Package Title: Test Bank

Course Title: Karp8e

Chapter Number: 1

Question Type: Multiple Choice

1) Who was the first person to describe living single cells?

a) Leeuwenhoek

b) Hooke

c) Schleiden

d) Schwann

e) Virchow

Answer: a

Difficulty: Easy

Learning Objective: LO 1.1 List the three tenets of the Cell Theory.

Section Reference: Section 1.1 The Discovery of Cells

2) The first compound light microscopes were constructed by the end of the sixteenth century. What is a compound microscope?

a) It has a moveable stage.

b) It has two lenses.

c) Its lens is double the size of the original microscopes.

d) The lens has two different colors.

e) They have two different light sources.

Answer: b

Difficulty: Easy

Learning Objective: LO 1.1 List the three tenets of the Cell Theory.

Section Reference: Section 1.1 The Discovery of Cells

3) Which of the following is a tenet of the Cell Theory?

1) All organisms are composed of one or more cells.

2) The cell is the structural unit of life.

3) Cells can arise only by division from a preexisting cell.

4) Cells divide only by fission.

a) 1

b) 2

c) 3

d) 4

e) 1, 2 and 3

Answer: e

Difficulty: Medium

Learning Objective: LO 1.1 List the three tenets of the Cell Theory..

Section Reference: Section 1.1 The Discovery of Cells

4) Who is generally credited with the discovery of cells?

a) Leeuwenhoek

b) Hooke

c) Schleiden

d) Schwann

e) Virchow

Answer: b

Difficulty: Easy

Learning Objective: LO 1.1 List the three tenets of the Cell Theory.

Section Reference: Section 1.1 The Discovery of Cells

5) Despite being correct about the first two tenets of the Cell Theory, Schleiden and Schwann made an error about another central feature of cells. What was their error?

a) They stated that all cells were smaller than 2 µ in diameter.

b) They claimed that all cells were exactly the same in every detail.

c) They stated that all cells were immortal.

d) They both agreed that cells could arise from noncellular materials.

e) They claimed that all cells had nuclei through their entire existence.

Answer: d

Difficulty: Medium

Learning Objective: LO 1.1 List the three tenets of the Cell Theory.

Section Reference: Section 1.1 The Discovery of Cells

6) Which of the following characteristics is(are) not a basic property of cells?

a) Cells carry out a variety of emotional reactions.

b) Cells engage in numerous mechanical activities.

c) Cells generally respond to stimuli.

d) Cells are capable of self-regulation.

e) Cells evolve.

Answer: a

Difficulty: Easy

Learning Objective: LO 1.2 List the fundamental properties shared by all cells, explaining their importance.

Section Reference: Section 1.2 Basic Properties of Cells

7) Which of the following characteristics is(are) a basic property of cells?

a) Cells are highly complex and organized.

b) Cells possess a genetic program and the means to use it.

c) Cells are capable of producing more of themselves.

d) Cells acquire and utilize energy.

e) All of these are correct.

Answer: e

Difficulty: Easy

Learning Objective: LO 1.2 List the fundamental properties shared by all cells, explaining their importance.

Section Reference: Section 1.1 1.2 Basic Properties of Cells

8) The first culture of human cells was begun by George and Martha Gey of Johns Hopkins University in 1951). The cells were obtained from a malignant tumor and named \_\_\_\_\_\_ cells after the donor, \_\_\_\_\_\_\_\_\_.

a) HeLa, Herbert Lane

b) HeLa, Henrietta Lacks

c) Roberts, John Roberts

d) MaLe, Martin Lewis

e) HeLa, Helen Lassiter

Answer: b

Difficulty: Medium

Learning Objective: LO 1.2 List the fundamental properties shared by all cells, explaining their importance.

Section Reference: Section 1.1 1.2 Basic Properties of Cells

9) Cells grown in culture, outside the body are called \_\_\_\_\_\_\_\_ cells. They have become an essential tool of cell and molecular biologists.

a) in vivo

b) live

c) in vitro

d) in culturo

e) vivacious

Answer: c

Difficulty: Medium

Learning Objective: LO 1.2 List the fundamental properties shared by all cells, explaining their importance.

Section Reference: Section 1.2 Basic Properties of Cells

10) A high powered microscope that allows investigators to examine the detailed surfaces of cells is called a \_\_\_\_\_\_\_\_\_\_\_.

a) scanning electron microscope

b) transmission electron microscope

c) fluorescence microscope

d) scanning tunneling microscope

e) confocal laser scanning microscope

Answer: a

Difficulty: Easy

Learning Objective: LO 1.2 List the fundamental properties shared by all cells, explaining their importance.

Section Reference: Section 1.1 1.2 Basic Properties of Cells

11) A \_\_\_\_\_\_\_\_\_\_\_\_\_\_ is used to reveal the detailed internal structure of cells.

a) scanning electron microscope

b) transmission electron microscope

c) fluorescence microscope

d) scanning tunneling microscope

e) confocal laser scanning microscope

Answer: b

Difficulty: Easy

Learning Objective: LO 1.2 List the fundamental properties shared by all cells, explaining their importance.

Section Reference: Section 1.1 1.2 Basic Properties of Cells

12) The apical ends of intestinal cells face the intestinal channel and have long processes that facilitate the absorption of nutrients. What is the name of these processes and what cytoskeletal element forms their internal skeleton?

a) microvilli, microtubules

b) villi, microtubules

c) microvilli, actin filaments

d) villi, actin filaments

e) microvilli, intermediate filaments

Answer: c

Difficulty: Medium

Learning Objective: LO 1.2 List the fundamental properties shared by all cells, explaining their importance.

