

Chapter 1: A Brief History of Microbiology

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

- 1) Antoni van Leeuwenhoek was the first person in history to
- A) use a magnifying glass.
 - B) develop a taxonomic system.
 - C) view protozoa and bacteria.
 - D) disprove spontaneous generation.
 - E) prove the germ theory.

Answer: C

- 2) The microbes commonly known as _____ are single-celled eukaryotes that are generally motile.
- A) archaea
 - B) bacteria
 - C) fungi
 - D) protozoa
 - E) viruses

Answer: D

- 3) Which of the following statements about algae is FALSE?
- A) The group includes seaweeds and kelps.
 - B) They are photosynthetic organisms.
 - C) They provide most of the oxygen on Earth.
 - D) They are important in the degradation of dead plants and animals.
 - E) They are a source of food for aquatic and marine animals.

Answer: D

- 4) Microbes that can live in the presence or absence of oxygen are called
- A) anaerobes.
 - B) facultative anaerobes.
 - C) obligate parasites.
 - D) archaea.
 - E) prokaryotes.

Answer: B

- 5) Which of the following scientists provided evidence in favor of the concept of spontaneous generation?
- A) Pasteur
 - B) Needham
 - C) Redi
 - D) Buchner
 - E) Spallanzani

Answer: B

- 6) The microbial production of alcohol from sugar is known as
- A) fermentation.
 - B) pasteurization.
 - C) metabolism.
 - D) abiogenesis.
 - E) antiseptics.

Answer: A

- 7) Which of the following statements about fungi is FALSE?
- A) Fungi are eukaryotes.
 - B) Molds form hyphae.
 - C) Fungi have a cell wall.
 - D) Fungi are photosynthetic.
 - E) Yeast are unicellular.

Answer: D

- 8) Which of the following statements concerning Koch's postulates is FALSE?
- A) Koch's postulates cannot be used to demonstrate the cause of all diseases.
 - B) A suspected pathogen must be able to be grown in the laboratory.
 - C) All of Koch's postulates must be satisfied before an organism can be proven to cause a particular disease.
 - D) Koch's postulates involve the experimental infection of susceptible hosts.
 - E) A suspected pathogen must be found in the majority of individuals with a particular disease.

Answer: E

- 9) Which of the following individuals pioneered the use of chemicals to reduce the incidence of infections during surgery?
- A) Nightingale
 - B) Snow
 - C) Ehrlich
 - D) Lister
 - E) Semmelweis

Answer: D

- 10) The study of the body's defenses against pathogens is called
- A) etiology.
 - B) immunology.
 - C) chemotherapy.
 - D) molecular biology.
 - E) epidemiology.

Answer: B

- 11) Which of the following questions largely stimulated the research of microbes during what is known as the Golden Age of Microbiology?
- A) What causes disease?
 - B) How do genes work?
 - C) Is spontaneous generation of microbes possible?
 - D) How are microbes related?
 - E) What causes disease, and is spontaneous generation of microbes possible?

Answer: E

12) The microbial activity of _____ is responsible for the production of various foods.

- A) archaea
- B) bacteria
- C) fungi
- D) protozoa
- E) both fungi and bacteria

Answer: E

13) Who was the scientist who first hypothesized that gene sequences could provide new insights into evolutionary relationships between organisms such as microbes?

- A) Woese
- B) Avery
- C) Ehrlich
- D) Kluver
- E) Pauling

Answer: E

14) Work by _____ laid the foundations of the field of environmental microbiology.

- A) Redi and Spallanzani
- B) Koch and Pasteur
- C) Beijerinck and Winogradsky
- D) Lister and Semmelweis
- E) Pauling and Woese

Answer: C

15) According to Kluver and van Niel, which of the following are true of basic biochemical reactions?

- A) They are shared by all living things.
- B) There are an unlimited number of them.
- C) They primarily involve the transfer of electrons and ions.
- D) Basic biochemical reactions shared by all living things primarily involve transfer of electrons and hydrogen ions.
- E) They primarily involve transfers of chemical groups.

