Bio 1

Cell

Basic and fundamental unit of life, it possesses a highly organized structure that enables it to carry out its vital functions.


NAD+
NADH

Types of Cells

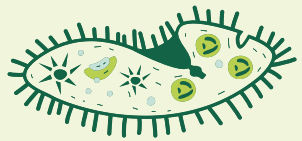
Prokaryotic
Lack a defined nucleus

Eukaryotic
Have a defined nucleus

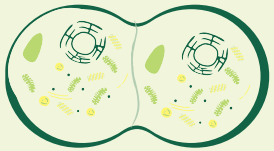
Prokaryotic
Dispersed genetic material in the cytoplasm.

Plant
Cellulose cell wall; chloroplasts and vacuoles.

Animal
Rigid cell wall; may have flagella.



Protist
They can have a cell wall, without differentiated tissues.



Fungal
Chitin Cell Wall; they are heterotrophs.

Parts of a prokaryotic cell

The term Prokaryote is derived from the words pro and karyon, which means “before” and “kernel”, respectively.

1. Glycocalyx – an outer layer that provides protection. It is an important virulence factor since it protects disease-causing bacteria. It helps bacteria hold on to surfaces and protects disease-causing bacteria. It helps bacteria hold on to surfaces and protects them from being engulfed by macrophages. It may exist as a rigid capsule or a more unstructured slime layer.
2. Cell wall – a structure that confers rigidity and shape to the cell. It is found outside of the plasma membrane and is composed of peptidoglycan.
3. Plasma membrane – a structure that prevents the loss of water and electrolytes inside the cell. It also prevents the entry of unwanted substances into the cell. It is composed of phospholipid bilayer.

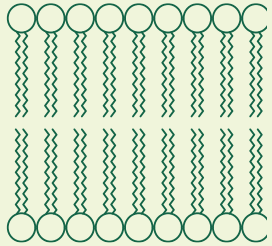
4. Plasmid – a small, circular, extrachromosomal DNA molecule found in the cytoplasm. It is separate from chromosomal DNA.
5. Nucleoid – the region where DNA is concentrated.
6. Cytoplasm – the whole inside region of the cell where chromosomes, ribosomes, and other cellular inclusions are suspended.
7. Ribosome – the site where proteins are synthesized or created.
8. Pilus (plural, pili) – a short, hairlike appendage on the surface of some bacteria. It helps bacteria adhere to the surfaces of host cells. It can also be used to transfer genetic material from one bacterium to another; in which case it is called sex pilus.

9. Flagellum (plural, flagella) – a long, threadlike structure that facilitates movement in bacteria.
10. Fimbriae – bristle-like fibers that are shorter than pili. It is primarily used for bacterial attachment to tissue surfaces.

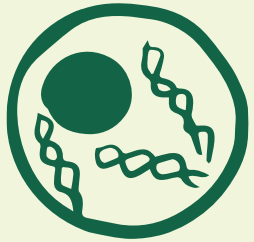
Eukaryotic cells

Eukaryotic cells are more complex than prokaryotic cells. A typical eukaryotic cell measures 10 to 100 μm in diameter. These cells have components that are surrounded by membranes in which are called organelles. The nucleus, the largest cell organelle, encloses the genetic material and is suspended in the cytoplasm. The most distinguishing feature of this type of cell is compartmentalization, which is achieved by the endomembrane system that occupies the interior of the cell, including the membrane-bound organelles. Most of these organelles independently perform their multiple biochemical jobs, which can proceed independently or simultaneously. Examples of eukaryotic cells are those that come from animals, plants, protists, and fungi.

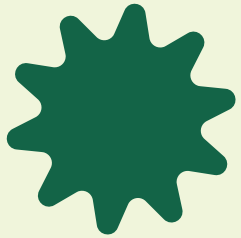
Composed of several fundamental components



Cell membrane

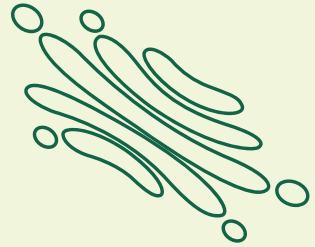


Nucleus



Ribosome

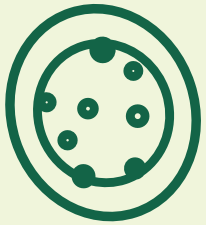
Rough endoplasmic reticulum.



