

MULTIPLE CHOICE. Choose the one alternative that best completes the statement or answers the question.

- 1) Which statement is generally NOT true? 1) _____
A) Microbial cells exist as single cells.
B) Microbial cells exclude the cells of plants and animals.
C) Microbial cells include both bacteria and viruses.
D) Microbial cells carry out their life processes of growth independently.
- 2) Basic microbiology can be used to 2) _____
A) model our understanding of cellular processes in multicellular organisms, including humans.
B) probe the fundamental processes of life.
C) study characteristics of cells of multicellular organisms.
D) do all of the above.
- 3) Applied microbiology deals with important practical problems in 3) _____
A) medicine. B) industry.
C) agriculture. D) all of the above.
- 4) The largest mass of living material on Earth comes from 4) _____
A) animals. B) plants.
C) microorganisms. D) plants and animals together.
- 5) Differential selection and reproduction of phenotypes occurs during a process called 5) _____
A) cellular differentiation. B) growth.
C) transformation. D) evolution.
- 6) In what/which domain(s) of life is/are microorganisms represented? 6) _____
A) Bacteria B) Archaea C) Eukarya D) all of the above
- 7) A specific molecule, used especially by evolutionary biologists, that is unique to a particular taxonomical group is called a 7) _____
A) biomarker. B) taxon.
C) metabolic tracer. D) genome.
- 8) Protein catalysts involved in the acceleration of the rate of chemical reactions are called 8) _____
A) enzymes. B) growth agents.
C) evolutionary molecules. D) catalytic converters.
- 9) Regarding early life on Earth, 9) _____
A) microbial life existed for billions of years before plant and animal life.
B) microbial life, plant life, and animal life all appeared at about the same time.
C) microbial life existed long before animals but has been around for about the same amount of time as plants.
D) it is impossible to determine which type of life first appeared.

- 10) Most prokaryotic cells reside _____
A) in the oceanic and terrestrial subsurfaces.
B) in lakes, rivers, and oceans.
C) in and on nonprokaryotic organisms (including humans and other animals).
D) on Earth's surface.
- 11) The person who described the "wee animalcules" was _____
A) Louis Pasteur. B) Ferdinand Cohn.
C) Robert Hooke. D) Antoni van Leeuwenhoek.
- 12) Fannie Hesse is credited with giving _____ the idea to use agar as a solidifying agent. _____
A) Sergei Winogradsky B) Robert Koch
C) Louis Pasteur D) Ferdinand Cohn
- 13) Which of the following is/are characteristic of cellular organisms? _____
A) regeneration and reproduction B) communication
C) metabolism D) all of the above
- 14) Which of the following is NOT a major ecosystem? _____
A) other organisms, such as plants and animals
B) terrestrial
C) aquatic
D) atmospheric
- 15) Which statement is TRUE? _____
A) Microbial communities are assemblages of populations.
B) Populations are assemblages of habitats.
C) Populations are assemblages of microbial communities.
D) Habitats are assemblages of microbial communities.
- 16) Louis Pasteur developed the vaccine(s) for _____
A) anthrax. B) rabies.
C) fowl cholera. D) all of the above.
- 17) The discovery of antibiotics and other important chemicals led to the field of _____
A) aquatic microbiology. B) agricultural microbiology.
C) industrial microbiology. D) marine microbiology.
- 18) Microbial sterilization is used to _____
A) kill all microbes in or on objects.
B) kill bacteria but not necessarily viruses or other microbes.
C) clean a work area.
D) decrease the possibility of contaminants growing in a culture.
- 19) Transparent double-sided dishes used for growing microbes are most commonly called _____
A) baker dishes. B) Petri dishes.
C) culture medium plates. D) sterilization plates.

