3.E: The Cell (Exercises)

3.1: Spontaneous Generation

The theory of spontaneous generation states that life arose from nonliving matter. It was a long-held belief dating back to Aristotle and the ancient Greeks. Experimentation by Francesco Redi in the 17th century presented the first significant evidence refuting spontaneous generation by showing that flies must have access to meat for maggots to develop on the meat. Louis Pasteur is credited with conclusively disproving the theory and proposed that “life only comes from life.”

Multiple Choice

Which of the following individuals argued in favor of the theory of spontaneous generation?

A. Francesco Redi
B. Louis Pasteur
C. John Needham
D. Lazzaro Spallanzani

Which of the following individuals is credited for definitively refuting the theory of spontaneous generation using broth in swan-neck flask?

A. Aristotle
B. Jan Baptista van Helmont
C. John Needham
Which of the following experimented with raw meat, maggots, and flies in an attempt to disprove the theory of spontaneous generation.

A. Aristotle  
B. Lazzaro Spallanzani  
C. Antonie van Leeuwenhoek  
D. Francesco Redi

Fill in the Blank

The assertion that "life only comes from life" was stated by Louis Pasteur in regard to his experiments that definitively refuted the theory of ___________.

True/False

Exposure to air is necessary for microbial growth.

Short Answer

Explain in your own words Pasteur’s swan-neck flask experiment.

Explain why the experiments of Needham and Spallanzani yielded in different results even though they used similar methodologies.

Critical Thinking

What would the results of Pasteur’s swan-neck flask experiment have looked like if they supported the theory of spontaneous generation?

3.2: Foundations of Modern Cell Theory

Although cells were first observed in the 1660s by Robert Hooke, cell theory was not well accepted for another 200 years. The work of scientists such as Schleiden, Schwann, Remak, and Virchow contributed to its acceptance.
Endosymbiotic theory states that mitochondria and chloroplasts, organelles found in many types of organisms, have their origins in bacteria. Significant structural and genetic information support this theory. The miasma theory was widely accepted until the 19th century.

**Multiple Choice**

Which of the following individuals did not contribute to the establishment of cell theory?

- A. Girolamo Fracastoro
- B. Matthias Schleiden
- C. Robert Remak
- D. Robert Hooke

A

Whose proposal of the endosymbiotic theory of mitochondrial and chloroplast origin was ultimately accepted by the greater scientific community?

- A. Rudolf Virchow
- B. Ignaz Semmelweis
- C. Lynn Margulis
- D. Theodor Schwann

C

Which of the following developed a set of postulates for determining whether a particular disease is caused by a particular pathogen?

- A. John Snow
- B. Robert Koch
- C. Joseph Lister
- D. Louis Pasteur

B

**Fill in the Blank**

John Snow is known as the Father of ____________. 
epidemiology

The ____________ theory states that disease may originate from proximity to decomposing matter and is not due to person-to-person contact.

miasma

The scientist who first described cells was ______________.

Robert Hooke

Short Answer

How did the explanation of Virchow and Remak for the origin of cells differ from that of Schleiden and Schwann?

What evidence exists that supports the endosymbiotic theory?

What were the differences in mortality rates due to puerperal fever that Ignaz Semmelweis observed? How did he propose to reduce the occurrence of puerperal fever? Did it work?

Critical Thinking

Why are mitochondria and chloroplasts unable to multiply outside of a host cell?

Why was the work of Snow so important in supporting the germ theory?

3.3: Unique Characteristics of Prokaryotic Cells

Prokaryotic cells differ from eukaryotic cells in that their genetic material is contained in a nucleoid rather than a membrane-bound nucleus. In addition, prokaryotic cells generally lack membrane-bound organelles. Prokaryotic cells of the same species typically share a similar cell morphology and cellular arrangement. Most prokaryotic cells have a cell wall that helps the organism maintain cellular morphology and protects it against changes in osmotic pressure.

Multiple Choice

Which of the following terms refers to a prokaryotic cell that is comma shaped?
A. coccus
B. coccobacilli
C. vibrio
D. spirillum

C

Which bacterial structures are important for adherence to surfaces? (Select all that apply.)