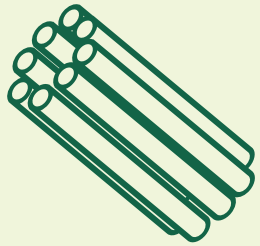
Golgi Apparatus

Mitochondria

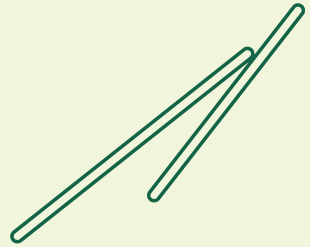
Chloroplasts



Lysosome and peroxisome



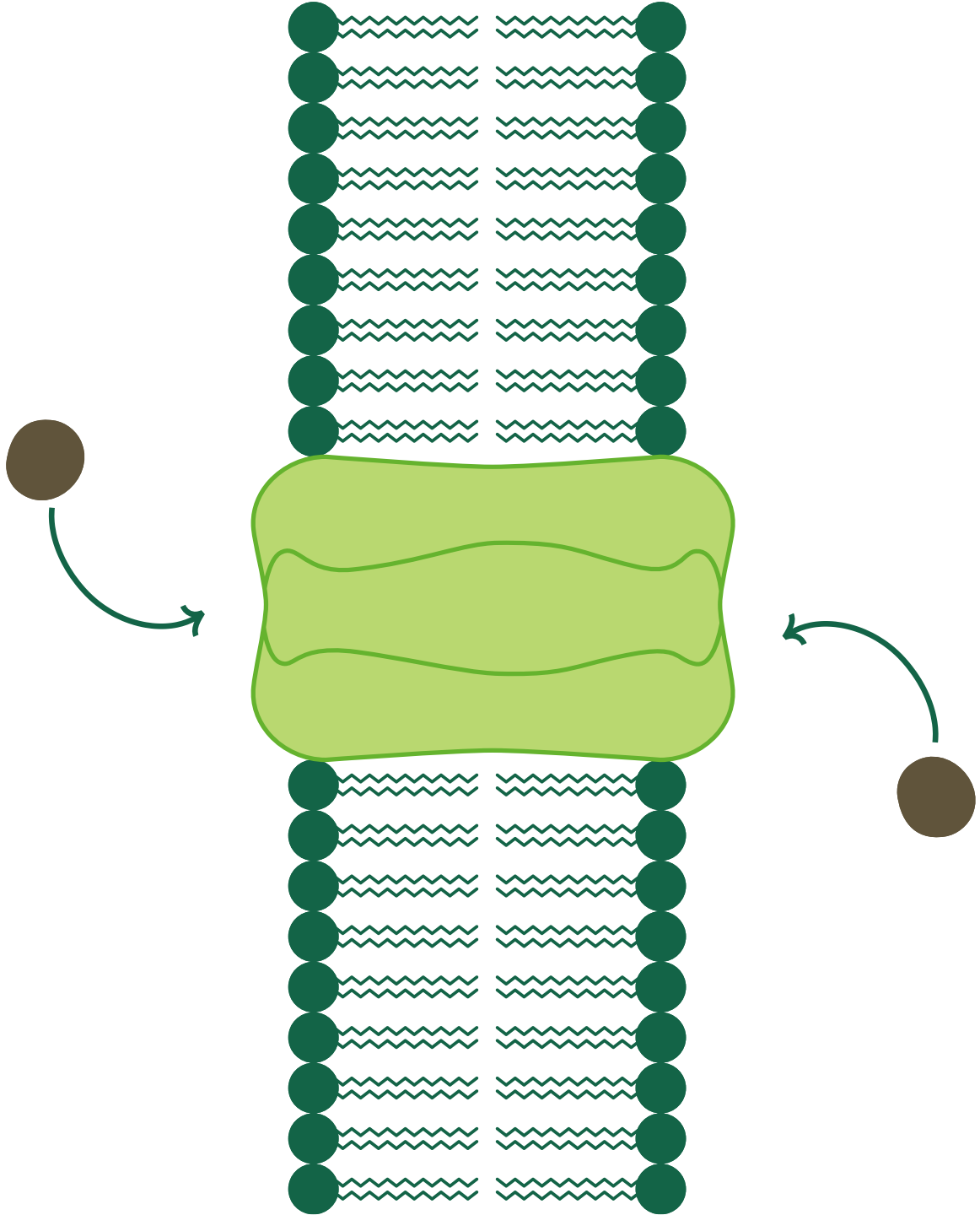
Centriole



Microtubules

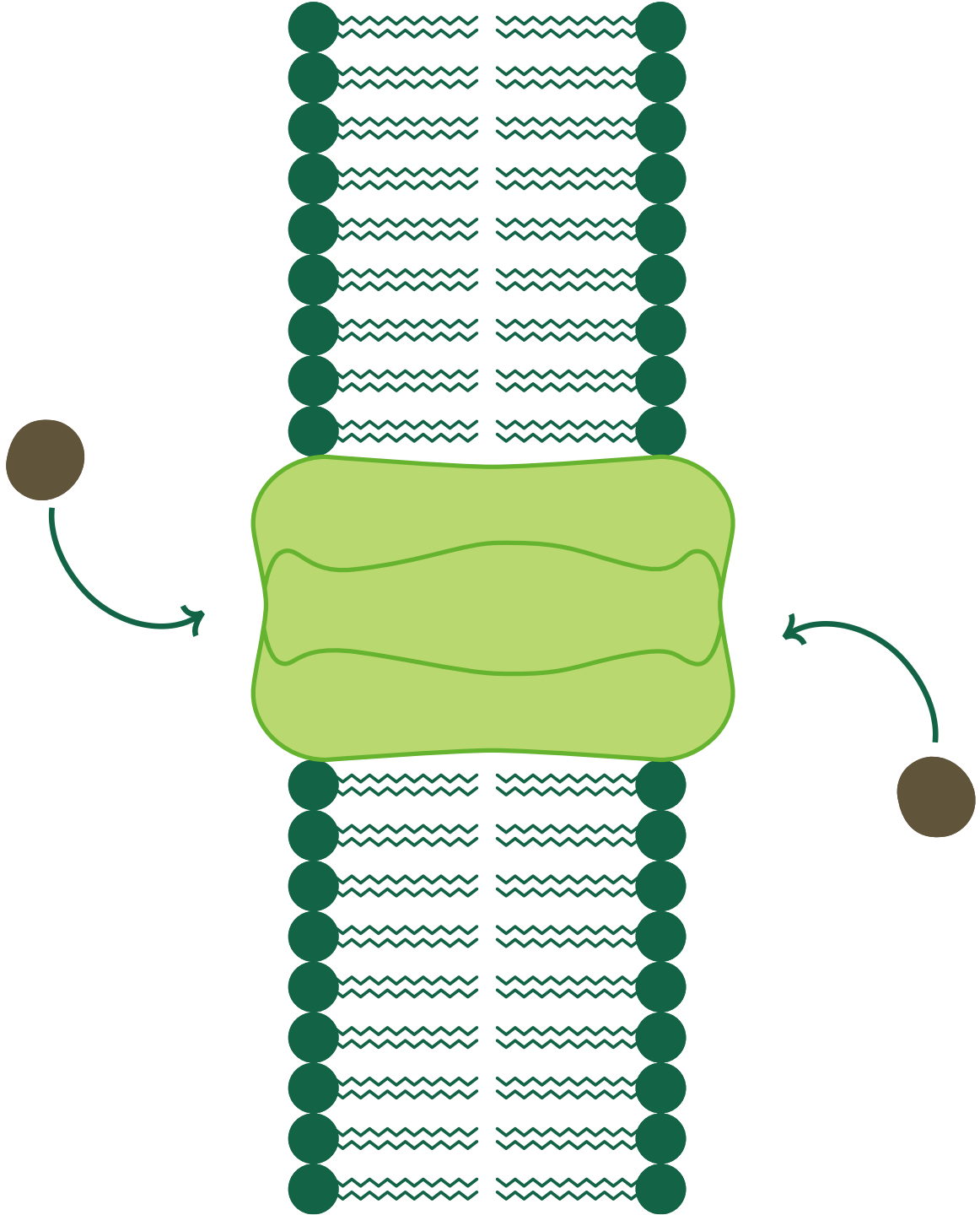
Cell membrane

The **cell membrane** sometimes called the **plasma membrane**, is a thin layer that separates the cell from its external environment. It is the outermost covering of animal cells and functions as a selective barrier that regulates the entrance and exit of substances into and out of cells. However, in plant cells, the cell wall is the outermost covering. The cell membrane can be described in two models: the classical model and the fluid mosaic model.