Section Reference: Section 1.1 1.2 Basic Properties of Cells

13) Virtually all chemical changes that take place in cells require \_\_\_\_\_\_\_\_, molecules that greatly increase the rate at which a chemical reaction occurs.

a) DNAs

b) carbohydrates

c) proteins

d) enzymes

e) emzymes

Answer: d

Difficulty: Easy

Learning Objective: LO 1.2 List the fundamental properties shared by all cells, explaining their importance.

Section Reference: Section 1.1 1.2 Basic Properties of Cells

14) You are conducting an experiment by trying to reproduce the work performed in 1891 by Hans Driesch, a German embryologist. You are working with a fertilized sea urchin egg and allow it to complete the first cell division after fertilization. You then carefully separate the two cells of the embryo and allow their development to continue. Based on Driesch's experiment, which result below would you expect to happen?

a) Both of the cells will die.

b) Both cells develop into complete and normal embryos that are somewhat smaller.

c) One cell develops into a normal, though smaller, embryo; the other dies.

d) One cell develops into half an embryo; the other develops into the other half of the embryo.

e) One cell develops into a defective embryo and the other dies.

Answer: b

Difficulty: Hard

Learning Objective: LO 1.2 List the fundamental properties shared by all cells, explaining their importance.

Section Reference: Section 1.1 1.2 Basic Properties of Cells

15) What factor or factors discovered with electron microscopy distinguished prokaryotic from eukaryotic cells?

1) their size

2) their color

3) the types of their internal structures or organelles

4) their fragility

a) 1

b) 2

c) 3

d) 4

e) 1 and 3

Answer: e

Difficulty: Medium

Learning Objective: LO 1.3 Compare and contrast the structure and function of a prokaryotic cell and a eukaryotic cell. Section Reference: Section 1.3 Characteristics that Distinguish Prokaryotic and Eukaryotic Cells

16) What characteristics distinguish prokaryotic and eukaryotic cells?

a) Eukaryotes have membrane-bound organelles; prokaryotes do not.

b) Prokaryotes have relatively little DNA; eukaryotes generally have much more.

c) Eukaryotic chromosomes are linear; prokaryotic chromosomes are circular.

d) Prokaryotic DNA is naked or nearly naked; eukaryotic DNA is usually heavily associated with protein.

e) All of these are correct.

Answer: e

Difficulty: Medium

Learning Objective: LO 1.3 Compare and contrast the structure and function of a prokaryotic cell and a eukaryotic cell.

Section Reference: Section 1.3 Characteristics that Distinguish Prokaryotic and Eukaryotic Cells

17) Which of the following are not considered to belong to the Archaea?

a) Methanogens

b) Halophiles

c) Acidophiles

d) Thermophiles

e) Eubacteria

Answer: e

Difficulty: Easy

Learning Objective: LO 1.4 Explain how study of the metagenome increases our understanding of prokaryotic diversity.

Section Reference: Section 1.4 Types of Prokaryotic Cells

18) Which of the following are considered to be eukaryotes?

a) amoebae

b) yeast

c) holly

d) starfish

e) All of these choices are correct.

Answer: e

Learning Objective: LO 1.3 Compare and contrast the structure and function of a prokaryotic cell and a eukaryotic cell.

Section Reference: Section 1.3 Characteristics that Distinguish Prokaryotic and Eukaryotic Cells

19) The genetic material of a prokaryotic cell is present in a \_\_\_\_\_\_\_\_\_, a poorly demarcated region of the cell that lacks a boundary membrane to separate it from the surrounding cytoplasm.

a) nucleus

b) chromatic region

c) nucleoid

d) pharmacopeia

e) genetome

Answer: c

Difficulty: Easy

Learning Objective: LO 1.4 Explain how study of the metagenome increases our understanding of prokaryotic diversity.

Section Reference: Section 1.4 Types of Prokaryotic Cells

20) Bacteria will often pass a piece of DNA from a donor bacterial cell to a recipient bacterial cell presumably through a structure called a pilus. What is this process called?

a) confirmation

b) transduction

c) transformation

d) conjugation

e) fission

Answer: d

Difficulty: Easy

Learning Objective: LO 1.3 Compare and contrast the structure and function of a prokaryotic cell and a eukaryotic cell.

Section Reference: Section 1.3 Characteristics that Distinguish Prokaryotic and Eukaryotic Cells

21) Cyanobacteria are obviously capable of photosynthesis, but many of them also convert nitrogen gas into reduced forms of nitrogen (such as ammonia) that can be used by cells in the synthesis of nitrogen-containing organic compounds, including amino acids and nucleotides. This process is called \_\_\_\_\_\_.

a) nitrogen fixation

b) denitrification

c) nitrification

d) respiration

e) ammoniation

Answer: a

Difficulty: Easy

Learning Objective: LO 1.4 Explain how study of the metagenome increases our understanding of prokaryotic diversity.

Section Reference: Section 1.4 Types of Prokaryotic Cells

22) The process by which a relatively unspecialized cell becomes highly specialized is called \_\_\_\_\_\_\_.

a) differentiation

b) determination

c) degeneracy

d) denaturation

e) renaturation

Answer: a

Difficulty: Easy

Learning Objective: LO 1.5 Explain the importance of cell differentiation within a eukaryotic organism.

Section Reference: Section 1.5 Types of Eukaryotic Cells

23) Bacteria often live in complex, multi-species communities, like the layer of plaque that grows on your teeth; such a community is called a(n) \_\_\_\_\_\_\_\_\_.

a) biotome

b) microtome

c) biofilm

d) anatome

e) disneyfilm

Answer: c

Difficulty: Medium

Learning Objective: LO 1.4 Explain how study of the metagenome increases our understanding of prokaryotic diversity.

