A cell is the smallest unit of a living thing. A living thing, whether made of one cell (like bacteria) or many cells (like a human), is called an organism. Thus, cells are the basic building blocks of all organisms. There are many types of cells, all grouped into one of two broad categories: prokaryotic and eukaryotic. For example, both animal and plant cells are classified as eukaryotic cells, whereas bacterial cells are classified as prokaryotic.

Review Questions

When viewing a specimen through a light microscope, scientists use ______ to distinguish the individual components of cells.

1. a beam of electrons
2. radioactive isotopes
3. special stains
4. high temperatures

C

The ______ is the basic unit of life.

1. organism
2. cell
3. tissue
4. organ

**Free Response**

In your everyday life, you have probably noticed that certain instruments are ideal for certain situations. For example, you would use a spoon rather than a fork to eat soup because a spoon is shaped for scooping, while soup would slip between the tines of a fork. The use of ideal instruments also applies in science. In what situation(s) would the use of a light microscope be ideal, and why?

A light microscope would be ideal when viewing a small living organism, especially when the cell has been stained to reveal details.

In what situation(s) would the use of a scanning electron microscope be ideal, and why?

A scanning electron microscope would be ideal when you want to view the minute details of a cell’s surface, because its beam of electrons moves back and forth over the surface to convey the image.

In what situation(s) would a transmission electron microscope be ideal, and why?

A transmission electron microscope would be ideal for viewing the cell’s internal structures, because many of the internal structures have membranes that are not visible by the light microscope.

What are the advantages and disadvantages of each of these types of microscopes?

The advantages of light microscopes are that they are easily obtained, and the light beam does not kill the cells. However, typical light microscopes are somewhat limited in the amount of detail they can reveal. Electron microscopes are ideal because you can view intricate details, but they are bulky and costly, and preparation for the microscopic examination kills the specimen.

### 4.2: Prokaryotic Cells

Cells fall into one of two broad categories: prokaryotic and eukaryotic. Only the predominantly single-celled organisms of the domains Bacteria and Archaea are classified as prokaryotes (pro- = “before”; -kary- = “nucleus”). Cells of animals, plants, fungi, and protists are all eukaryotes (ceu- = “true”) and are made up of eukaryotic cells.

**Review Questions**

Prokaryotes depend on _________ to obtain some materials and to get rid of wastes.

1. ribosomes
2. flagella
3. cell division
4. diffusion

D

Bacteria that lack fimbriae are less likely to ________.

1. adhere to cell surfaces
2. swim through bodily fluids
3. synthesize proteins
4. retain the ability to divide

A

Free Response

Antibiotics are medicines that are used to fight bacterial infections. These medicines kill prokaryotic cells without harming human cells. What part or parts of the bacterial cell do you think antibiotics target? Why?

The cell wall would be targeted by antibiotics as well as the bacteria’s ability to replicate. This would inhibit the bacteria’s ability to reproduce, and it would compromise its defense mechanisms.

Explain why not all microbes are harmful.

Some microbes are beneficial. For instance, *E. coli* bacteria populate the human gut and help break down fiber in the diet. Some foods such as yogurt are formed by bacteria.

4.3: Eukaryotic Cells

Our natural world also utilizes the principle of form following function, especially in cell biology, and this will become clear as we explore eukaryotic cells. Unlike prokaryotic cells, eukaryotic cells have: 1) a membrane-bound nucleus; 2) numerous membrane-bound organelles such as the endoplasmic reticulum, Golgi apparatus, chloroplasts, mitochondria, and others; and 3) several, rod-shaped chromosomes. Because a eukaryotic cell’s nucleus is surrounded by a membrane, it is has “true nucleus.”

Review Questions

Which of the following is surrounded by two phospholipid bilayers?

1. the ribosomes
2. the vesicles
3. the cytoplasm
4. the nucleoplasm
D

Peroxisomes got their name because hydrogen peroxide is:

1. used in their detoxification reactions
2. produced during their oxidation reactions
3. incorporated into their membranes
4. a cofactor for the organelles’ enzymes

B

In plant cells, the function of the lysosomes is carried out by __________.

1. vacuoles
2. peroxisomes
3. ribosomes
4. nuclei

A

Which of the following is found both in eukaryotic and prokaryotic cells?

1. nucleus
2. mitochondrion
3. vacuole
4. ribosomes

D

Free Response

You already know that ribosomes are abundant in red blood cells. In what other cells of the body would you find them in great abundance? Why?

Ribosomes are abundant in muscle cells as well because muscle cells are constructed of the proteins made by the ribosomes.

What are the structural and functional similarities and differences between mitochondria and chloroplasts?

