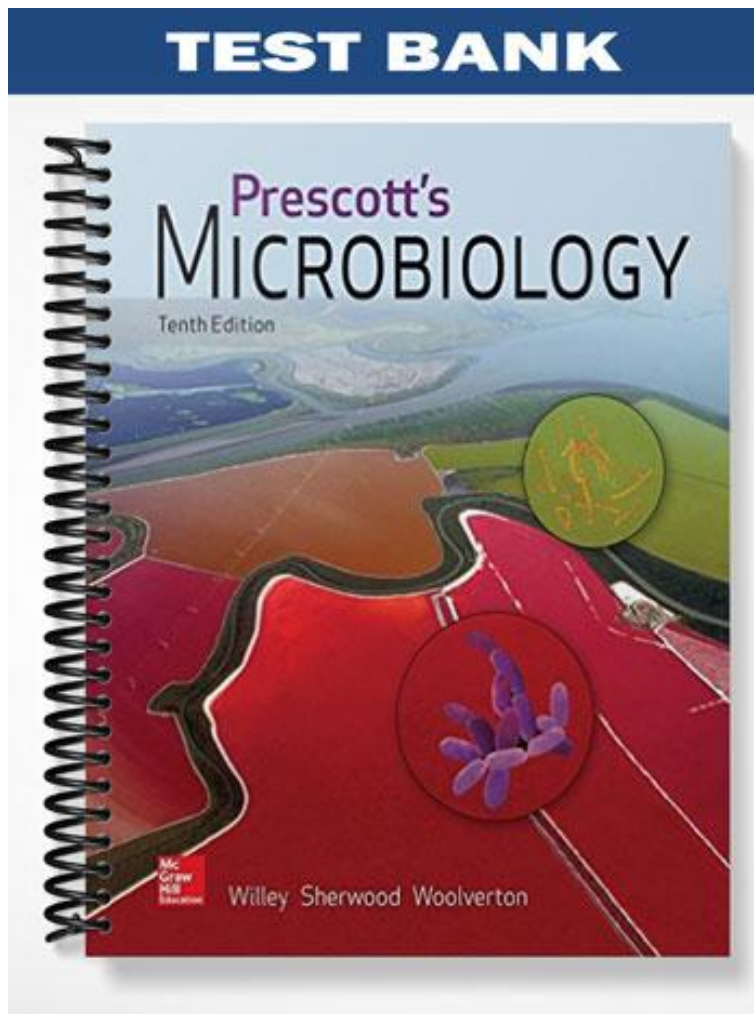


**TEST BANK**



Prescott's  
**MICROBIOLOGY**

Tenth Edition

Mc  
Graw  
Hill  
Education

Wiley Sherwood Woolverton

## Chapter 01 The Evolution of Microorganisms and Microbiology

### True / False Questions

1. Extant microorganisms are organisms from the fossil record that are no longer present on Earth today.

**FALSE**

*ASM Objective: 01.05 The evolutionary relatedness of organisms is best reflected in phylogenetic trees.*

*ASM Topic: Module 01 Evolution*

*Blooms Level: 2. Understand*

*Learning Outcome: 01.01.04 Determine the type of microbe (e.g., bacterium, fungus, etc.) when given a description of a newly discovered microbe*

*Learning Outcome: 01.02.01 Propose a time line of the origin and history of microbial life and integrate supporting evidence into it*

*Section: 01.02*

*Topic: Taxonomy of Microorganisms*

### Fill in the Blank Questions

2. All cellular organisms can be placed into one of three \_\_\_\_\_, which include the *Bacteria*, *Archaea*, and the *Eukarya*.

**domains**

*ASM Objective: 01.05 The evolutionary relatedness of organisms is best reflected in phylogenetic trees.*

*ASM Topic: Module 01 Evolution*

*Blooms Level: 2. Understand*

*Learning Outcome: 01.01.04 Determine the type of microbe (e.g., bacterium, fungus, etc.) when given a description of a newly discovered microbe*

*Section: 01.02*

*Topic: Taxonomy of Microorganisms*

3. *Archaea* are cellular organisms that have unique cell membrane \_\_\_\_\_.

**lipids**

*ASM Objective: 02.01 The structure and function of microorganisms have been revealed by the use of microscopy (including bright field, phase contrast, fluorescent, and electron).*

*ASM Objective: 02.03 Bacteria and Archaea have specialized structures (e.g. flagella, endospores, and pili) that often confer critical capabilities.*

*ASM Topic: Module 02 Cell Structure and Function*

*Blooms Level: 1. Remember*

*Learning Outcome: 01.01.04 Determine the type of microbe (e.g., bacterium, fungus, etc.) when given a description of a newly discovered microbe*

*Learning Outcome: 01.02.02 Design a set of experiments that could be used to place a newly discovered cellular microbe on a phylogenetic tree based on small subunit (SSU) rRNA sequences*

*Section: 01.01*

*Topic: Archaea*

### **True / False Questions**

4. Microbiologists study a variety of organisms, but all are considered either *Bacteria* or *Archaea*.

**FALSE**

*ASM Objective: 05.03 Microorganisms and their environment interact with and modify each other.*

*ASM Objective: 05.04 Microorganisms, cellular and viral, can interact with both human and nonhuman hosts in beneficial, neutral or detrimental ways.*

*ASM Topic: Module 05 Microbial Systems*

*Blooms Level: 2. Understand*

*Learning Outcome: 01.01.01 Differentiate the biological entities studied by microbiologists from those studied by other biologists*

*Section: 01.01*

*Topic: Taxonomy of Microorganisms*

5. All eukaryotes have a membrane-delimited nucleus.

**TRUE**

*ASM Objective: 02.01 The structure and function of microorganisms have been revealed by the use of microscopy (including bright field, phase contrast, fluorescent, and electron).*

*ASM Objective: 02.04 While microscopic eukaryotes (for example, fungi, protozoa and algae) carry out some of the same processes as bacteria, many of the cellular properties are fundamentally different.*

*ASM Topic: Module 02 Cell Structure and Function*

*Blooms Level: 2. Understand*

*Learning Outcome: 01.01.01 Differentiate the biological entities studied by microbiologists from those studied by other biologists*

*Learning Outcome: 01.01.04 Determine the type of microbe (e.g., bacterium, fungus, etc.) when given a description of a newly discovered microbe*

*Section: 01.01*

*Topic: Taxonomy of Microorganisms*

## Chapter 01 - The Evolution of Microorganisms and Microbiology

6. Viruses are not generally studied by microbiologists because they are not classified as living organisms.

**FALSE**

*ASM Objective: 02.05 The replication cycles of viruses (lytic and lysogenic) differ among viruses and are determined by their unique structures and genomes.*

*ASM Objective: 05.04 Microorganisms, cellular and viral, can interact with both human and nonhuman hosts in beneficial, neutral or detrimental ways.*

*ASM Topic: Module 02 Cell Structure and Function*

*ASM Topic: Module 05 Microbial Systems*

*Blooms Level: 2. Understand*

*Learning Outcome: 01.01.01 Differentiate the biological entities studied by microbiologists from those studied by other biologists*

*Section: 01.01*

*Topic: Taxonomy of Microorganisms*

7. Viruses constitute the fourth domain of life in current biological classification schemes.

**FALSE**

*ASM Objective: 01.05 The evolutionary relatedness of organisms is best reflected in phylogenetic trees.*

*ASM Topic: Module 01 Evolution*

*Blooms Level: 2. Understand*

*Learning Outcome: 01.01.02 Explain Carl Woese's contributions in establishing the three-domain system for classifying cellular life*

*Section: 01.01*

*Topic: Taxonomy of Microorganisms*

### Multiple Choice Questions

8. Protists contain all of the following forms of life EXCEPT

A. protozoa.

**B.** fungi.

C. slime molds.

D. algae.

*ASM Objective: 02.04 While microscopic eukaryotes (for example, fungi, protozoa and algae) carry out some of the same processes as bacteria, many of the cellular properties are fundamentally different.*

*ASM Objective: 05.01 Microorganisms are ubiquitous and live in diverse and dynamic ecosystems.*

*ASM Topic: Module 02 Cell Structure and Function*

*ASM Topic: Module 05 Microbial Systems*

*Blooms Level: 1. Remember*

*Learning Outcome: 01.01.01 Differentiate the biological entities studied by microbiologists from those studied by other biologists*

*Section: 01.01*

*Topic: Taxonomy of Microorganisms*

9. Cells with a relatively complex morphology that have a true membrane-delimited nucleus are called

- A. prokaryotes.
- B. eukaryotes.**
- C. urkaryotes.
- D. nokaryotes.

*ASM Objective: 01.01 Cells, organelles (e.g. mitochondria and chloroplasts) and all major metabolic pathways evolved from early prokaryotic cells.*

*ASM Objective: 02.01 The structure and function of microorganisms have been revealed by the use of microscopy (including bright field, phase contrast, fluorescent, and electron).*

*ASM Objective: 02.04 While microscopic eukaryotes (for example, fungi, protozoa and algae) carry out some of the same processes as bacteria, many of the cellular properties are fundamentally different.*

*ASM Topic: Module 01 Evolution*

*ASM Topic: Module 02 Cell Structure and Function*

*Blooms Level: 2. Understand*

*Learning Outcome: 01.01.01 Differentiate the biological entities studied by microbiologists from those studied by other biologists*

*Learning Outcome: 01.01.04 Determine the type of microbe (e.g., bacterium, fungus, etc.) when given a description of a newly discovered microbe*

*Section: 01.01*

*Topic: Taxonomy of Microorganisms*

10. Cells with a relatively simple cell morphology that do not have a true membrane-delimited nucleus are called

- A. prokaryotes.**
- B. eukaryotes.
- C. urkaryotes.
- D. nokaryotes.

*ASM Objective: 01.01 Cells, organelles (e.g. mitochondria and chloroplasts) and all major metabolic pathways evolved from early prokaryotic cells.*

*ASM Objective: 02.01 The structure and function of microorganisms have been revealed by the use of microscopy (including bright field, phase contrast, fluorescent, and electron).*

*ASM Objective: 02.04 While microscopic eukaryotes (for example, fungi, protozoa and algae) carry out some of the same processes as bacteria, many of the cellular properties are fundamentally different.*

*ASM Topic: Module 01 Evolution*

*ASM Topic: Module 02 Cell Structure and Function*

*Blooms Level: 2. Understand*

*Learning Outcome: 01.01.01 Differentiate the biological entities studied by microbiologists from those studied by other biologists*

*Learning Outcome: 01.01.04 Determine the type of microbe (e.g., bacterium, fungus, etc.) when given a description of a newly discovered microbe*

*Section: 01.01*

*Topic: Taxonomy of Microorganisms*

11. The ribosomal RNA studies that led to the division of prokaryotic organisms into the Bacteria and the Archaea were begun by

A. Pasteur.

**B.** Woese.

C. Needham.

D. Watson.

*ASM Objective: 01.05 The evolutionary relatedness of organisms is best reflected in phylogenetic trees.*

*ASM Objective: 02.03 Bacteria and Archaea have specialized structures (e.g. flagella, endospores, and pili) that often confer critical capabilities.*

*ASM Topic: Module 01 Evolution*

*ASM Topic: Module 02 Cell Structure and Function*

*Blooms Level: 1. Remember*

*Learning Outcome: 01.01.02 Explain Carl Woese's contributions in establishing the three-domain system for classifying cellular life*

*Section: 01.01*

*Topic: Archaea*

*Topic: Bacteria*

*Topic: Taxonomy of Microorganisms*

12. Proteins function in modern cells as

A. catalysts.

B. hereditary information.

C. structural elements.

**D.** both catalysts and structural elements.

*ASM Objective: 02.01 The structure and function of microorganisms have been revealed by the use of microscopy (including bright field, phase contrast, fluorescent, and electron).*

*ASM Objective: 03.01 Bacteria and Archaea exhibit extensive, and often unique, metabolic diversity (e.g. nitrogen fixation, methane production, anoxygenic photosynthesis).*

*ASM Topic: Module 02 Cell Structure and Function*

*ASM Topic: Module 03 Metabolic Pathways*

*Blooms Level: 2. Understand*

*Learning Outcome: 01.02.01 Propose a time line of the origin and history of microbial life and integrate supporting evidence into it*

*Section: 01.02*

*Topic: Bacterial Cellular Morphology*

13. RNA serves to convert the information stored in DNA to \_\_\_\_\_.
- A. carbohydrates
  - B. protein**
  - C. lipids
  - D. RNA

*ASM Objective: 02.01 The structure and function of microorganisms have been revealed by the use of microscopy (including bright field, phase contrast, fluorescent, and electron).*

*ASM Objective: 03.01 Bacteria and Archaea exhibit extensive, and often unique, metabolic diversity (e.g. nitrogen fixation, methane production, anoxygenic photosynthesis).*

*ASM Objective: 04.02 Although the central dogma is universal in all cells, the processes of replication, transcription, and translation differ in Bacteria, Archaea, and Eukaryotes.*

*ASM Topic: Module 02 Cell Structure and Function*

*ASM Topic: Module 03 Metabolic Pathways*

*ASM Topic: Module 04 Information Flow and Genetics*

*Blooms Level: 2. Understand*

*Learning Outcome: 01.02.01 Propose a time line of the origin and history of microbial life and integrate supporting evidence into it*

*Section: 01.02*

*Topic: Taxonomy of Microorganisms*

### **True / False Questions**

14. The earliest microbial fossils that have been found are dated from approximately 4.5 million years ago.

**FALSE**

*ASM Objective: 02.01 The structure and function of microorganisms have been revealed by the use of microscopy (including bright field, phase contrast, fluorescent, and electron).*

*ASM Topic: Module 01 Evolution*

*ASM Topic: Module 02 Cell Structure and Function*

*Blooms Level: 1. Remember*

*Learning Outcome: 01.02.01 Propose a time line of the origin and history of microbial life and integrate supporting evidence into it*

*Section: 01.02*

*Topic: Bacteria*

### **Multiple Choice Questions**

15. Which of the following distinguish the field of microbiology from other fields of biology?

A. The size of the organism studied.

B. The techniques used to study organisms regardless of their size.

**C.** Both the size of the organism studied and the techniques employed in the study of organisms.

D. Neither the size of the organism studied nor the techniques employed in the study of organisms regardless of their size.