Section Reference: Section 1.4 Types of Prokaryotic Cells

24) The rapidity and cost-efficiency of DNA sequencing has made it possible to sequence virtually all of the genes present in the microbes of a given habitat. This generates a collective genome for that habitat, which has come to be called a(n) \_\_\_\_\_\_\_\_\_.

a) metachron

b) metagenome

c) netagenome

d) megagene

e) exogenome

Answer: b

Difficulty: Medium

Learning Objective: LO 1.4 Explain how study of the metagenome increases our understanding of prokaryotic diversity.

Section Reference: Section 1.4 Types of Prokaryotic Cells

25) The collection of bacteria that live on and within the human body are being isolated, identified and characterized; they are referred to as the human \_\_\_\_\_\_. It has been demonstrated that these organisms differ based upon the age, diet, geography and state of health of the human from which they were obtained.

a) macrobiome

b) metagenome

c) minibiome

d) microbiome

e) homobiome

Answer: d

Difficulty: Medium

Learning Objective: LO 1.4 Explain how study of the metagenome increases our understanding of prokaryotic diversity.

Section Reference: Section 1.4 Types of Prokaryotic Cells

26) Studies on mice suggest that bacterial species predominating in obese individuals differ from those in the digestive tracts of lean individuals and that they play a role in weight gain in obese individuals. What are these bacteria in obese individuals proposed to do that increases weight gain in obese individuals?

a) They make obese mice eat more food.

b) They release chemicals that increase the caloric intake by the mice.

c) The bacteria in obese individuals may release more calories from digested food than their counterparts in leaner individuals.

d) The bacteria in obese individuals turn the food in the intestines to fat.

e) The bacteria in obese individuals produce gas that makes their hosts obese.

Answer: c

Difficulty: Medium

Learning Objective: LO 1.4 Explain how study of the metagenome increases our understanding of prokaryotic diversity.

Section Reference: Section 1.4 Types of Prokaryotic Cells

27) Which of the following is not a model organism?

a) Mus musculus

b) Drosophila melanogaster

c) Homo sapiens

d) Arabidopsis thaliana

e) Caenorhabditis elegans

Answer: c

Difficulty: Medium

Learning Objective: LO 1.5 Explain the importance of cell differentiation within a eukaryotic organism.

Section Reference: Section 1.5 Types of Eukaryotic Cells

28) The field of biological research in which biologists are attempting to create a living cell in the laboratory, essentially from scratch is known as \_\_\_\_\_\_\_\_\_\_. More modestly, this branch of biology also has a goal of developing novel life forms, beginning with existing organisms, that have a unique value in medicine, industry or in cleaning up the environment.

a) megalomaniacal biology

b) synthetic biology

c) production-grade biology

d) industrial biology

e) pharmaceutical biology

Answer: b

Difficulty: Easy

Learning Objective: LO 1.7 Explain why cells are so small.

Section Reference: Section 1.7 The Sizes of Cells and Their Components

29) What is the most appropriate unit of measurement for macromolecular complexes including ribosomes and microfilaments?

a) picometers

b) angstroms

c) nanometers

d) micrometers

d) centimeters

Answer: c

Difficulty: Easy

Learning Objective: LO 1.7 Explain why cells are so small.

Section Reference: Section 1.7 The Sizes of Cells and Their Components

30) What is the most appropriate unit of measurement for most types of cells?

a) picometers

b) angstroms

c) nanometers

d) micrometers

d) centimeters

Answer: d

Difficulty: Easy

Learning Objective: LO 1.7 Explain why cells are so small.

Section Reference: Section 1.7 The Sizes of Cells and Their Components

31) Why are viruses not considered to be organisms and not described as being alive?

1) Virions are unable to reproduce by themselves.

2) Virions are not able to metabolize by themselves.

3) Virions are not able to synthesize DNA by themselves.

4) Virions are not able to assemble spontaneously.

a) 1

b) 2

c) 3

d) 4

e) 1, 2 and 3

Answer: e

Difficulty: Easy

Learning Objective: LO 1.8 Describe the structure of a virus and two mechanisms of viral infection of a host cell.

Section Reference: Section 1.8 Viruses and Viroids

32) Which of the following statements about viruses is not true?

a) All viruses are obligatory intracellular parasites.

b) All viruses are obligatory intercellular parasites.

c) Viruses occur in a wide variety of very different shapes, sizes and constructions.

d) A viral host may be a plant, an animal or a bacterial cell.

e) Viral genetic material can be either RNA or DNA.

Answer: b

Difficulty: Medium

Learning Objective: LO 1.8 Describe the structure of a virus and two mechanisms of viral infection of a host cell.

Section Reference: Section 1.8 Viruses and Viroids

33) Outside of a living cell, the virus exists as a particle called a(n) \_\_\_\_\_\_\_\_, which is little more than a macromolecular package.

a) virulent

b) virusette

c) virulant

d) virion

e) infectoid

Answer: d

Difficulty: Easy

Learning Objective: LO 1.8 Describe the structure of a virus and two mechanisms of viral infection of a host cell.

Section Reference: Section 1.8 Viruses and Viroids

34) Viruses like adenovirus, which causes respiratory infections in mammals, have a 20-sided polyhedral capsid. What is this polyhedral shape called?

a) tetrahedron

b) dodechedron

c) polygon

d) icosahedron

e) octahedron

Answer: d

Difficulty: Medium

Learning Objective: LO 1.8 Describe the structure of a virus and two mechanisms of viral infection of a host cell.

