Module 1:
Cells and Life

Lesson 2

Cell structure and function

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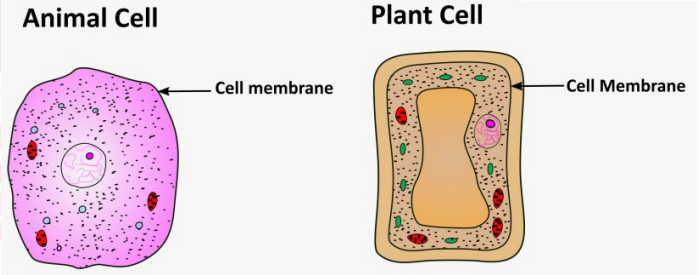
What surrounds a cell?

- Different types of cells perform different functions, but all cells have some structure in common.
- **Every cell** is surrounded by a protective boundary called a cell membrane.



- The **cell membrane** is a flexible covering that protects the inside of a cell from the environment outside a cell.

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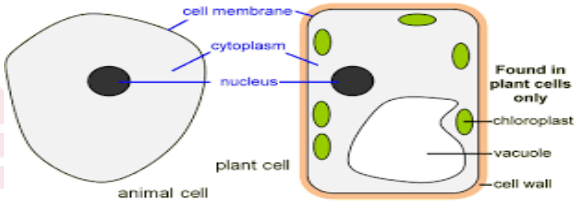
What surrounds a cell?

➢ Cell membrane

- The cell membrane surrounds the cytoplasm.
- The **cytoplasm** is a fluid inside a cell that contains salts and other molecules.
- The **important role of cell membrane** is to control the movement of a substance into and out of cells.
- A cell membrane is semipermeable – it allows only nutrients to enter and wastes to leave a cell.



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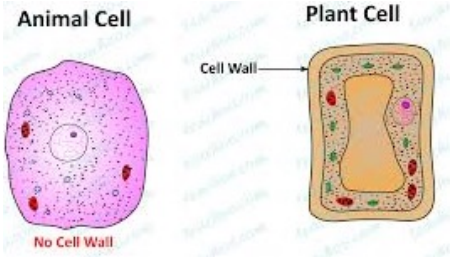
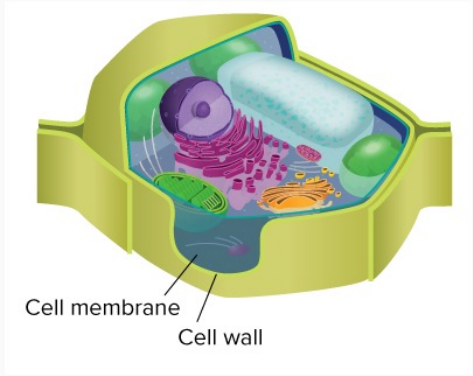
What surrounds a cell?



➢ Cell Wall

- The cell wall is a stiff structure **outside** the cell membrane.
- Cells in plants, fungi, bacteria and some types of protists (amoeba) have cell walls.
- Cell walls provide structure and help protect the cell from the outside environment (attack by viruses and other harmful organisms).



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Activity - 4

What structure surrounds the cytoplasm of plant and animal cells?

……Cell membrane……..

What structure encloses the cell membrane of a plant cell?

……Cell wall ……..

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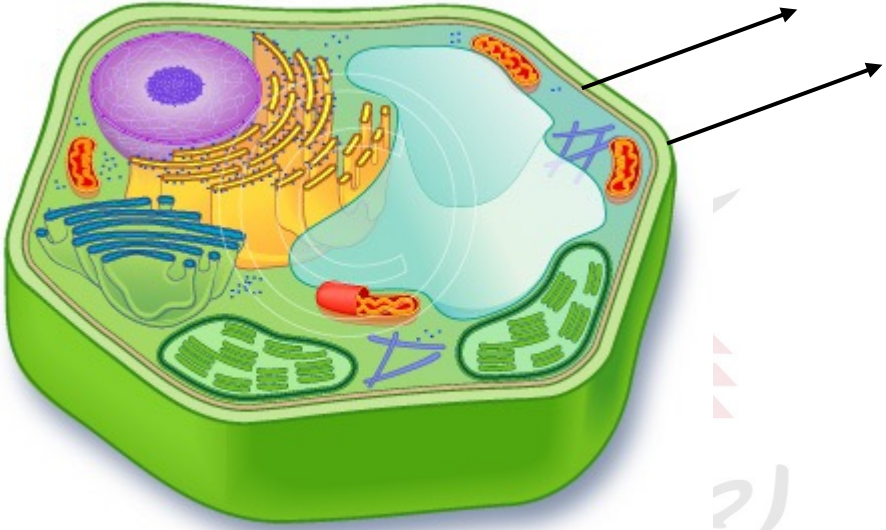
Activity - 5



Identify and label the cell wall and cell membrane.

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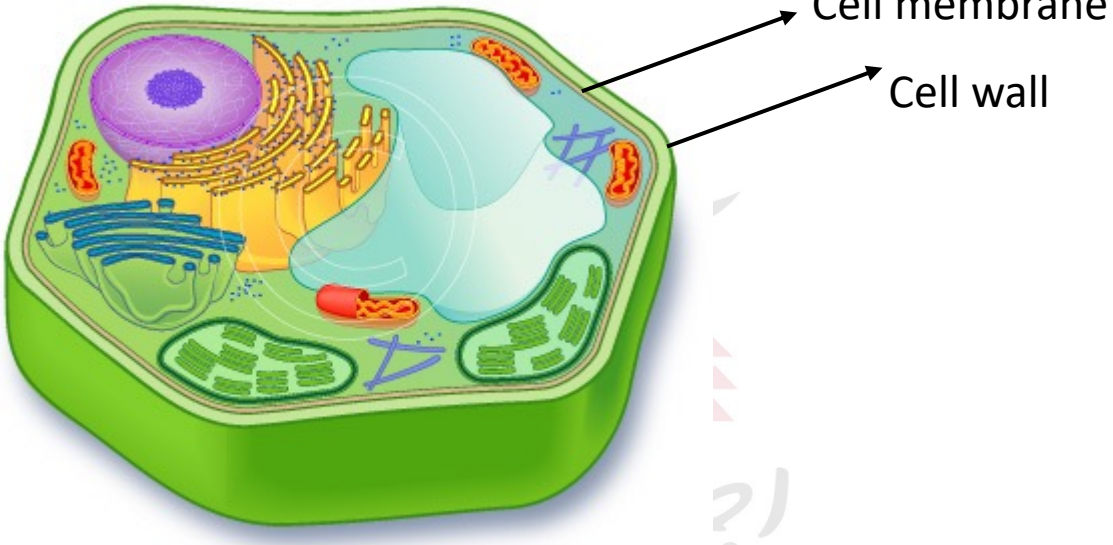
Activity - 5



Identify and label the cell wall and cell membrane.

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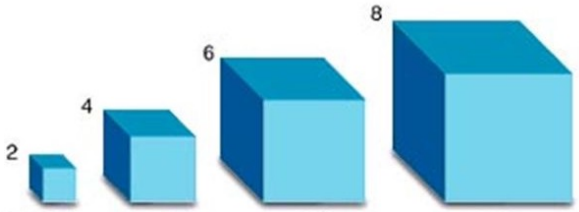
How does cell size affect the transport of materials?

➢ Surface Area and volume

- Nutrients, oxygen, and other materials enter and leave a cell through the cell membrane.
- The area of the cell membrane is the cell's **surface area**.
- The **volume** is the amount of space inside the cell.

What is surface area to volume ratio?



