

Cell Structure and Function

ESSENTIAL QUESTION

What are the different parts that make up a cell?

By the end of this lesson, you should be able to compare the structure and function of cell parts in plant and animal cells.

Indiana Standards

7.3.3 Explain that although the way cells function is similar in all living organisms, multicellular organisms also have specialized cells whose specialized functions are directly related to their structure.

7.3.4 Compare and contrast similarities and differences between specialized subcellular components within plant and animal cells, including organelles and cell walls that perform essential functions and give a cell its shape and structure.

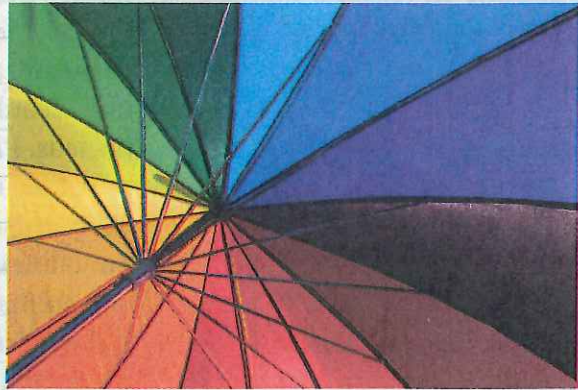
Cells have many parts. This part is called a Golgi complex. It functions like a shipping facility, packaging and distributing proteins and other materials for use in the cell.

Engage Your Brain

1 Predict Check T or F to show whether you think each statement is true or false.

- | T | F | |
|--------------------------|--------------------------|---|
| <input type="checkbox"/> | <input type="checkbox"/> | All cells have the same structure and function. |
| <input type="checkbox"/> | <input type="checkbox"/> | Prokaryotes do not have a nucleus. |
| <input type="checkbox"/> | <input type="checkbox"/> | Plant cells are the same as animal cells. |
| <input type="checkbox"/> | <input type="checkbox"/> | All organisms are multicellular. |

2 Relate How does the structure of this umbrella relate to its function?



Active Reading

3 Synthesis You can often define an unknown word if you know the meaning of its word parts. Use the word parts and sentence below to make an educated guess about the meaning of the word *chloroplast*.

Word part	Meaning
<i>chloro-</i>	green
<i>plast</i>	structure

Example sentence

Plant cells have chloroplasts, which contain a green pigment used for making their own food.

chloroplast:

Vocabulary Terms

- cytoskeleton
- mitochondrion
- ribosome
- endoplasmic reticulum
- Golgi complex
- cell wall
- vacuole
- chloroplast
- lysosome

4 Apply As you learn the definition of each vocabulary term in this lesson, create your own definition or sketch to help you remember the meaning of the term.

Being Eu-nique

What are the characteristics of eukaryotic cells?

Active Reading

5 Identify As you read, underline the characteristics of eukaryotic cells.

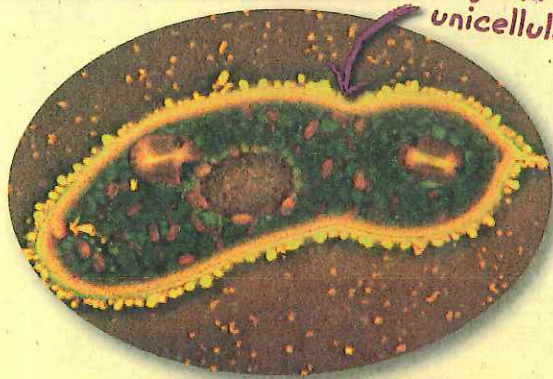
Visualize It!