Section Reference: Section 1.8 Viruses and Viroids

35) Among the most complex viruses are the \_\_\_\_\_\_\_\_, which are also the most abundant biological entities on Earth.

a) mammalian viruses

b) bacterial viruses

c) vibriovirions

d) bacteriophages

e) bacterial viruses and bacteriophages

Answer: e

Difficulty: Medium

Learning Objective: LO 1.8 Describe the structure of a virus and two mechanisms of viral infection of a host cell.

Section Reference: Section 1.8 Viruses and Viroids

36) Usually, a virus infects a cell and arrests the normal synthetic activities of the host, redirecting the cell to use its available materials to manufacture viral nucleic acids and proteins, which assemble into new viruses. Ultimately, the infected cell ruptures and releases a new generation of viral particles that can infect neighboring cells. This type of infection is called a(n) \_\_\_\_\_\_\_\_\_ infection.

a) lytic

b) proviral

c) eluctable

d) virulent

e) avirulent

Answer: a

Difficulty: Medium

Learning Objective: LO 1.8 Describe the structure of a virus and two mechanisms of viral infection of a host cell.

Section Reference: Section 1.8 Viruses and Viroids

37) In some cases, an infecting virus does not lead to the death of the host cell, but instead integrates its DNA into the DNA of the host cell's chromosomes. Integration of the viral DNA can have different effects like exhibiting normal behavior until exposure to a stimulus that activates the dormant viral DNA, production of viral progeny that bud off of the infected cell or a loss of control over growth and division leading to malignancy. Such an infection is referred to as a(n) \_\_\_\_\_\_ infection.

a) lytic

b) proviral

c) eluctable

d) virulent

e) avirulent

Answer: b

Difficulty: Medium

Learning Objective: LO 1.8 Describe the structure of a virus and two mechanisms of viral infection of a host cell.

Section Reference: Section 1.8 Viruses and Viroids

38) From what is the lipid-containing outer envelope surrounding the viral capsid of many animal viruses derived?

a) the nuclear envelope

b) the outer mitochondrial membrane

c) the plasma membrane

d) the lysosomal membrane

e) the outer membrane of the chloroplast

Answer: c

Difficulty: Medium

Learning Objective: LO 1.8 Describe the structure of a virus and two mechanisms of viral infection of a host cell.

Section Reference: Section 1.8 Viruses and Viroids

39) Which of the following is not typically a behavior exhibited by a cell with a proviral infection?

1) Immediate production of new viruses and subsequent lysis of the host cell.

40) Normal behavior until exposure to a stimulus, like UV radiation, that activates dormant viral DNA, leading to lysis of the host cell and release of viral progeny.

3) Production of new viral progeny that bud at the cell surface without lysing the infected cell.

4) Loss of control in animal cells over their growth and division followed by malignancy.

a) 1

b) 2

c) 3

d) 4

e) 1 and 3

Answer: a

Difficulty: Medium

Learning Objective: LO 1.8 Describe the structure of a virus and two mechanisms of viral infection of a host cell.

Section Reference: Section 1.8 Viruses and Viroids

41) What advantageous uses have viruses been shown to have?

a) The activities of viral genes mimic those of host genes so they are useful for studying mechanisms of DNA replication and gene expression in their much more complex hosts.

b) They can be used as a means to introduce foreign genes into human cells, which may serve as a basis for treatment of human diseases by gene therapy.

c) Insect-killing viruses may play an increasing role in the war against insect pests.

d) Bacteria-killing viruses may play an increasing role in the war against bacterial pathogens.

e) All of these are correct.

Answer: e

Difficulty: Medium

Learning Objective: LO 1.8 Describe the structure of a virus and two mechanisms of viral infection of a host cell.

Section Reference: Section 1.8 Viruses and Viroids

42) Potato spindle-tuber disease, which causes potatoes to become gnarled and cracked, is caused by an infectious agent consisting of a small circular RNA molecule that totally lacks a protein coat. These infectious agents are thought to exert their effects by interfering with the cell's normal path of gene expression. Such an infectious agent is known as a(n) \_\_\_\_\_\_\_\_\_\_.

a) provirous

b) bacteriophage

c) viroid

d) virunette

e) eviscerion

Answer: c

Difficulty: Easy

Learning Objective: LO 1.8 Describe the structure of a virus and two mechanisms of viral infection of a host cell.

Section Reference: Section 1.8 Viruses and Viroids

43) What major feature distinguishes the theoretical first eukaryotic common ancestor (FECA) from prokaryotes?

a) DNA

b) closed internal compartments

c) plasma membrane

d) ribosomes

e) heterotrophy

Difficulty: Medium

Learning Objective: LO 1.9 Explain how Margulis and Woese contributed to our understanding of the origin of complex cells.

Section Reference: Section 1.9 Experimental Pathways: The Origin of Eukaryotic Cells

Answer: b

Question Type: Essay

44) You are observing a cell. Its cell wall is made of a long-chain polysaccharide called peptidoglycan. It has the ability to make all but the simplest molecules and can make all of the 20 amino acids. What kind of cell is it? If the cell contained pigments capable of photosynthesis, what would it be called?

Answer:

Difficulty: Medium

Learning Objective: LO 1.3 Compare and contrast the structure and function of a prokaryotic cell and a eukaryotic cell.

Section Reference: Section 1.3 Characteristics that Distinguish Prokaryotic and Eukaryotic Cells

Solution: The cell is a bacterium. With photosynthetic pigments, it is a Cyanobacterium.

45) A fertilized frog egg is allowed to divide and the two daughter cells are then separated. What happens?

