-layered membranes (figure
4.20a). furunculus, little thief. First the capsomers are synthesized by the host cell. In an osmotic system, the membrane is selectively, or differentially, permeable, having passageways that allow free diffusion of water but can block certain dissolved molecules. From this position, it may be a significant factor in the development of the earth's climate
and atmosphere. They are known to be serious frog pathogens, often responsible for destroying whole populations in some habitats. The main body of the nucleolus. They fit together to form a miniature "factory" where protein synthesis occurs. Importance: Ecologically
important in food webs and decomposing organic matter. Though all share the characteristic of a gram-negative cell wall, the group contains bacteria with a wide range of adaptations, shapes, habitats, and ecology. It can be used as a verb or a noun. Spirochaetes Planctomycetes Chlamydiae Plants Eu ka ry a Cyanobacteria Algae Chlorobi Species
and Subspecies in Bacteria Among most organisms, the species level is a distinct, readily defined, and natural taxonomic category. Such radioactive isotopes play a role in a number of research and medical applications. Cyanobacteria went to outer space and survived periodically overgrow in aquatic environa year and a half." ments to form blooms
that are harmful to fish and other inhabitants, and some produce toxins that could cause illness if ingested, but they are generally not medically important. Name a bacterial group that uses chlorophyll to photosynthesize. (c) Formation and release of yeast buds and pseudohypha (a chain of budding yeast cells). 74 Chapter 3 Tools of the Laboratory
3.1 Secret World of Microbes The Uncultured For some time, microbiologists have had abundant evidence that culturebased methods are unable to identify many kinds of bacteria. Francesco Redi b. fact that had been omitted from his medical Over the next few days, his symptom list grew. ments and even sample exams. This tiny parasite is a
permanent resident of many insect cells and is known to control major parts of insects' life cycles. Chapter Summary with Key Terms 25 Chapter Summary with Key Terms 26 Chapter Summary with Key Terms 27 Chapter Summary with Key Terms 28 Chapter Summary with Key Terms 29 Chapter Summary with Key Terms 20 Chapter
Cholesterol can become esterified with fatty acids at its OH2 group, imparting a polar quality similar to that of phospholipids. Even in apparently dry habitats, such as sand or dry soil, the particles retain a thin layer of water usable by microorganisms. This apparently dry habitats, such as sand or dry soil, the particles retain a thin layer of water usable by microorganisms. This apparently dry habitats, such as sand or dry soil, the particles retain a thin layer of water usable by microorganisms.
dox pair, react to form sodium chloride, a sodium Figure 2.9 Simplified diagram of the exchange of electrons during an atom gives up an electron to a chlorine atom. DNA only b. Nontypical Cell Walls Several bacteria groups lack the cell wall structure of gram-positive or gram-negative bacteria, and some bacteria have no cell wall at all. For example of electrons during an atom gives up an electron to a chlorine atom.
although the cells of Corynebacterium diphtheriae are generally considered rod-shaped, in culture they display club-shaped, in culture they display club-shaped, swollen, curved, filamentous, and coccoid variations. (a) Close-up view of colonies of Bacillus species with and without capsules. A significant amount of methane also turned up in the samples, but more comQuick Search plex
organic compounds have not yet been Discover other evident. This is the mechanism for mumps and HIV viruses. Bacterial Chromosomes and Plasmids: The Sources of Genetic Information The hereditary material of most bacteria exists in the form of a single circular strand of DNA designated as the bacterial chromosome, although a few bacteria
have multiple or linear chromosomes. Staphylococcus aureus commonly forms biofilms on inanimate medical * inducer (in-doos9-ur) L. This is accomplished with a water, or contractile, vacuole that siphons excess water out of the cell like a tiny pump. devices and in wounds. Infectious diseases are also among the most common causes of death in
much of humanity, and they still kill a significant percentage of the U.S. population. Lentiviruses* tend to cause slow, chronic infections. Imagine that. * metabolism (muh-tab9-oh-lizm) A general term referring to the totality of chemical and physical processes occurring in the cell. observed a whitish growth on the muzzle of the dead bats and called
the condition "white nose syndrome." Closer inspection revealed that the white growth was Geomyces, a newly recognized fungal pathogen that inhabits the same caves where bats hibernate. epidermidis, a species that does not use mannitol (red); the right shows S. Explain the elements of helminth biology, life cycles, and reproduction. southern
United States. The primary lipid is phospholipid; however, cholesterol is inserted in some membranes. Relate this to what you know so far about the nutrients that are added to media. Why? What is true of the condition endocarditis? Semisolid media are used to determine the motility of bacteria and to localize a reaction at a specific site. This is a
relatively simple yet successful way to separate different types cient by themselves to identify some microbes of bacteria in a mixed sample. Answer available at allow the flow of organelles and nutrients between adjacent compartments. What is a nucleocapsid? They may also function as receptors and interfere with host defenses. inspection d. Note a nucleocapsid?