Surface area (square inches)	24	96	216	384
Volume (cubic inches)	8	64	216	512
Surface area/volume	3.0	1.5	1.0	0.75

Volume increases faster than surface area.
The surface area and volume both increase ...
but, not at the same rate.

As cells increase in size, surface area to volume ratios decrease, making cells unable to obtain nutrients or remove wastes.

Smaller cells can transport substances more easily

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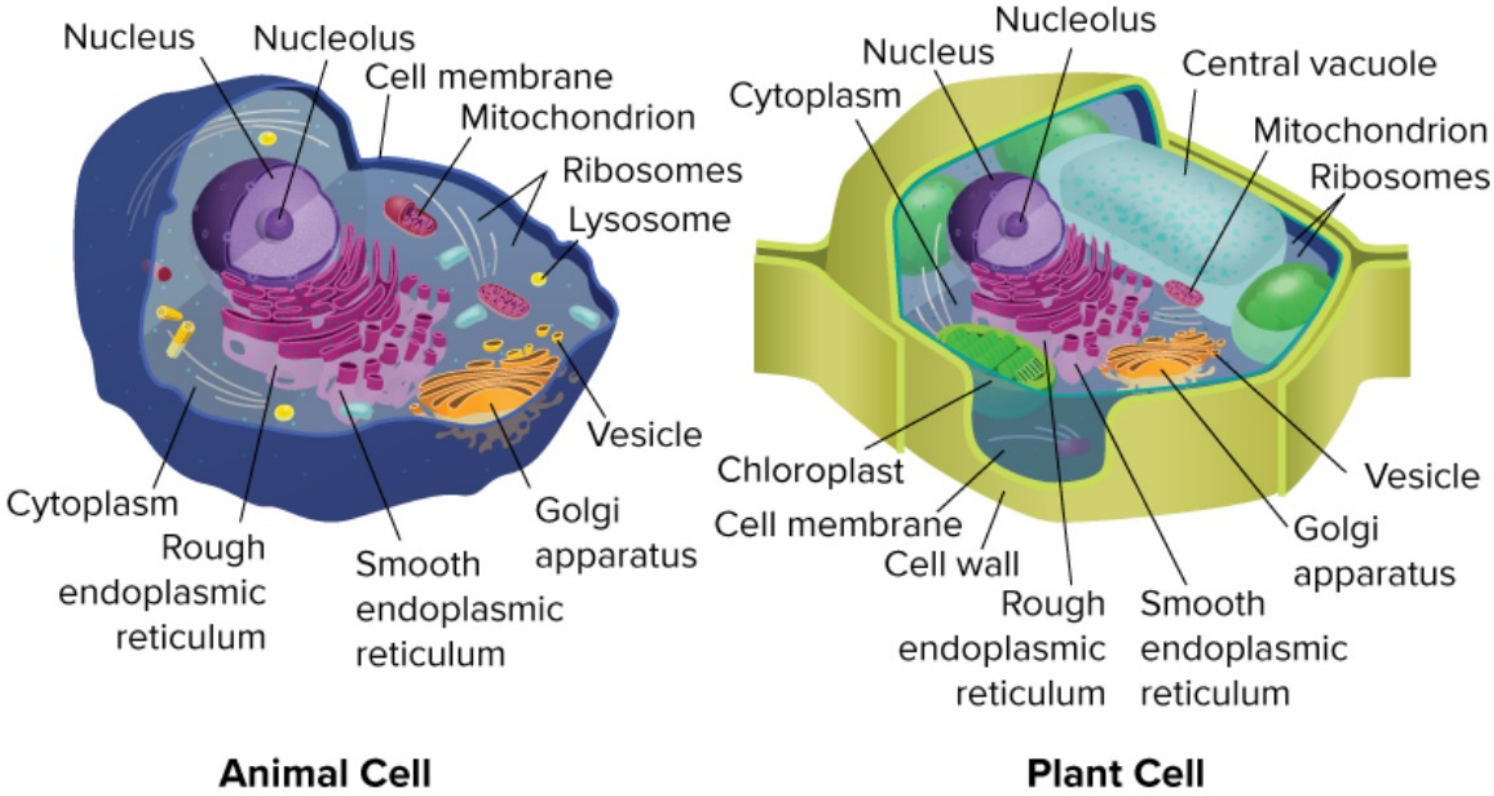
What organelles are involved in the transport of materials?



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What organelles are involved in the transport of materials?

- The cell membrane enables materials to enter and leave the cell.
- There are other organelles related to the transport of materials as well.

Ribosomes Amino acid molecules made up of carbon, hydrogen, oxygen, nitrogen, and sometimes sulfur, join together to form long chains called **proteins**. Some proteins help cells communicate with each other while others transport substances inside cells. Proteins are made on small structures called ribosomes. Unlike other cell organelles, a ribosome is not surrounded by a membrane.

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What organelles are involved in the transport of materials?

Endoplasmic Reticulum Ribosomes can be attached to a weblike organelle called the endoplasmic reticulum (en duh PLAZ mihk • rih TIHK yuh lum), or ER. The ER spreads from the nucleus throughout most of the cytoplasm. Endoplasmic reticulum with ribosomes on its surface is called rough endoplasmic reticulum. Rough ER is the site of protein production. ER without ribosomes is called smooth ER. Smooth ER is important because it helps remove harmful substances from a cell.

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What organelles are involved in the transport of materials?

Vacuoles Some cells also have saclike structures called vacuoles. Vacuoles are organelles that store food, water, and waste material. A typical plant cell usually has one large vacuole. Some animal cells have many small vacuoles. A plant cell's vacuole may take up half of the cell's size. This vacuole not only stores water and other substances, but also enables the plant to stay rigid and supported when filled with water.

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What organelles are involved in the transport of materials?

The Golgi Apparatus Proteins are prepared for their specific jobs or functions by an organelle called the Golgi apparatus. Then the Golgi apparatus packages the proteins into tiny, membrane-bound, ball-like structures called vesicles. Vesicles are organelles that transport substances from one area of a cell to another area of a cell. Some vesicles in an animal cell are called lysosomes. Lysosomes contain substances that help break down and recycle cellular components.

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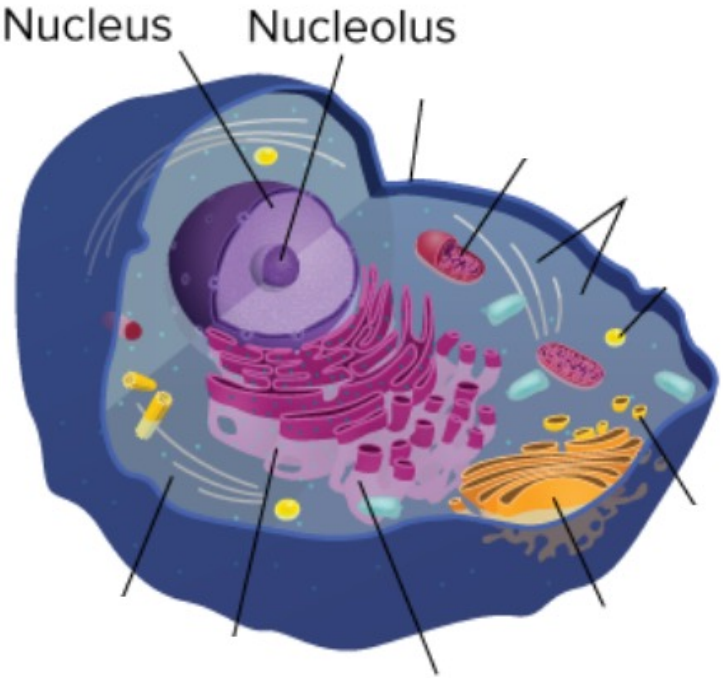
Activity - 6