6 Apply A euglenoid is a unicellular organism. Why is it a eukaryote like the plant and animal cells shown here?

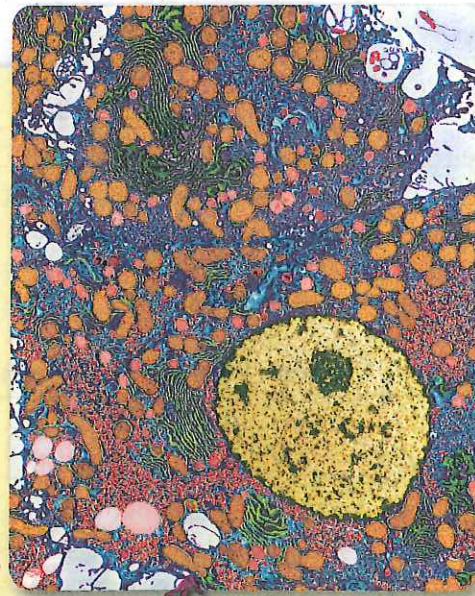
All organisms are made up of one or more cells, but what kinds of cells? There are two types of cells, prokaryotes (proh•KAHR•ee•ottz) and eukaryotes (yoo•KAHR•ee•ottz). Prokaryotes are unicellular organisms that do not have a nucleus or membrane-bound organelles. Eukaryotes can be unicellular or multicellular and have membrane-bound organelles, including a nucleus. Plants and animals are eukaryotes.

Eukaryotic cells can differ from each other depending on their *structure* and *function*. Structure is the arrangement of parts. Function is the activity the parts carry out. For example, plant cells and animal cells have some common structures. However, other differences in their cell structures and functions are what make plants and animals so different from each other.

Even cells within the same organism can differ from each other depending on their function. Most of the cells in multicellular organisms are specialized to perform a specific function. However, all eukaryotic cells have a nucleus, membrane-bound organelles, and common structures that protect and support the cell.



Euglena are unicellular protists



Animal liver cell



Duckweed plant cell

Parts that Protect and Support the Cell

Every cell is surrounded by a cell membrane. The cell membrane acts as a barrier between the inside of a cell and the cell's environment. The cytoplasm is the region between the cell membrane and the nucleus that includes the fluid and all of the organelles. The cell membrane protects the cell and regulates what enters and leaves the cell.

Throughout the cytoplasm of eukaryotic cells is a **cytoskeleton**. The cytoskeleton is a network of protein filaments that gives shape and support to cells. The cytoskeleton is also involved in cell division and in movement. It helps objects move around inside the cell, or it may form structures that help the whole organism, such as unicellular organisms, to move.

The cell membrane is a double layer of phospholipids. Water molecules and some gas molecules can pass through the cell membrane.

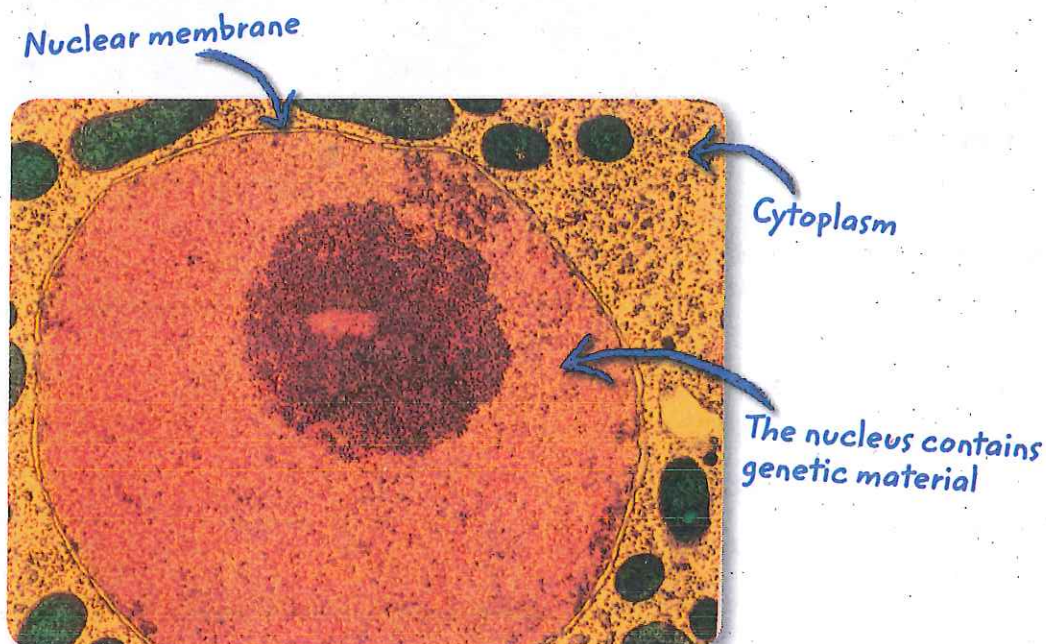


Other larger materials must pass through protein channels in the membrane.