Answer:

Difficulty: Medium

Learning Objective: LO 1.2 List the fundamental properties shared by all cells, explaining their importance.

Section Reference: Section 1.2 Basic Properties of Cells

Solution: Both cells will develop into a complete tadpole. The tadpoles will, however, be smaller than if the two daughter cells had not been separated.

46) Wilhelm Roux performed an experiment in which he allowed a frog embryo to divide into two cells. He then killed one of the cells with a hot needle, but did not separate the cell he had killed from the remaining cell. The embryo developed abnormally, leading Roux to conclude that the cells in a developing embryo have their developmental potential restricted at each division, even the first. Driesch and others demonstrated that separation of cells in a number of embryos resulted in the development of two smaller, but normal, embryos. Which of these investigators is most likely to have made a procedural error in his experimental design and what was it?

Answer:

Difficulty: Medium

Learning Objective: LO 1.2 List the fundamental properties shared by all cells, explaining their importance.

Section Reference: Section 1.2 Basic Properties of Cells

Solution: Roux made the mistake. By failing to remove the dead cell from the one he had spared, he caused problems in the further development of the embryo. Had he removed the dead cell, the remaining cell would probably have developed normally.

47) Why are viruses not considered by most biologists to be living organisms?

Answer:

Difficulty: Easy

Learning Objective: LO 1.8 Describe the structure of a virus and two mechanisms of viral infection of a host cell.

Section Reference: Section 1.8 Viruses and Viroids

Solution: In order to reproduce, they must take over the cellular machinery of their host cell. They are incapable of reproducing on their own.

48) Prokaryotic cells are generally smaller than eukaryotic cells and have no membrane-bound organelles, which act to transport some materials around the cell and compartmentalize certain cellular processes. Why do prokaryotic cells not require such membrane-bound organelles?

Answer:

Difficulty: Hard

Learning Objective: LO 1.3 Compare and contrast the structure and function of a prokaryotic cell and a eukaryotic cell.

Section Reference: Section 1.3 Characteristics that Distinguish Prokaryotic and Eukaryotic Cells

Solution: Prokaryotic cells are smaller, and simple diffusion is sufficient to move things around the cell.

49) Why are Archaea restricted to such harsh and difficult habitats?

Answer:

Difficulty: Medium

Learning Objective: LO 1.4 Explain how study of the metagenome increases our understanding of prokaryotic diversity.

Section Reference: Section 1.4 Types of Prokaryotic Cells

Solution: These habitats closely resemble the Earth before oxygen appeared in the atmosphere, and they are relatively anaerobic. Archaea cannot survive in more aerobic environments.

50) If one accepts the suggestion that the Archaea are similar to the prokaryotes from which all eukaryotes are descended, how does one explain the extreme environments in which they live when their descendants thrive in more moderate environments?

Answer:

Difficulty: Medium

Learning Objective: LO 1.4 Explain how study of the metagenome increases our understanding of prokaryotic diversity.

Section Reference: Section 1.4 Types of Prokaryotic Cells

Solution: The environments in which they live now more closely resemble the environment in which their ancestors evolved earlier in the Earth's history. Their descendant eukaryotes evolved to survive in the relatively benign environment now extant.

51) You are studying a virus. It has an icosahedral protein capsid and is surrounded by a lipid-containing envelope. What kind of organism does the virus infect?

Answer:

Difficulty: Medium

Learning Objective: LO 1.8 Describe the structure of a virus and two mechanisms of viral infection of a host cell.

Section Reference: Section 1.8 Viruses and Viroids

Solution: It is a eukaryotic virus. Prokaryotic viruses would not have a lipid envelope. Eukaryotic viruses often have lipid envelopes, which arise from the cell membrane that surrounds the mature virus as it buds from the cell.

52) A virus infects a cell that has been placed in culture. The cell grows into a clone of cells with no apparent infection. Three months later, the cells are exposed to ultraviolet light. Shortly thereafter, most of the cells lyse and shed large amounts of virus. What kind of infection is this? What kind of infection results in a loss of growth control at some time after infection?

Answer:

Difficulty: Medium

Learning Objective: LO 1.8 Describe the structure of a virus and two mechanisms of viral infection of a host cell.

Section Reference: Section 1.8 Viruses and Viroids

Solution: A provirus had been formed with the viral genome incorporated into the host cell's genome. The ultraviolet light caused the activation of the viral genome and subsequent lysis. A proviral infection.

53) You are studying an infectious agent, the effects of which resemble a virus. You isolate the agent and treat it with an enzyme that degrades proteins and it is unaffected. However, if treated with RNase, it loses its infectivity. What kind of pathogen is it most likely to be?

Answer:

Difficulty: Medium

Learning Objective: LO 1.8 Describe the structure of a virus and two mechanisms of viral infection of a host cell.

Section Reference: Section 1.8 Viruses and Viroids

Solution: A viroid.

54) Techniques for sequencing DNA have become very rapid and cost-efficient. Consequently, researchers have begun to sequence all of the genes of all of the microbes present in a given habitat. What term has been coined to describe such a collective genome? What information does such a collective genome provide? What is an example of a microbiome?

Answer:

Difficulty: Medium

Learning Objective: LO 1.4 Explain how study of the metagenome increases our understanding of prokaryotic diversity.

Section Reference: Section 1.4 Types of Prokaryotic Cells

Solution: Such a collective genome for a given habitat is called a metagenome. A metagenome can provide information about the types of proteins organisms in a particular habitat manufacture and thus give information about many of the metabolic activities in which they engage. One example of a microbiome would be the microorganisms that live on or within our own bodies, in habitats like intestinal tract, the mouth, vagina and skin.