Label the animal cell



Cell membrane

Mitochondrion

Ribosomes

Cytoplasm

Lysosome

Vesicle

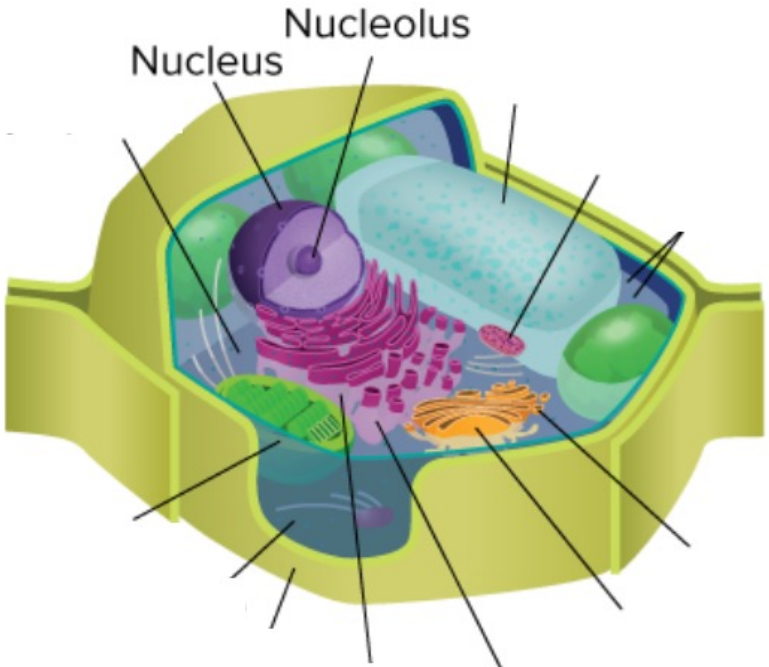
Golgi apparatus

Smooth endoplasmic reticulum

Rough endoplasmic reticulum

Activity - 6

Label the plant cell



Lysosome

Vesicle

Golgi apparatus

Smooth endoplasmic reticulum

Rough endoplasmic reticulum

Cytoplasm

Cell membrane

Central vacuole

Mitochondrion

Ribosomes

Cell wall

Chloroplast

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What powers cellular activity?

➢ Mitochondria

- Mitochondrion is a bean-shaped organelle.
- It is called the powerhouse of cell.
- Mitochondria are found in both plant and animal cells.
- Mitochondria are the site of cellular respiration – a series of chemical reaction in which food molecules are broken down and the energy in them is converted to ATP.

➢ Powering plant cells

- In addition to mitochondria, plant cell contain organelles called chloroplast.
- Chloroplast are organelles that use light energy and make food- a sugar called - from water and carbon dioxide

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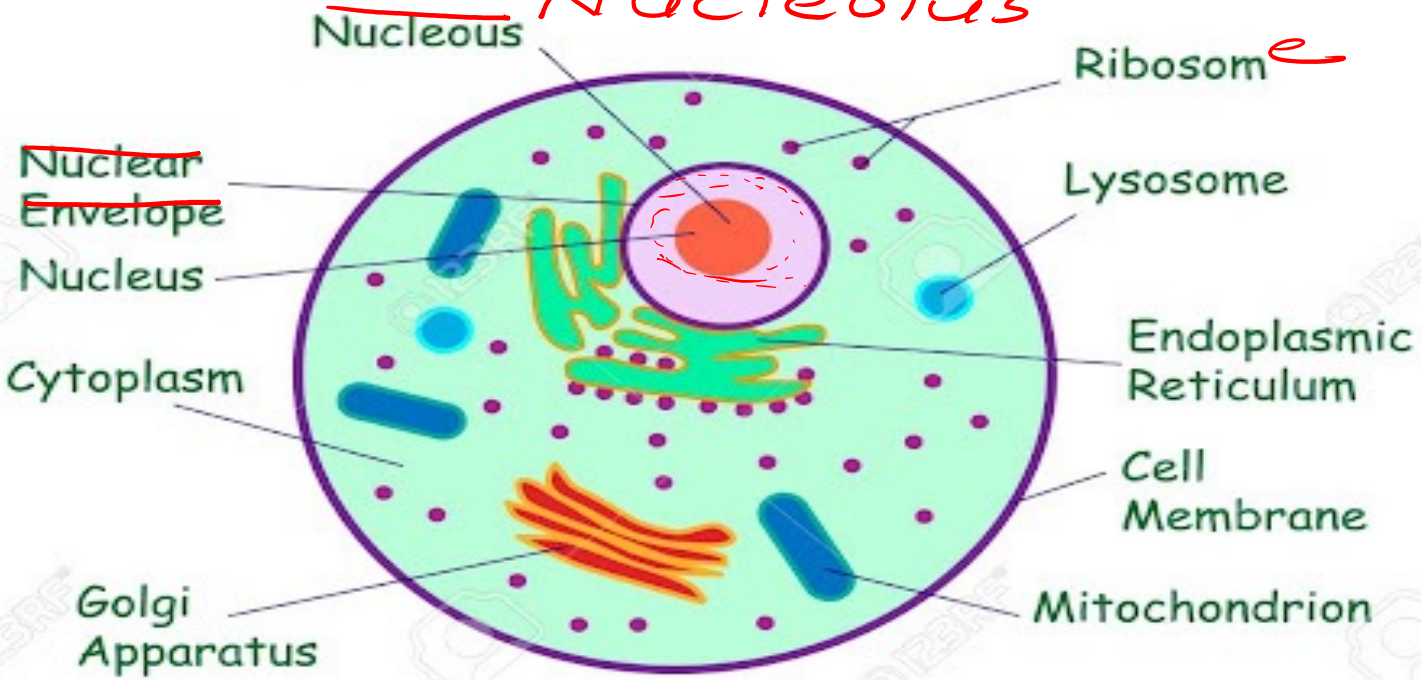
Animal Cell