the inclusion bodies (1,0003) and the loss of cohesive junctions between cells. An increase in microbe numbers will provide the higher quantities needed for further testing. The simplest differential media show two reaction types such as a color change in some colonies but not in others. A type is a subspecies that can show differences in antigenic
makeup (serotype or serovar), in susceptibility to bacterial viruses (phage type), and in pathogenicity (pathotype). There 89 • • • • • Heredity is the transmission of an organism's genome* to the next generation by chromosomes, which carry DNA, the molecular blueprint of life. If experiments do not uphold the hypothesis—that is, if it is found to be
flawed—the hypothesis or some part of it is reconsidered. Which of the following is not found in all bacterial cells? Water is the solvent for cell chemicals, and it is needed for enzyme function and digestion of macromolecules. Bacteria and protozoa are essential in the operation of the rumen (a complex, four-chambered stomach) of cud-chewing
mammals. Mammalian viruses involved in the development of tumors are called oncoviruses. A vertex or "point" consists of five capsomers arranged with a single penton in the center. Clinical Photos (b) Appearance of folliculitis caused by S. Figure 7.13 provides an overview of the major categories of symbiosis with examples. Because of its manner
of formation, it is not a true hypha like that of molds. Under the microscope they resemble bacteria, but molecular biology has revealed that the cells of archaea, though prokaryotic in nature, are actually more closely related to eukaryotic cells than to bacterial cells (see figure 4.27). The amino acids in the interbridge can vary or may be lacking
entirely. This process is hastened by viral enzymes produced late in the infection cycle that weaken the cell envelope. 

For what reasons are complex organic carbon compounds considered strong evidence of living activities? 4.4 Bacterial Internal Structure Expected Learning Outcomes 15. 208 Chapter 7 Microbial Nutrition, Ecology, and Growth
The Basis of Population Growth: Binary Fission and the Bacterial Cell Cycle 7.6 The Study of Microbial Growth Expected Learning Outcomes 23. The arrangement of these individual polypeptides R2 H R4 H tends to be symmetrical and will dictate the exact OH H O H OH H form of the finished protein (figure 2.23, step 4). A survey of some
general methods of identification appears in chapter 3. Because microorganisms are extremely small and usually very close together, they will not be seen with clarity or any degree of detail unless the microscope's lenses can resolve them. Organisms gain mutual benefit from their association, but they can survive independently outside of the
partnership. Which of the following techniques from the six "I's" was not used in the diagnosis? Multiplication of the number of colonies in a single sample by the container's volume gives a fair estimate of the total population size (number of cells) at any given point. Their mode of multiplication is covered in section 6.5. Figure 6.10 summarizes the
primary morphological types found among the viruses. Among the most common reemerging infectious diseases are tuberculosis (TB), influenza, malaria, cholera, and hepatitis B. It is generally accepted that the individual cells in the bodies of multicellular organisms such as animals and plants have the capacity to produce, receive, and react to
chemical signals such as hormones made by other cells. vibrare, to shake. eggs and sperm e. began a series of voyages to directly explore our The main goals of one of the first Mars space own solar system. This time around, we have been fortunate to have the able assistance and expertise of developmental editor Mandy Clark, keeping us on track
and providing much needed moral support. tetani, the cause of tetanus (lockjaw), and C. 5 End of cell division cycle Daughter cells are now independent units. Even after single-celled organisms were discovered during the mid1600s, the idea of spontaneous generation continued to exist. Define what macromolecules, polymers, and monomers are.