- 29) Microbial control in wastewaters would most logically be a part of _____
 A) bacterial energetics. B) aquatic microbiology.
 C) microbial technology. D) microbial genetics.
- 30) Robert Koch contributed to the field of microbiology by being the first person to _____
 A) formulate four postulates for definitively linking a specific microorganism to a specific disease.
 B) use agar as a solidifying agent in growth media.
 C) develop the tuberculin test.
 D) all of the above.
- 31) The science of grouping and classifying microorganisms is known as _____
 A) metabolomics. B) microbial physiology.
 C) proteomics. D) microbial systematics.
- 32) *Mycobacterium tuberculosis* is very difficult to stain because of the _____
 A) lack of a cell wall.
 B) large amounts of a waxy lipid present in its cell wall.
 C) location of the DNA within the cell.
 D) presence of ribosomes in the cytoplasm.
- 33) Louis Pasteur's most famous success was his work on _____
 A) *Mycobacterium tuberculosis*. B) fermentation in the winemaking process.
 C) the rabies vaccine. D) optical isomers.
- 34) Microorganisms play key roles in the cycling of important nutrients in plant nutrition, particularly those of _____
 A) sulfur. B) carbon, nitrogen, and sulfur.
 C) nitrogen. D) carbon.
- 35) Microbial ecology is the study of _____
 A) the diversity and activities of marine microorganisms.
 B) the grouping and classifying of microorganisms.
 C) microorganisms in their natural environments.
 D) microbial processes in the soil that benefit plant growth.
- 36) The structure that confers structural strength on the cell is known as the _____
 A) cell wall. B) cytoplasmic membrane.
 C) ribosome. D) cytoplasm.
- 37) Which part of the human body does not contain a significant normal microbial flora? _____
 A) stomach B) oral cavity C) skin D) large intestine

TRUE/FALSE. Write 'T' if the statement is true and 'F' if the statement is false.

- 38) Without microorganisms, all higher life forms on Earth would cease to exist. _____
- 39) Most microorganisms are pathogenic. _____
- 40) All microorganisms require molecular oxygen to carry on life functions. _____

- 41) Metabolism is common to all cellular organisms. 41) _____
- 42) According to our present understanding, each of the major domains has what is known as its own universal ancestor. 42) _____
- 43) Microbiology as a distinct science did not develop until the eighteenth century. 43) _____
- 44) The environment in which a microbial population lives is its habitat. 44) _____
- 45) Differentiation occurs only in multicellular organisms. 45) _____
- 46) The discipline of microbiology is intimately associated with biochemistry and genetics, because cells are both biochemical catalysts and genetic coding devices. 46) _____
- 47) Smallpox is a major killer in parts of the developing world. 47) _____
- 48) Sergei Winogradsky worked with bacteria involved in cycling nitrogen and sulfur. 48) _____
- 49) *Treponema pallidum*, a bacterium associated with syphilis, is not considered a pathogen because to date it remains unculturable in the lab, and, therefore, Koch's postulates are unable to be fulfilled. 49) _____
- 50) Marine microorganisms likely control many important global parameters, including climate and atmospheric chemistry. 50) _____

SHORT ANSWER. Write the word or phrase that best completes each statement or answers the question.

- 51) A microbial cell's membrane is considered _____, because its internal constituents are maintained within the cell, however it also imports and exports other molecules in response to its environment. 51) _____
- 52) Some microorganisms can undergo _____ in which various cell types can become specialized and arise from one parent cell type. 52) _____
- 53) Cyanobacteria and purple bacteria both obtain energy from light, however only the _____ are capable of releasing _____. 53) _____
- 54) The process whereby microorganisms are used to help clean up pollution created by human activities is known as _____. 54) _____
- 55) An ecosystem could be defined as _____ along with their _____. 55) _____
- 56) Robert Koch received the 1905 Nobel Prize for Physiology or Medicine for _____. 56) _____
- 57) The three major bioenergy products of microorganisms are _____, _____, and _____. 57) _____
- 58) Microbial biochemistry involves the discovery of _____ and the _____. 58) _____