Answer: D

16) Semmelweis advocated handwashing as a method of preventing which of the following diseases?

- A) cholera
- B) puerperal fever
- C) smallpox
- D) anthrax
- E) syphilis

Answer: B

17) Paul Ehrlich used chemotherapy to treat

- A) cholera.
- B) cancer.
- C) anthrax.
- D) smallpox.
- E) syphilis.

Answer: E

18) Which of the following is NOT a characteristic of viruses?

- A) They are visible with a light microscope.
- B) They are acellular.
- C) They are composed of genetic material and protein.
- D) They are smaller than prokaryotic cells.
- E) They are obligatory parasites.

Answer: A

19) The first true vaccine protected against disease caused by a _____ pathogen.

- A) bacterial
- B) protozoal
- C) fungal
- D) viral
- E) archaeal

Answer: D

20) All of the following individuals were involved in improving public health in the 19th century EXCEPT

- A) Snow.
- B) Spallanzani.
- C) Nightingale.
- D) Semmelweis.
- E) Lister.

Answer: B

21) *Saccharomyces cerevisiae* is an example of which of the following types of microbes?

- A) fungus
- B) protozoan
- C) prokaryote
- D) alga
- E) virus

Answer: A

22) Inserting a gene from the hepatitis B virus into yeast so that the yeast produces a viral protein is an example of

- A) etiology.
- B) genetic engineering.
- C) immunology.
- D) microbial genetics.
- E) gene therapy.

Answer: B

23) Which of the following was NOT an aspect of Pasteur's experiments to disprove spontaneous generation?

- A) The necks of the flasks he used were bent into an S-shape.
- B) He boiled the infusions to kill any microbes present.
- C) The flasks were incubated for very long periods of time.
- D) The flasks were free of microbes until they were opened.
- E) The flasks he used were sealed with corks.

Answer: E

- 24) Proteins that promote chemical reactions in the cell are called
- A) spores.
 - B) enzymes.
 - C) genes.
 - D) protozoa.
 - E) flagella.

Answer: B

- 25) Which of the following is NOT a characteristic of protozoa?
- A) Most exhibit asexual reproduction.
 - B) They are single-celled organisms.
 - C) They are eukaryotic organisms.
 - D) They are the microbes most similar to plants.
 - E) They frequently possess cilia or flagella.

Answer: D

- 26) Which of the following scientists was the first to develop a taxonomic system for classifying organisms?
- A) Linnaeus
 - B) Needham
 - C) Leeuwenhoek
 - D) Lister
 - E) Pasteur

Answer: A

- 27) Which of the following is NOT an observation Pasteur made concerning the fermentation of grape juice?
- A) Yeast can grow with or without oxygen.
 - B) Bacteria produce acid in grape juice.
 - C) Pasteurization kills yeast to prevent spoilage of grape juice.
 - D) Yeast cells can grow and reproduce in grape juice.
 - E) Yeast can grow in sealed or open flasks of grape juice.

Answer: C

- 28) Put the following events in the history of microbiology in order, from the earliest to the latest:
- I. Leeuwenhoek observes microbes using a microscope.
 - II. Pasteur disproves spontaneous generation.
 - III. Woese discovers the archaea.
 - IV. Fracastoro proposes that "germs" cause disease.
 - V. Ehrlich discovers the first "magic bullet."
- A) III, IV, I, II, V
 - B) V, IV, I, III, II
 - C) IV, I, V, II, III
 - D) III, V, II, IV, I
 - E) IV, I, II, V, III

Answer: E

- 29) John Snow's research during a cholera outbreak in London laid the foundation for which of the following branches of microbiology?
- A) infection control
 - B) epidemiology
 - C) immunology
 - D) both infection control and epidemiology
 - E) infection control, epidemiology, and immunology

Answer: D

- 30) Robert Koch was involved in research on all of the following topics EXCEPT
- A) the cause of anthrax.
 - B) the cause of fermentation.
 - C) development of a method to prove the cause of an infectious disease.
 - D) the cause of tuberculosis.
 - E) techniques for isolating microbes in the laboratory.