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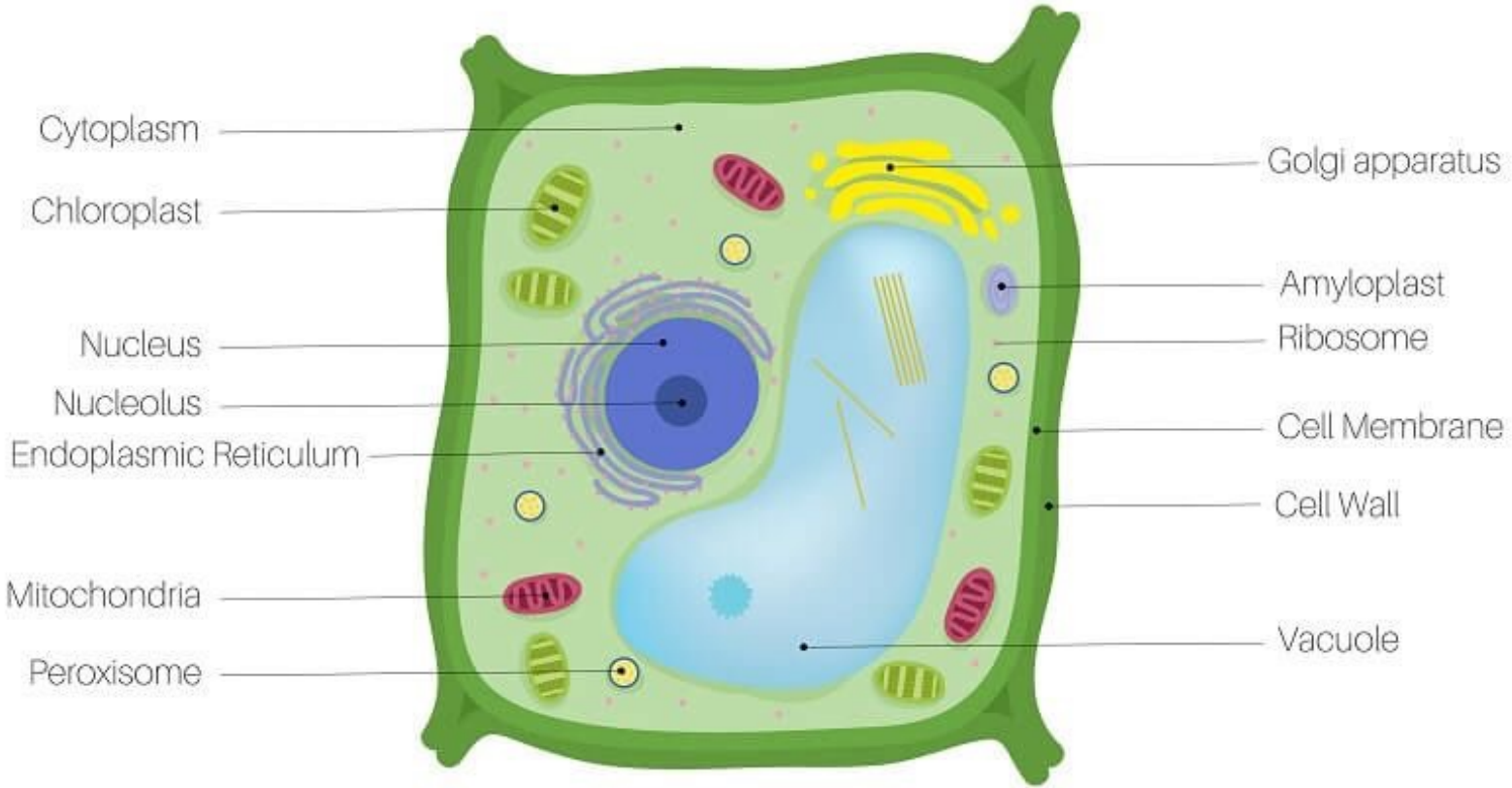
Plant cell



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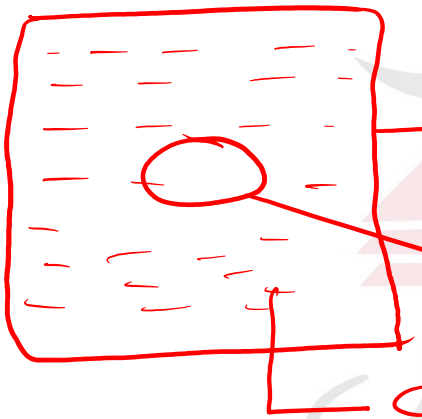
Cell

Animal



cell membrane

nucleus

cytoplasm

Plant cell

cytoplasm

Cell wall

nucleus

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ENCOUNTER THE PHENOMENON

- How do the parts of an ostrich egg–the largest cell on the planet–work together in order for it to function?
- Bird eggs have different structures, such as a shell, a membrane, and a yolk. Each structure has a different function that assists in development of the baby bird.
- Place an uncooked egg in a bowl. Feel the shell and record your observations in your Science Notebook. Crack open the egg. Pour the contents into the bowl. Observe the inside of the shell and the contents of the egg. Record your observations. What do you think is the role of the eggshell? What does the structure of the eggshell tell you about its function?

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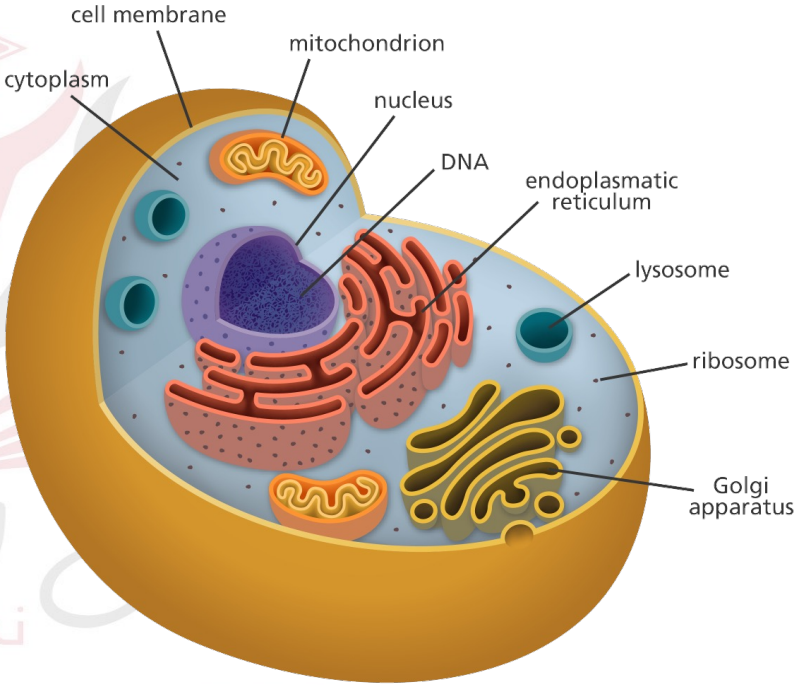
What surrounds a cell?

- Although different types of cells perform different functions, all cells have some structures in common.
- Every cell is surrounded by a protective boundary called a membrane.
- **The cell membrane is a flexible covering that protects the inside of a cell from the environment outside a cell.**



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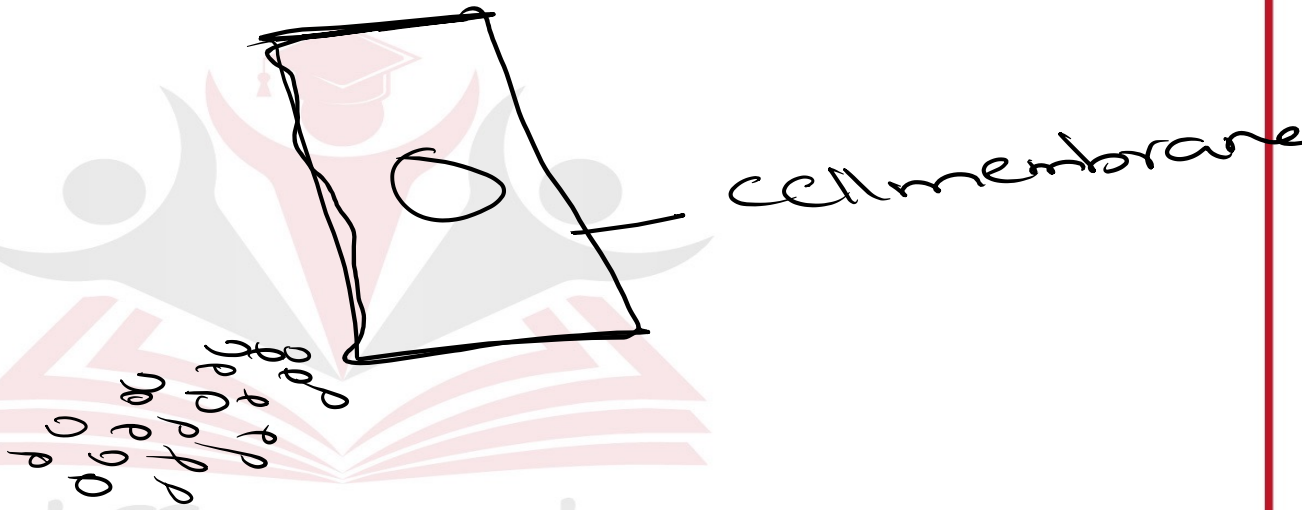

