Chapter 22 Exercises

Review Questions

1. The first forms of life on Earth were thought to be _____.
- **a.** single-celled plants
- **b.** prokaryotes
- **c.** insects
- **d.** large animals such as dinosaurs

2. Microbial mats _____.
- **a.** are the earliest forms of life on Earth
- **b.** obtained their energy and food from hydrothermal vents
- **c.** are multilayered sheets of prokaryotes including mostly bacteria but also archaea
- **d.** all of these

3. The first organisms that oxygenated the atmosphere were _____.
- **a.** cyanobacteria
- **b.** phototrophic organisms
- **c.** anaerobic organisms
- **d.** all of these

4. Halophiles are organisms that require _____.
- **a.** a salt concentration of at least 0.2 M
- **b.** high sugar concentration
- **c.** the addition of halogens
- **d.** all of these

5. Many of the first prokaryotes to be cultured in a scientific lab were human or animal pathogens. Why would these species be more readily cultured than nonpathogenic prokaryotes?
- **a.** Pathogenic prokaryotes are hardier than nonpathogenic prokaryotes.
- **b.** Nonpathogenic prokaryotes require more supplements in their growth media.
- **c.** Most of the necessary culture conditions could be inferred for pathogenic prokaryotes.
- **d.** Pathogenic bacteria can grow as free bacteria, but nonpathogenic bacteria only grow as parts of large colonies.

6. The presence of a membrane-enclosed nucleus is a characteristic of _____.
- **a.** prokaryotic cells
- **b.** eukaryotic cells
- **c.** all cells
- **d.** viruses

7. Which of the following consist of prokaryotic cells?
- **a.** bacteria and fungi
- **b.** archaea and fungi
- **c.** protists and animals
- **d.** bacteria and archaea

8. The cell wall is _____.
- **a.** interior to the cell membrane
- **b.** exterior to the cell membrane
- **c.** a part of the cell membrane
- **d.** interior or exterior, depending on the particular cell

9. Organisms most likely to be found in extreme environments are _____.
- **a.** fungi
- **b.** bacteria
- **c.** viruses
- **d.** archaea

10. Prokaryotes stain as gram-positive or gram-negative because of differences in the cell _____.
- **a.** wall
- **b.** cytoplasm
- **c.** nucleus
- **d.** chromosome

11. Pseudopeptidoglycan is a characteristic of the walls of _____.
- **a.** eukaryotic cells
- **b.** bacterial prokaryotic cells
- **c.** archaean prokaryotic cells
- **d.** bacterial and archaean prokaryotic cells

12. The lipopolysaccharide layer (LPS) is a characteristic of the wall of _____.
- **a.** archaean cells
- **b.** gram-negative bacteria
- **c.** bacterial prokaryotic cells
- **d.** eukaryotic cells

13. Which of the following elements is *not* a micronutrient?
- **a.** boron
- **b.** calcium
- **c.** chromium
- **d.** manganese

14. Prokaryotes that obtain their energy from chemical compounds are called _____.
- **a.** phototrophs
- **b.** auxotrophs
- **c.** chemotrophs
- **d.** lithotrophs

15. Ammonification is the process by which _____.
- **a.** ammonia is released during the decomposition of nitrogen-containing organic compounds
- **b.** ammonium is converted to nitrite and nitrate in soils
- **c.** nitrate from soil is transformed to gaseous nitrogen compounds, such as NO, N_2O, and N_2
- **d.** gaseous nitrogen is fixed to yield ammonia

16. Plants use carbon dioxide from the air and are, therefore, called _____.
- **a.** consumers
- **b.** producers
- **c.** decomposer
- **d.** carbon fixers

17. Cyanobacteria harness energy from the sun through photosynthesis and oxidize water to provide electrons for energy generation. Thus, we classify cyanobacteria as _____.
- **a.** photolithotrophs
- **b.** photoautotrophs
- **c.** chemolithoautotrophs
- **d.** chemoorganotrophs

18. A disease that is constantly present in a population is called _____.
- **a.** pandemic
- **b.** epidemic
- **c.** endemic
- **d.** re-emerging

19. Which of the statements about biofilms is correct?
- **a.** Biofilms are considered responsible for diseases such as cystic fibrosis.
- **b.** Biofilms produce dental plaque and colonize catheters and prostheses.
- **c.** Biofilms colonize open wounds and burned tissue.
- **d.** All statements are correct.