*ASM Objective: 02.01 The structure and function of microorganisms have been revealed by the use of microscopy (including bright field, phase contrast, fluorescent, and electron).*

*ASM Objective: 02.04 While microscopic eukaryotes (for example, fungi, protozoa and algae) carry out some of the same processes as bacteria, many of the cellular properties are fundamentally different.*

*ASM Objective: 03.01 Bacteria and Archaea exhibit extensive, and often unique, metabolic diversity (e.g. nitrogen fixation, methane production, anoxygenic photosynthesis).*

*ASM Objective: 04.01 Genetic variations can impact microbial functions (e.g., in biofilm formation, pathogenicity and drug resistance).*

*ASM Objective: 05.01 Microorganisms are ubiquitous and live in diverse and dynamic ecosystems.*

*ASM Objective: 06.01 Microbes are essential for life as we know it and the processes that support life (e.g. in biogeochemical cycles and plant and / or animal microbiota).*

*ASM Topic: Module 02 Cell Structure and Function*

*ASM Topic: Module 03 Metabolic Pathways*

*ASM Topic: Module 04 Information Flow and Genetics*

*ASM Topic: Module 05 Microbial Systems*

*ASM Topic: Module 06 Impact of Microorganisms*

*Blooms Level: 2. Understand*

*Learning Outcome: 01.04.01 Construct a concept map, table, or drawing that illustrates the diverse nature of microbiology and how it has improved human conditions*

*Section: 01.02*

*Section: 01.03*

*Section: 01.04*

*Topic: History of Microbiology*



16. Who of the following developed a set of criteria that could be used to establish a causative link between a particular microorganism and a particular disease?

- A. Fracastoro
- B. Koch**
- C. Pasteur
- D. Lister

*ASM Objective: 05.04 Microorganisms, cellular and viral, can interact with both human and nonhuman hosts in beneficial, neutral or detrimental ways.*

*ASM Topic: Module 05 Microbial Systems*

*Blooms Level: 1. Remember*

*Learning Outcome: 01.03.01 Evaluate the importance of the contributions to microbiology made by Hooke, Leeuwenhoek, Pasteur, Koch, Cohn, Beijerinck, von Behring, Kitasato, Metchnikoff, and Winogradsky*

*Learning Outcome: 01.03.02 Outline a set of experiments that might be used to decide if a particular microbe is the causative agent of a disease*

*Section: 01.03*

*Topic: Bacteria*

*Topic: History of Microbiology*

17. Who of the following was the first to observe and accurately describe microorganisms?

- A. Pasteur
- B. Lister
- C. van Leeuwenhoek**
- D. Tyndall

*ASM Objective: 02.01 The structure and function of microorganisms have been revealed by the use of microscopy (including bright field, phase contrast, fluorescent, and electron).*

*ASM Objective: 02.04 While microscopic eukaryotes (for example, fungi, protozoa and algae) carry out some of the same processes as bacteria, many of the cellular properties are fundamentally different.*

*ASM Topic: Module 02 Cell Structure and Function*

*Blooms Level: 1. Remember*

*Learning Outcome: 01.03.01 Evaluate the importance of the contributions to microbiology made by Hooke, Leeuwenhoek, Pasteur, Koch, Cohn, Beijerinck, von Behring, Kitasato, Metchnikoff, and Winogradsky*

*Section: 01.03*

*Topic: History of Microbiology*

18. Who of the following provided the evidence needed to discredit the concept of spontaneous generation?

- A. Pasteur
- B. Koch
- C. Semmelweiss
- D. Lister

*ASM Objective: 05.03 Microorganisms and their environment interact with and modify each other.*

*ASM Objective: 05.04 Microorganisms, cellular and viral, can interact with both human and nonhuman hosts in beneficial, neutral or detrimental ways.*

*ASM Topic: Module 05 Microbial Systems*

*Blooms Level: 1. Remember*

*Learning Outcome: 01.03.01 Evaluate the importance of the contributions to microbiology made by Hooke, Leeuwenhoek, Pasteur, Koch, Cohn, Beijerinck, von Behring, Kitasato, Metchnikoff, and Winogradsky*

*Section: 01.03*

*Topic: History of Microbiology*

19. The concept that living organisms arise from nonliving material is called

- A. biogenesis.
- B. cell theory.
- C. spontaneous generation.
- D. germ theory.

*ASM Objective: 05.01 Microorganisms are ubiquitous and live in diverse and dynamic ecosystems.*

*ASM Objective: 05.03 Microorganisms and their environment interact with and modify each other.*

*ASM Topic: Module 05 Microbial Systems*

*Blooms Level: 1. Remember*

*Learning Outcome: 01.03.01 Evaluate the importance of the contributions to microbiology made by Hooke, Leeuwenhoek, Pasteur, Koch, Cohn, Beijerinck, von Behring, Kitasato, Metchnikoff, and Winogradsky*

*Section: 01.03*

*Topic: History of Microbiology*

20. The concept that human and animal diseases are caused by microorganisms is called the
- A. cell theory.
  - B. germ theory.**
  - C. causative theory.
  - D. disease theory.

*ASM Objective: 05.04 Microorganisms, cellular and viral, can interact with both human and nonhuman hosts in beneficial, neutral or detrimental ways.*

*ASM Topic: Module 05 Microbial Systems*

*Blooms Level: 2. Understand*

*Learning Outcome: 01.03.01 Evaluate the importance of the contributions to microbiology made by Hooke, Leeuwenhoek, Pasteur, Koch, Cohn, Beijerinck, von Behring, Kitasato, Metchnikoff, and Winogradsky*

*Learning Outcome: 01.03.02 Outline a set of experiments that might be used to decide if a particular microbe is the causative agent of a disease*

*Section: 01.03*

*Topic: History of Microbiology*

21. Whose work on spontaneous generation first demonstrated the existence of a very heat-resistant form of bacteria that are called endospores?
- A. Schwann
  - B. Redi
  - C. Tyndall**
  - D. Pasteur

*ASM Objective: 02.03 Bacteria and Archaea have specialized structures (e.g. flagella, endospores, and pili) that often confer critical capabilities.*

*ASM Objective: 05.01 Microorganisms are ubiquitous and live in diverse and dynamic ecosystems.*

*ASM Topic: Module 02 Cell Structure and Function*

*ASM Topic: Module 05 Microbial Systems*

*Blooms Level: 1. Remember*

*Learning Outcome: 01.03.01 Evaluate the importance of the contributions to microbiology made by Hooke, Leeuwenhoek, Pasteur, Koch, Cohn, Beijerinck, von Behring, Kitasato, Metchnikoff, and Winogradsky*

*Section: 01.03*

*Topic: History of Microbiology*

22. Antiseptic surgery was pioneered by

- A. Pasteur.
- B. Lister.**
- C. Jenner.
- D. Kitasato.

*ASM Objective: 03.04 The growth of microorganisms can be controlled by physical, chemical, mechanical, or biological methods.*

*ASM Objective: 05.04 Microorganisms, cellular and viral, can interact with both human and nonhuman hosts in beneficial, neutral or detrimental ways.*

*ASM Topic: Module 03 Metabolic Pathways*

*ASM Topic: Module 05 Microbial Systems*

*Blooms Level: 1. Remember*

*Learning Outcome: 01.03.01 Evaluate the importance of the contributions to microbiology made by Hooke, Leeuwenhoek, Pasteur, Koch, Cohn, Beijerinck, von Behring, Kitasato, Metchnikoff, and Winogradsky*

*Section: 01.03*

*Topic: History of Microbiology*

23. Studies by Emil von Behring and Shibasaburo Kitasato demonstrated that inactivated toxins can induce the synthesis of antitoxins in the blood of rabbits. These antitoxins (antibodies) are the basis of

- A. humoral immunity.**
- B. cell-mediated immunity.
- C. antibiotic immunity.
- D. phagocyte-mediated immunity.

*ASM Objective: 05.03 Microorganisms and their environment interact with and modify each other.*

*ASM Objective: 05.04 Microorganisms, cellular and viral, can interact with both human and nonhuman hosts in beneficial, neutral or detrimental ways.*

*ASM Topic: Module 05 Microbial Systems*

*Blooms Level: 1. Remember*

*Section: 01.03*

*Topic: History of Microbiology*

Chapter 01 - The Evolution of Microorganisms and Microbiology

24. The first surgical antiseptic to be used was

- A. iodine.
- B. ethanol.
- C. phenol.**
- D. None of the choices are correct.

*ASM Objective: 03.04 The growth of microorganisms can be controlled by physical, chemical, mechanical, or biological methods.*

*ASM Objective: 05.04 Microorganisms, cellular and viral, can interact with both human and nonhuman hosts in beneficial, neutral or detrimental ways.*

*ASM Topic: Module 03 Metabolic Pathways*

*ASM Topic: Module 05 Microbial Systems*

*Blooms Level: 1. Remember*

*Learning Outcome: 01.03.01 Evaluate the importance of the contributions to microbiology made by Hooke, Leeuwenhoek, Pasteur, Koch, Cohn, Beijerinck, von Behring, Kitasato, Metchnikoff, and Winogradsky*

*Section: 01.03*

*Topic: History of Microbiology*

25. Old cultures of bacteria that have lost their ability to cause disease are said to be

- A. impotent.
- B. virulent.
- C. pathogenic.
- D. attenuated.**

*ASM Objective: 03.04 The growth of microorganisms can be controlled by physical, chemical, mechanical, or biological methods.*

*ASM Objective: 05.03 Microorganisms and their environment interact with and modify each other.*

*ASM Topic: Module 03 Metabolic Pathways*

*ASM Topic: Module 05 Microbial Systems*

*Blooms Level: 1. Remember*

*Learning Outcome: 01.03.01 Evaluate the importance of the contributions to microbiology made by Hooke, Leeuwenhoek, Pasteur, Koch, Cohn, Beijerinck, von Behring, Kitasato, Metchnikoff, and Winogradsky*

*Section: 01.03*

*Topic: History of Microbiology*

26. Who is credited with developing and documenting the first vaccination procedure against smallpox?

- A. Koch
- B. Pasteur
- C. Jenner**
- D. Lister

*ASM Objective: 03.04 The growth of microorganisms can be controlled by physical, chemical, mechanical, or biological methods.*

*ASM Objective: 05.03 Microorganisms and their environment interact with and modify each other.*

*ASM Objective: 05.04 Microorganisms, cellular and viral, can interact with both human and nonhuman hosts in beneficial, neutral or detrimental ways.*

*ASM Topic: Module 03 Metabolic Pathways*

*ASM Topic: Module 05 Microbial Systems*

*Blooms Level: 1. Remember*

*Learning Outcome: 01.03.01 Evaluate the importance of the contributions to microbiology made by Hooke, Leeuwenhoek, Pasteur, Koch, Cohn, Beijerinck, von Behring, Kitasato, Metchnikoff, and Winogradsky*

*Section: 01.03*

*Topic: History of Microbiology*

27. Who is credited with developing a vaccine against chicken cholera?

- A. Koch
- B. Pasteur**
- C. Jenner
- D. Lister

*ASM Objective: 03.04 The growth of microorganisms can be controlled by physical, chemical, mechanical, or biological methods.*

*ASM Objective: 05.04 Microorganisms, cellular and viral, can interact with both human and nonhuman hosts in beneficial, neutral or detrimental ways.*

*ASM Topic: Module 03 Metabolic Pathways*

*ASM Topic: Module 05 Microbial Systems*

*Blooms Level: 1. Remember*

*Learning Outcome: 01.03.01 Evaluate the importance of the contributions to microbiology made by Hooke, Leeuwenhoek, Pasteur, Koch, Cohn, Beijerinck, von Behring, Kitasato, Metchnikoff, and Winogradsky*

*Section: 01.03*

*Topic: History of Microbiology*

28. Who of the following first discovered that some blood leukocytes could engulf disease-causing bacteria?

- A. von Behring
- B. Meister
- C. Metchnikoff**
- D. Ivanowski

*ASM Objective: 03.04 The growth of microorganisms can be controlled by physical, chemical, mechanical, or biological methods.*

*ASM Objective: 05.03 Microorganisms and their environment interact with and modify each other.*

*ASM Objective: 05.04 Microorganisms, cellular and viral, can interact with both human and nonhuman hosts in beneficial, neutral or detrimental ways.*

*ASM Topic: Module 03 Metabolic Pathways*

*ASM Topic: Module 05 Microbial Systems*

*Blooms Level: 1. Remember*

*Learning Outcome: 01.03.01 Evaluate the importance of the contributions to microbiology made by Hooke, Leeuwenhoek, Pasteur, Koch, Cohn, Beijerinck, von Behring, Kitasato, Metchnikoff, and Winogradsky*

*Section: 01.03*

*Topic: History of Microbiology*

29. The use of enrichment cultures and selective media was pioneered by

- A. Beijerinck.**
- B. Jenner.
- C. Pasteur.
- D. von Behring.