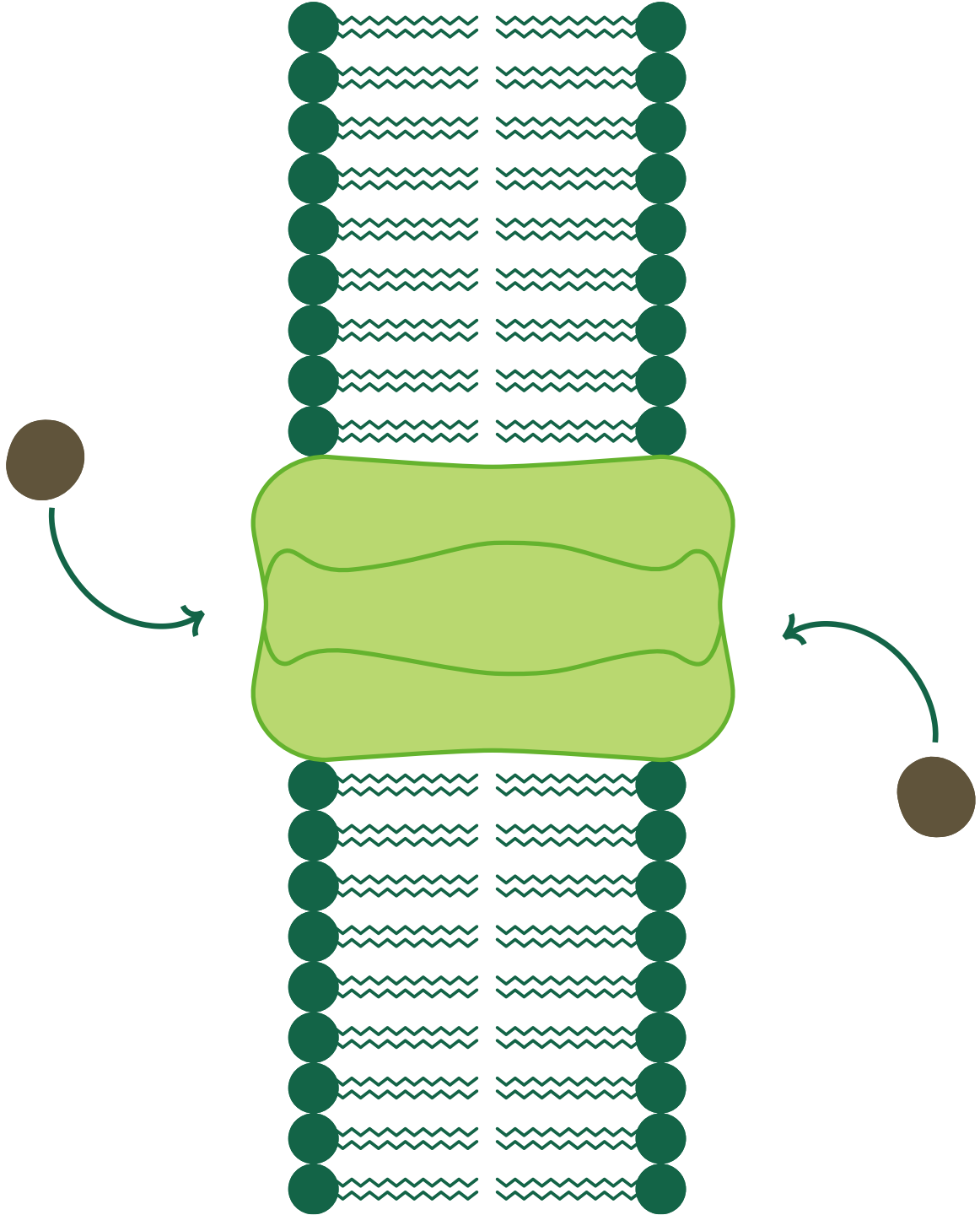
Cell membrane

In 1930, British biologists Hugh Davson and James Danielli hypothesized that the cell is covered by a thin, flexible envelope made up of phospholipid bilayer and proteins. This was the classical plasma membrane model. Through the help of the early electron microscopists, it was confirmed that the phospholipid membrane has hydrophobic and hydrophilic ends.



Cell membrane

In 1972, Jonathan Singer and Garth Nicholson proposed the fluid mosaic model of the plasma membrane which revolutionized our understanding of the nature of the membrane. This was made possible using modern electron microscope, which is more precise in nature. It states that at normal temperature, the plasma membrane behaves like a thin layer of fluid covering the surface of the cell and that individual phospholipids diffuse rapidly throughout the surface of the membrane.



Cytoplasm

The region of the cell that surrounds the nucleus is the cytoplasm. It is semifluid matrix, and it is the largest interior part of the cell where organelles and cellular inclusions are suspended.

Cytoplasmic Organelles

1. The **endoplasmic reticulum (ER)** is a network of intercommunicating channels composed of membrane-enclosed sacs and tubules. It serves as an intracellular highway through which molecules can be transported from one part of the cell to another. There are two forms: the **rough endoplasmic reticulum (RER)** and the **smooth endoplasmic reticulum (SER)**.