55) You study two populations of mice, a lean population and an obese population. You measure the calories released from digested food by the microorganisms in the microbiomes isolated from the digestive tracts of the two mouse populations. One of the microbiomes releases significantly more calories than the other. Which microbiome would be likely to release significantly more calories? What significance might this have for human health?

Answer:

Difficulty: Medium

Learning Objective: LO 1.4 Explain how study of the metagenome increases our understanding of prokaryotic diversity.

Section Reference: Section 1.4 Types of Prokaryotic Cells

Solution: The microbiome from the obese population of mice would be likely to release more calories from digested food than the microbiome from leaner individuals. It is possible that obese humans may also have a microbiome in their digestive tracts that releases more calories from the same amount of food. For example, it has been shown that obese and lean humans have markedly different populations of bacteria in their digestive tracts. As obese individuals lose weight, their bacterial profile shifts toward that of leaner individuals. This could contribute to weight gain in obese individuals.

56) What factors presently limit the scope of organ transplantation as a treatment for human disease?

Answer:

Difficulty: Medium

Learning Objective: LO 1.6 Explain how various types of stem cells may be useful in combatting human disease.

Section Reference: Section 1.6 The Human Perspective: The Prospect of Cell Replacement Therapy

Solution: The use of organ transplantation in treating human disease is presently greatly limited by the low availability of donor organs and the high risk of immunologic rejection.

57) In bone marrow transplantation, what is the usual source of the donor cells? For what diseases is bone marrow transplantation most often used?

Answer:

Difficulty: Medium

Learning Objective: LO 1.6 Explain how various types of stem cells may be useful in combatting human disease.

Section Reference: Section 1.6 The Human Perspective: The Prospect of Cell Replacement Therapy

Solution: The interior of the donor's pelvic bones. Lymphomas and leukemias, which are cancers affecting the number of white blood cells.

58) Briefly summarize the procedure involved in bone marrow transplantation.

Answer:

Difficulty: Hard

Learning Objective: LO 1.6 Explain how various types of stem cells may be useful in combatting human disease.

Section Reference: Section 1.6 The Human Perspective: The Prospect of Cell Replacement Therapy

Solution: First, the patient is exposed to a high level of radiation and/or toxic chemicals. These treatments kill the cancerous cells and all of the cells involved in the formation of red and white blood cells. Once the blood-forming cells have been destroyed, they are replaced by the transplantation of bone marrow cells from a healthy donor. The small percentage of hematopoietic stem cells (HSCs) in the donor's bone marrow can restock the patient's blood-forming bone marrow tissue and thus regenerate the blood tissue of the transplant recipient

59) Why are radiation and toxic chemicals ideal for destroying a recipient's blood cells?

Answer:

Difficulty: Easy

Learning Objective: LO 1.6 Explain how various types of stem cells may be useful in combatting human disease.

Section Reference: Section 1.6 The Human Perspective: The Prospect of Cell Replacement Therapy

Solution: The blood-forming cells are particularly sensitive to radiation and toxic chemicals.

60) What is the difference between bone marrow transplantation and blood transfusion?

Answer:

Difficulty: Hard

Learning Objective: LO 1.6 Explain how various types of stem cells may be useful in combatting human disease.

Section Reference: Section 1.6 The Human Perspective: The Prospect of Cell Replacement Therapy

Solution: In blood transfusion, the recipient receives only the differentiated blood cells, especially the red blood cells and platelets present in the circulation. In bone marrow transplantation, the recipient receives the hematopoietic stem cells that are not generally present in the circulation but instead are found in the bone marrow.

61) What is the normal purpose of hematopoietic stem cells in the bone marrow?

Answer:

Difficulty: Medium

Learning Objective: LO 1.6 Explain how various types of stem cells may be useful in combatting human disease.

Section Reference: Section 1.6 The Human Perspective: The Prospect of Cell Replacement Therapy

Solution: They are normally responsible for replacing the millions of red and white blood cells that age and die every minute in our bodies. A single HSC is capable of reconstituting the entire hematopoietic (blood-forming) system of an irradiated mouse.

62) What is the name for undifferentiated cells that are both capable of self-renewal (production of more cells like themselves) and multipotent, that is capable of differentiating into two or more mature cell types?

Answer:

Difficulty: Easy

Learning Objective: LO 1.6 Explain how various types of stem cells may be useful in combatting human disease.

Section Reference: Section 1.6 The Human Perspective: The Prospect of Cell Replacement Therapy

Solution: Stem cells.

63) What are glial cells?

Answer:

Difficulty: Medium

Learning Objective: LO 1.6 Explain how various types of stem cells may be useful in combatting human disease.

Section Reference: Section 1.6 The Human Perspective: The Prospect of Cell Replacement Therapy

Solution: Glial cells are the supportive cells of the brain.

64) How have investigators been able to improve the situation of golden retrievers suffering from an inherited disease very similar to the human skeletal-muscle disorder muscular dystrophy? What are isolated stem cells present in adult skeletal muscle called?

Answer:

Difficulty: Medium

Learning Objective: LO 1.6 Explain how various types of stem cells may be useful in combatting human disease.

Section Reference: Section 1.6 The Human Perspective: The Prospect of Cell Replacement Therapy

Solution: Researchers have isolated stem cells from the muscles of these dogs, corrected the genetic disorder in the isolated cells and increased the number of these genetically modified cells by growing them in culture. When these stem cells are injected back into the diseased animals, many of them return to skeletal muscle where they take up residence. Once back in the muscle tissue, the corrected cells divide and differentiate into new muscle cells and thus contribute to a marked improvement in the mobility and gait of the diseased animals. Stem cells isolated from skeletal muscle tissue are called satellite cells.