- 59) DNA sequencing to study organisms' entire nucleotide sequences initially brought about the field of _____, which has itself spawned the subdisciplines of _____ and _____ that represent more functional -based approaches. 59) _____
- 60) The _____ is the fundamental unit of life. 60) _____
- 61) The disease anthrax is caused by the pathogenic bacterium _____, which produces heat-resistant structures known as _____. 61) _____
- 62) Groups of cells derived from a single parent cell by successive cell divisions are known as _____ and which live in environments known as _____. 62) _____
- 63) The first documented description of a microorganism was of a _____ by _____. 63) _____
- 64) _____ produced by microbial fermentation of glucose from sugarcane or cornstarch is becoming a more important component of biofuels in the United States, and specialized _____ microbiologists are needed to make this a commercially available product. 64) _____
- 65) _____ was the first to describe microorganisms, while _____ was the first person to see bacteria. 65) _____
- 66) A population of identical cells is known as a(n) _____. 66) _____
- 67) _____ described the first virus and the basic principles of virology. 67) _____
- 68) The discoveries of Martinus Beijerinck and Sergei Winogradsky led to practical advances in the field of _____. 68) _____
- 69) Bioremediation _____ by introducing pollutant-consuming microorganisms or specific nutrients that help microorganisms degrade pollutants. 69) _____
- 70) _____ was the first to identify a new form of autotrophy in which energy is obtained from oxidizing inorganic compounds called _____. 70) _____

ESSAY. Write your answer in the space provided or on a separate sheet of paper.

- 71) Explain the nature and function of an enrichment culture.
- 72) Why is it incorrect to say that an object is partially sterile?
- 73) Microbes were first formally observed during the mid-1600s, but the cell theory was not enunciated until 1839. Write a brief essay explaining why microbiology did not become a formally recognized science until Louis Pasteur's and Robert Koch's time.
- 74) List three contributions of Ferdinand Cohn to the development of microbiology.
- 75) Compare and contrast the works of Louis Pasteur and Robert Koch in terms of both applied and basic science.

- 76) Explain why microbial cells are excellent models for understanding cell function in higher organisms.
- 77) Compare and contrast the leading causes of death in 1900 with the leading causes of death today. What roles have microbiologists played in the dramatic changes that are evident?
- 78) Explain how you would use Robert Koch's postulates to determine that *Streptococcus pyogenes* is the causative agent of streptococcal pharyngitis ("strep throat").
- 79) The text states that antibiotics are derived from microorganisms. What is the benefit to an antibiotic-producing microorganism of producing an antibiotic in its natural habitat?
- 80) Describe beneficial and harmful ways in which microorganisms interact with agricultural crops.
- 81) Provide evidence supporting the statement that an ecosystem is controlled by microbial activities.
- 82) Explain why only anaerobic bacteria inhabited Earth for the first two billion years of its existence.
- 83) How would the presence of endospores in Louis Pasteur's nutrient solutions have affected his conclusions about spontaneous generation?
- 84) Using specific examples, explain why it is sometimes impossible to satisfy Robert Koch's postulates.
- 85) Explain why infectious diseases are much less lethal in developed countries than in underdeveloped countries.
- 86) Describe two capabilities of microbes that exemplify their dynamic nature.
- 87) Compare and contrast the functions microbes serve in the digestive systems of both humans and ruminants (e.g., cattle).

Answer Key

Testname: UNTITLED1

- 1) C
- 2) D
- 3) D
- 4) C
- 5) D
- 6) D
- 7) A
- 8) A
- 9) A
- 10) A
- 11) D
- 12) B
- 13) D
- 14) D
- 15) A
- 16) D
- 17) C
- 18) A
- 19) B
- 20) C
- 21) C
- 22) A
- 23) D
- 24) B
- 25) D
- 26) D
- 27) D
- 28) C
- 29) B
- 30) D
- 31) D
- 32) B
- 33) C
- 34) B
- 35) C
- 36) A
- 37) A
- 38) TRUE
- 39) FALSE
- 40) FALSE
- 41) TRUE
- 42) FALSE
- 43) FALSE
- 44) TRUE
- 45) FALSE
- 46) TRUE
- 47) FALSE
- 48) TRUE
- 49) FALSE
- 50) FALSE