*ASM Objective: 03.03 The survival and growth of any microorganism in a given environment depends on its metabolic characteristics.*

*ASM Objective: 03.04 The growth of microorganisms can be controlled by physical, chemical, mechanical, or biological methods.*

*ASM Topic: Module 03 Metabolic Pathways*

*Blooms Level: 1. Remember*

*Learning Outcome: 01.03.01 Evaluate the importance of the contributions to microbiology made by Hooke, Leeuwenhoek, Pasteur, Koch, Cohn, Beijerinck, von Behring, Kitasato, Metchnikoff, and Winogradsky*

*Section: 01.03*

*Topic: History of Microbiology*

## True / False Questions

30. Fanny Hesse first suggested that agar be used to solidify microbiological media.

**TRUE**

*ASM Objective: 03.04 The growth of microorganisms can be controlled by physical, chemical, mechanical, or biological methods.*

*ASM Objective: 06.03 Humans utilize and harness microorganisms and their products.*

*ASM Topic: Module 03 Metabolic Pathways*

*ASM Topic: Module 06 Impact of Microorganisms*

*Blooms Level: 1. Remember*

*Learning Outcome: 01.03.01 Evaluate the importance of the contributions to microbiology made by Hooke, Leeuwenhoek, Pasteur, Koch, Cohn, Beijerinck, von Behring, Kitasato, Metchnikoff, and Winogradsky*

*Section: 01.03*

*Topic: History of Microbiology*

31. M. J. Berkeley demonstrated that the great potato blight of Ireland was caused by a fungus.

**TRUE**

*ASM Objective: 05.04 Microorganisms, cellular and viral, can interact with both human and nonhuman hosts in beneficial, neutral or detrimental ways.*

*ASM Topic: Module 05 Microbial Systems*

*Blooms Level: 1. Remember*

*Learning Outcome: 01.03.01 Evaluate the importance of the contributions to microbiology made by Hooke, Leeuwenhoek, Pasteur, Koch, Cohn, Beijerinck, von Behring, Kitasato, Metchnikoff, and Winogradsky*

*Section: 01.03*

*Topic: History of Microbiology*

32. Invisible living creatures were thought to exist and cause disease long before they were ever observed.

**TRUE**

*ASM Objective: 05.04 Microorganisms, cellular and viral, can interact with both human and nonhuman hosts in beneficial, neutral or detrimental ways.*

*ASM Topic: Module 05 Microbial Systems*

*Blooms Level: 2. Understand*

*Learning Outcome: 01.03.01 Evaluate the importance of the contributions to microbiology made by Hooke, Leeuwenhoek, Pasteur, Koch, Cohn, Beijerinck, von Behring, Kitasato, Metchnikoff, and Winogradsky*

*Section: 01.03*

*Topic: History of Microbiology*



33. Koch's postulates were instrumental in establishing that *Mycobacterium leprae* is the cause of leprosy.

**FALSE**

*ASM Objective: 05.04 Microorganisms, cellular and viral, can interact with both human and nonhuman hosts in beneficial, neutral or detrimental ways.*

*ASM Topic: Module 05 Microbial Systems*

*Blooms Level: 1. Remember*

*Learning Outcome: 01.03.01 Evaluate the importance of the contributions to microbiology made by Hooke, Leeuwenhoek, Pasteur, Koch, Cohn, Beijerinck, von Behring, Kitasato, Metchnikoff, and Winogradsky*

*Learning Outcome: 01.03.03 Predict the difficulties that might arise when using Koch's postulates to determine if a microbe causes a disease unique to humans*

*Section: 01.03*

*Topic: History of Microbiology*

34. Edward Jenner's work in preventing rabies led to the use of the term vaccination to describe a type of procedure used in the prevention of disease.

**FALSE**

*ASM Objective: 05.04 Microorganisms, cellular and viral, can interact with both human and nonhuman hosts in beneficial, neutral or detrimental ways.*

*ASM Objective: 06.03 Humans utilize and harness microorganisms and their products.*

*ASM Topic: Module 05 Microbial Systems*

*Blooms Level: 1. Remember*

*Learning Outcome: 01.03.01 Evaluate the importance of the contributions to microbiology made by Hooke, Leeuwenhoek, Pasteur, Koch, Cohn, Beijerinck, von Behring, Kitasato, Metchnikoff, and Winogradsky*

*Section: 01.03*

*Topic: History of Microbiology*

35. Although developed over 100 years ago, Koch's postulates continue to be used successfully in all known human infectious diseases.

**FALSE**

*ASM Objective: 05.04 Microorganisms, cellular and viral, can interact with both human and nonhuman hosts in beneficial, neutral or detrimental ways.*

*ASM Topic: Module 05 Microbial Systems*

*Blooms Level: 2. Understand*

*Learning Outcome: 01.03.03 Predict the difficulties that might arise when using Koch's postulates to determine if a microbe causes a disease unique to humans*

*Section: 01.03*

*Topic: History of Microbiology*

36. Viruses and bacteria were first cultured in the laboratory at about the same time.

**FALSE**

*ASM Objective: 05.04 Microorganisms, cellular and viral, can interact with both human and nonhuman hosts in beneficial, neutral or detrimental ways.*

*ASM Topic: Module 05 Microbial Systems*

*Blooms Level: 2. Understand*

*Learning Outcome: 01.03.01 Evaluate the importance of the contributions to microbiology made by Hooke, Leeuwenhoek, Pasteur, Koch, Cohn, Beijerinck, von Behring, Kitasato, Metchnikoff, and Winogradsky*

*Section: 01.03*

*Topic: History of Microbiology*

37. Charles Chamberland developed porcelain filters that allowed other scientists to demonstrate that viruses are smaller than bacteria.

**TRUE**

*ASM Topic: Module 06 Impact of Microorganisms*

*Blooms Level: 1. Remember*

*Learning Outcome: 01.03.01 Evaluate the importance of the contributions to microbiology made by Hooke, Leeuwenhoek, Pasteur, Koch, Cohn, Beijerinck, von Behring, Kitasato, Metchnikoff, and Winogradsky*

*Section: 01.03*

*Topic: History of Microbiology*

38. The first disease to be identified as being caused by a virus was tobacco mosaic disease.

**TRUE**

*ASM Objective: 05.04 Microorganisms, cellular and viral, can interact with both human and nonhuman hosts in beneficial, neutral or detrimental ways.*

*ASM Topic: Module 05 Microbial Systems*

*Blooms Level: 1. Remember*

*Learning Outcome: 01.03.01 Evaluate the importance of the contributions to microbiology made by Hooke, Leeuwenhoek, Pasteur, Koch, Cohn, Beijerinck, von Behring, Kitasato, Metchnikoff, and Winogradsky*

*Learning Outcome: 01.03.02 Outline a set of experiments that might be used to decide if a particular microbe is the causative agent of a disease*

*Section: 01.03*

*Topic: History of Microbiology*

39. John Tyndall demonstrated that microorganisms present in the air are carried on dust particles.

**TRUE**

*ASM Objective: 05.01 Microorganisms are ubiquitous and live in diverse and dynamic ecosystems.*

*ASM Objective: 05.03 Microorganisms and their environment interact with and modify each other.*

*ASM Topic: Module 05 Microbial Systems*

*Blooms Level: 1. Remember*

*Learning Outcome: 01.03.01 Evaluate the importance of the contributions to microbiology made by Hooke, Leeuwenhoek, Pasteur, Koch, Cohn, Beijerinck, von Behring, Kitasato, Metchnikoff, and Winogradsky*

*Section: 01.03*

*Topic: History of Microbiology*

40. Agastino Bassi demonstrated that a type of silkworm disease was caused by a fungus and proposed that many diseases are caused by microorganisms.

**TRUE**

*ASM Objective: 05.04 Microorganisms, cellular and viral, can interact with both human and nonhuman hosts in beneficial, neutral or detrimental ways.*

*ASM Topic: Module 05 Microbial Systems*

*Blooms Level: 1. Remember*

*Learning Outcome: 01.03.01 Evaluate the importance of the contributions to microbiology made by Hooke, Leeuwenhoek, Pasteur, Koch, Cohn, Beijerinck, von Behring, Kitasato, Metchnikoff, and Winogradsky*

*Section: 01.03*

*Topic: History of Microbiology*

41. The usefulness of agar in solidifying microbiological growth media is limited because it does not remain solid at temperatures above 28°C.

**FALSE**

*ASM Objective: 03.03 The survival and growth of any microorganism in a given environment depends on its metabolic characteristics.*

*ASM Objective: 06.03 Humans utilize and harness microorganisms and their products.*

*ASM Topic: Module 03 Metabolic Pathways*

*ASM Topic: Module 06 Impact of Microorganisms*

*Blooms Level: 2. Understand*

*Learning Outcome: 01.03.01 Evaluate the importance of the contributions to microbiology made by Hooke, Leeuwenhoek, Pasteur, Koch, Cohn, Beijerinck, von Behring, Kitasato, Metchnikoff, and Winogradsky*

*Section: 01.03*

*Topic: History of Microbiology*

42. Robert Koch developed a vaccine that could be used to prevent anthrax.

**FALSE**

*ASM Objective: 03.04 The growth of microorganisms can be controlled by physical, chemical, mechanical, or biological methods.*

*ASM Objective: 05.04 Microorganisms, cellular and viral, can interact with both human and nonhuman hosts in beneficial, neutral or detrimental ways.*

*ASM Topic: Module 03 Metabolic Pathways*

*ASM Topic: Module 05 Microbial Systems*

*Blooms Level: 1. Remember*

*Learning Outcome: 01.03.01 Evaluate the importance of the contributions to microbiology made by Hooke, Leeuwenhoek, Pasteur, Koch, Cohn, Beijerinck, von Behring, Kitasato, Metchnikoff, and Winogradsky*

*Section: 01.03*

*Topic: History of Microbiology*

### **Fill in the Blank Questions**

43. Elie Metchnikoff discovered \_\_\_\_\_, which is a major feature of the host immune response.

**phagocytosis**

*ASM Objective: 03.04 The growth of microorganisms can be controlled by physical, chemical, mechanical, or biological methods.*

*ASM Objective: 05.03 Microorganisms and their environment interact with and modify each other.*

*ASM Objective: 05.04 Microorganisms, cellular and viral, can interact with both human and nonhuman hosts in beneficial, neutral or detrimental ways.*

*ASM Topic: Module 03 Metabolic Pathways*

*ASM Topic: Module 05 Microbial Systems*

*Blooms Level: 1. Remember*

*Section: 01.03*

*Topic: History of Microbiology*

44. An Italian physician, \_\_\_\_\_, challenged the concept of spontaneous generation by demonstrating that maggots do not arise from decaying meat but rather from developing fly eggs.

**Redi**

*ASM Objective: 05.01 Microorganisms are ubiquitous and live in diverse and dynamic ecosystems.*

*ASM Objective: 05.03 Microorganisms and their environment interact with and modify each other.*

*ASM Objective: 05.04 Microorganisms, cellular and viral, can interact with both human and nonhuman hosts in beneficial, neutral or detrimental ways.*

*ASM Topic: Module 05 Microbial Systems*

*Blooms Level: 1. Remember*

*Learning Outcome: 01.03.01 Evaluate the importance of the contributions to microbiology made by Hooke, Leeuwenhoek, Pasteur, Koch, Cohn, Beijerinck, von Behring, Kitasato, Metchnikoff, and Winogradsky*

*Section: 01.03*

*Topic: History of Microbiology*

## Chapter 01 - The Evolution of Microorganisms and Microbiology

45. \_\_\_\_\_ discovered that soil bacteria could oxidize iron, sulfur, and ammonia to obtain energy.

**Winogradsky**

*ASM Objective: 05.01 Microorganisms are ubiquitous and live in diverse and dynamic ecosystems.*

*ASM Objective: 05.03 Microorganisms and their environment interact with and modify each other.*

*ASM Objective: 06.01 Microbes are essential for life as we know it and the processes that support life (e.g. in biogeochemical cycles and plant and / or animal microbiota).*

*ASM Topic: Module 05 Microbial Systems*

*ASM Topic: Module 06 Impact of Microorganisms*

*Blooms Level: 1. Remember*

*Learning Outcome: 01.03.01 Evaluate the importance of the contributions to microbiology made by Hooke, Leeuwenhoek, Pasteur, Koch, Cohn, Beijerinck, von Behring, Kitasato, Metchnikoff, and Winogradsky*

*Section: 01.03*

*Topic: History of Microbiology*

46. \_\_\_\_\_ was the first to isolate a root nodule bacterium capable of nitrogen fixation.

**Beijerinck**

*ASM Objective: 05.01 Microorganisms are ubiquitous and live in diverse and dynamic ecosystems.*

*ASM Objective: 05.03 Microorganisms and their environment interact with and modify each other.*

*ASM Topic: Module 05 Microbial Systems*

*Blooms Level: 1. Remember*

*Learning Outcome: 01.03.01 Evaluate the importance of the contributions to microbiology made by Hooke, Leeuwenhoek, Pasteur, Koch, Cohn, Beijerinck, von Behring, Kitasato, Metchnikoff, and Winogradsky*

*Section: 01.03*

*Topic: History of Microbiology*

### **True / False Questions**

47. The endosymbiotic hypothesis is generally accepted as the origin of two eukaryotic organelles: mitochondria and chloroplasts.

**TRUE**

*ASM Objective: 01.01 Cells, organelles (e.g. mitochondria and chloroplasts) and all major metabolic pathways evolved from early prokaryotic cells.*

*ASM Topic: Module 01 Evolution*

*Blooms Level: 2. Understand*

*Learning Outcome: 01.02.01 Propose a time line of the origin and history of microbial life and integrate supporting evidence into it*

*Section: 01.02*

*Topic: Taxonomy of Microorganisms*

48. The relationship between specific bacteria and specific diseases was first demonstrated by Koch.

**TRUE**

*ASM Objective: 05.04 Microorganisms, cellular and viral, can interact with both human and nonhuman hosts in beneficial, neutral or detrimental ways.*

*ASM Topic: Module 05 Microbial Systems*

*Blooms Level: 1. Remember*

*Learning Outcome: 01.03.01 Evaluate the importance of the contributions to microbiology made by Hooke, Leeuwenhoek, Pasteur, Koch, Cohn, Beijerinck, von Behring, Kitasato, Metchnikoff, and Winogradsky*

*Section: 01.03*

*Topic: History of Microbiology*

49. Some microorganisms are useful in bioremediation processes that reduce the effects of pollution.

**TRUE**

*ASM Objective: 05.03 Microorganisms and their environment interact with and modify each other.*

*ASM Objective: 06.01 Microbes are essential for life as we know it and the processes that support life (e.g. in biogeochemical cycles and plant and / or animal microbiota).*

*ASM Objective: 06.03 Humans utilize and harness microorganisms and their products.*

*ASM Topic: Module 05 Microbial Systems*

*ASM Topic: Module 06 Impact of Microorganisms*

*Blooms Level: 2. Understand*

*Learning Outcome: 01.04.01 Construct a concept map, table, or drawing that illustrates the diverse nature of microbiology and how it has improved human conditions*

*Learning Outcome: 01.04.02 Support the belief held by many microbiologists that microbiology is experiencing its second golden age*

*Section: 01.04*

*Topic: History of Microbiology*

### **Fill in the Blank Questions**

50. The branch of microbiology that deals with diseases of humans and animals is called \_\_\_\_\_ microbiology.

**medical**

*ASM Objective: 05.04 Microorganisms, cellular and viral, can interact with both human and nonhuman hosts in beneficial, neutral or detrimental ways.*

*ASM Topic: Module 05 Microbial Systems*

*Blooms Level: 1. Remember*

*Learning Outcome: 01.04.01 Construct a concept map, table, or drawing that illustrates the diverse nature of microbiology and how it has improved human conditions*

*Section: 01.04*

*Topic: History of Microbiology*

51. The branch of microbiology that deals with the mechanisms by which the human body protects itself from disease-causing organisms is called \_\_\_\_\_.