Answer: B

- 31) Which of the following is an INCORRECT pairing?
- A) protozoa: multicellular
 - B) fungi: cell walls
 - C) algae: aquatic and marine habitats
 - D) prokaryotes: no nuclei
 - E) viruses: acellular parasites

Answer: A

- 32) What was the first disease proven to be bacterial in origin?
- A) yellow fever
 - B) cholera
 - C) anthrax
 - D) malaria
 - E) tuberculosis

Answer: C

- 33) The work of Lister, Nightingale, and Semmelweis all contributed to controlling infectious disease by
- A) developing techniques for isolating pathogens.
 - B) developing methods for reducing nosocomial infections.
 - C) identifying the sources of infectious agents.
 - D) determining the taxonomic relationships among microbes.
 - E) developing vaccines.

Answer: B

- 34) Who discovered penicillin?
- A) Fleming
 - B) Ehrlich
 - C) Kitasato
 - D) Pasteur
 - E) Domagk

Answer: A

35) All of the following were involved in developing the germ theory of disease EXCEPT

- A) Koch.
- B) Pauling.
- C) Fracastoro.
- D) Snow.
- E) Pasteur.

Answer: B

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

Match the terms with the appropriate description:

- A) Antisepsis
- B) Prokaryote
- C) Pathogen
- D) Bioremediation
- E) Abiogenesis
- F) Nosocomial

36) Microorganisms characterized by the absence of a nucleus

Answer: B

37) A term that literally means "against putrefaction"

Answer: A

38) Refers to an infection acquired in a health care setting

Answer: F

39) A term that literally means "produces disease"

Answer: C

Match the terms with the appropriate definition:

- A) Epidemiology
- B) Biotechnology
- C) Bioremediation
- D) Chemotherapy
- E) Serology
- F) Biochemistry
- G) Molecular biology
- H) Etiology

40) The study of the causation of disease

Answer: H

41) The use of microorganisms to restore damaged environments

Answer: C

42) The study of the blood components that fight infection

Answer: E

43) The study of the occurrence, distribution, and spread of disease

Answer: A

44) The study of the chemical reactions associated with living things

Answer: F

45) The use of microbes in the manufacture of useful products

Answer: B

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

46) The taxonomic scheme developed by Linnaeus remains largely unchanged in modern biology.

Answer: True False

47) Christian Gram devised a staining technique that divides all bacteria into two groups.

Answer: True False

48) The production of human blood-clotting factor by *E. coli* is an example of bioremediation.

Answer: True False

49) Walter Reed proved that a virus causes yellow fever in humans.

Answer: True False

50) Gene therapy is a modern approach to preventing infectious disease.

Answer: True False

51) Koch's postulates can be used only to prove the causes of infectious diseases.

Answer: True False

52) Joseph Lister reduced the incidence of wound infections in health care settings by using chlorinated lime water.

Answer: True False

53) Robert Koch developed a vaccine to prevent anthrax after identifying the causative agent.

Answer: True False

54) Fermentation can occur in the absence of living cells.

Answer: True False

55) Lazzaro Spallanzani was the first scientist to provide evidence disproving the spontaneous generation of microorganisms.

Answer: True False

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

56) Microbes that move by means of cilia are _____.

Answer: protozoa

- 57) A cell that contains a nucleus is called a(n) _____ cell.
Answer: eukaryotic
- 58) A(n) _____ organism makes its own food using solar energy.
Answer: photosynthetic
- 59) Microbes that cause infectious disease are called _____.
Answer: pathogens
- 60) _____ is an asexual method of reproduction associated with yeasts.
Answer: Budding
- 61) A(n) _____ is a potential explanation for a set of observations made by a scientist studying a phenomenon.
Answer: hypothesis
- 62) Bacteria that can live without oxygen are termed _____.
Answer: anaerobic
- 63) Robert Koch discovered the cause of _____, a disease of animals that can be spread to humans.
Answer: anthrax
- 64) A(n) _____ is a mass of cells that are descended from a single cell through successive cell divisions.
Answer: colony
- 65) The first true vaccine provided protection from disease caused by a(n) _____.
Answer: virus
- 66) Ignaz Semmelweis demonstrated the importance of _____ as a means of preventing disease transmission.
Answer: handwashing
- 67) _____, a term synonymous with immunization, is derived from the Latin name of the cowpox virus.
Answer: Vaccination
- 68) _____ is the use of chemicals to treat diseases such as bacterial infections.
Answer: Chemotherapy
- 69) Organisms such as bacteria that can convert atmospheric nitrogen into nitrate are often studied in _____ microbiology.
Answer: environmental
- 70) The _____ of an organism is all the chemical reactions that take place in the organism.
Answer: metabolism