Genetic Material in the Nucleus

The nucleus is an organelle in eukaryotic cells that contains the cell's genetic material. Deoxyribonucleic acid, or DNA, is stored in the nucleus. DNA is genetic material that contains information needed for cell processes, such as making proteins. Proteins perform most actions of a cell. Although DNA is found in the nucleus, proteins are not made there. Instead, instructions for how to make proteins are stored in DNA. These instructions are sent out of the nucleus through pores in the nuclear membrane. The nuclear membrane is a double layer. Each layer is similar in structure to the cell membrane. The outer membrane has pores.

7 Describe What are two functions of the cell membrane?



Part-iculars

What organelles are found in plant and animal cells?

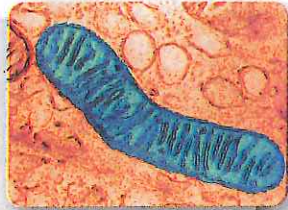
Even though plant and animal cells are microscopic, they are very complex. They have many parts that function to keep the cell alive. Many of these parts are membrane-bound organelles that perform a specific function.

Mitochondria

Organisms need energy for life processes. Cells carry out such processes for growth and repair, movement of materials into and out of the cell, and chemical processes. Cells get energy by breaking down food using a process called *cellular respiration*. Cellular respiration occurs in an organelle called the **mitochondrion** (my•TOH•kahn•dree•ahn). In cellular respiration, cells use oxygen to release energy stored in food. For example, cells break down the sugar glucose to release the energy stored in the sugar. The mitochondria then transfer the energy released from the sugar to a molecule called adenosine triphosphate, or ATP. Cells use ATP to carry out cell processes.

Mitochondria have their own DNA and they have two membranes. The outer membrane is smooth. The inner membrane has many folds. Folds increase the surface area inside the mitochondria where cellular respiration occurs.