**immunology**

*ASM Objective: 05.04 Microorganisms, cellular and viral, can interact with both human and nonhuman hosts in beneficial, neutral or detrimental ways.*

*ASM Topic: Module 05 Microbial Systems*

*Blooms Level: 1. Remember*

*Learning Outcome: 01.04.02 Support the belief held by many microbiologists that microbiology is experiencing its second golden age*

*Section: 01.04*

*Topic: History of Microbiology*

52. \_\_\_\_\_ microbiologists monitor community food establishments and water supplies in order to control the spread of communicable diseases.

**Public health**

*ASM Objective: 05.04 Microorganisms, cellular and viral, can interact with both human and nonhuman hosts in beneficial, neutral or detrimental ways.*

*ASM Topic: Module 05 Microbial Systems*

*Blooms Level: 1. Remember*

*Learning Outcome: 01.04.01 Construct a concept map, table, or drawing that illustrates the diverse nature of microbiology and how it has improved human conditions*

*Section: 01.04*

*Topic: History of Microbiology*

53. The branch of microbiology that studies the relationship between microorganisms and their habitats is called \_\_\_\_\_.

**microbial ecology**

*ASM Objective: 03.03 The survival and growth of any microorganism in a given environment depends on its metabolic characteristics.*

*ASM Objective: 05.01 Microorganisms are ubiquitous and live in diverse and dynamic ecosystems.*

*ASM Objective: 05.03 Microorganisms and their environment interact with and modify each other.*

*ASM Topic: Module 03 Metabolic Pathways*

*ASM Topic: Module 05 Microbial Systems*

*Blooms Level: 1. Remember*

*Learning Outcome: 01.04.01 Construct a concept map, table, or drawing that illustrates the diverse nature of microbiology and how it has improved human conditions*

*Section: 01.04*

*Topic: History of Microbiology*

54. \_\_\_\_\_ and \_\_\_\_\_ microbiology investigates the spoilage of products for human consumption and the use of microorganisms in the production of cheese, yogurt, pickles, beer, and the like.

**Food, dairy**

*ASM Objective: 05.01 Microorganisms are ubiquitous and live in diverse and dynamic ecosystems.*

*ASM Objective: 05.04 Microorganisms, cellular and viral, can interact with both human and nonhuman hosts in beneficial, neutral or detrimental ways.*

*ASM Topic: Module 05 Microbial Systems*

*Blooms Level: 1. Remember*

*Learning Outcome: 01.04.01 Construct a concept map, table, or drawing that illustrates the diverse nature of microbiology and how it has improved human conditions*

*Section: 01.04*

*Topic: History of Microbiology*

55. \_\_\_\_\_ microbiology involves the use of microorganisms to make products such as antibiotics, vaccines, steroids, alcohols, vitamins, amino acids, and enzymes.

**Industrial**

*ASM Objective: 06.03 Humans utilize and harness microorganisms and their products.*

*ASM Topic: Module 06 Impact of Microorganisms*

*Blooms Level: 1. Remember*

*Learning Outcome: 01.04.01 Construct a concept map, table, or drawing that illustrates the diverse nature of microbiology and how it has improved human conditions*

*Section: 01.04*

*Topic: History of Microbiology*

56. Microbial \_\_\_\_\_ are scientists who investigate the synthesis of antibiotics and toxins, the production of energy with microorganisms, and the ways in which microorganisms survive harsh environmental conditions.

**physiologists**

*ASM Objective: 03.02 The interactions of microorganisms among themselves and with their environment are determined by their metabolic abilities (e.g., quorum sensing, oxygen consumption, nitrogen transformations).*

*ASM Objective: 03.03 The survival and growth of any microorganism in a given environment depends on its metabolic characteristics.*

*ASM Objective: 03.04 The growth of microorganisms can be controlled by physical, chemical, mechanical, or biological methods.*

*ASM Objective: 05.01 Microorganisms are ubiquitous and live in diverse and dynamic ecosystems.*

*ASM Objective: 05.03 Microorganisms and their environment interact with and modify each other.*

*ASM Topic: Module 03 Metabolic Pathways*

*ASM Topic: Module 05 Microbial Systems*

*Blooms Level: 1. Remember*

*Learning Outcome: 01.04.01 Construct a concept map, table, or drawing that illustrates the diverse nature of microbiology and how it has improved human conditions*

*Section: 01.04*

*Topic: History of Microbiology*



57. Microbial \_\_\_\_\_ focuses on the nature of heredity and how it regulates the development and function of cells and organisms.

**genetics**

*ASM Objective: 04.01 Genetic variations can impact microbial functions (e.g., in biofilm formation, pathogenicity and drug resistance).*

*ASM Objective: 04.02 Although the central dogma is universal in all cells, the processes of replication, transcription, and translation differ in Bacteria, Archaea, and Eukaryotes.*

*ASM Objective: 04.03 The regulation of gene expression is influenced by external and internal molecular cues and/or signals.*

*ASM Topic: Module 04 Information Flow and Genetics*

*Blooms Level: 1. Remember*

*Learning Outcome: 01.04.01 Construct a concept map, table, or drawing that illustrates the diverse nature of microbiology and how it has improved human conditions*

*Section: 01.04*

*Topic: History of Microbiology*

**Multiple Choice Questions**

58. Which of the following provides the best explanation for why viruses are not included in the three domain system?

- A. Viruses are too small.
- B. Viruses have either DNA or RNA, not both.
- C. Viruses are not a cellular life form.**
- D. Viruses show no evidence of evolution.

*ASM Objective: 01.05 The evolutionary relatedness of organisms is best reflected in phylogenetic trees.*

*ASM Topic: Module 01 Evolution*

*Blooms Level: 5. Evaluate*

*Learning Outcome: 01.01.02 Explain Carl Woese's contributions in establishing the three-domain system for classifying cellular life*

*Section: 01.01*

*Topic: Taxonomy of Microorganisms*

59. A new microbe has been discovered in the rumen of sheep. Microscopy shows no evidence of a nuclear membrane and biochemical studies of the cell wall demonstrate the lack of peptidoglycan. Metabolic studies show that this microbe generates methane. This microbe would most likely be classified in the:

- A. Domain Bacteria
- B. Domain Archaea**
- C. Domain Eukarya, Kingdom Fungi
- D. Domain Eukarya, Protists

*ASM Objective: 03.01 Bacteria and Archaea exhibit extensive, and often unique, metabolic diversity (e.g. nitrogen fixation, methane production, anoxygenic photosynthesis).*

*ASM Objective: 03.03 The survival and growth of any microorganism in a given environment depends on its metabolic characteristics.*

*ASM Topic: Module 03 Metabolic Pathways*

*Blooms Level: 4. Analyze*

*Learning Outcome: 01.01.02 Explain Carl Woese's contributions in establishing the three-domain system for classifying cellular life*

*Learning Outcome: 01.01.04 Determine the type of microbe (e.g., bacterium, fungus, etc.) when given a description of a newly discovered microbe*

*Section: 01.01*

*Topic: Taxonomy of Microorganisms*

60. What is the most compelling reason why “protists” are not considered to be a taxonomic group?

- A. They are not cellular life forms.
- B. They are too small to be included among the eukaryotes.
- C. The group includes both prokaryotic and eukaryotic cell types.
- D. The organisms often included in this group are very diverse and don't form a cohesive taxon.**

*ASM Objective: 01.05 The evolutionary relatedness of organisms is best reflected in phylogenetic trees.*

*ASM Objective: 05.01 Microorganisms are ubiquitous and live in diverse and dynamic ecosystems.*

*ASM Topic: Module 01 Evolution*

*ASM Topic: Module 05 Microbial Systems*

*Blooms Level: 5. Evaluate*

*Learning Outcome: 01.01.02 Explain Carl Woese's contributions in establishing the three-domain system for classifying cellular life*

*Learning Outcome: 01.01.04 Determine the type of microbe (e.g., bacterium, fungus, etc.) when given a description of a newly discovered microbe*

*Section: 01.01*

*Topic: Taxonomy of Microorganisms*

61. Scientists study microorganisms on Earth today to search for life forms elsewhere, as well as to explore the origins of life on Earth. These microorganisms that are studied are referred to as:

- A. existing.
- B. extant.**
- C. extinct.
- D. extirpated.

*ASM Objective: 05.03 Microorganisms and their environment interact with and modify each other.*

*ASM Objective: 06.02 Microorganisms provide essential models that give us fundamental knowledge about life processes.*

*ASM Topic: Module 05 Microbial Systems*

*ASM Topic: Module 06 Impact of Microorganisms*

*Blooms Level: 3. Apply*

*Learning Outcome: 01.01.01 Differentiate the biological entities studied by microbiologists from those studied by other biologists*

*Learning Outcome: 01.02.01 Propose a time line of the origin and history of microbial life and integrate supporting evidence into it*

*Section: 01.01*

*Section: 01.02*

*Topic: Taxonomy of Microorganisms*

62. The most important aspect of agar that makes it a useful ingredient for solidifying media for bacterial culture is

- A. It provides an excellent nitrogen source for bacteria.
- B. Bacteria are unable to break it down so it stays solidified.**
- C. It melts at 100°C and solidifies at temperatures below 50°C.
- D. It provides an excellent carbon and energy source for bacteria.

*ASM Objective: 03.03 The survival and growth of any microorganism in a given environment depends on its metabolic characteristics.*

*ASM Objective: 03.04 The growth of microorganisms can be controlled by physical, chemical, mechanical, or biological methods.*

*ASM Objective: 06.03 Humans utilize and harness microorganisms and their products.*

*ASM Topic: Module 03 Metabolic Pathways*

*ASM Topic: Module 06 Impact of Microorganisms*

*Blooms Level: 5. Evaluate*

*Learning Outcome: 01.03.01 Evaluate the importance of the contributions to microbiology made by Hooke, Leeuwenhoek, Pasteur, Koch, Cohn, Beijerinck, von Behring, Kitasato, Metchnikoff, and Winogradsky*

*Section: 01.03*

*Topic: History of Microbiology*

63. Which molecule is believed to have preceded the other three during the evolution of life?

- A. ATP
- B. Proteins
- C. DNA
- D. RNA**

*ASM Objective: 01.05 The evolutionary relatedness of organisms is best reflected in phylogenetic trees.*

*ASM Objective: 04.01 Genetic variations can impact microbial functions (e.g., in biofilm formation, pathogenicity and drug resistance).*

*ASM Topic: Module 01 Evolution*

*ASM Topic: Module 04 Information Flow and Genetics*

*Blooms Level: 3. Apply*

*Learning Outcome: 01.02.01 Propose a time line of the origin and history of microbial life and integrate supporting evidence into it*  
*Section: 01.02*

*Topic: Taxonomy of Microorganisms*

64. What is the most compelling reason why DNA, rather than RNA, evolved to be the storage repository for genetic information in cellular life forms?

- A. DNA has deoxyribose rather than ribose.
- B. DNA molecules are more chemically stable than RNA molecules.**
- C. DNA is double-stranded rather than single-stranded.

*ASM Objective: 04.02 Although the central dogma is universal in all cells, the processes of replication, transcription, and translation differ in Bacteria, Archaea, and Eukaryotes.*

*ASM Topic: Module 04 Information Flow and Genetics*

*Blooms Level: 5. Evaluate*

*Learning Outcome: 01.02.01 Propose a time line of the origin and history of microbial life and integrate supporting evidence into it*  
*Section: 01.02*

*Topic: Taxonomy of Microorganisms*

65. Each of the following provides evidence in support of the primary role of RNA in the evolution of life EXCEPT:

- A. Some RNA molecules are catalytic.
- B. RNA catalyzes peptide bond formation during protein synthesis.
- C. ATP (energy currency of the cell) is a ribonucleotide.
- D. RNA is less chemically stable than DNA.**
- E. RNA can regulate gene expression.

*ASM Topic: Module 01 Evolution*

*ASM Topic: Module 04 Information Flow and Genetics*

*Blooms Level: 4. Analyze*

*Learning Outcome: 01.02.01 Propose a time line of the origin and history of microbial life and integrate supporting evidence into it*  
*Section: 01.02*

*Topic: Taxonomy of Microorganisms*

66. While each of these processes are believed to have evolved prior to aerobic respiration, which one is the most critical process, without which aerobic respiration could never have developed?

- A. Oxygenic photosynthesis
- B. Anoxygenic photosynthesis
- C. Alcohol fermentation
- D. Lactic acid fermentation

*ASM Objective: 03.01 Bacteria and Archaea exhibit extensive, and often unique, metabolic diversity (e.g. nitrogen fixation, methane production, anoxygenic photosynthesis).*

*ASM Objective: 03.02 The interactions of microorganisms among themselves and with their environment are determined by their metabolic abilities (e.g., quorum sensing, oxygen consumption, nitrogen transformations).*

*ASM Objective: 03.03 The survival and growth of any microorganism in a given environment depends on its metabolic characteristics.*

*ASM Objective: 05.03 Microorganisms and their environment interact with and modify each other.*

*ASM Topic: Module 03 Metabolic Pathways*

*ASM Topic: Module 05 Microbial Systems*

*Blooms Level: 4. Analyze*

*Learning Outcome: 01.02.01 Propose a time line of the origin and history of microbial life and integrate supporting evidence into it*

*Section: 01.02*

*Topic: History of Microbiology*

67. Which term is most inclusive? In other words, which term includes all the others?

- A. Microbial species
- B. Microbial strain
- C. Biovars
- D. Serovars

*ASM Objective: 01.04 The traditional concept of species is not readily applicable to microbes due to asexual reproduction and the frequent occurrence of horizontal gene transfer.*

*ASM Objective: 01.05 The evolutionary relatedness of organisms is best reflected in phylogenetic trees.*

*ASM Topic: Module 01 Evolution*

*Blooms Level: 4. Analyze*

*Learning Outcome: 01.02.03 Compare and contrast the definitions of plant and animal species, microbial species, and microbial strains*

*Section: 01.02*

*Topic: Bacteria*

*Topic: Taxonomy of Microorganisms*

68. Which of the processes named here is the least likely to contribute to the evolution of genetic diversity of bacteria and archaea?