A. endospores
B. cell walls
C. fimbriae
D. capsules
E. flagella

C, D

Which of the following cell wall components is unique to gram-negative cells?

A. lipopolysaccharide
B. teichoic acid
C. mycolic acid
D. peptidoglycan

A

Which of the following terms refers to a bacterial cell having a single tuft of flagella at one end?

A. monotrichous
B. amphitrichous
C. peritrichous
D. lophotrichous

D

Bacterial cell walls are primarily composed of which of the following?

A. phospholipid
B. protein
C. carbohydrate
D. peptidoglycan

D

True/False

Bacteria have 80S ribosomes each composed of a 60S large subunit and a 40S small subunit.

False

Fill in the Blank

Prokaryotic cells that are rod-shaped are called _________.

bacilli

The type of inclusion containing polymerized inorganic phosphate is called _________.

volutin (or metachromatic granule)

Short Answer

What is the direction of water flow for a bacterial cell living in a hypotonic environment? How do cell walls help bacteria living in such environments?

How do bacterial flagella respond to a chemical gradient of an attractant to move toward a higher concentration of the chemical?

Label the parts of the prokaryotic cell.
Critical Thinking

Which of the following slides is a good example of staphylococci?

![Images of bacterial structures]

(credit a: modification of work by U.S. Department of Agriculture; credit b: modification of work by Centers for Disease Control and Prevention; credit c: modification of work by NIAID)

Provide some examples of bacterial structures that might be used as antibiotic targets and explain why.

The causative agent of botulism, a deadly form of food poisoning, is an endospore-forming bacterium called *Clostridium botulinum*. Why might it be difficult to kill this bacterium in contaminated food?

3.4: Unique Characteristics of Eukaryotic Cells

Eukaryotic cells are defined by the presence of a nucleus containing the DNA genome and bound by a nuclear membrane (or nuclear envelope) composed of two lipid bilayers that regulate transport of materials into and out of the nucleus through nuclear pores. Eukaryotic cell morphologies vary greatly and may be maintained by various structures, including the cytoskeleton, the cell membrane, and/or the cell wall. The nucleolus in the nucleus of eukaryotic cells is the site of ribosomal synthesis.
Multiple Choice

Which of the following organelles is not part of the endomembrane system?

A. endoplasmic reticulum
B. Golgi apparatus
C. lysosome
D. peroxisome

D

Which type of cytoskeletal fiber is important in the formation of the nuclear lamina?

A. microfilaments
B. intermediate filaments
C. microtubules
D. fibronectin

B

Sugar groups may be added to proteins in which of the following?

A. smooth endoplasmic reticulum
B. rough endoplasmic reticulum
C. Golgi apparatus
D. lysosome

C

Which of the following structures of a eukaryotic cell is not likely derived from endosymbiotic bacterium?

A. mitochondrial DNA
B. mitochondrial ribosomes
C. inner membrane
D. outer membrane

D

Which type of nutrient uptake involves the engulfment of small dissolved molecules into vesicles?
A. active transport  
B. pinocytosis  
C. receptor-mediated endocytosis  
D. facilitated diffusion

B

Which of the following is not composed of microtubules?

A. desmosomes  
B. centrioles  
C. eukaryotic flagella  
D. eukaryotic cilia

A

True/False

Mitochondria in eukaryotic cells contain ribosomes that are structurally similar to those found in prokaryotic cells.

True

Fill in the Blank

Peroxisomes typically produce _____________, a harsh chemical that helps break down molecules.

hydrogen peroxide

Microfilaments are composed of _____________ monomers.

actin
Short Answer

What existing evidence supports the theory that mitochondria are of prokaryotic origin?

Why do eukaryotic cells require an endomembrane system?

Name at least two ways that prokaryotic flagella are different from eukaryotic flagella.

Critical Thinking

Label the lettered parts of this eukaryotic cell.

A B C D E F G H

How are peroxisomes more like mitochondria than like the membrane-bound organelles of the endomembrane system?
How do they differ from mitochondria?

Why must the functions of both lysosomes and peroxisomes be compartmentalized?