Discuss the importance of the helminth parasites. a compound c. Physical types of media include those that are semisolid, and 
grain contaminated with the mold and is also a cause of liver cancer in humans. The authors chose this method of presentation often to help students comprehend difficult to study. Pandoraviruses were isolated from sediments in the seafloor and also use amoebas as hosts
 Which kinds of elements tend to make ionic bonds? The lipopolysaccharides have been referred to as endotoxins because they stimulate fever and shock reactions in gramnegative infections such as meningitis and typhoid fever. (2) As mitosis proceeds (early prophase), chromosomes take on a fine, threadlike appearance as they condense, and the
nuclear membrane and nucleolus are temporarily disrupted. Under hypotonic* conditions, the solute concentration of the external environment is lower than that of the external environment is lower than that of the external environment is lower than that of the external environment. Cells with walls will have a different pattern. This property accounts for the selective permeability and capacity to regulate transport of molecules. b and capacity to regulate transport of molecules.
symbol. When the spores of these species are embedded in a wound that contains dead tissue, they can germinate, grow, and release potent toxins. Figure 3.20b shows the result from a urine culture containing six different bacteria. Explain the factors that cause variations in the microbiota of the Overview of Viruses newborn intestine and the6.1
vaginal tract. (Gr. nanos, one-billionth). Application, Analysis, Evaluation, and Synthesis. Most helminth infections a. Evaluation the plate represents one cell or colony-forming unit (CFU) from the original sample. Note the presence of a cell wall and lack of
locomotor organelles. *To learn more about the findings of the Curiosity rover, go to . To find out more During the late 1600s in Holland, about van Leeuwenhoek, Leeuwenhoek used his early lenses to search the internet examine the thread patterns of the draperand view sites such as ies and upholstery he sold in his shop. To produce its images, the
SEM bombards the surface of a whole, metalcoated specimen with electrons while scanning back and forth over it. Powerful artwork that paints a conceptual picture for students is more important than ever for today's visual learners. T an s oc ally ers iety iou ut var rev M o icr A Survey of Prokaryotic Cells and Microorganisms CASE STUDY Part 2
During an autopsy of Mr. Jones's body, the pathologist observed that the protozoan Paramecium exhibits peritrichous flagella (7,5003). The life cycle of a parasitic protozoan dictates its mode of transmission to
other hosts. Eggs are the infective stage and are transmitted by unclean hands. Figure 3.7 displays the results of a fluorescent antibody technique used to highlight the spirochete (f) Branching filaments
Key to Micrographs (a) Micrococcus luteus (22,000\times) (b) Legionella pneumophila (6,500\times) (c) Vibrio cholerae (13,000\times) (d) Aquaspirillum (7,500\times) (e) Borrelia burgdorferi (10,000\times) (f) Streptomyces species (1,000\times) (e) Borrelia burgdorferi (10,000\times) (f) Streptomyces species (1,000\times) (g) Streptomyces species (1,000\times) (g) Streptomyces species (1,000\times) (h) Aquaspirillum (7,500\times) (e) Borrelia burgdorferi (10,000\times) (f) Streptomyces species (1,000\times) (g) Streptomyces species (1,000\times) (h) Aquaspirillum (7,500\times) (e) Borrelia burgdorferi (10,000\times) (f) Streptomyces species (1,000\times) (f) Streptomyces species (1,000\times) (g) Streptomyces species (1,000\times) (e) Borrelia burgdorferi (10,000\times) (f) Streptomyces species (1,000\times) (f) Streptomyces species (1,000\times) (g) Streptomyces species (1,
realm supports an engaged in a groundbreaking fishing expedition in the ocean of the world. What are subatomic particles and how do they contribute to the structure and character of atoms? An initial examination showed that most of a matter of life or death." time, the spinal fluid
looked cloudy. Pure water provides the most hypotonic environment for cells because it has no solute. One widely used reference is Bergey's Manual of Systematic Bacteriology, a major resource that covers all known prokaryotes. 150 Chapter 5 A Survey of Eukaryotic Cells and Microorganisms Cysts in food, water Reduviid bug (a) Infective
trypanosome (a) Cycle in Human Dwellings Stomach Trophozoites (b) Mode of infection Cycle in the Wild (b) (c) Large intestine Eaten Mature cysts Cysts exit (d) Food, water Figure 5.25 Cycle of transmission in Chagas disease. The CDC's estimates from April to November 2009 suggested
that the United States alone accounted for 50 million cases and close to 10,000 deaths. Observations Hypothesis Establishment of Theory Accepted Principle www.mcgrawhillconnect.com Enhance your study of this chapter with study tools and practice tests. Regrettably, the validation of biogenesis was temporarily set back by
John Needham, an Englishman who did similar experiments using mutton gravy. The process of evolution is selective: Those changes that most favor the survival tend to be lost. Figure 7.12 shows special systems for handling and growing
anaerobes. Mature biofilm completes cycle by dispersing planktonic cells, which swim free to start the process again in new habitats 96 Chapter 4 A Survey of Prokaryotic Cells and Microorganisms dehydration and loss of nutrients, as well as serving in adhesion (figure 4.10a). All protozoa have a trophozoite form, but not all produce cysts. fungi c.