Answer Key

Testname: UNTITLED1

- 51) semi-permeable
- 52) cellular differentiation
- 53) cyanobacteria / oxygen
- 54) bioremediation
- 55) living organisms (biotic) / chemical and physical environments (abiotic)
- 56) his contributions on tuberculosis
- 57) biodiesel / methane / ethanol (any order)
- 58) microbial enzymes / chemical reactions they perform
- 59) genomics / proteomics / metabolomics (second and third in either order)
- 60) cell
- 61) *Bacillus anthracis* / endospores
- 62) (microbial) populations / (microbial) habitats
- 63) mold / Robert Hooke
- 64) Ethanol / industrial
- 65) Robert Hooke / Antoni van Leeuwenhoek
- 66) pure culture
- 67) Martinus Beijerinck
- 68) agricultural microbiology
- 69) accelerates the natural cleanup process
- 70) Sergei Winogradsky / chemolithotrophy
- 71) Answers will vary, but an enrichment culture uses media, chemicals, or culture conditions to select for or enhance specific characteristics of an organism.
- 72) Answers will vary, but sterile means the absence of living organisms. Something is either sterile or it is not.
- 73) Answers will vary, but a theme should be the lack of powerful microscopy tools.
- 74) Answers could possibly include: founding bacteriology as a separate science, studying *Beggiatoa*, discovering the genus *Bacillus* (along with its endospore formation and its life cycle), devising methods to prevent contamination, and founding a major scientific journal.
- 75) Answers will vary, but should highlight the differences between basic scientific research in which fundamental ideas are discovered opposed to the usage of microbiological principles to solve larger questions. Examples of Pasteur's basic science contributions are his work showing that fermentation was mediated by microorganisms and the preferential metabolism of particular optical isomers by microbes. Pasteur also applied his ideas to develop sterilization techniques. Robert Koch focused more on the application of microbiology to identify the cause of tuberculosis by developing pure culturing techniques and the four postulates to link microbes to a disease.
- 76) Answers will vary but should include commonality of function, biochemical and genetic similarities, and ease and speed with which they can be grown in large quantities.
- 77) Answers will vary, but a focus should be that pathogens that killed people in the early 1900s are now treatable due to knowledge learned from microbiologists.
- 78) Answers will vary but will need to detail how *S. pyogenes* will be subjected to all four postulates.
- 79) Answers will vary, but it must first be stated the antibiotic-producing microbe would need to be resistant to the antibiotic. This should then follow into a discussion on how antibiotic production could be viewed as a way to persist in the environment, such as maintaining dominance in a community over others.
- 80) Certain microbes are beneficial to crops when they produce nutrients (e.g., NH_4^+ , SO_4^{2-}) usable by a crop from a substrate that was unusable. Other microbes can cause diseases in plants, much like pathogens cause disease in humans.
- 81) Answers will vary, but one example could be oxygen depletion, where a loss of oxygen would then favor anaerobic microorganisms.
- 82) Answers will vary, but the key idea is an anoxic environment will not allow aerobic organisms to survive.
- 83) Answers will vary, but ultimately this could have confounded Pasteur if the endospores sometimes went into a vegetative growth phase and other times no growth was observed.

Answer Key

Testname: UNTITLED1

- 84) Answers will vary, but one issue is the consideration for a model animal host that will react to the (human) pathogen in the same manner as in a human host. For example, a chicken would not show flu -like symptoms when infected with the influenza virus.
- 85) Answers will vary but should emphasize ways in which increased knowledge about microbial pathogenesis has influenced preventative care (e.g., sanitation) and treatment (e.g., antimicrobial drugs).
- 86) Answers could possibly include cell-cell communication, ability to move (motility), and exchange of materials (any two).
- 87) Answers will vary but should focus on humans having a high cell localized density in the colon (large intestine), whereas ruminants have higher microbial populations in the rumen.