8 Explain Why are mitochondria called the powerhouses of cells?



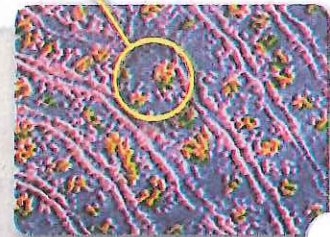
Ribosomes

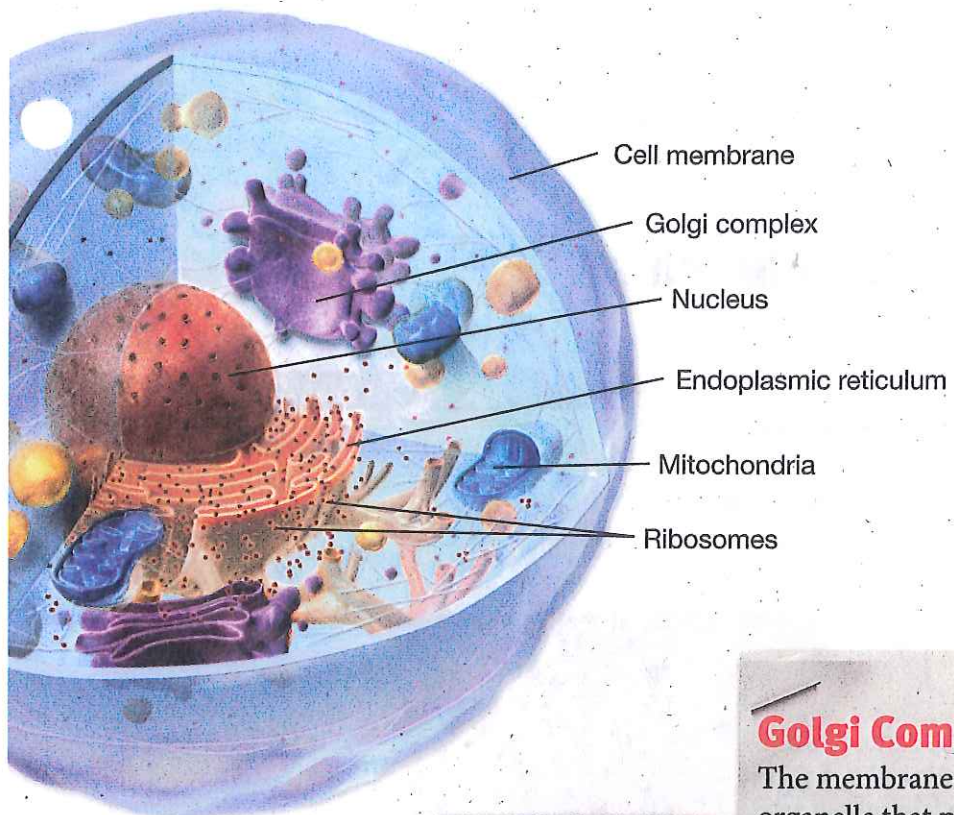
Ribosomes

Proteins control most chemical reactions of cells and provide structural support for cells and tissues. Some proteins are even exported out of the cell for other functions throughout the body. Making, packaging, and transporting proteins requires many organelles. The **ribosome** is the organelle that makes proteins by putting together chains of amino acids using instructions encoded in the cell's DNA. An amino acid is any of about 20 different carbon-based molecules that are used to make proteins. Almost all cells have ribosomes, which are the smallest organelles.

Ribosomes are not enclosed in a membrane. In prokaryotes, the ribosomes are suspended freely in the cytoplasm. In eukaryotes, some ribosomes are free, and others are attached to another organelle called the *endoplasmic reticulum*.

9 Describe How do ribosomes make proteins?





Endoplasmic Reticulum

In the cytoplasm is a system of membranes near the nucleus called the **endoplasmic reticulum** (ehn•doh•PLAHZ•mick rhett•ICK•yoo•luhm), or ER. The ER assists in the production, processing, and transport of proteins and in the production of lipids. The ER is either smooth or rough. Rough ER has ribosomes attached to its membrane, while smooth ER does not. Ribosomes on the rough ER make many of the cell's proteins. Some of these proteins move through the ER to different places in the cell. The smooth ER makes lipids and breaks down toxic materials that could damage the cell.

10 Compare How does rough ER differ from smooth ER in structure and function?



Golgi Complex

The membrane-bound organelle that packages and distributes materials, such as proteins, is called the **Golgi complex** (GOHL•ghee COHM•plehkHz). It is named after Camillo Golgi, the Italian scientist who first identified the organelle.

The Golgi complex is a system of flattened membrane sacs. Lipids and proteins from the ER are delivered to the Golgi complex where they may be modified to do different jobs. The final products are enclosed in a piece of the Golgi complex's membrane. This membrane pinches off to form a small bubble, or vesicle. The vesicle transports its contents to other parts of the cell or out of the cell.

11 Describe What is the function of the Golgi complex?



Now Showing:

The Plant Cell

What additional parts are found in plant cells?

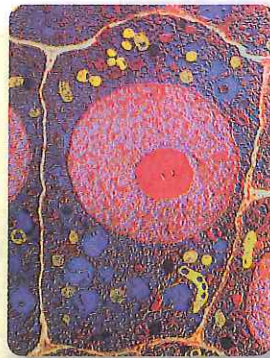
Think about some ways that plants are different from animals. Plants don't move around, and some have flowers. Plant cells do have a cell membrane, cytoskeleton, nucleus, mitochondria, ribosomes, ER, and a Golgi complex just like animal cells do. In addition, plant cells have a cell wall, large central vacuole, and chloroplasts.

Active Reading

12 Identify As you read, underline the functions of the cell wall, large central vacuole, and the chloroplasts.

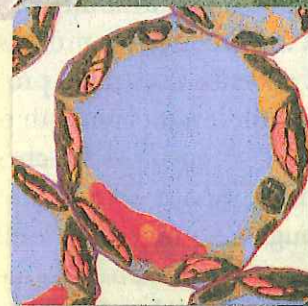
Cell Wall

In addition to the cell membrane, plant cells have a **cell wall**. The cell wall is a rigid structure that surrounds the cell membrane, identified by the yellow line around the plant cell in this photo. Cell walls provide support and protection to the cell. Plants don't have a skeleton like many animals do, so they get their shape from the cell wall. The cells of fungi, archaea, bacteria, and some protists also have cell walls.