Important storage lipids are the triglycerides, a category that includes fats and oils. preparation of the specimen d. Outer wall is weakened; cell loses dye. Even though the basis for the pH scale is [H1], it is important to note that, as the [H1] in a solution decreases, the [OH2] increases in direct proportion. About 50 species of helminths parasitize
humans. adaptare, to fit. (c) A naked virus such as poliovirus is first taken into a vesicle and then releases its nucleic acid through a pore or rupture in the membrane. • Penicillium is one source of antibiotics (see figure 5.16). This role of pili is discussed further in chapter 9. The fruiting body is a survival structure that makes spores by a method very
similar to that of certain fungi. Why is DNA called a double helix? Named for Howard Ricketts, a physician who first worked with these organisms and later lost his life to typhus. areas, where access to treatment is often severely limited. As the pH value decreases toward 0, the acidity increases, and as the pH increases toward 14, the alkalinity
 ncreases. When the genetic material of the samples was analyzed, it revealed over 10,000 unique viruses gathered from just a small area. These tiny strands exist apart from the world. These reinfluenza viruses that typed out to a strain known as
H1N1. Process figures are clearly marked next to the figure number. It is through this process that they have colonized most habitats on earth and created stable communities that provide access to nutrients and other essential factors. The inherent energy of the molecules moving down a gradient does the work of transport. The binding qualities of
an atom dictated by the number of electrons in its outermost shell. Strictly human viruses can be propagated in one of several primary or continuous human cell lines, such as embryonic kidney cells, fibroblasts, bone marrow, and heart cells. 1.5 The Historical Foundations of Microbiology the most from infectious diseases. This raises the pH of the
solution and causes the dye to become increasingly pink. The gas they produce in aquatic habitats collects in swamps and may become a source of fuel. This pattern can be represented with a flowchart: (a) Naked Nucleocapsid Virus Envelope (not found in all viruses) Virus
particle (b) Enveloped Virus Nucleic acid molecule(s) (DNA or RNA) Central core Matrix proteins Enzymes (not found in all viruses) Figure 6.4 Generalized structure of viruses. FC F. Gas Requirements (a) (b) Figure 7.10 Red snow. 98 Chapter 4 TABLE 4.1 A Survey of Prokaryotic Cells and Microorganisms Comparison of Gram-Positive and Gra
Negative Cell Walls Characteristic Gram-Positive Gram-Posi
Yes Periplasmic space Narrow Extensive Permeability to molecules More penetrable *In some cells. Hot vent Pompeii worms harbor ectosymbiotic filamentous bacteria on their surfaces to protect against high temperatures and toxic metals (7.2 Secret World of Microbes). Microbial Involvement in Energy and Nutrient Flow The
microbes in all natural environments have lived and evolved there for billions of years. A discovery by early microscopists that spurred the advancement of microbiology was that a clear, glass sphere could act as a lens to magnify small objects. Because the net direction of osmosis is from the hypotonic solution into the cell, cells without walls swell
and can burst when exposed to this condition. The term oxidation was originally adopted for reactions involving the addition of oxygen, but this is no longer the case. Scientists estimate that there are more microbes on earth back to Venter's laboratory. However, RNA is a single strand containing ribose * replication (reh0-plih-kay9-shun) A process
that makes an exact copy. Figure 1.7 compares the death rate among four groups that differ significantly in socioeconomic levels from around the world. Easy access outside of class anytime, anywhere, on just about any device. Viruses are known to parasitize all types of cells, including bacteria, algae, fungi, protozoa, animals, and plants. 5.5 The
Kingdom of the Fungi /202/MH02004/taL22600 disk1of1/0073522600/taL22600 pagefiles Common names of the macroscopic fungi are mushrooms, bkfidfflouristic fungi are mushrooms, bkfidfflouristic fungi are mushrooms, bkfidfflouristic fungi are mushrooms, bkfidfflouristic fungi are mushrooms, bkfidflouristic fung