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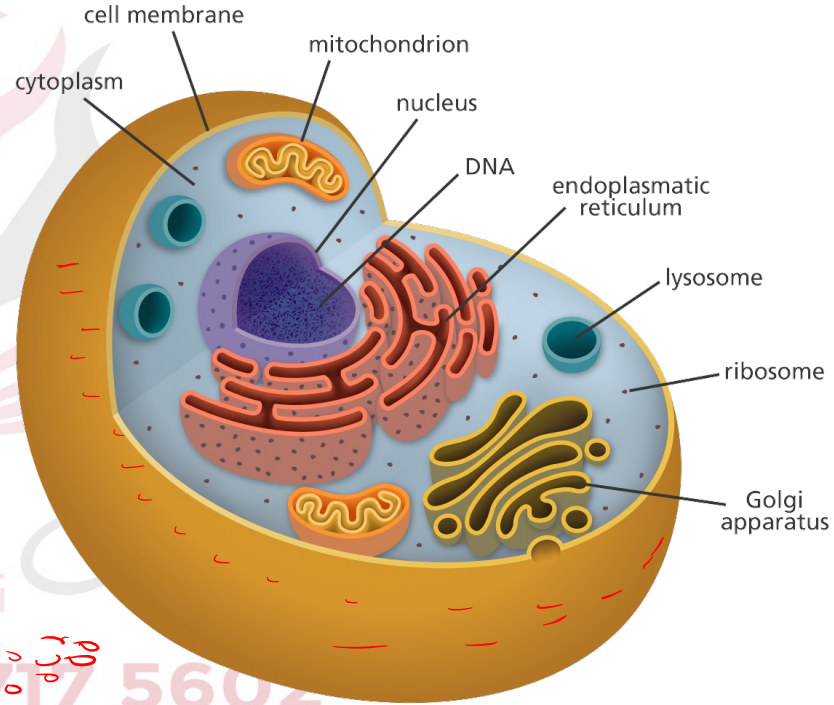
Cell Membrane

- The cell membrane surrounds the cytoplasm.
- ~~The cytoplasm is a fluid inside a~~ cell that contains salts and other molecules.
- A cell membrane is semipermeable. This means it allows only certain substances, like nutrients and wastes, to enter or leave a cell

https://www.twig-world.com/film/the-cell-membrane-1044/



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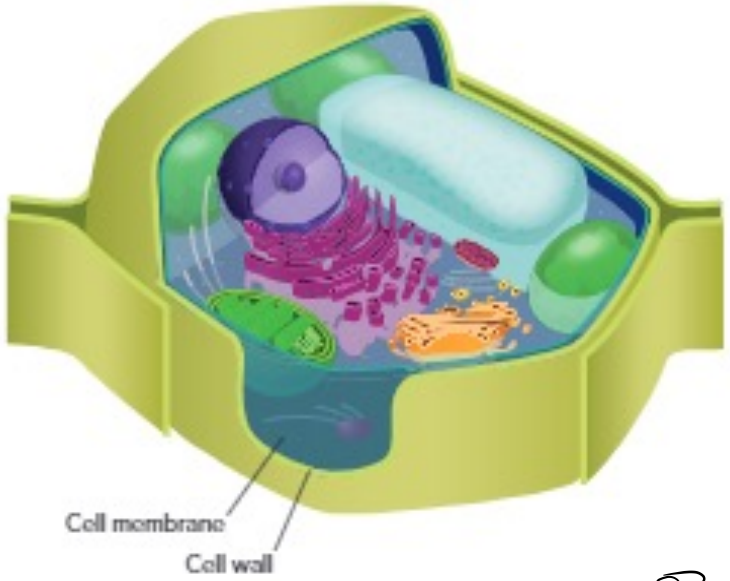
cell wall

- Plant cells, fungal cells, bacteria, and some types of protists have cell walls.
- A cell wall is a stiff structure outside the cell membrane.
- A cell wall protects a cell from attack by viruses and other harmful organisms.
- In some plant cells and fungal cells, a cell wall helps maintain the cell's shape and gives structural support
- https://www.twig-world.com/film/glossary/cell-wall-298/



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How does cell size affect the transport of materials?

- Nutrients, oxygen, and other materials enter and leave a cell through the cell membrane.
- **Surface Area and Volume:**
- The movement of nutrients, waste material, and other substances into and out of a cell is important for survival. For this movement to happen, the area of the cell membrane must be large compared to its volume.

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Cell Size and Transport of Materials

- **M ATH Connection**

A ratio is a comparison of two numbers, such as surface area and volume. If a cell were cube-shaped, you would calculate surface area by multiplying its length (ℓ) by its width (w) by the number of sides (6).You would calculate the volume of the cell by multiplying its length (ℓ) by its width (w) by its height (h). To find the surface-area-to-volume ratio of the cell, divide its surface area by its volume

$$\text{Surface area} = \ell \times w \times 6$$

$$\text{Volume} = \ell \times w \times h$$

$$\frac{\text{Surface area}}{\text{Volume}}$$

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Surface area $= l \times w \times 6$

Volume $= l \times w \times h$

Ratio $= \frac{\text{Surface area}}{\text{Volume}}$

l = length, w = width, h = height

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1. Find surface area and volume and ratio of a cell its $l = 1mm$, $w = 1mm$, $h = 1mm$.

Surface area $= l \times w \times 6$

$= 1 \times 1 \times 6$

$= 6\ mm^2$

Volume $= l \times w \times h$

$= 1 \times 1 \times 1$

$= 1\ mm^3$

Ratio $= \frac{\text{Surface area}}{\text{Volume}} = \frac{6}{1} = 6$

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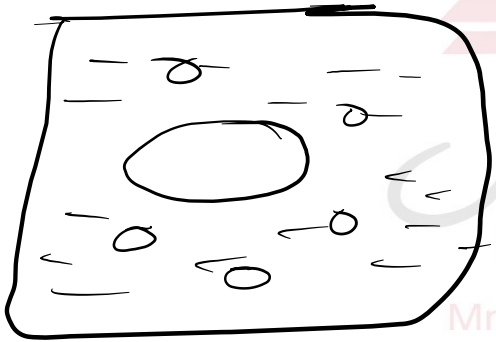
What organelles are involved in the transport of materials?



Ribosomes

Proteins are made on small structures called ribosomes. Unlike other cell organelles, a ribosome is not surrounded by a membrane

carbon, hydrogen, oxygen, nitrogen, and sometimes sulfur, join to form

Some proteins help cells communicate with each other while others transport substances inside cells.