- A. Mutation
- B. Sexual reproduction**
- C. Binary fission
- D. Horizontal gene transfer

*ASM Objective: 01.02 Mutations and horizontal gene transfer, with the immense variety of microenvironments, have selected for a huge diversity of microorganisms.*

*ASM Objective: 01.04 The traditional concept of species is not readily applicable to microbes due to asexual reproduction and the frequent occurrence of horizontal gene transfer.*

*ASM Topic: Module 01 Evolution*

*Blooms Level: 4. Analyze*

*Learning Outcome: 01.02.03 Compare and contrast the definitions of plant and animal species, microbial species, and microbial strains*

*Section: 01.02*

*Topic: Archaea*

*Topic: Bacteria*

*Topic: Taxonomy of Microorganisms*

69. A student is observing microorganisms in a sample of pond water. One organism of interest has an obvious nucleus, small oval structures containing a green pigment, and does not appear to be motile. In which of the following groups would this microbe most likely be classified?

- A. Eukaryotes (Fungi)
- B. Eukaryotes (Algae)**
- C. Bacteria
- D. Archaea
- E. Eukaryotes (Protozoa)

*ASM Objective: 02.04 While microscopic eukaryotes (for example, fungi, protozoa and algae) carry out some of the same processes as bacteria, many of the cellular properties are fundamentally different.*

*ASM Objective: 05.01 Microorganisms are ubiquitous and live in diverse and dynamic ecosystems.*

*ASM Topic: Module 02 Cell Structure and Function*

*ASM Topic: Module 05 Microbial Systems*

*Blooms Level: 4. Analyze*

*Learning Outcome: 01.01.04 Determine the type of microbe (e.g., bacterium, fungus, etc.) when given a description of a newly discovered microbe*

*Section: 01.01*

*Topic: Taxonomy of Microorganisms*

70. A student is observing microorganisms in a sample of pond water. One organism of interest has an obvious nucleus and has been moving rapidly during observation and appears to have rows of cilia along its surface. In which of the following groups would this microbe most likely be classified?

- A. Eukaryotes (Fungi)
- B. Eukaryotes (Algae)
- C. Bacteria
- D. Eukaryotes (Protozoa)**

*ASM Objective: 02.01 The structure and function of microorganisms have been revealed by the use of microscopy (including bright field, phase contrast, fluorescent, and electron).*

*ASM Objective: 02.04 While microscopic eukaryotes (for example, fungi, protozoa and algae) carry out some of the same processes as bacteria, many of the cellular properties are fundamentally different.*

*ASM Topic: Module 02 Cell Structure and Function*

*Blooms Level: 4. Analyze*

*Learning Outcome: 01.01.04 Determine the type of microbe (e.g., bacterium, fungus, etc.) when given a description of a newly discovered microbe*

*Section: 01.01*

*Topic: Taxonomy of Microorganisms*

### Fill in the Blank Questions

71. A microbial \_\_\_\_\_ is a collection of strains that share many stable properties and differ significantly from other groups of strains.

**species**

*ASM Objective: 01.04 The traditional concept of species is not readily applicable to microbes due to asexual reproduction and the frequent occurrence of horizontal gene transfer.*

*ASM Objective: 01.05 The evolutionary relatedness of organisms is best reflected in phylogenetic trees.*

*ASM Topic: Module 01 Evolution*

*Blooms Level: 2. Understand*

*Learning Outcome: 01.02.03 Compare and contrast the definitions of plant and animal species, microbial species, and microbial strains*

*Section: 01.02*

*Topic: Taxonomy of Microorganisms*

### Multiple Choice Questions

72. Morphovars, serovars, biovars, and pathovars are examples of terms that refer to microbial \_\_\_\_\_.

- A. species
- B. strains**
- C. types
- D. Archaea

*ASM Objective: 01.02 Mutations and horizontal gene transfer, with the immense variety of microenvironments, have selected for a huge diversity of microorganisms.*

*ASM Objective: 01.04 The traditional concept of species is not readily applicable to microbes due to asexual reproduction and the frequent occurrence of horizontal gene transfer.*

*ASM Topic: Module 01 Evolution*

*Blooms Level: 2. Understand*

*Learning Outcome: 01.02.03 Compare and contrast the definitions of plant and animal species, microbial species, and microbial strains*

*Section: 01.02*

*Topic: Taxonomy of Microorganisms*

73. In a search for new antibiotics, a previously unknown organism has been recovered from the soil. It is nonmotile and is composed of long threadlike structures formed from nucleated cells. It is not-photosynthetic and absorbs its nutrients. This organism will most likely be classified among the

- A. Bacteria
- B. Archaea
- C. Eukaryotes (Fungi)**
- D. Eukaryotes (Protozoa)
- E. Eukaryotes (Algae)

*ASM Objective: 01.05 The evolutionary relatedness of organisms is best reflected in phylogenetic trees.*

*ASM Objective: 02.04 While microscopic eukaryotes (for example, fungi, protozoa and algae) carry out some of the same processes as bacteria, many of the cellular properties are fundamentally different.*

*ASM Objective: 05.01 Microorganisms are ubiquitous and live in diverse and dynamic ecosystems.*

*ASM Objective: 06.04 Because the true diversity of microbial life is largely unknown, its effects and potential benefits have not been fully explored.*

*ASM Topic: Module 01 Evolution*

*ASM Topic: Module 02 Cell Structure and Function*

*ASM Topic: Module 05 Microbial Systems*

*ASM Topic: Module 06 Impact of Microorganisms*

*Blooms Level: 3. Apply*

*Learning Outcome: 01.01.01 Differentiate the biological entities studied by microbiologists from those studied by other biologists*

*Learning Outcome: 01.01.04 Determine the type of microbe (e.g., bacterium, fungus, etc.) when given a description of a newly discovered microbe*

*Section: 01.01*

*Topic: Taxonomy of Microorganisms*

## Matching Questions



74. Match the microbe with an example of its importance to humans.

- |   |          |          |
|---|----------|----------|
| 1. Members of this group have caused "mad cow disease" and Creutzfeldt Jacob disease.   | Viruses  | <u>5</u> |
| 2. Members of this group are photosynthetic, include unicellular and multicellular forms, and are the foundation of aquatic food chains.  | Prions   | <u>1</u> |
| 3. This group includes beneficial microorganisms that fix nitrogen, make antibiotics, vitamins and enzymes, as well as harmful microorganisms that cause disease such as plague and strep throat. | Fungi    | <u>4</u> |
| 4. Members of this group include decomposers, associate with plant roots and help plants grow, produce antibiotics, help bread rise, and help make wine.  | Algae    | <u>2</u> |
| 5. Members of this microbial group cause serious diseases such as smallpox, AIDS, and Ebola fever.  | Bacteria | <u>3</u> |

*ASM Objective: 02.04 While microscopic eukaryotes (for example, fungi, protozoa and algae) carry out some of the same processes as bacteria, many of the cellular properties are fundamentally different.*

*ASM Objective: 05.01 Microorganisms are ubiquitous and live in diverse and dynamic ecosystems.*

*ASM Objective: 05.03 Microorganisms and their environment interact with and modify each other.*

*ASM Objective: 05.04 Microorganisms, cellular and viral, can interact with both human and nonhuman hosts in beneficial, neutral or detrimental ways.*

*ASM Objective: 06.01 Microbes are essential for life as we know it and the processes that support life (e.g. in biogeochemical cycles and plant and / or animal microbiota).*

*ASM Objective: 06.03 Humans utilize and harness microorganisms and their products.*

*ASM Topic: Module 05 Microbial Systems*

*ASM Topic: Module 06 Impact of Microorganisms*

*Blooms Level: 3. Apply*

*Learning Outcome: 01.01.03 Provide an example of the importance to humans of each of the major types of microbes*

*Section: 01.01*

*Topic: Taxonomy of Microorganisms*

## Multiple Choice Questions

75. Three the SSU rRNA sequences of 3 organisms have been compared. For organisms 1 and 2, two of the twelve nucleotides in the sequence are different. For organisms 1 and 3, six of the twelve nucleotides are different. Which organism has greater evolutionary distance from organism 1?
- A. Organism 2
  - B. Organism 3**
  - C. The evolutionary distance is the same.
  - D. Evolutionary distance cannot be predicted from this data.

*ASM Objective: 01.05 The evolutionary relatedness of organisms is best reflected in phylogenetic trees.*

*ASM Topic: Module 01 Evolution*

*Blooms Level: 3. Apply*

*Learning Outcome: 01.02.02 Design a set of experiments that could be used to place a newly discovered cellular microbe on a phylogenetic tree based on small subunit (SSU) rRNA sequences*

*Section: 01.02*

*Topic: Taxonomy of Microorganisms*

## Ranking Questions

76. The following are steps in using SSU rRNA molecules to develop phylogenetic trees. Place these steps in the correct order.
- 5** Count the number of nucleotide differences between each pair of sequences and calculate the evolutionary distance.
  - 6** Input data into computer and use appropriate software to construct a phylogenetic tree.
  - 4** Align nucleotide sequences to compare.
  - 1** Isolate DNA from cells of each organism being tested.
  - 2** Amplify the DNA of the SSU rRNA genes of each organism using polymerase chain reaction.
  - 3** Determine the nucleotide sequence of the SSU rRNA genes of each organism.

*ASM Objective: 01.05 The evolutionary relatedness of organisms is best reflected in phylogenetic trees.*

*ASM Topic: Module 01 Evolution*

*Blooms Level: 3. Apply*

*Learning Outcome: 01.02.02 Design a set of experiments that could be used to place a newly discovered cellular microbe on a phylogenetic tree based on small subunit (SSU) rRNA sequences*

*Section: 01.02*

*Topic: Taxonomy of Microorganisms*

## Multiple Choice Questions

77. Which group of microbes contains organisms necessary for production of wine and bread?

- A. Bacteria
- B. Archaea
- C. Fungi**
- D. Algae

*ASM Objective: 06.03 Humans utilize and harness microorganisms and their products.*

*ASM Topic: Module 06 Impact of Microorganisms*

*Blooms Level: 1. Remember*

*Learning Outcome: 01.01.03 Provide an example of the importance to humans of each of the major types of microbes*

*Section: 01.01*

*Topic: Taxonomy of Microorganisms*

**Fill in the Blank Questions**

1. The \_\_\_\_\_ is the point at which a lens focuses parallel beams of light.  
**focal point**

*ASM Objective: 08.01 Properly prepare and view specimens for examination using microscopy (bright field and, if possible, phase contrast).  
ASM Topic: Module 08 Microbiology Laboratory Skills  
Blooms Level: 1. Remember  
Learning Outcome: 02.01.02 Correlate lens strength and focal length  
Section: 02.01  
Topic: Microscopy*

2. The \_\_\_\_\_ is the distance between the center of a lens and the point at which it focuses parallel beams of light.  
**focal length**

*ASM Objective: 08.01 Properly prepare and view specimens for examination using microscopy (bright field and, if possible, phase contrast).  
ASM Topic: Module 08 Microbiology Laboratory Skills  
Blooms Level: 1. Remember  
Learning Outcome: 02.01.02 Correlate lens strength and focal length  
Section: 02.01  
Topic: Microscopy*

**True / False Questions**

3. Light rays are refracted (bent) when they cross the interface between materials with different refractive indices.

**TRUE**

*ASM Objective: 08.01 Properly prepare and view specimens for examination using microscopy (bright field and, if possible, phase contrast).*

*ASM Topic: Module 08 Microbiology Laboratory Skills*

*Blooms Level: 1. Remember*

*Learning Outcome: 02.01.01 Relate the refractive indices of glass and air to the path light takes when it passes through a prism or convex lens*

*Section: 02.01*

*Topic: Microscopy*

### Multiple Choice Questions

4. Confocal microscopes exhibit improved contrast and resolution by

A. illumination of a large area of the specimen.

**B.** blocking out stray light with an aperture located above the objective lens.

C. use of light at longer wavelengths.

D. use of ultraviolet light to illuminate the specimen.

*ASM Objective: 08.01 Properly prepare and view specimens for examination using microscopy (bright field and, if possible, phase contrast).*

*Blooms Level: 2. Understand*

*Learning Outcome: 02.02.01 Evaluate the parts of a light microscope in terms of their contributions to image production and use of the microscope*

*Section: 02.02*

*Topic: Microscopy*

5. A 30× objective and a 20× ocular produce a total magnification of

A. 230×.

B. 320×.

C. 50×.

**D.** 600×.

*ASM Objective: 08.01 Properly prepare and view specimens for examination using microscopy (bright field and, if possible, phase contrast).*

*ASM Topic: Module 08 Microbiology Laboratory Skills*

*Blooms Level: 3. Apply*

*Learning Outcome: 02.02.01 Evaluate the parts of a light microscope in terms of their contributions to image production and use of the microscope*

*Learning Outcome: 02.02.02 Predict the relative degree of resolution based on light wavelength and numerical aperture of the lens used to examine a specimen*

*Section: 02.02*

*Topic: Microscopy*

Chapter 02 - Microscopy

6. A 45× objective and a 10× ocular produce a total magnification of

- A. 900×.
- B. 55×.
- C. 450×.**
- D. 145×.

*ASM Objective: 08.01 Properly prepare and view specimens for examination using microscopy (bright field and, if possible, phase contrast).*

*ASM Topic: Module 08 Microbiology Laboratory Skills*

*Blooms Level: 3. Apply*

*Learning Outcome: 02.02.01 Evaluate the parts of a light microscope in terms of their contributions to image production and use of the microscope*

*Section: 02.02*

*Topic: Microscopy*

7. A microscope that exposes specimens to ultraviolet, violet, or blue light and forms an image with the light emitted at a different wavelength is called a \_\_\_\_\_ microscope.