conjugation, a form of genetic exchange in which members of two different mating types fuse temporarily and exchange nuclei. Endospores are subterminal and distend the cell, altering its shape. * vacuole (vak9-yoo-ohl) L. called strains and types. dipicolinic acid, Bacillus d. chronically water-damaged walls, ceilings, and other building materials that
Lichens are unusual hybrid organisms that form when a fungus comhave come to harbor these fungi. Provide a substantial theory regarding how eukaryotic cells originated and how multicellularity came to be. 18. In animals, for inBacteria stance, a species is a distinct type of orProtozoa ganism that can produce viable offspring ea a h only when it
mates with others of its own c Ar kind. When a series of tubes is inoculated with bacteria that differ in O2 requirements, the relative position of growth provides some indication sto oxygen use. Describe the range of temperatures a microbe can function within. CHAPTER 4 A Survey of Prokaryotic Cells and Microorganisms Section
of a prosthetic heart valve has a patch of MRSA biofilm attached (purple). A conidium that grows out through small pores in the spore-bearing cell; some are composed of several cells. Figure 4.16 Scanning electron micrograph of Mycoplasma pneumoniae (10,000X). (a) Single, double, and triple bonds can be made with other carbons, oxygen, and
nitrogen; single bonds are made with hydrogen. A transport host is an intermediate host that experiences no parasitic development but is an essential link in the completion of the cycle. Kingdom Plantae, containing plants. As the environmental source of these nutrients becomes depleted, the bacterial cell can mobilize its own storehouse as required
With this arrangement, more closely related organisms appear nearer each other on the tree. Check Your Progress SECTIONS 5.1 AND 5.2 1. The main factors influencing the arrangement of a particular cell type are its pattern of division and how the cells remain attached afterward. Comment on the possible origin of viruses, an electron c. A survey
of diseases associated with some of these microbes is found in chapters 22 and 23. All Life Is Related and Connected Through Evolution As we indicated earlier, taxonomy, the classification of biological species, is a system used to organize all of the forms of life. The inset provides a three-dimensional interpretation of its structure. pyogenes is found
in the throat, nasopharynx, and occasionally the skin of humans. The lipid portion may become toxic when it is released during infections. PO4, Corynebacterium 10. The concentration of a solution expresses the amount of solvent. They are identified in the laboratory by microscopic detection of the adult worm
or its larvae and eggs, which often have distinctive shapes or external and internal structures. Describe the goals of nomenclature and how the binomial system is structured. Note that all three dehydration synthesis reactions release water molecule is required for breaking the bond between two glucose molecules, digestion is also
termed hydrolysis.* Starch is the primary storage food of green plants, microscopic algae, and some fungi; glycogen (animal starch) is a stored carbohydrate for animals and certain groups of bacteria and protozoa. Liquid media are defined as water-based solutions that do not solidify at temperatures above freezing and that tend to flow freely when
the container is tilted (figure 3.14). 36 Chapter 2 The Chemistry of Biology -++H H Water molecule +O+-H H H Water molecule +O+-H H H O H O ++O H H +O H H O H O ++O H H O ++O H H O H O ++O 
(cation) (anion) - Figure 2.7 Ionization. This includes gram-negative intestinal bacteria and staphylococci. (1003) and (f2) Micrococcus luteus bacteria lives on the skin surface (2,0003) Parasitism A microbe invades the sterile regions of a host and occupies its tissues and cells, causing some degree of damage. spores d. Research with bacteria that are
not culturable indicates that not all cells divide this way. Both flagella and cilia are found primarily in production? The maggots subsequently developed without access to the meat. Nonliquefiable solid media do not melt. What atoms must be
present in a molecule for it to be considered organic? Figure 4.33 The hottest life forms on earth. The cells are suspended in a suitable fluid (water, broth, saline) that temporarily maintains viability and provides space and a medium for locomotion. If a cell lives in a hypotonic environment, what will occur if it is placed in a hypertonic one?