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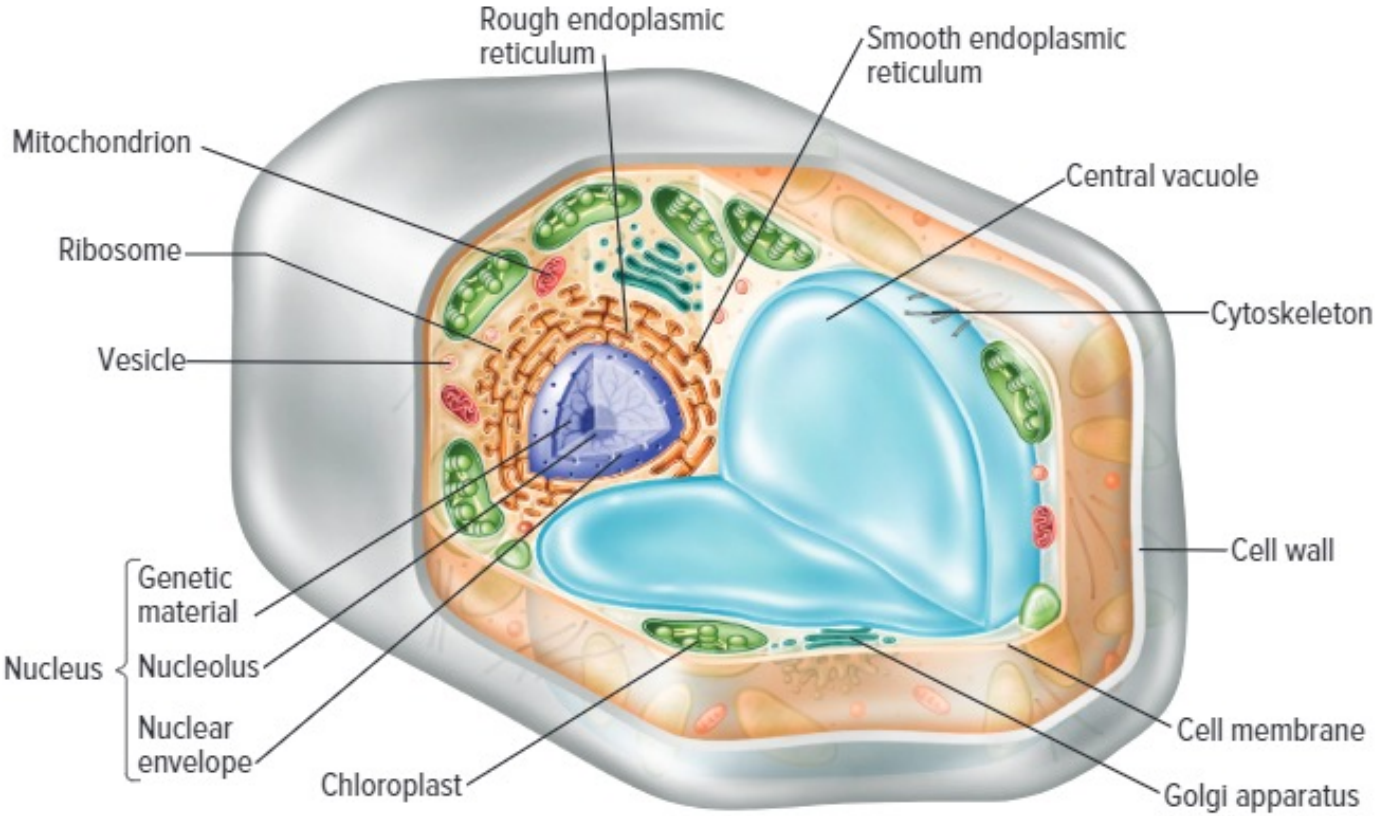
This plant cell has a cell membrane and a cell wall.



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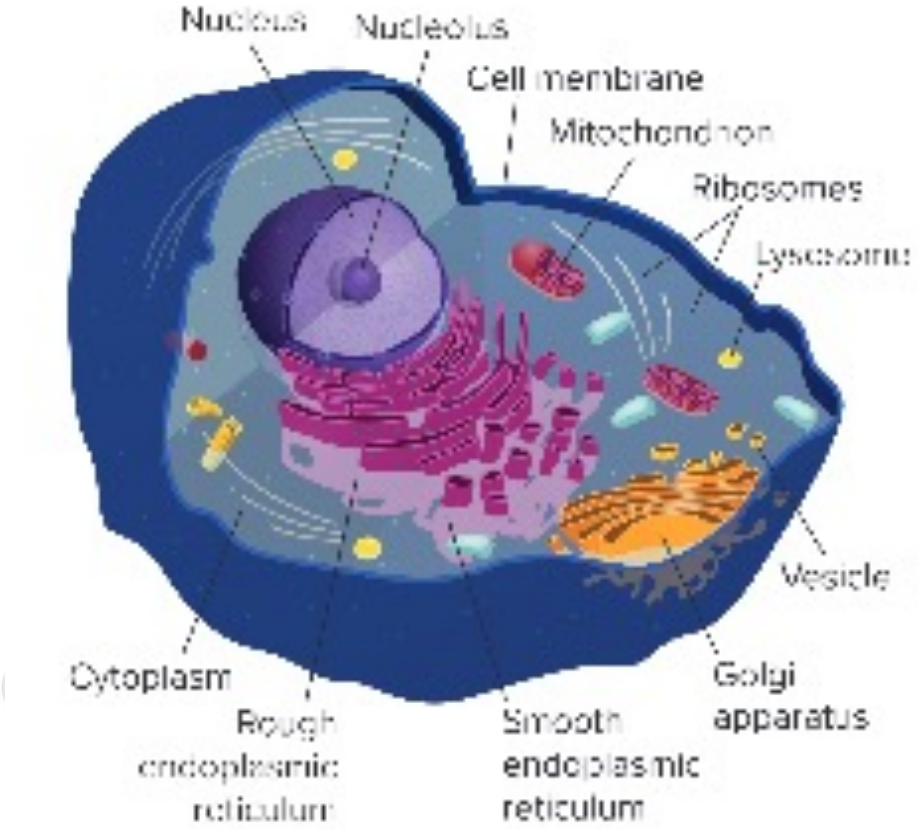

Animal Cell

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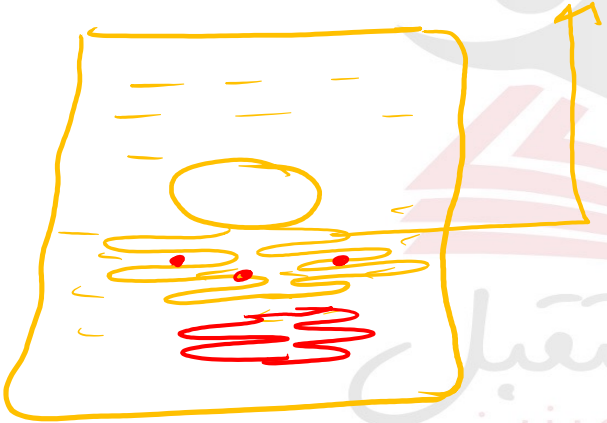
Endoplasmic Reticulum



Ribosomes can be attached to a weblike organelle called the endoplasmic reticulum or ER.

The ER spreads from the nucleus throughout most of the cytoplasm.

Endoplasmic reticulum with ribosomes on its surface is called rough endoplasmic reticulum. Rough ER is the site of protein production.

ER without ribosomes is called smooth ER. Smooth ER is helps remove harmful substances from a cell.