- A. phase-contrast
- B. dark-field
- C. scanning electron
- D. fluorescence**

*ASM Objective: 08.01 Properly prepare and view specimens for examination using microscopy (bright field and, if possible, phase contrast).*

*ASM Topic: Module 08 Microbiology Laboratory Skills*

*Blooms Level: 1. Remember*

*Learning Outcome: 02.02.03 Create a table that compares and contrasts the various types of light microscopes in terms of their uses, how images are created, and the quality of images produced*

*Section: 02.02*

*Topic: Microscopy*

8. Immersion oil can be used to increase the resolution achieved with some microscope lenses because it increases the \_\_\_\_\_ between the specimen and the objective lens.

- A. optical density
- B. refractive index**
- C. optical density and refractive index
- D. neither optical density nor refractive index

*ASM Objective: 08.01 Properly prepare and view specimens for examination using microscopy (bright field and, if possible, phase contrast).*

*ASM Topic: Module 08 Microbiology Laboratory Skills*

*Blooms Level: 2. Understand*

*Learning Outcome: 02.01.01 Relate the refractive indices of glass and air to the path light takes when it passes through a prism or convex lens*

*Section: 02.01*

*Topic: Microscopy*

## True / False Questions

9. A substage condenser is used to focus light onto the specimen, which increases the resolution of a light microscope.

**TRUE**

*ASM Objective: 08.01 Properly prepare and view specimens for examination using microscopy (bright field and, if possible, phase contrast).*

*ASM Topic: Module 08 Microbiology Laboratory Skills*

*Blooms Level: 2. Understand*

*Learning Outcome: 02.02.01 Evaluate the parts of a light microscope in terms of their contributions to image production and use of the microscope*

*Section: 02.02*

*Topic: Microscopy*

## Fill in the Blank Questions

10. The \_\_\_\_\_ is the distance between the specimen and the objective lens when the specimen is in focus.

**working distance**

*ASM Objective: 08.01 Properly prepare and view specimens for examination using microscopy (bright field and, if possible, phase contrast).*

*ASM Topic: Module 08 Microbiology Laboratory Skills*

*Blooms Level: 1. Remember*

*Learning Outcome: 02.02.01 Evaluate the parts of a light microscope in terms of their contributions to image production and use of the microscope*

*Section: 02.02*

*Topic: Microscopy*

11. The useful magnification of a light microscope is limited by the \_\_\_\_\_ of the light source being utilized.

**wavelength**

*ASM Objective: 08.01 Properly prepare and view specimens for examination using microscopy (bright field and, if possible, phase contrast).*

*ASM Topic: Module 08 Microbiology Laboratory Skills*

*Blooms Level: 2. Understand*

*Learning Outcome: 02.02.02 Predict the relative degree of resolution based on light wavelength and numerical aperture of the lens used to examine a specimen*

*Section: 02.02*

*Topic: Microscopy*

12. The special dyes used in fluorescence microscopy that absorb light at one wavelength and emit light at a different wavelength are called \_\_\_\_\_.

**fluorochromes**

*ASM Objective: 08.01 Properly prepare and view specimens for examination using microscopy (bright field and, if possible, phase contrast).*

*Blooms Level: 1. Remember*

*Learning Outcome: 02.02.03 Create a table that compares and contrasts the various types of light microscopes in terms of their uses, how images are created, and the quality of images produced*

*Section: 02.02*

*Topic: Microscopy*

13. In order to view a specimen with a total magnification of 400×, a \_\_\_\_\_ objective must be used if the ocular is 10×.

**40×**

*ASM Objective: 08.01 Properly prepare and view specimens for examination using microscopy (bright field and, if possible, phase contrast).*

*ASM Topic: Module 08 Microbiology Laboratory Skills*

*Blooms Level: 3. Apply*

*Learning Outcome: 02.02.01 Evaluate the parts of a light microscope in terms of their contributions to image production and use of the microscope*

*Section: 02.02*

*Topic: Microscopy*

### **True / False Questions**

14. Confocal microscopes, in combination with specialized computer software, can be used to create three-dimensional images of cell structures.

**TRUE**

*ASM Objective: 08.01 Properly prepare and view specimens for examination using microscopy (bright field and, if possible, phase contrast).*

*ASM Topic: Module 08 Microbiology Laboratory Skills*

*Blooms Level: 2. Understand*

*Learning Outcome: 02.02.03 Create a table that compares and contrasts the various types of light microscopes in terms of their uses, how images are created, and the quality of images produced*

*Section: 02.02*

*Topic: Microscopy*



Chapter 02 - Microscopy

15. A light microscope with an objective lens numerical aperture of 0.65 is capable of allowing two objects 400 nm apart to be distinguished when using light with a wavelength of 420 nm.

**TRUE**

*ASM Objective: 08.01 Properly prepare and view specimens for examination using microscopy (bright field and, if possible, phase contrast).*

*ASM Topic: Module 08 Microbiology Laboratory Skills*

*Blooms Level: 4. Analyze*

*Learning Outcome: 02.02.02 Predict the relative degree of resolution based on light wavelength and numerical aperture of the lens used to examine a specimen*

*Section: 02.02*

*Topic: Microscopy*

16. Resolution improves when the wavelength of the illuminating light decreases.

**TRUE**

*ASM Objective: 08.01 Properly prepare and view specimens for examination using microscopy (bright field and, if possible, phase contrast).*

*ASM Topic: Module 08 Microbiology Laboratory Skills*

*Blooms Level: 4. Analyze*

*Learning Outcome: 02.02.02 Predict the relative degree of resolution based on light wavelength and numerical aperture of the lens used to examine a specimen*

*Section: 02.02*

*Topic: Microscopy*

17. Immersion oil is used to prevent a specimen from drying out.

**FALSE**

*ASM Objective: 08.01 Properly prepare and view specimens for examination using microscopy (bright field and, if possible, phase contrast).*

*ASM Topic: Module 08 Microbiology Laboratory Skills*

*Blooms Level: 2. Understand*

*Learning Outcome: 02.02.01 Evaluate the parts of a light microscope in terms of their contributions to image production and use of the microscope*

*Section: 02.02*

*Topic: Microscopy*

18. It is possible to build a light microscope capable of 10,000× magnification, but the image would not be sharp because resolution is independent of magnification.

**TRUE**

*ASM Objective: 08.01 Properly prepare and view specimens for examination using microscopy (bright field and, if possible, phase contrast).*

*ASM Topic: Module 08 Microbiology Laboratory Skills*

*Blooms Level: 2. Understand*

*Learning Outcome: 02.02.02 Predict the relative degree of resolution based on light wavelength and numerical aperture of the lens used to examine a specimen*

*Section: 02.02*

*Topic: Microscopy*

19. Immersion oil increases the amount of light entering the objective lens.

**TRUE**

*ASM Objective: 08.01 Properly prepare and view specimens for examination using microscopy (bright field and, if possible, phase contrast).*

*ASM Topic: Module 08 Microbiology Laboratory Skills*

*Blooms Level: 2. Understand*

*Learning Outcome: 02.02.02 Predict the relative degree of resolution based on light wavelength and numerical aperture of the lens used to examine a specimen*

*Section: 02.02*

*Topic: Microscopy*

### **Multiple Choice Questions**

20. If the objective lenses of a microscope can be changed without losing focus on the specimen, they are said to be

A. equifocal.

B. totifocal.

**C. parfocal.**

D. optifocal.

*ASM Objective: 08.01 Properly prepare and view specimens for examination using microscopy (bright field and, if possible, phase contrast).*

*ASM Topic: Module 08 Microbiology Laboratory Skills*

*Blooms Level: 2. Understand*

*Learning Outcome: 02.02.01 Evaluate the parts of a light microscope in terms of their contributions to image production and use of the microscope*

*Section: 02.02*

*Topic: Microscopy*

21. An instrument that magnifies slight differences in the refractive index of cell structures is called a (n) \_\_\_\_\_ microscope.

- A.** phase-contrast
- B. electron
- C. fluorescence
- D. densitometric

*ASM Objective: 08.01 Properly prepare and view specimens for examination using microscopy (bright field and, if possible, phase contrast).*

*ASM Topic: Module 08 Microbiology Laboratory Skills*

*Blooms Level: 2. Understand*

*Learning Outcome: 02.02.03 Create a table that compares and contrasts the various types of light microscopes in terms of their uses, how images are created, and the quality of images produced*

*Section: 02.02*

*Topic: Microscopy*

22. The instrument that produces a bright image of the specimen against a dark background is called a (n) \_\_\_\_\_ microscope.

- A. phase-contrast
- B. electron
- C. bright-field
- D.** dark-field

*ASM Objective: 08.01 Properly prepare and view specimens for examination using microscopy (bright field and, if possible, phase contrast).*

*ASM Topic: Module 08 Microbiology Laboratory Skills*

*Blooms Level: 2. Understand*

*Learning Outcome: 02.02.03 Create a table that compares and contrasts the various types of light microscopes in terms of their uses, how images are created, and the quality of images produced*

*Section: 02.02*

*Topic: Microscopy*

23. As the magnification of a series of objective lenses increases, the working distance

- A. increases.
- B.** decreases.
- C. stays the same.
- D. cannot be predicted.

*ASM Objective: 08.01 Properly prepare and view specimens for examination using microscopy (bright field and, if possible, phase contrast).*

*ASM Topic: Module 08 Microbiology Laboratory Skills*

*Blooms Level: 4. Analyze*

*Learning Outcome: 02.01.02 Correlate lens strength and focal length*

*Section: 02.01*

*Topic: Microscopy*

24. Prior to staining, smears of microorganisms are heat-fixed in order to
- A. allow eventual visualization of internal structures.
  - B. ensure removal of dust particles from the slide surface.
  - C. attach it firmly to the slide.**
  - D. create small pores in cells that facilitates binding of stain to cell structures.

*ASM Objective: 08.01 Properly prepare and view specimens for examination using microscopy (bright field and, if possible, phase contrast).*

*ASM Topic: Module 08 Microbiology Laboratory Skills*

*Blooms Level: 2. Understand*

*Learning Outcome: 02.03.01 Recommend a fixation process to use when the microbe is a bacterium or archaeon and when the microbe is a protist*

*Section: 02.03*

*Topic: Preparing Microscopy Specimens*

25. Acid-fast organisms such as *Mycobacterium tuberculosis* contain \_\_\_\_\_ constructed from mycolic acids in their cell walls.
- A. proteins
  - B. carbohydrates
  - C. lipids**
  - D. peptidoglycan

*ASM Objective: 02.01 The structure and function of microorganisms have been revealed by the use of microscopy (including bright field, phase contrast, fluorescent, and electron).*

*ASM Objective: 02.02 Bacteria have unique cell structures that can be targets for antibiotics, immunity and phage infection.*

*ASM Topic: Module 02 Cell Structure and Function*

*Blooms Level: 2. Understand*

*Learning Outcome: 02.03.02 Plan a series of appropriate staining procedures to describe an unknown bacterium as fully as possible*

*Section: 02.03*

*Topic: Mycobacteria*

*Topic: Preparing Microscopy Specimens*

26. In the Gram-staining procedure, the primary stain is
- A. iodine.
  - B. safranin.
  - C. crystal violet.**
  - D. alcohol.

*ASM Objective: 08.01 Properly prepare and view specimens for examination using microscopy (bright field and, if possible, phase contrast).*

*ASM Topic: Module 08 Microbiology Laboratory Skills*

*Blooms Level: 1. Remember*

*Learning Outcome: 02.03.02 Plan a series of appropriate staining procedures to describe an unknown bacterium as fully as possible*

*Learning Outcome: 02.03.03 Compare what happens to Gram-positive and Gram-negative bacterial cells at each step of the Gram-staining procedure*

*Section: 02.03*

*Topic: Preparing Microscopy Specimens*

Chapter 02 - Microscopy

27. In the Gram-staining procedure, the decolorizer is

- A. iodine.
- B. safranin.
- C. crystal violet.
- D. ethanol or acetone.**

*ASM Objective: 08.01 Properly prepare and view specimens for examination using microscopy (bright field and, if possible, phase contrast).*

*ASM Topic: Module 08 Microbiology Laboratory Skills*

*Blooms Level: 1. Remember*

*Learning Outcome: 02.03.02 Plan a series of appropriate staining procedures to describe an unknown bacterium as fully as possible*

*Learning Outcome: 02.03.03 Compare what happens to Gram-positive and Gram-negative bacterial cells at each step of the Gram-staining procedure*

*Section: 02.03*

*Topic: Preparing Microscopy Specimens*

28. In the Gram-staining procedure, the counterstain is

- A. iodine.
- B. safranin.**
- C. crystal violet.
- D. alcohol.

*ASM Topic: Module 08 Microbiology Laboratory Skills*

*Blooms Level: 1. Remember*

*Learning Outcome: 02.03.02 Plan a series of appropriate staining procedures to describe an unknown bacterium as fully as possible*

*Learning Outcome: 02.03.03 Compare what happens to Gram-positive and Gram-negative bacterial cells at each step of the Gram-staining procedure*

*Section: 02.03*

*Topic: Identifying Microorganisms*

*Topic: Preparing Microscopy Specimens*

29. In the Gram-staining procedure, the mordant is

- A. iodine.**
- B. safranin.
- C. crystal violet.
- D. alcohol.

*ASM Objective: 08.01 Properly prepare and view specimens for examination using microscopy (bright field and, if possible, phase contrast).*

*ASM Topic: Module 08 Microbiology Laboratory Skills*

*Blooms Level: 1. Remember*

*Learning Outcome: 02.03.02 Plan a series of appropriate staining procedures to describe an unknown bacterium as fully as possible*

*Learning Outcome: 02.03.03 Compare what happens to Gram-positive and Gram-negative bacterial cells at each step of the Gram-staining procedure*

*Section: 02.03*

*Topic: Preparing Microscopy Specimens*

30. After the primary stain has been added but before the decolorizer has been used, gram-positive organisms are stained \_\_\_\_\_ and gram-negative organisms are stained \_\_\_\_\_.

- A.** purple; purple
- B. purple; colorless
- C. purple; pink
- D. pink; pink

*ASM Objective: 08.01 Properly prepare and view specimens for examination using microscopy (bright field and, if possible, phase contrast).*

*ASM Topic: Module 08 Microbiology Laboratory Skills*

*Blooms Level: 4. Analyze*

*Learning Outcome: 02.03.03 Compare what happens to Gram-positive and Gram-negative bacterial cells at each step of the Gram-staining procedure*

*Section: 02.03*

*Topic: Preparing Microscopy Specimens*

31. After the decolorizer has been added, gram-positive organisms are stained \_\_\_\_\_ and gram-negative organisms are stained \_\_\_\_\_.