65) Why is it hoped that transplantation of stem cells may help humans who have heart disease?

Answer:

Difficulty: Medium

Learning Objective: LO 1.6 Explain how various types of stem cells may be useful in combatting human disease.

Section Reference: Section 1.6 The Human Perspective: The Prospect of Cell Replacement Therapy

Solution: The human heart contains cardiac stem cells that are capable differentiating into the cells that form the muscle tissue of the heart (the cardiomyocytes of the myocardium) and the heart's blood vessels. It is hoped that these cells might have the potential to regenerate healthy heart tissue in a patient who has had a serious heart attack or is suffering from congestive heart failure.

66) Why are adult stem cells an ideal system for cell replacement therapies?

Answer:

Difficulty: Hard

Learning Objective: LO 1.6 Explain how various types of stem cells may be useful in combatting human disease.

Section Reference: Section 1.6 The Human Perspective: The Prospect of Cell Replacement Therapy

Solution: Adult stem cells can be isolated directly from the patient, grown in culture, and reintroduced back into the same patient reducing the risk of rejection of the injected cells and the resultant tissue.

67) What are embryonic stem (ES) cells? How do ES cells differ from adult stem cells?

Answer:

Difficulty: Medium

Learning Objective: LO 1.6 Explain how various types of stem cells may be useful in combatting human disease.

Section Reference: Section 1.6 The Human Perspective: The Prospect of Cell Replacement Therapy

Solution: They are a type of stem cell isolated from very young mammalian embryos. They are the cells in the early embryo that give rise to all of the various structures of the mammalian fetus. Unlike adult stem cells, ES cells are pluripotent, which means that they are capable of differentiating into every type of cell in the body.

68) What cells are likely to be the first used in human trials using ES cells for cell replacement therapy and what do these cells do? What have researchers had to do to get these cells to differentiate in culture? What happened when these human cells were transplanted into rats with paralyzing spinal cord injuries?

Answer:

Difficulty: Hard

Learning Objective: LO 1.6 Explain how various types of stem cells may be useful in combatting human disease.

Section Reference: Section 1.6 The Human Perspective: The Prospect of Cell Replacement Therapy

Solution: The first trials will likely utilize oligodendrocytes, which produce the myelin sheaths that become wrapped around nerve cells. Researchers have been able to differentiate pure colonies of oligodendrocytes when human ES cells were cultured in a medium containing insulin, thyroid hormone and a combination of certain growth factors. When human oligodendrocytes were transplanted into rats with paralyzing spinal cord injuries, the animals regained considerable motility.

69) What is the primary risk of using human ES cells in cell replacement therapy to treat diseases like type I diabetes and macular degeneration? Why is this a risk?

Answer:

Difficulty: Medium

Learning Objective: LO 1.6 Explain how various types of stem cells may be useful in combatting human disease.

Section Reference: Section 1.6 The Human Perspective: The Prospect of Cell Replacement Therapy

Solution: The primary risk of using ES cells in cell replacement treatment in humans is the unnoticed presence of undifferentiated ES cells among the differentiated cell population. Undifferentiated ES cells are capable of forming a type of benign tumor called a teratoma, which may contain a bizarre mass of various differentiated tissues, including hair and teeth. Formation of a teratoma within the central nervous system could have severe consequences. Another potential risk is that culture of ES cells presently involves the use of non-human biological materials; these materials pose potential risks of causing disease.

70) What advantage in cell replacement therapy do adult stem cells have over ES cells? What disadvantage do these same cells have relative to ES stem cells?

Answer:

Difficulty: Medium

Learning Objective: LO 1.6 Explain how various types of stem cells may be useful in combatting human disease.

Section Reference: Section 1.6 The Human Perspective: The Prospect of Cell Replacement Therapy

Solution: They can be isolated from the individual who is being treated and will thus not face immunological rejection when used in cell replacement. Adult stem cells do not seem to have an unlimited potential to proliferate as is characteristic of ES cells.

71) How might ES cells be “customized” so that they possess the same genetic makeup as the individual who is being treated, thus protecting them from attack by the recipient's immune system? What is the major ethical question associated with this procedure? What practical impediments presently stand in the way of this procedure and how might they be removed?

Answer:

Difficulty: Medium

Learning Objective: LO 1.6 Explain how various types of stem cells may be useful in combatting human disease.

Section Reference: Section 1.6 The Human Perspective: The Prospect of Cell Replacement Therapy

Solution: This could be accomplished by a procedure called somatic cell nuclear transfer (SCNT). An unfertilized egg could be removed from the ovary of an unrelated woman donor. The nucleus of this unfertilized egg could be removed and replaced by the nucleus of a cell from the patient to be treated. The egg would then have the same chromosome composition as that of the patient. The egg would then be allowed to develop to an early embryonic stage, and the ES cells would be removed, cultured and induced to differentiate into the type of cell required by the patient. SCNT requires the formation of a human embryo that is used only as a source of ES cells. Many would consider it to be an abortion and would therefore object. The process of SCNT is so expensive and technically demanding that it is highly improbable that it could ever be practiced as part of any routine medical treatment. If ES cell-based therapy is ever practiced, it would probably depend on the use of a bank of hundreds or thousands of different ES cells. Such a bank could contain cells that are close enough as a tissue match to be suitable for use in the majority of patients.

72) It was long thought that cell differentiation was irreversible, i.e., once a cell like a fibroblast, a white blood cell or a cartilage cell has differentiated, it could not revert to any other cell type. Surprisingly, this is not the case. Shinya Yamanaka and his colleagues have succeeded in reprogramming a fully differentiated mouse cell, specifically a type of connective tissue fibroblast, into a pluripotent stem cell. How was this stunning feat accomplished? How did they demonstrate that iPS cells were indeed pluripotent?