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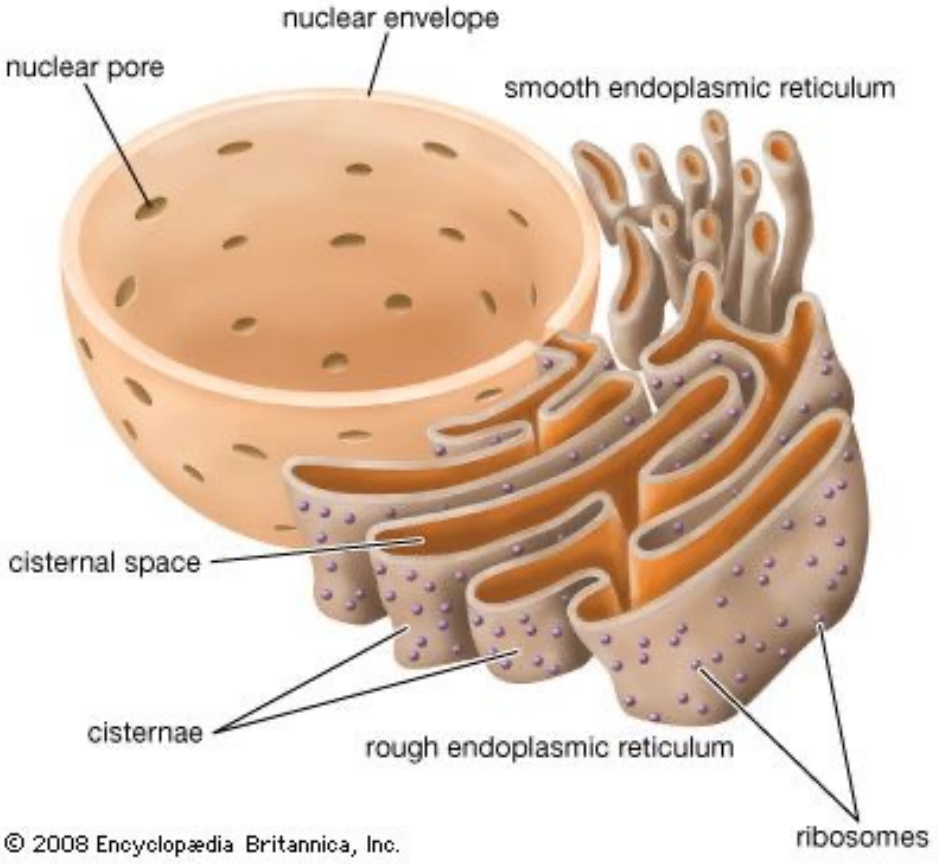
Endoplasmic reticulum



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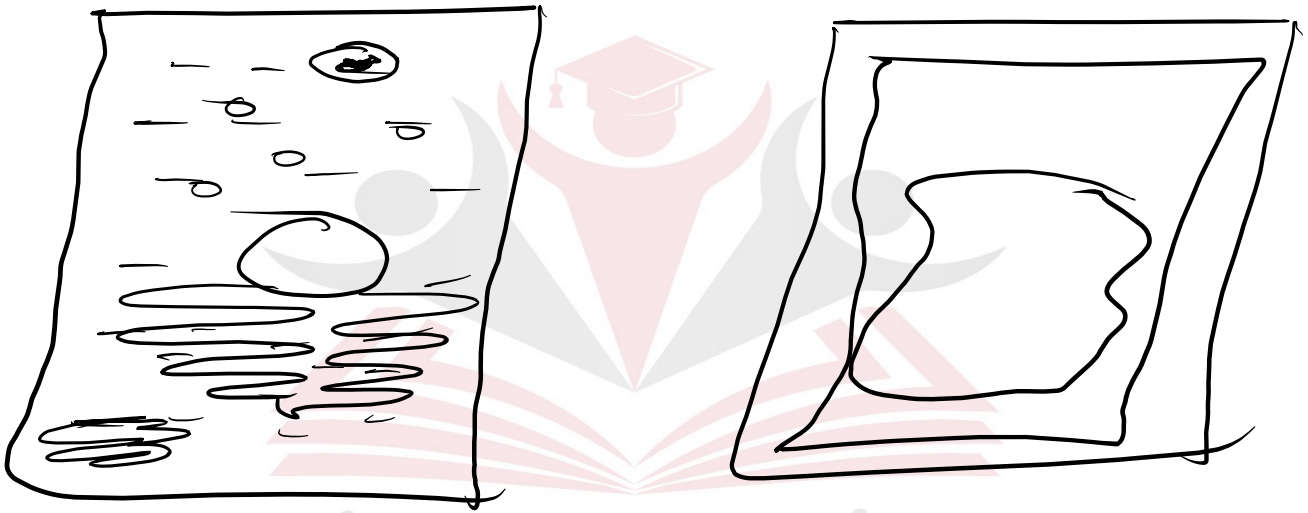

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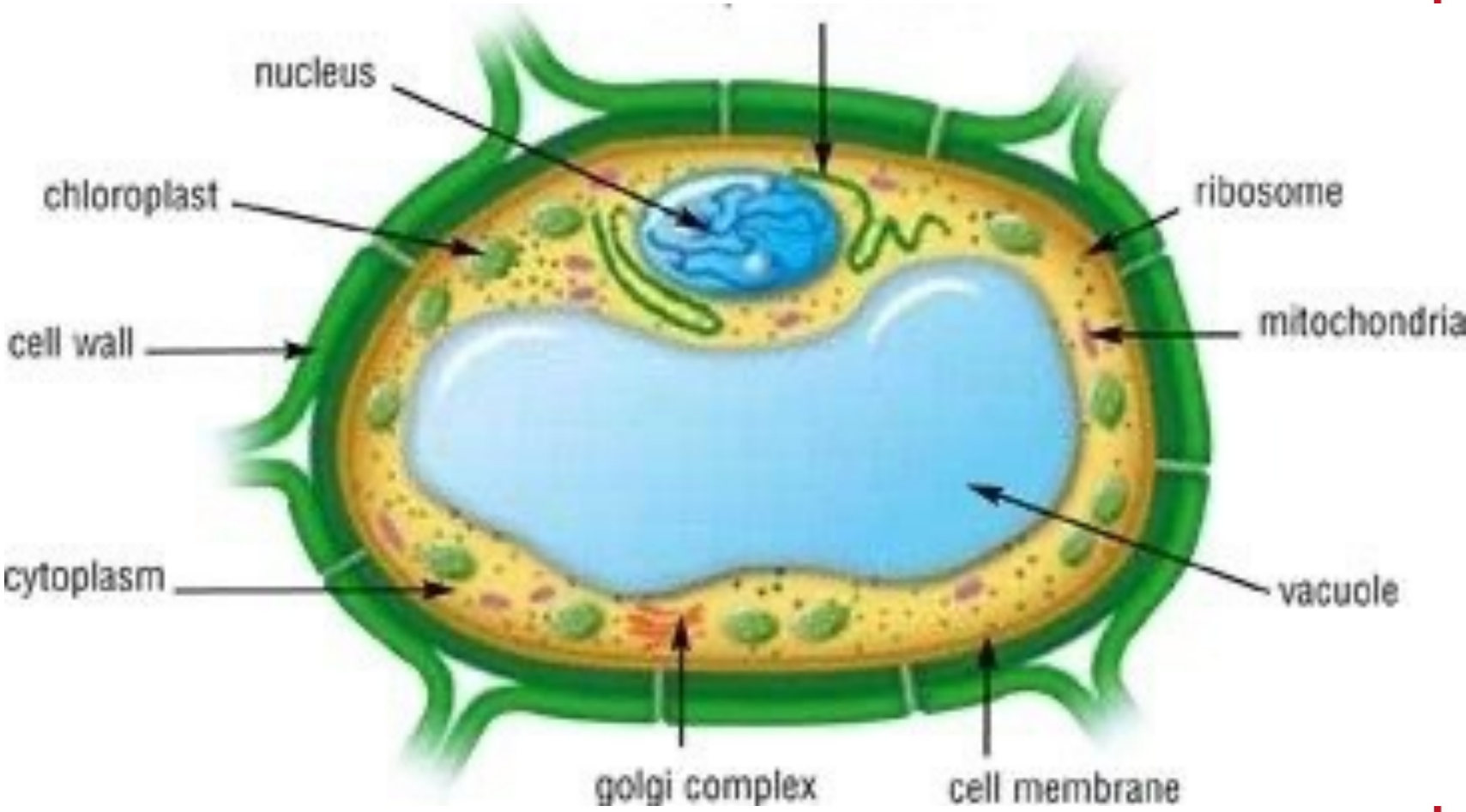

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Vacuoles are organelles that store food, water, and waste material.