- A. purple; purple
- B.** purple; colorless
- C. purple; pink
- D. pink; pink

*ASM Objective: 08.01 Properly prepare and view specimens for examination using microscopy (bright field and, if possible, phase contrast).*

*ASM Topic: Module 08 Microbiology Laboratory Skills*

*Blooms Level: 4. Analyze*

*Learning Outcome: 02.03.03 Compare what happens to Gram-positive and Gram-negative bacterial cells at each step of the Gram-staining procedure*

*Section: 02.03*

*Topic: Preparing Microscopy Specimens*

32. After the secondary stain has been added, gram-positive organisms are stained \_\_\_\_\_ and gram-negative organisms are stained \_\_\_\_\_.

- A. purple; purple
- B. purple; colorless
- C. purple; pink**
- D. pink; pink

*ASM Objective: 08.01 Properly prepare and view specimens for examination using microscopy (bright field and, if possible, phase contrast).*

*ASM Topic: Module 08 Microbiology Laboratory Skills*

*Blooms Level: 4. Analyze*

*Learning Outcome: 02.03.03 Compare what happens to Gram-positive and Gram-negative bacterial cells at each step of the Gram-staining procedure*

*Section: 02.03*

*Topic: Preparing Microscopy Specimens*

33. If the decolorizer is left on too long in the Gram-staining procedure, gram-positive organisms will be stained \_\_\_\_\_ and gram-negative organisms will be stained \_\_\_\_\_.

- A. purple; blue
- B. purple; colorless
- C. purple; pink
- D. pink; pink**

*ASM Objective: 08.01 Properly prepare and view specimens for examination using microscopy (bright field and, if possible, phase contrast).*

*ASM Topic: Module 08 Microbiology Laboratory Skills*

*Blooms Level: 4. Analyze*

*Learning Outcome: 02.03.03 Compare what happens to Gram-positive and Gram-negative bacterial cells at each step of the Gram-staining procedure*

*Section: 02.03*

*Topic: Preparing Microscopy Specimens*

34. If the decolorizer is not left on long enough in the Gram-staining procedure, gram-positive organisms will be stained \_\_\_\_\_ and gram-negative organisms will be stained \_\_\_\_\_.

- A. purple; purple
- B. purple; colorless
- C. purple; pink
- D. pink; pink

*ASM Objective: 08.01 Properly prepare and view specimens for examination using microscopy (bright field and, if possible, phase contrast).*

*ASM Topic: Module 08 Microbiology Laboratory Skills*

*Blooms Level: 4. Analyze*

*Learning Outcome: 02.03.03 Compare what happens to Gram-positive and Gram-negative bacterial cells at each step of the Gram-staining procedure*

*Section: 02.03*

*Topic: Preparing Microscopy Specimens*

35. Which of the following is considered to be a differential staining procedure?

- A. Gram stain
- B. Acid-fast stain
- C. Both Gram stain and Acid-fast stain
- D. Leifson's flagella stain

*ASM Objective: 08.01 Properly prepare and view specimens for examination using microscopy (bright field and, if possible, phase contrast).*

*ASM Topic: Module 08 Microbiology Laboratory Skills*

*Blooms Level: 2. Understand*

*Learning Outcome: 02.03.03 Compare what happens to Gram-positive and Gram-negative bacterial cells at each step of the Gram-staining procedure*

*Section: 02.03*

*Topic: Identifying Microorganisms*

*Topic: Preparing Microscopy Specimens*



36. Basic dyes such as methylene blue bind to cellular molecules that are
- A. hydrophobic.
  - B. negatively charged.**
  - C. positively charged.
  - D. aromatic.

*ASM Objective: 08.01 Properly prepare and view specimens for examination using microscopy (bright field and, if possible, phase contrast).*

*ASM Topic: Module 08 Microbiology Laboratory Skills*

*Blooms Level: 2. Understand*

*Learning Outcome: 02.03.02 Plan a series of appropriate staining procedures to describe an unknown bacterium as fully as possible*

*Section: 02.03*

*Topic: Preparing Microscopy Specimens*

### **True / False Questions**

37. Gram staining divides bacterial species into two groups based on differences in cell wall structure.

**TRUE**

*ASM Objective: 02.01 The structure and function of microorganisms have been revealed by the use of microscopy (including bright field, phase contrast, fluorescent, and electron).*

*ASM Objective: 08.01 Properly prepare and view specimens for examination using microscopy (bright field and, if possible, phase contrast).*

*ASM Topic: Module 02 Cell Structure and Function*

*ASM Topic: Module 08 Microbiology Laboratory Skills*

*Blooms Level: 2. Understand*

*Learning Outcome: 02.03.03 Compare what happens to Gram-positive and Gram-negative bacterial cells at each step of the Gram-staining procedure*

*Section: 02.03*

*Topic: Bacterial Cellular Morphology*

*Topic: Preparing Microscopy Specimens*

38. Negative staining facilitates the visualization of bacterial capsules that are intensely stained by the procedure.

**FALSE**

*ASM Objective: 02.01 The structure and function of microorganisms have been revealed by the use of microscopy (including bright field, phase contrast, fluorescent, and electron).*

*ASM Objective: 02.03 Bacteria and Archaea have specialized structures (e.g. flagella, endospores, and pili) that often confer critical capabilities.*

*ASM Objective: 08.01 Properly prepare and view specimens for examination using microscopy (bright field and, if possible, phase contrast).*

*ASM Topic: Module 02 Cell Structure and Function*

*ASM Topic: Module 08 Microbiology Laboratory Skills*

*Blooms Level: 2. Understand*

*Learning Outcome: 02.03.02 Plan a series of appropriate staining procedures to describe an unknown bacterium as fully as possible*

*Section: 02.03*

*Topic: Bacterial Cellular Morphology*

*Topic: Microscopy*

*Topic: Preparing Microscopy Specimens*

39. Negative staining with India ink can be used to reveal the presence of capsules that surround bacterial cells.

**TRUE**

*ASM Objective: 02.01 The structure and function of microorganisms have been revealed by the use of microscopy (including bright field, phase contrast, fluorescent, and electron).*

*ASM Objective: 02.03 Bacteria and Archaea have specialized structures (e.g. flagella, endospores, and pili) that often confer critical capabilities.*

*ASM Objective: 08.01 Properly prepare and view specimens for examination using microscopy (bright field and, if possible, phase contrast).*

*ASM Topic: Module 02 Cell Structure and Function*

*ASM Topic: Module 08 Microbiology Laboratory Skills*

*Blooms Level: 2. Understand*

*Learning Outcome: 02.03.02 Plan a series of appropriate staining procedures to describe an unknown bacterium as fully as possible*

*Section: 02.03*

*Topic: Bacterial Cellular Morphology*

*Topic: Microscopy*

*Topic: Preparing Microscopy Specimens*

40. Mordants increase the binding between a stain and specimen.

**TRUE**

*ASM Objective: 08.01 Properly prepare and view specimens for examination using microscopy (bright field and, if possible, phase contrast).*

*ASM Topic: Module 08 Microbiology Laboratory Skills*

*Blooms Level: 2. Understand*

*Learning Outcome: 02.03.02 Plan a series of appropriate staining procedures to describe an unknown bacterium as fully as possible*

*Section: 02.03*

*Topic: Microscopy*

*Topic: Preparing Microscopy Specimens*

41. In order to stain flagella so that they may be readily observed by light microscopy, it is usually necessary to increase their thickness.

**TRUE**

*ASM Objective: 02.01 The structure and function of microorganisms have been revealed by the use of microscopy (including bright field, phase contrast, fluorescent, and electron).*

*ASM Objective: 02.03 Bacteria and Archaea have specialized structures (e.g. flagella, endospores, and pili) that often confer critical capabilities.*

*ASM Objective: 08.01 Properly prepare and view specimens for examination using microscopy (bright field and, if possible, phase contrast).*

*ASM Topic: Module 02 Cell Structure and Function*

*ASM Topic: Module 08 Microbiology Laboratory Skills*

*Blooms Level: 2. Understand*

*Learning Outcome: 02.03.02 Plan a series of appropriate staining procedures to describe an unknown bacterium as fully as possible*

*Section: 02.03*

*Topic: Bacterial Cellular Morphology*

*Topic: Microscopy*

*Topic: Preparing Microscopy Specimens*

### **Fill in the Blank Questions**

42. The procedure in which a single stain is used to visualize microorganisms is called

\_\_\_\_\_ staining.

**simple**

*ASM Objective: 08.01 Properly prepare and view specimens for examination using microscopy (bright field and, if possible, phase contrast).*

*ASM Topic: Module 08 Microbiology Laboratory Skills*

*Blooms Level: 1. Remember*

*Learning Outcome: 02.03.02 Plan a series of appropriate staining procedures to describe an unknown bacterium as fully as possible*

*Section: 02.03*

*Topic: Microscopy*

*Topic: Preparing Microscopy Specimens*

43. \_\_\_\_\_ is the process by which internal and external structures of cells and organisms are preserved and maintained in position.

**Fixation**

*ASM Objective: 08.01 Properly prepare and view specimens for examination using microscopy (bright field and, if possible, phase contrast).*

*ASM Topic: Module 08 Microbiology Laboratory Skills*

*Blooms Level: 1. Remember*

*Learning Outcome: 02.03.01 Recommend a fixation process to use when the microbe is a bacterium or archaeon and when the microbe is a protist*

*Section: 02.03*

*Topic: Bacterial Cellular Morphology*

*Topic: Preparing Microscopy Specimens*

44. Thin films of bacteria that have been air-dried onto a glass microscope slide are called \_\_\_\_\_.

**smears**

*ASM Objective: 08.01 Properly prepare and view specimens for examination using microscopy (bright field and, if possible, phase contrast).*

*ASM Topic: Module 08 Microbiology Laboratory Skills*

*Blooms Level: 1. Remember*

*Learning Outcome: 02.03.02 Plan a series of appropriate staining procedures to describe an unknown bacterium as fully as possible*

*Section: 02.03*

*Topic: Microscopy*

*Topic: Preparing Microscopy Specimens*

45. A procedure that divides organisms into two or more groups depending on their individual reactions to the same staining procedure is referred to as \_\_\_\_\_ staining.

**differential**

*ASM Objective: 08.01 Properly prepare and view specimens for examination using microscopy (bright field and, if possible, phase contrast).*

*ASM Topic: Module 08 Microbiology Laboratory Skills*

*Blooms Level: 1. Remember*

*Learning Outcome: 02.03.02 Plan a series of appropriate staining procedures to describe an unknown bacterium as fully as possible*

*Section: 02.03*

*Topic: Microscopy*

*Topic: Preparing Microscopy Specimens*

## Multiple Choice Questions

46. The Gram-staining procedure is an example of \_\_\_\_\_.

- A. simple staining
- B. negative staining
- C. differential staining**
- D. fluorescent staining

*ASM Objective: 08.01 Properly prepare and view specimens for examination using microscopy (bright field and, if possible, phase contrast).*

*ASM Topic: Module 08 Microbiology Laboratory Skills*

*Blooms Level: 2. Understand*

*Learning Outcome: 02.03.03 Compare what happens to Gram-positive and Gram-negative bacterial cells at each step of the Gram-staining procedure*

*Section: 02.03*

*Topic: Preparing Microscopy Specimens*

## True / False Questions

47. The Gram-staining procedure is widely used because it allows rapid identification of a microorganism with little additional testing.

**FALSE**

*ASM Objective: 08.01 Properly prepare and view specimens for examination using microscopy (bright field and, if possible, phase contrast).*

*ASM Topic: Module 08 Microbiology Laboratory Skills*

*Blooms Level: 3. Apply*

*Learning Outcome: 02.03.02 Plan a series of appropriate staining procedures to describe an unknown bacterium as fully as possible*

*Section: 02.03*

*Topic: Identifying Microorganisms*

*Topic: Preparing Microscopy Specimens*

### Multiple Choice Questions

48. Regions of a specimen with higher electron density scatter \_\_\_\_\_ electrons and, therefore, appear \_\_\_\_\_ in the image projected onto the screen of a transmission electron microscope.

A. more; lighter

**B.** more; darker

C. fewer; darker

D. fewer; lighter

*ASM Objective: 08.01 Properly prepare and view specimens for examination using microscopy (bright field and, if possible, phase contrast).*

*ASM Topic: Module 08 Microbiology Laboratory Skills*

*Blooms Level: 2. Understand*

*Learning Outcome: 02.04.01 Create a concept map, illustration, or table that compares transmission electron microscopes (TEMs) to light microscopes*

*Learning Outcome: 02.04.02 Decide when it would be best to examine a microbe by TEM, scanning electron microscopy (SEM), and electron cryotomography*

*Section: 02.04*

*Topic: Microscopy*

*Topic: Preparing Microscopy Specimens*

### True / False Questions

49. Because transmission electron microscopy uses electrons rather than light, it is not necessary to stain biological specimens before observing them.

**FALSE**

*ASM Objective: 08.01 Properly prepare and view specimens for examination using microscopy (bright field and, if possible, phase contrast).*

*ASM Topic: Module 08 Microbiology Laboratory Skills*

*Blooms Level: 2. Understand*

*Learning Outcome: 02.04.01 Create a concept map, illustration, or table that compares transmission electron microscopes (TEMs) to light microscopes*

*Learning Outcome: 02.04.02 Decide when it would be best to examine a microbe by TEM, scanning electron microscopy (SEM), and electron cryotomography*

*Section: 02.04*

*Topic: Microscopy*

*Topic: Preparing Microscopy Specimens*

50. Scanning electron microscopes bombard specimens with a stream of electrons; however, the specimen image is produced by electrons that are derived from atoms of the specimen itself rather than by the electrons used to bombard the specimen.