Answer:

Difficulty: Hard

Learning Objective: LO 1.6 Explain how various types of stem cells may be useful in combatting human disease.

Section Reference: Section 1.6 The Human Perspective: The Prospect of Cell Replacement Therapy

Solution: They accomplished the feat by introducing, into the mouse fibroblasts, the genes encoding four key proteins that are characteristic of ES cells. These genes (Oct4, Sox2, Klf4 and Myc) are thought to play a key role in maintaining the cells in an undifferentiated state and allowing them to continue to self-renew. The genes were introduced into cultured fibroblasts using gene-carrying viruses; those rare cells that became reprogrammed were selected from the others in the culture by specialized techniques. This new type of cells was called induced pluripotent cells (iPS cells). They injected the iPS cells into a mouse blastocyst and found that they participated in the differentiation of all of the cells of the body, including eggs and sperm.

73) What feature of iPS cells removes all the ethical reservations that accompany work with ES cells and makes it much easier to generate iPS cells in the lab? What difficulties must be overcome before iPS cells can be used as a source of cells for human therapy? How might the problem of immune rejection of iPS cell replacements eventually be avoided?

Answer:

Difficulty: Medium

Learning Objective: LO 1.6 Explain how various types of stem cells may be useful in combatting human disease.

Section Reference: Section 1.6 The Human Perspective: The Prospect of Cell Replacement Therapy

Solution: Unlike ES cells, the generation of iPS cells does not require the use of an embryo. It will be important to develop cell-reprogramming techniques that do not use gene-carrying viruses, because such cells carry the potential of developing into cancers. Like ES cells, undifferentiated iPS cells also give rise to teratomas, so it is essential that only fully differentiated cells be transplanted into human subjects. Also like ES cells, the iPS cells in current use have the same tissue antigens as the donors who originally provided them, so they would stimulate an immune attack if they were to be transplanted into other human recipients. Unlike the formation of ES cells, however, it will be much easier to generate personalized, tissue-compatible iPS cells, because they can be derived from a simple skin biopsy from each patient. While this aspect of preparing iPS cells is easier, it still does take considerable time, expense and technical expertise to generate a population of iPS cells from a specific donor. If iPS cells are ever developed for therapeutic use, they would likely come from a large cell bank that could provide cells that are close tissue matches to most potential recipients. It may also eventually be possible to remove all of the genes from iPS cells that normally prevent them from being transplanted into random recipients. If this could be achieved, it might be possible to develop a single "universal donor" iPS cell line that is invisible to the recipient's immune system. Cells of this type could be used as the basis for cell replacement in everyone.

74) What is transdifferentiation?

Answer:

Difficulty: Easy

Learning Objective: LO 1.6 Explain how various types of stem cells may be useful in combatting human disease.

Section Reference: Section 1.6 The Human Perspective: The Prospect of Cell Replacement Therapy

Solution: Transdifferentiation has occurred when one type of differentiated cell has been converted directly (without the cells passing through an intermediate stem-cell state) into another type of differentiated cell.

75) Which cells in the pancreas produce the enzymes responsible for digestion of food in the intestine? What do pancreatic beta cells do? What treatment was used to cause the reprogramming of pancreatic acinar cells into pancreatic beta cells? How did the researchers know that the transdifferentiation had, in fact, occurred and resulted in the production of more pancreatic beta cells? Why is the use of adenoviruses to deliver the genes in this experiment less of a risk in humans than using some other viruses would be?

Answer:

Difficulty: Medium

Learning Objective: LO 1.6 Explain how various types of stem cells may be useful in combatting human disease.

Section Reference: Section 1.6 The Human Perspective: The Prospect of Cell Replacement Therapy

Solution: Pancreatic acinar cells. They synthesize and secrete the hormone insulin. Viruses that carried three genes known to be important in the differentiation of beta cells in the embryo were injected into diabetic mice. It is likely that the transdifferentiation of a significant number of acinar cells into beta cells occurred since the animals were able to regulate their blood sugar levels with much lower doses of insulin after the injection and transdifferentiation. The adenoviruses do not become a permanent part of the recipient cell as can happen with other viruses. This removes some of the concerns about using viruses as gene carriers in humans.

76) What makes the 16S rRNA molecule useful for studies of molecular evolution?

Difficulty: Medium

Learning Objective: LO 1.9 Explain how Margulis and Woese contributed to our understanding of the origin of complex cells.

Section Reference: Section 1.9 Experimental Pathways: The Origin of Eukaryotic Cells

Solution: Ribosomal RNA is present in large quantities in all cells, it is easy to purify, and tends to change only slowly over long periods of evolutionary time. Comparison of the nucleotide sequence of 16S rRNA is used by researchers to study relationships of very distantly related organisms.

77) What is the endosymbiont theory?

Difficulty: Medium

Learning Objective: LO 1.9 Explain how Margulis and Woese contributed to our understanding of the origin of complex cells.

Section Reference: Section 1.9 Experimental Pathways: The Origin of Eukaryotic Cells

Solution: The hypothesis proposed by Lynn Margulis has come to be known as the endosymbiont theory. It predicts that certain organelles of a eukaryotic cell evolved from smaller prokaryotic cells that had taken up residence in the cytoplasm of a larger host cell. This stable fusion of two cell types – an endosymbiont – gave rise to the first eukaryotic common ancestor through the development of an internal membrane system and membrane-enclosed DNA.