some possible solutions to the problem of neglected diseases? Some species of microorganisms (especially pathogens) are also sometimes designated by informal names, such as the gonococcus (Neisseria gonorrhoeae) or the TB bacillus (Mycobacterium tuberculosis), but this is not the usual practice. We will see examples of some of these media in
later chapters. Megavirus 800 nm 2. The chemi12. Fortunately, the disease experienced by most people was milder than the usual seasonal flu, and it cleared up with few complications. For example, helium has one filled shell, with no tendency either to give up electrons or to take them from other elements, making it a stable, inert (nonreactive) gas.
infective stage d. Because protozoa lack a cell wall, they have a certain amount of flexibility. deoxyribose, a pentose, and nucleic acids c. 9. i h h common symbiotic flagellate in termite intestines, displaying numerous flagellate in termite intestines, displayi
backbone of a nucleic acid strand is a chain of alternating phosphate-sugar molecules, and the nitrogen bases branch off the side of this backbone (figure 2.24b, c). adhesion 8. Determining the oxygen requirements of a microbe from a biochemical standpoint can be a very time-consuming process. enveloped, icosahedral d. In 2012,
we witnessed how a simple medical procedure could turn into a medical nightmare because a common, mostly harmless fungus got into the wrong place at the wrong time. 38. Describe the structure of the Chlorophyta, Oedogonium, displaying its green
filaments and reproductive structures, including eggs (clear spheres) and zygotes (dark spheres) and z
all objects are inhabited by them. One could use the method of addition 2 1 2 5 4; 4 1 4 5 8; 8 1 8 5 16; 16 1 16 5 32, and so on, or a method of multiplication (for example, 25 5 2 3 2 3 2), but it is easy to see that for 20 or 30 generations, this calculation could be very tedious. 3.2 The Microscope: Window on an Invisible Realm A. Predict the
kinds of bonds that occur in ammonium (NH3), phosphate (PO4), disulfide (S—S), and magnesium chloride (MgCl2). At Pasadena City College, Barry developed a new course in human genetics and helped to institute a biotechnology program.
intracellular concentrations that are hundreds of times greater than the habitat. When it comes to organizing coverage of microbial interactions, we are faced with a broad continuum, ranging from organisms living together in a totally dependent existence to free-living microbes that interact in loose and temporary unions. A massive vaccination
campaign aimed to reduce cases and to stamp out the disease completely. Fill in the following summary table for defining, comparing, and contrasting eukaryotic cells. Acronyms made from blending several characteristics include picornaviruses, and hepadnaviruses (for hepatitis and DNA). Barry is a member of the
American Society for Microbiology and regularly attends meetings in his fields of interest, both to keep current of changes in the discipline and to exchange teaching and learning strategies with others in the field. Several important human diseases are caused by rickettsias. Hydrogen bonds involve weak attractive forces between hydrogen (1 charge)
and nearby oxygens and nitrogens (2 charge). Addition of color blocking for improving readability and separation of figure components. In the majority of the water molecule causes it to form hydrogen bonds with other water
molecules, but it can also interact readily with charged or polar molecules. Microbes survive in their habitats through the process of gradual adjustment of anatomy and physiology, a process called adaptation.* It is this adaptability that allows microbes to inhabit all parts of the biosphere. Assigning Scientific Names Many larger organisms are known
by a common name suggested by certain dominant features. 6.6 Techniques in Cultivating and Identifying Animal Viruses A. Other structural formulas of three sugars with the same molecular formula, C6H12O6. Because of the tremendous variety in ciliary arrangements and
functions, ciliates are among the most diverse and awesome cells in the biological 5. Examples include metals and their salts (magnesium sulfate, ferric nitrate, sodium phosphate), gases (oxygen, carbon dioxide), and water. Solid (cannot be liquefied) 2. 5.4 Eukaryotic-Prokaryotic Comparisons and Taxonomy of Eukaryotes A. A theory is a collection of
statements, propositions, or concepts that explains or accounts for a natural event. Their charges balance out, and no single molecule of NaCl is present. Endosymbiotic protozoans and bacteria do the final work of breaking down the wood particles, and all mutualists share in the nutrients provided (see figure). He found "animals appearing to me ten
thousand times more than those which may be perceived in the water with the naked eye." He didn't stop there. One of their assumptions was that, because the universe. Most organic chemicals in cells contain other elements The Chemistry of Carbon and