**TRUE**

*ASM Objective: 08.01 Properly prepare and view specimens for examination using microscopy (bright field and, if possible, phase contrast).*

*ASM Topic: Module 08 Microbiology Laboratory Skills*

*Blooms Level: 2. Understand*

*Learning Outcome: 02.04.01 Create a concept map, illustration, or table that compares transmission electron microscopes (TEMs) to light microscopes*

*Learning Outcome: 02.04.02 Decide when it would be best to examine a microbe by TEM, scanning electron microscopy (SEM), and electron cryotomography*

*Section: 02.04*

*Topic: Microscopy*

*Topic: Preparing Microscopy Specimens*

51. It was possible to view viruses only after the invention of the electron microscope because they are too small to be seen with a light microscope.

**TRUE**

*ASM Objective: 02.01 The structure and function of microorganisms have been revealed by the use of microscopy (including bright field, phase contrast, fluorescent, and electron).*

*ASM Objective: 08.01 Properly prepare and view specimens for examination using microscopy (bright field and, if possible, phase contrast).*

*ASM Topic: Module 02 Cell Structure and Function*

*ASM Topic: Module 08 Microbiology Laboratory Skills*

*Blooms Level: 2. Understand*

*Learning Outcome: 02.04.01 Create a concept map, illustration, or table that compares transmission electron microscopes (TEMs) to light microscopes*

*Learning Outcome: 02.04.02 Decide when it would be best to examine a microbe by TEM, scanning electron microscopy (SEM), and electron cryotomography*

*Section: 02.04*

*Topic: Microscopy*

### Fill in the Blank Questions

52. An electron microscope uses \_\_\_\_\_ lenses to focus beams of electrons onto a specimen.

**magnetic**

*ASM Objective: 08.01 Properly prepare and view specimens for examination using microscopy (bright field and, if possible, phase contrast).*

*ASM Topic: Module 08 Microbiology Laboratory Skills*

*Blooms Level: 2. Understand*

*Learning Outcome: 02.04.01 Create a concept map, illustration, or table that compares transmission electron microscopes (TEMs) to light microscopes*

*Section: 02.04*

*Topic: Microscopy*

### Multiple Choice Questions

53. Scanning electron microscopy is most often used to reveal

**A.** surface structures.

B. internal structures.

C. both surface and internal structures simultaneously.

D. either surface or internal structures, but not simultaneously.

*ASM Objective: 08.01 Properly prepare and view specimens for examination using microscopy (bright field and, if possible, phase contrast).*

*ASM Topic: Module 08 Microbiology Laboratory Skills*

*Blooms Level: 2. Understand*

*Learning Outcome: 02.04.02 Decide when it would be best to examine a microbe by TEM, scanning electron microscopy (SEM), and electron cryotomography*

*Section: 02.04*

*Topic: Microscopy*

54. Small internal cell structures are best visualized with a
- A. light microscope.
  - B. dark-field microscope.
  - C. transmission electron microscope.**
  - D. flagellar microscope.

*ASM Objective: 08.01 Properly prepare and view specimens for examination using microscopy (bright field and, if possible, phase contrast).*

*ASM Topic: Module 08 Microbiology Laboratory Skills*

*Blooms Level: 2. Understand*

*Learning Outcome: 02.04.02 Decide when it would be best to examine a microbe by TEM, scanning electron microscopy (SEM), and electron cryotomography*

*Section: 02.04*

*Topic: Bacterial Cellular Morphology*

*Topic: Microscopy*

55. In transmission electron microscopy, spreading a specimen out in a thin film with uranyl acetate, which does not penetrate the specimen, is called
- A. freeze-etching.
  - B. simple staining.
  - C. shadow staining.
  - D. negative staining.**

*ASM Objective: 08.01 Properly prepare and view specimens for examination using microscopy (bright field and, if possible, phase contrast).*

*ASM Topic: Module 08 Microbiology Laboratory Skills*

*Blooms Level: 2. Understand*

*Learning Outcome: 02.04.01 Create a concept map, illustration, or table that compares transmission electron microscopes (TEMs) to light microscopes*

*Learning Outcome: 02.04.02 Decide when it would be best to examine a microbe by TEM, scanning electron microscopy (SEM), and electron cryotomography*

*Section: 02.04*

*Topic: Microscopy*

*Topic: Preparing Microscopy Specimens*

## Fill in the Blank Questions



56. \_\_\_\_\_ breaks frozen specimens along lines of greatest weakness, often down the middle of lipid bilayer membranes so that they may be observed by transmission electron microscopy.

**Freeze-etching**

*ASM Objective: 08.01 Properly prepare and view specimens for examination using microscopy (bright field and, if possible, phase contrast).*

*ASM Topic: Module 08 Microbiology Laboratory Skills*

*Blooms Level: 2. Understand*

*Learning Outcome: 02.04.02 Decide when it would be best to examine a microbe by TEM, scanning electron microscopy (SEM), and electron cryotomography*

*Section: 02.04*

*Topic: Microscopy*

*Topic: Preparing Microscopy Specimens*

57. The \_\_\_\_\_ microscope is capable of atomic resolution of specimens, even when they are immersed in water.

**Scanning tunneling**

*ASM Objective: 08.01 Properly prepare and view specimens for examination using microscopy (bright field and, if possible, phase contrast).*

*ASM Topic: Module 08 Microbiology Laboratory Skills*

*Blooms Level: 2. Understand*

*Learning Outcome: 02.05.01 Distinguish scanning tunneling from atomic force microscopes in terms of how they create images and their uses*

*Section: 02.05*

*Topic: Microscopy*

58. The designer of the first transmission electron microscope, \_\_\_\_\_, was awarded the 1986 Nobel Prize in physics.

**Ernst Ruska**

*ASM Objective: 08.01 Properly prepare and view specimens for examination using microscopy (bright field and, if possible, phase contrast).*

*ASM Topic: Module 08 Microbiology Laboratory Skills*

*Blooms Level: 1. Remember*

*Learning Outcome: 02.04.02 Decide when it would be best to examine a microbe by TEM, scanning electron microscopy (SEM), and electron cryotomography*

*Section: 02.04*

*Topic: History of Microbiology*

*Topic: Microscopy*

**Multiple Choice Questions**

59. Atomic force microscopes use a scanning probe that maintains a fixed distance from the surface of the specimen. It is useful for specimens that
- A.** do not conduct electricity well.
  - B. have extremely uneven surfaces.
  - C. both do not conduct electricity well and have extremely uneven surfaces are correct.
  - D. neither do not conduct electricity well nor have extremely uneven surfaces is correct.

*ASM Objective: 08.01 Properly prepare and view specimens for examination using microscopy (bright field and, if possible, phase contrast).*

*ASM Topic: Module 08 Microbiology Laboratory Skills*

*Blooms Level: 2. Understand*

*Learning Outcome: 02.05.01 Distinguish scanning tunneling from atomic force microscopes in terms of how they create images and their uses*

*Section: 02.05*

*Topic: Microscopy*

### **True / False Questions**

60. Scanning tunneling electron microscopes create a three-dimensional image of specimens at atomic level resolution.

**TRUE**

*ASM Objective: 08.01 Properly prepare and view specimens for examination using microscopy (bright field and, if possible, phase contrast).*

*ASM Topic: Module 08 Microbiology Laboratory Skills*

*Blooms Level: 2. Understand*

*Learning Outcome: 02.05.01 Distinguish scanning tunneling from atomic force microscopes in terms of how they create images and their uses*

*Section: 02.05*

*Topic: Microscopy*

### **Multiple Choice Questions**

61. If immersion oil was replaced with water, what would happen?
- A. The refractive index would increase, improving resolution.
  - B.** The refractive index of water would be greater than air but less than oil, improving resolution less than oil.
  - C. The refractive index of water would be less than that of air, decreasing resolution.
  - D. There would be no difference.

*ASM Objective: 08.01 Properly prepare and view specimens for examination using microscopy (bright field and, if possible, phase contrast).*  
*ASM Topic: Module 08 Microbiology Laboratory Skills*  
*Blooms Level: 4. Analyze*  
*Learning Outcome: 02.02.02 Predict the relative degree of resolution based on light wavelength and numerical aperture of the lens used to examine a specimen*  
*Section: 02.02*  
*Topic: Microscopy*

62. As the resolution of a microscope system improves, the size of the smallest object that can be seen clearly
- A. is larger.
  - B.** is smaller.
  - C. is not affected.

*ASM Objective: 08.01 Properly prepare and view specimens for examination using microscopy (bright field and, if possible, phase contrast).*  
*ASM Topic: Module 08 Microbiology Laboratory Skills*  
*Blooms Level: 3. Apply*  
*Section: 02.02*  
*Topic: Microscopy*

63. If you forgot to heat fix a smear before doing a Gram stain, which of the following might occur?
- A. The stains would not adhere to the bacteria.
  - B.** The smear may not adhere to the slide.
  - C. The decolorization step of the Gram stain would not work properly.
  - D. Gram-positive and Gram-negative bacteria would both stain purple.

*ASM Objective: 08.01 Properly prepare and view specimens for examination using microscopy (bright field and, if possible, phase contrast).*  
*ASM Topic: Module 08 Microbiology Laboratory Skills*  
*Blooms Level: 4. Analyze*  
*Learning Outcome: 02.03.01 Recommend a fixation process to use when the microbe is a bacterium or archaeon and when the microbe is a protist*  
*Learning Outcome: 02.03.03 Compare what happens to Gram-positive and Gram-negative bacterial cells at each step of the Gram-staining procedure*  
*Section: 02.03*  
*Topic: Microscopy*  
*Topic: Preparing Microscopy Specimens*

64. A specimen has been prepared for viewing with a transmission electron microscope, using uranyl acetate as a negative stain. The area stained by the uranyl acetate will be \_\_\_\_\_ electron dense compared to specimen itself.

- A.** more
- B. less
- C. equally

*ASM Objective: 08.01 Properly prepare and view specimens for examination using microscopy (bright field and, if possible, phase contrast).*

*ASM Topic: Module 08 Microbiology Laboratory Skills*

*Blooms Level: 3. Apply*

*Learning Outcome: 02.04.01 Create a concept map, illustration, or table that compares transmission electron microscopes (TEMs) to light microscopes*

*Learning Outcome: 02.04.02 Decide when it would be best to examine a microbe by TEM, scanning electron microscopy (SEM), and electron cryotomography*

*Section: 02.04*

*Topic: Microscopy*

*Topic: Preparing Microscopy Specimens*

65. If you forgot the decolorization step while performing a Gram stain, which outcome would you expect?

- A. Gram-positive bacteria would stain pink.
- B.** Gram-negative bacteria would stain purple.
- C. Gram-negative bacteria would be unstained.
- D. Gram-positive bacteria would be unstained.

*ASM Objective: 08.01 Properly prepare and view specimens for examination using microscopy (bright field and, if possible, phase contrast).*

*ASM Topic: Module 08 Microbiology Laboratory Skills*

*Blooms Level: 4. Analyze*

*Learning Outcome: 02.03.03 Compare what happens to Gram-positive and Gram-negative bacterial cells at each step of the Gram-staining procedure*

*Section: 02.03*

*Topic: Preparing Microscopy Specimens*

66. If you forgot to apply the safranin counterstain while performing a Gram stain, which outcome would you expect?

- A. Gram-positive bacteria would stain pink.
- B. Gram-negative bacteria would stain purple.
- C. Gram-negative and Gram-positive bacteria would be unstained.
- D. Gram-negative bacteria would be unstained.**

*ASM Objective: 08.01 Properly prepare and view specimens for examination using microscopy (bright field and, if possible, phase contrast).*

*ASM Topic: Module 08 Microbiology Laboratory Skills*

*Blooms Level: 4. Analyze*

*Learning Outcome: 02.03.03 Compare what happens to Gram-positive and Gram-negative bacterial cells at each step of the Gram-staining procedure*

*Section: 02.03*

*Topic: Preparing Microscopy Specimens*

67. Which type of microscopy would be preferred for creating a three dimensional view of the distribution and arrangement of flagella on a bacterial cell surface?

- A. Bright-field microscopy
- B. Scanning electron microscopy**
- C. Fluorescence microscopy
- D. Transmission electron microscopy

*ASM Objective: 08.01 Properly prepare and view specimens for examination using microscopy (bright field and, if possible, phase contrast).*

*ASM Topic: Module 08 Microbiology Laboratory Skills*

*Blooms Level: 3. Apply*

*Learning Outcome: 02.04.02 Decide when it would be best to examine a microbe by TEM, scanning electron microscopy (SEM), and electron cryotomography*

*Learning Outcome: 02.05.02 Evaluate light microscopy, electron microscopy, and scanning probe microscopy in terms of their uses, resolution, and the quality of the images created*

*Section: 02.04*

*Section: 02.05*

*Topic: Microscopy*

Chapter 02 - Microscopy

68. Which type of microscopy would be preferred for showing fine internal detail of the eukaryotic organelles?

- A. Bright-field microscopy
- B. Scanning electron microscopy
- C. Fluorescence microscopy
- D. Transmission electron microscopy**

*ASM Objective: 08.01 Properly prepare and view specimens for examination using microscopy (bright field and, if possible, phase contrast).*

*ASM Topic: Module 08 Microbiology Laboratory Skills*

*Blooms Level: 3. Apply*

*Learning Outcome: 02.04.02 Decide when it would be best to examine a microbe by TEM, scanning electron microscopy (SEM), and electron cryotomography*

*Learning Outcome: 02.05.02 Evaluate light microscopy, electron microscopy, and scanning probe microscopy in terms of their uses, resolution, and the quality of the images created*

*Section: 02.04*

*Section: 02.05*

*Topic: Microscopy*

69. You are researching the structure of a transmembrane protein. Which type of microscopy would provide you the best view of this protein?

- A. Bright field microscopy
- B. Scanning electron microscopy
- C. Transmission electron microscopy
- D. Atomic force microscopy**

*ASM Objective: 08.01 Properly prepare and view specimens for examination using microscopy (bright field and, if possible, phase contrast).*

*ASM Topic: Module 08 Microbiology Laboratory Skills*

*Blooms Level: 3. Apply*

*Learning Outcome: 02.05.01 Distinguish scanning tunneling from atomic force microscopes in terms of how they create images and their uses*

*Learning Outcome: 02.05.02 Evaluate light microscopy, electron microscopy, and scanning probe microscopy in terms of their uses, resolution, and the quality of the images created*

*Section: 02.05*

*Topic: Microscopy*