Both are similar in that they are enveloped in a double membrane, both have an intermembrane space, and both make ATP. Both mitochondria and chloroplasts have DNA, and mitochondria have inner folds called cristae and a matrix, while chloroplasts have chlorophyll and accessory pigments in the thylakoids that form stacks (grana) and a stroma.
4.4: The Endomembrane System and Proteins

The endomembrane system is a group of membranes and organelles in eukaryotic cells that works together to modify, package, and transport lipids and proteins. It includes the nuclear envelope, lysosomes, and vesicles, which we’ve already mentioned, and the endoplasmic reticulum and Golgi apparatus. Although not technically within the cell, the plasma membrane is included in the endomembrane system because, as you will see, it interacts with the other endomembranous organelles.

Review Questions

Which of the following is not a component of the endomembrane system?

1. mitochondrion
2. Golgi apparatus
3. endoplasmic reticulum
4. lysosome

A

The process by which a cell engulfs a foreign particle is known as:

1. endosymbiosis
2. phagocytosis
3. hydrolysis
4. membrane synthesis

B

Which of the following is most likely to have the greatest concentration of smooth endoplasmic reticulum?

1. a cell that secretes enzymes
2. a cell that destroys pathogens
3. a cell that makes steroid hormones
4. a cell that engages in photosynthesis

C

Which of the following sequences correctly lists in order the steps involved in the incorporation of a proteinaceous molecule within a cell?

1. synthesis of the protein on the ribosome; modification in the Golgi apparatus; packaging in the endoplasmic reticulum; tagging in the vesicle
2. synthesis of the protein on the lysosome; tagging in the Golgi; packaging in the vesicle; distribution in the endoplasmic reticulum
3. synthesis of the protein on the ribosome; modification in the endoplasmic reticulum; tagging in the Golgi; distribution
via the vesicle

4. synthesis of the protein on the lysosome; packaging in the vesicle; distribution via the Golgi; tagging in the endoplasmic reticulum

C

Free Response

In the context of cell biology, what do we mean by form follows function? What are at least two examples of this concept?

"Form follows function" refers to the idea that the function of a body part dictates the form of that body part. As an example, compare your arm to a bat’s wing. While the bones of the two correspond, the parts serve different functions in each organism and their forms have adapted to follow that function.

In your opinion, is the nuclear membrane part of the endomembrane system? Why or why not? Defend your answer.

Since the external surface of the nuclear membrane is continuous with the rough endoplasmic reticulum, which is part of the endomembrane system, then it is correct to say that it is part of the system.

4.5: The Cytoskeleton

Within the cytoplasm, there are ions and organic molecules, plus a network of protein fibers that help maintain the shape of the cell, secure some organelles in specific positions, allow cytoplasm and vesicles to move within the cell, and enable cells within multicellular organisms to move. Collectively, this network of protein fibers is known as the cytoskeleton. There are three types of fibers within the cytoskeleton: microfilaments, intermediate filaments, and microtubules.

Review Questions

Which of the following have the ability to disassemble and reform quickly?

1. microfilaments and intermediate filaments
2. microfilaments and microtubules
3. intermediate filaments and microtubules
4. only intermediate filaments

B

Which of the following do not play a role in intracellular movement?

1. microfilaments and intermediate filaments
2. microfilaments and microtubules
3. intermediate filaments and microtubules
4. only intermediate filaments

D

Free Response

What are the similarities and differences between the structures of centrioles and flagella?

Centrioles and flagella are alike in that they are made up of microtubules. In centrioles, two rings of nine microtubule “triplets” are arranged at right angles to one another. This arrangement does not occur in flagella.

How do cilia and flagella differ?

Cilia and flagella are alike in that they are made up of microtubules. Cilia are short, hair-like structures that exist in large numbers and usually cover the entire surface of the plasma membrane. Flagella, in contrast, are long, hair-like structures; when flagella are present, a cell has just one or two.

4.6: Connections between Cells and Cellular Activities

You already know that a group of similar cells working together is called a tissue. As you might expect, if cells are to work together, they must communicate with each other, just as you need to communicate with others if you work on a group project. Let’s take a look at how cells communicate with each other.

Review Questions

Which of the following are found only in plant cells?

1. gap junctions
2. desmosomes
3. plasmodesmata
4. tight junctions

C

The key components of desmosomes are cadherins and __________.

1. actin
2. microfilaments
3. intermediate filaments
4. microtubules

C
Free Response

How does the structure of a plasmodesma differ from that of a gap junction?

They differ because plant cell walls are rigid. Plasmodesmata, which a plant cell needs for transportation and communication, are able to allow movement of really large molecules. Gap junctions are necessary in animal cells for transportation and communication.

Explain how the extracellular matrix functions.

The extracellular matrix functions in support and attachment for animal tissues. It also functions in the healing and growth of the tissue.