A typical plant cell usually has one large vacuole. Some animal cells have many small vacuoles. A plant cell's vacuole may take up half of the cell's size.

This vacuole not only stores water and other substances, but also enables the plant to stay rigid and supported when filled with water.

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The Golgi Apparatus

Proteins are prepared for their specific jobs or functions by an organelle called the Golgi apparatus.

Then the Golgi apparatus packages the proteins into tiny, membrane-bound, ball-like structures called vesicles.

Vesicles are organelles that transport substances from one area of a cell to another area of a cell. Some vesicles in an animal cell are called lysosomes.

Lysosomes contain substances that help break down and recycle cellular components

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Mitochondria(Powerhouse)

- Mitochondrion powers the cell through chemical reactions.
- Mitochondria are found in both plant and animal cells. It has two membranes to increase the surface area for these reactions to occur.
- Mitochondria are a vital part of cellular respiration.
- Cellular respiration is a series of chemical reactions that convert the energy in food molecules into a usable form of energy called ATP

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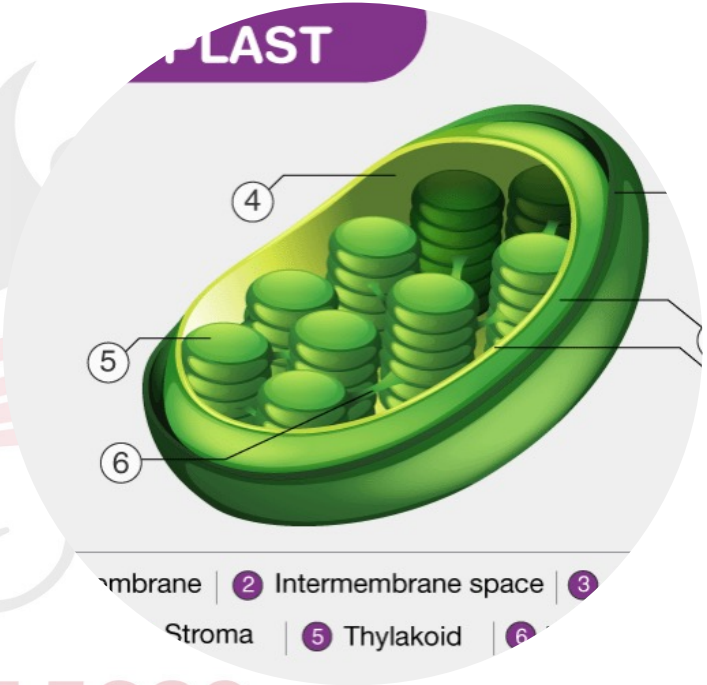
Chloroplasts

- Chloroplasts are organelles that use light energy and make food—a sugar called glucose—from water and carbon dioxide.



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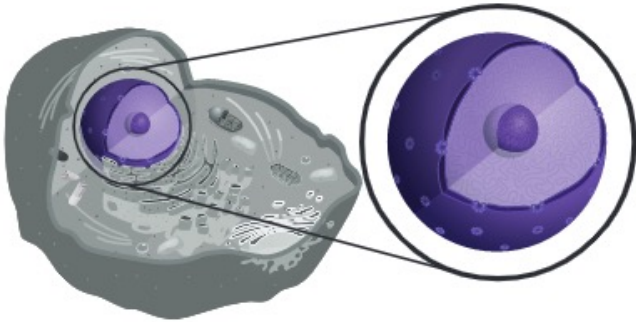
nucleus



- **The nucleus is the part of a eukaryotic cell that directs cell activities and contains important cellular information stored in DNA.**
- DNA is organized into structures called chromosomes. The DNA of each cell carries information that provides instructions for making all the proteins a cell requires

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Types of cells and structures

Cells in the body can be incredibly diverse.

- Red blood cells are disk-shaped, which helps them move through blood vessels so that they can carry oxygen throughout the body.
- Xylem cells are tubelike cells that transport water from the roots to the leaves of plants.
- The neuron is a cell found in many animals that transmits impulses from different parts of the body. Each cell is unique but works with other cells as body functions are carried out

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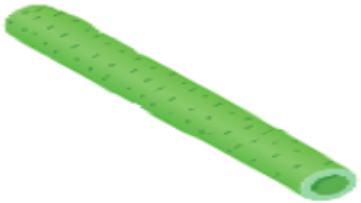
Types of cells and structures

Red blood cells are disk-shaped, which helps them move through blood vessels



Xylem cells are tubelike cells that transport water from the roots to the leaves of plants.

The neuron is a cell found in many animals that transmits impulses from different parts of the body

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- Classify information about organelles and cell structures. Draw a table like the one below in your Science Notebook. In the center column, describe the function of each. In the right-hand column, indicate whether the organelle is in a plant cell, an animal cell, or both.

Organelle	Function	Plant, animal, or both
Nucleus	It directs cell activities.	both
Mitochondria	It release energy	both
Chloroplasts	It makes food for plants	plants
Cell wall	It protects the cell	plants
Cell membrane	It protects the cell	both

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Three-Dimensional Thinking

2. Rosa is planning an investigation using a microscope to try to identify a group of cells. She sees that the cells are joined together, so she knows that they are from one organism. If she also sees that all of the cells have cells walls, Rosa can conclude that she could be looking at

A bacterial cells.
B human cells.
C mouse cells.
D plant cells.

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3. Mitochondria function as subsystems within the larger system of the cell as a whole. Which explains why a mitochondrion, shown on the right, is known as the “powerhouse” of a cell?

A. It converts energy in food to ATP.
B. It helps the cell gather sunlight
C. The cell eats it as food.
D. It has two membranes

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Which statement could you use to construct an explanation for why it is important for a cell's surface-area-to-volume ratio to not be too small?

A. Wastes and nutrients need to move through the membrane
B. If a cell's surface-area-to-volume ratio was too small, the cell would starve
C. If a cell's surface-area-to-volume ratio was too small, the cell would not produce enough waste material
D. If a cell's surface-area-to-volume ratio was too small, the organelles would grow too large to fit within the cell

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Infer

Suppose that you are a scientist and you have been given a sample of unknown cells. By looking at the cells under a microscope, what would you be able to determine about the organisms the cells came from? Explain your reasoning

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Explain

Your friend is making a model of a cell and wants to use metal to represent the cell membrane because metal is solid and would allow nothing to enter or leave the cell. Explain why you agree or disagree with his reasoning.

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Infer

Suppose that you are a scientist and you have been given a sample of unknown cells. By looking at the cells under a microscope, what would you be able to determine about the organisms the cells came from? Explain your reasoning

Answers may vary. Sample answer: By looking at the cells under a microscope, I would be able to infer what kind of organism the cells came from. I could see if the cells had cell walls, and if so, I could infer they came from a plant, fungus, bacteria or protist. If the cells had chloroplasts, I could infer that they were either from a plant or were a protist.

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Explain

Your friend is making a model of a cell and wants to use metal to represent the cell membrane because metal is solid and would allow nothing to enter or leave the cell. Explain why you agree or disagree with his reasoning.

Answers may vary. Sample answer: I disagree because cell membranes are flexible and allow certain materials to enter and leave cells.

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