Large Central Vacuole

A **vacuole** (VAK•yoo•ohl) is a fluid-filled vesicle found in the cells of most animals, plants, and fungi. A vacuole may contain enzymes, nutrients, water, or wastes. Plant cells also have a large central vacuole that stores water. Central vacuoles full of water help support the cell. Plants may wilt when the central vacuole loses water.



13 Compare How do large central vacuoles differ from vacuoles?

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Visualize It!

14 Identify Label these cell parts on the plant cell shown here:

- Mitochondrion
- Golgi complex
- Nucleus
- Endoplasmic reticulum
- Ribosomes
- Cell wall
- Cell membrane
- Cytoskeleton

A _____

B _____

C _____

D _____

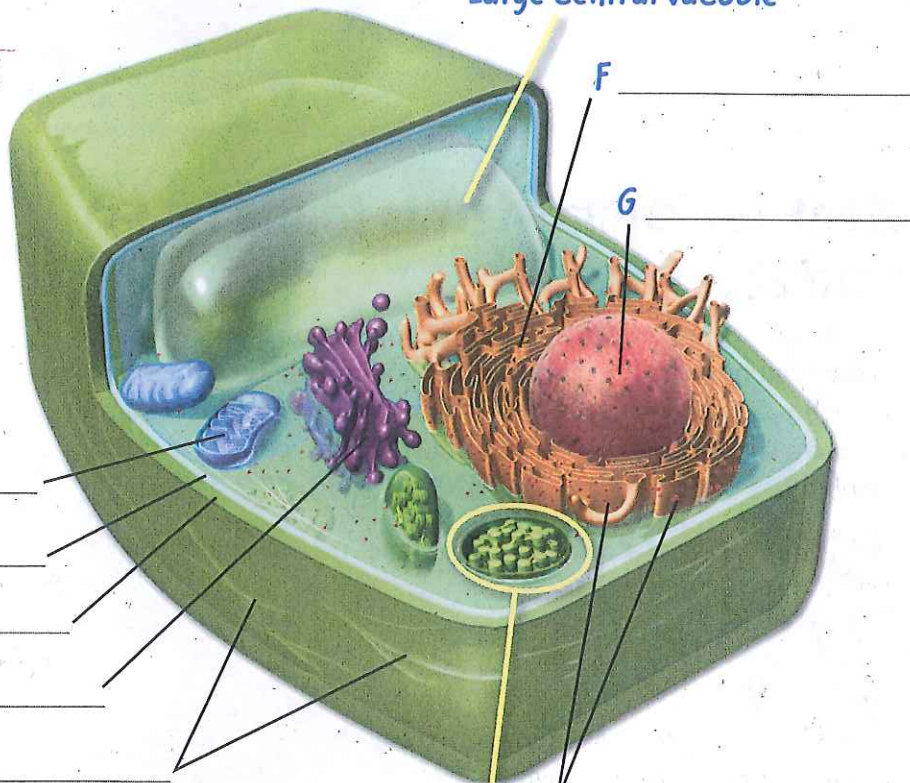
E _____

Large central vacuole

F _____

G _____

H _____

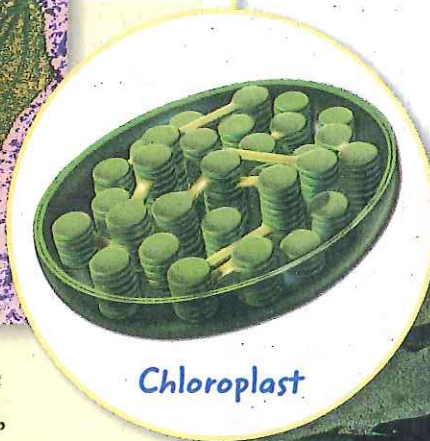


Chloroplasts

Animals must eat food to provide their cells with energy. However, plants, and some protists, can make their own food using photosynthesis.

These organisms have **chloroplasts** (KLOHR•oh•plahstz), organelles

where photosynthesis occurs. Photosynthesis is the process by which cells use sunlight, carbon dioxide, and water to make sugar and oxygen. Chloroplasts are green because they contain a green pigment called *chlorophyll* (KLOHR•oh•fill). Chlorophyll absorbs the energy in sunlight. This energy is used to make sugar, which is then used by mitochondria to make ATP. Chloroplasts have two outer membranes.