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

71) Explain why there was such a long period of time between the era of Leeuwenhoek's work and the beginnings of the Golden Age of Microbiology.

Answer: There are many reasons for this large gap between scientific eras. One reason was that scientists after Leeuwenhoek were unable to duplicate the quality of his microscopes because he had been extremely secretive. Another reason was the absence of a philosophical framework for the study of microorganisms, which was developed only after Pasteur conducted his experiments disproving spontaneous generation and showing that microbes were basically similar to other forms of life in their origins. A third reason was that suitable methods for studying microbes were not available until the mid-19th century, the era of scientists such as Robert Koch and his colleagues (who devised methods of growing and isolating microbes) and Christian Gram (who devised an important staining technique useful in the classification of microbes).

72) Biotechnology can be said to have ancient roots. Explain.

Answer: Biotechnology is the use of microbes to yield beneficial products. Humans have used microbes to their benefit for millennia in producing beer and wine, which were often safer to drink than the available water, and in preserving foods. Examples of the latter include the production of wine, which essentially preserved fruit juices, and of cheese and yogurt, which extended the storage life of milk products. Soy sauce and other fermented sauces were also preserved by fermentation and were later shown to enhance the flavors of certain foods.

73) Use the basic steps of the scientific method to describe Pasteur's experiments to investigate spontaneous generation.

Answer: The observation that life seemed to appear from non-life led some scientists to believe in the theory of spontaneous generation. However, there were some who believed in biogenesis: that life must come from life. The question Pasteur hoped to answer was "Where do microbes come from?" Pasteur's hypothesis was that the "parents" of microbes were present in the air on dust particles and that spontaneous generation was not a valid theory. In his experiments he used swan-necked flasks, which were designed to prevent microbes from entering the sterile broth inside them. He observed that the broth remained sterile in the control flask even though air could move into and out of the flask. The experimental flasks were also swan-necked, but they were tilted to allow the dust that had settled to enter the flask. The control flasks stayed sterile, and the experimental flasks became cloudy. These observations led Pasteur to accept his hypothesis. He concluded that the microbes came from the dust and that spontaneous generation was therefore not a valid theory.

74) Explain how the discipline of biochemistry grew out of the science of microbiology.

Answer: Some of the first experiments in biochemistry are attributed to Louis Pasteur in his research on the causes of fermentation. His research was extended by Eduard Buchner, who showed that enzymes produced by microbial cells are responsible for the phenomenon of fermentation. Later, in the early 20th century, Kluyver and van Niel advocated the use of microbes in research on basic biochemical reactions, which they maintained are common to all living things. Further advances in biochemistry were made as microbiologists such as Beadle and Tatum and Avery and his colleagues explored the nature of the genetic material and its function using microorganisms as model systems.

75) Compare and contrast the three types of eukaryotic microbes.

Answer: The three types of eukaryotic microbes are fungi, protozoa, and algae. Because they are all composed of eukaryotic cells, they have basic similarities in cellular structure, including the presence of a nucleus. However, these types of microbes differ in many ways as well. In terms of their nutrition, fungi and protozoa obtain their food from other organisms, whereas algae can make their own food through photosynthesis. Algae and fungi can be multicellular organisms, but protozoa are found only as single-celled organisms. Protozoa are unique among the three in that they are animal-like in their characteristics, including movement. Algae are most like plants and are found in primarily water-based environments.