hydrogen. (c) Pyrimidine bases are found in both DNA and RNA, but T is found only in RNA, and U is found only in RNA, the exact copying of the DNA code into two new molecules 19. Probably the most intriquing and exceptional members of this group are the slime bacteria, or myxobacteria. Foundations in microbiology / Kathleen Park Talaro,
Pasadena City College, Barry Chess, Pasadena City College, Some viruses come equipped with the necessary enzymes for synthesis of viral components; others utilize those of the host. But the primary reproductive mode of fungi involves the productive mode of fun
reactions within and between monosaccharides. But this method had its limitations. In a number of diagnostic procedures, fluorescent dyes are bound to specific antibodies. The nucleolus provides a constant supply of ribosomes that travel through the nuclear pores to the RER. An organism's scientific name is sometimes abbreviated to save space, as
in H. qur t 6 c 7. Between these two extremes are parasites of varying pathogenicity, depending on their particular adaptations. Answer available at talaro9 * vector (vek9-tur) L. (b) A strew of beautiful algae called diatoms shows the intricate and varied structure of their silica cell wall. M. (b) As the H2O diffuses into the sac, the volume increases and
forces the excess solution into the tube, which will rise continually. Explain the main features of the scientific method, and differentiate between inductive reasoning and between hypothesis and theory. Because ports caused concern because influenza cases would normally this virus strain had previously appeared in 1918 and 1976 and
was have been in decline by this time in the season, and most of the associated with pigs, for a time, this outbreak was initially attributed cases occurred in healthy young adults, rather to a "swine flu virus." But this influenza virus than very young or old patients, as is the usual "Beginning with those first was unlike any that had appeared in the past.
The final action of this apparatus is to pinch off finished condensing vesicles that will be conveyed to organelles such as lysosomes or transported outside the cell as secretory vesicles (figure 5.8). Culture media are contained in test tubes, flasks, isolated from the red alga Gelidium. What causes elements to differ? 1.3 Human Use of Microorganisms
(a) Expected Learning Outcome 6. 5 6 Cortex and outer coat layers are deposited. O NAG The bulk of the gram-positive cell wall is a thick, homogeneous sheath of peptidoglycan ranging from 20 to 80 nm in thickness. Spores of Bacillus anthracis, the agent of anthrax, are classified as a high level bioterrorism agent. Experiments with animals indicates.
that this method controls some infections as well as traditional drugs can. It may be summarized by the equation: Sunlight absorbed CO2 1 H2S —————n (CH2O)n 1 SO 1 H2O by bacteriochlorophyll Note that this type of photosynthesis is different in several respects. motile, nonmotile d. In contrast, the fungi produce many different types of
spores for both survival and reproduction (see chapter 5). * mesophiles (mez9-oh-fylz) Gr. mesos, middle. Evolution accounts for the millions of different species on the earth and their adaptation to its many and diverse habitats. Concept Mapping An Introduction to Concept Mapping found at provides guidance for working with concept maps. *
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some peeds down The complete on a cycle about personal control and active active and active ac
ncludes hyperthermophiles Revised section on coevolution and interrelationships Figure that defines, classifies, and compares microbial interrelationships using text and images Revised figure for spectrophotometry New figure and text featuring technology and uses of flow cytometry The Ef for t of an E xper tly Craft ted Learning Tool Chapter 8 • • • • • • New Case Study dealing with an outbreak of botulism in a prison Revised two figures on enzyme-substrate reactions New ribozyme figure for oxidative phosphorylation and the proton motive force Revision on text coverage of shotosynthesis New figure for the light-dependent reactions New figure for the light-independent reactions of electrophoresis technique New figure of fluorescent in-situ hybridization Updated box on the human genome with a new figure of SNPs Revised tables on genetically-engineered plants and animals Clinical Connections written for gene therapy New microarray figure showcasing the technology involved Chapter 11 • • • • Updated Case Study on the outbreak of hepatitis C Reorganization of figure 11.1 outlining the major types of microbial control New photos for tables covering the applications of physical and chemical agents New figure outlining the course of
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