Chloroplast

15 Describe What is the role of chlorophyll inside chloroplasts?

Think Outside the Book Inquiry

16 Describe Cyanobacteria and green algae are similar to plants. Choose one of these organisms and explain why they are similar to plants but are not classified as plants.

Introducing:

The Animal Cell

What additional part is found in animal cells?

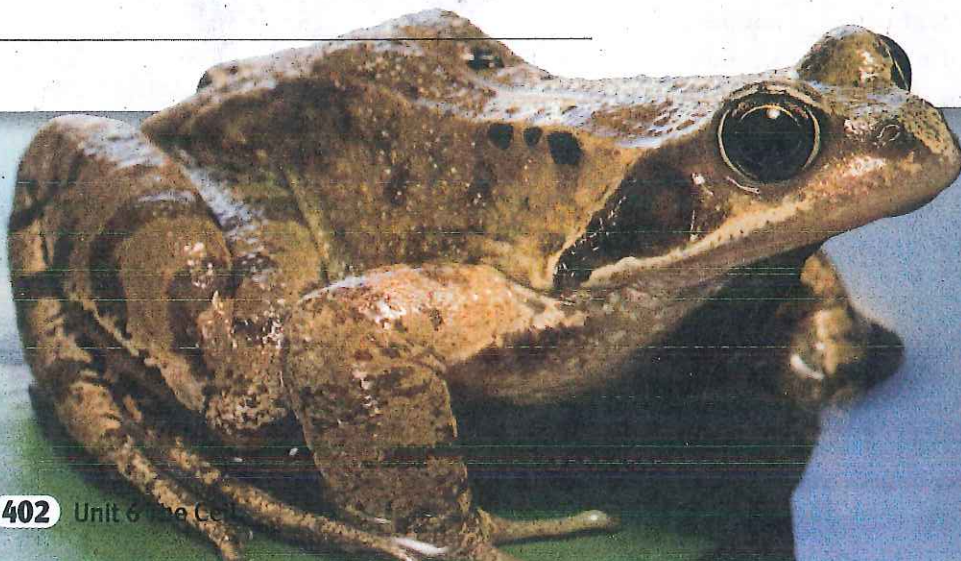
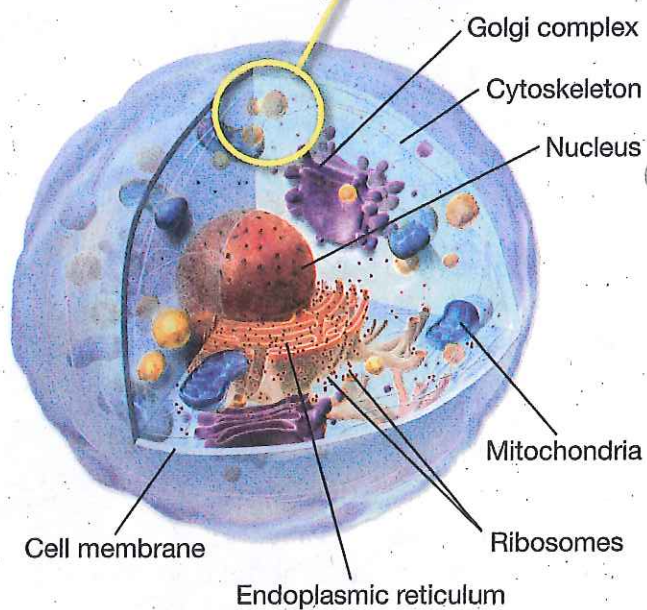
Animal cells are eukaryotic cells that contain a nucleus and are surrounded by a cell membrane. They contain many of the same organelles as most plant cells, including mitochondria, ribosomes, ER, and a Golgi complex. Most animal cells also contain a membrane-bound organelle called a *lysosome*.

Active Reading 17 Recognize As you read, underline the function of lysosomes.

Lysosomes

Organelles called **lysosomes** (LY•soh•zohmz) contain digestive enzymes, which break down worn-out or damaged organelles, waste materials, and foreign invaders in the cell. Some of these materials are collected in vacuoles. A lysosome attaches to the vacuole and releases the digestive enzymes inside. Some of these materials are recycled and reused in the cell. For example, a human liver cell recycles half of its materials each week.