20. Which of these statements is *true*?
- **a.** An antibiotic is any substance produced by an organism that is antagonistic to the growth of prokaryotes.
- **b.** An antibiotic is any substance produced by a prokaryote that is antagonistic to the growth of other viruses.
- **c.** An antibiotic is any substance produced by a prokaryote that is antagonistic to the growth of eukaryotic cells.
- **d.** An antibiotic is any substance produced by a prokaryote that prevents growth of the same prokaryote.

21. A person in England arrives at a medical clinic with a fever and swollen lymph nodes shortly after returning from a visit to New Mexico. For which bacteria should the doctor test the patient?
- **a.** *Salmonella enterica*
- **b.** *Borrelia burgdorferi*
- **c.** *Clostridium botulinum*
- **d.** *Yersinia pestis*

22. MRSA has emerged as a serious infectious disease, with the first case of methicillin-resistant *S. aureus* being detected in 1961. Why are medical professionals so concerned when antibiotics exist that can kill MRSA?
- **a.** MRSA can transfer methicillin resistance to other bacteria.
- **b.** Patients are not treated with the correct antibiotics rapidly enough to prevent serious illness.
- **c.** MRSA could acquire additional antibiotic resistance genes from other bacteria to become a "superbug."
- **d.** All statements are correct.

23. Which of these occurs through symbiotic nitrogen fixation?
- **a.** The plant benefits from using an endless source of nitrogen.
- **b.** The soil benefits from being naturally fertilized.
- **c.** Bacteria benefit from using photosynthates from the plant.
- **d.** All of these occur.

24. Medications that treat bacterial infections are called _____.
- **a.** pesticides
- **b.** bioremediators
- **c.** recalcitrant compounds
- **d.** antibiotics

25. Bioremediation includes _____.
- **a.** the use of prokaryotes that can fix nitrogen
- **b.** the use of prokaryotes to clean up pollutants
- **c.** the use of prokaryotes as natural fertilizers
- **d.** all of these

26. In addition to providing yogurt with its unique flavor and texture, lactic acid-producing bacteria also provide what additional benefit during food production?
- **a.** providing xenobiotics
- **b.** lowering the pH to kill pathogenic bacteria
- **c.** pasteurizing milk products
- **d.** breaking down lactose for lactose-intolerant individuals

Critical Thinking Questions

27. Describe briefly how you would detect the presence of a non-culturable prokaryote in an environmental sample.

28. Why do scientists believe that the first organisms on Earth were extremophiles?

29. A new bacterial species is discovered and classified as an endolith, an extremophile that lives inside rock. If the bacteria were discovered in the permafrost of Antarctica, describe two extremophile features the bacteria must possess.

30. Mention three differences between bacteria and archaea.

31. Explain the statement that both bacteria and archaea have the same basic structures but are built from different chemical components.

32. A scientist isolates a new species of prokaryote. He notes that the specimen is a bacillus with a lipid bilayer and cell wall that stains positive for peptidoglycan. Its circular chromosome replicates from a single origin of replication. Is the specimen most likely an Archaea, a gram-positive bacterium, or a gram-negative bacterium? How do you know?

33. Think about the conditions (temperature, light, pressure, and organic and inorganic materials) that you may find in a deep-sea hydrothermal vent. What type of prokaryotes, in terms of their metabolic needs (autotrophs, phototrophs, chemotrophs, etc.) would you expect to find there?

34. Farmers continually rotate the crops grown in different fields to maintain nutrients in the soil. How would planting soybeans in a field the year after the field was used to grow carrots help maintain nitrogen in the soil?

35. Imagine a region of soil became contaminated, killing bacteria that decompose dead plants and animals. How would this affect the carbon cycle in the area? Be specific in stating where carbon would accumulate in the cycle.

36. Explain the reason why the imprudent and excessive use of antibiotics has resulted in a major global problem.

37. Researchers have discovered that washing spinach with water several times does not prevent foodborne diseases due to *E. coli*. How can you explain this fact?

38. Your friend believes that prokaryotes are always detrimental and pathogenic. How would you explain to them that they are wrong?

39. Many people use antimicrobial soap to kill bacteria on their hands. However, overuse may actually increase the risk of infection. How could this occur?