18 Compare How are lysosomes similar to vacuoles?



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19 Compare Draw a sketch for each organelle identified in the *Structure* column. Put check marks in the last two columns to identify whether the cell structure can be found in plant cells, animal cells, or both.

Structure	Function	In plant cell?	In animal cell?
Nucleus	Contains the genetic material		
Endoplasmic reticulum	Processes and transports proteins and makes lipids		
Golgi complex	Packages and distributes materials within or out of the cell		
Ribosome	Makes proteins		
Chloroplast	Uses sunlight, carbon dioxide, and water to make food by photosynthesis		
Mitochondria	Breaks down food molecules to release energy by cellular respiration		
Large central vacuole	Stores water and helps give shape to the cell		
Lysosome	Produce enzymes that digests wastes, cell parts, and foreign invaders		

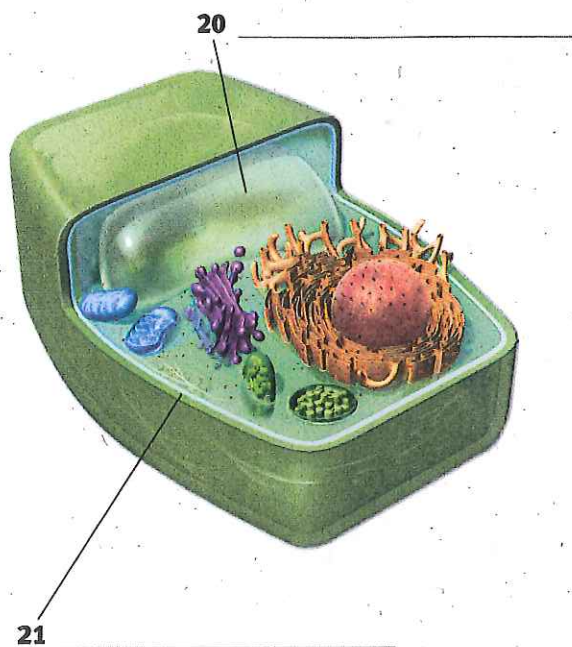


Visual Summary

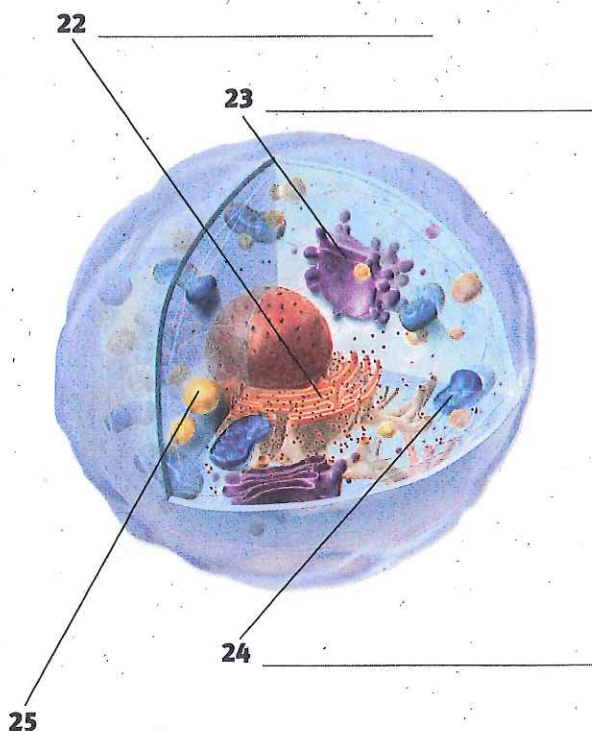
To complete this summary, fill in the blanks to identify the organelles in each cell. Then, use the key below to check your answers. You can use this page to review the main concepts of the lesson.

Compare Plant Cells and Animal Cells

Structures in plant cells



Structures in animal cells



Plants and animals are eukaryotic cells. The structures inside a cell work together to keep the cell and the entire organism alive.

Answers: 20 large central vacuole; 21 cell wall; 22 endoplasmic reticulum; 23 Golgi complex; 24 mitochondrion; 25 lysosome

26 Summarize How do eukaryotic cells differ from each other?