Endoplasmic Reticulum

RER looks rough due to the presence of ribosomes on its membrane surface. A cell with more RER produces a large amount of proteins to be inserted into the membranes or exported to the outside. On the other hand, the SER is more tubular and nongranular due to the absence of ribosomes. SER is usually involved in the synthesis of steroids in gland cells, breakdown of toxic substances by liver cells, and regulations of calcium levels in muscle cells.

Cytoplasmic Organelles

2. The **Golgi apparatus,** which is similar to the endoplasmic reticulum, is also a system of membranes. It appears as a series of flattened sacs with a characteristic convex shape. It is surrounded with numerous vesicles filled with fluid and suspended substances. It works in close association with the ER. It is responsible for the processing, packaging, and sorting of secretory materials use within the cell or for exocytosis.

Cytoplasmic Organelles

3. The mitochondrion (plural , mitochondria) is the power plant of the cell. It varies in size, shape, and number depending on the degree of cellular activity. It contains enzymes that help in the chemical oxidation of food molecules and produces energy in the form of ATP. Studies have shown that active cells such as your liver cells have more mitochondria compare to less active cells such as your skin cells. A single liver cell may contain as many as 2,500 mitochondria, while a skin cell will have only few hundred.

Cytoplasmic Organelles

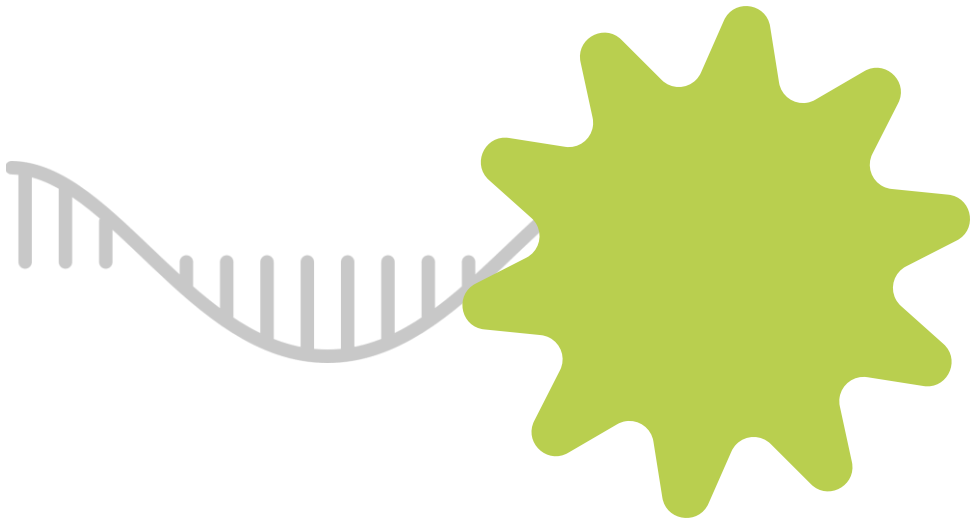
4. **Lysosomes** are small, spherical, membrane-bound organelles which contain various kinds of enzymes. Enzymes are molecules digest proteins, nucleic acids, polysaccharides, and lipids. They protect a cell from invading bacteria and other pathogens. They also break down damaged or worn out cell parts. They can engulf and digest targeted molecules. When a molecule is broken down, the products pass through the lysosome membrane and are returned back into the cytoplasm to be recycled.

Cytoplasmic Organelles

5. **Secretory granules** are large, dense granules with membranes. These fuse with the cell membrane to secrete substances such as enzymes, proteins, and signaling molecules out of the cell.
6. **Lipid droplet** store fatty acids and sterols. They take up much space and volume in adipocytes or fat cells. They appear as black spherical bodies of varying sizes when stained.

Cellular macromolecules

Cellular macromolecules are substances suspended in the cytoplasm with varying functions and are not membrane-bound structures. Their quantity is dependent on the cell type.



1. Ribosome

Ribosomes are not considered organelles because they are not surrounded by membranes. Each ribosome is an assemblage of two organic compounds, namely, proteins and RNA. They are the molecules that synthesize proteins.

2. Centrosomes

The centrosome is the part of the cytoplasm that produces microtubes. In animal cells, it forms two small parts called the centrioles. The centrioles are small cylindrical structures made of short microtubules arranged in a circle. Through their main function is to assist in cell division, studies have shown that certain cells continue to divide even without them.

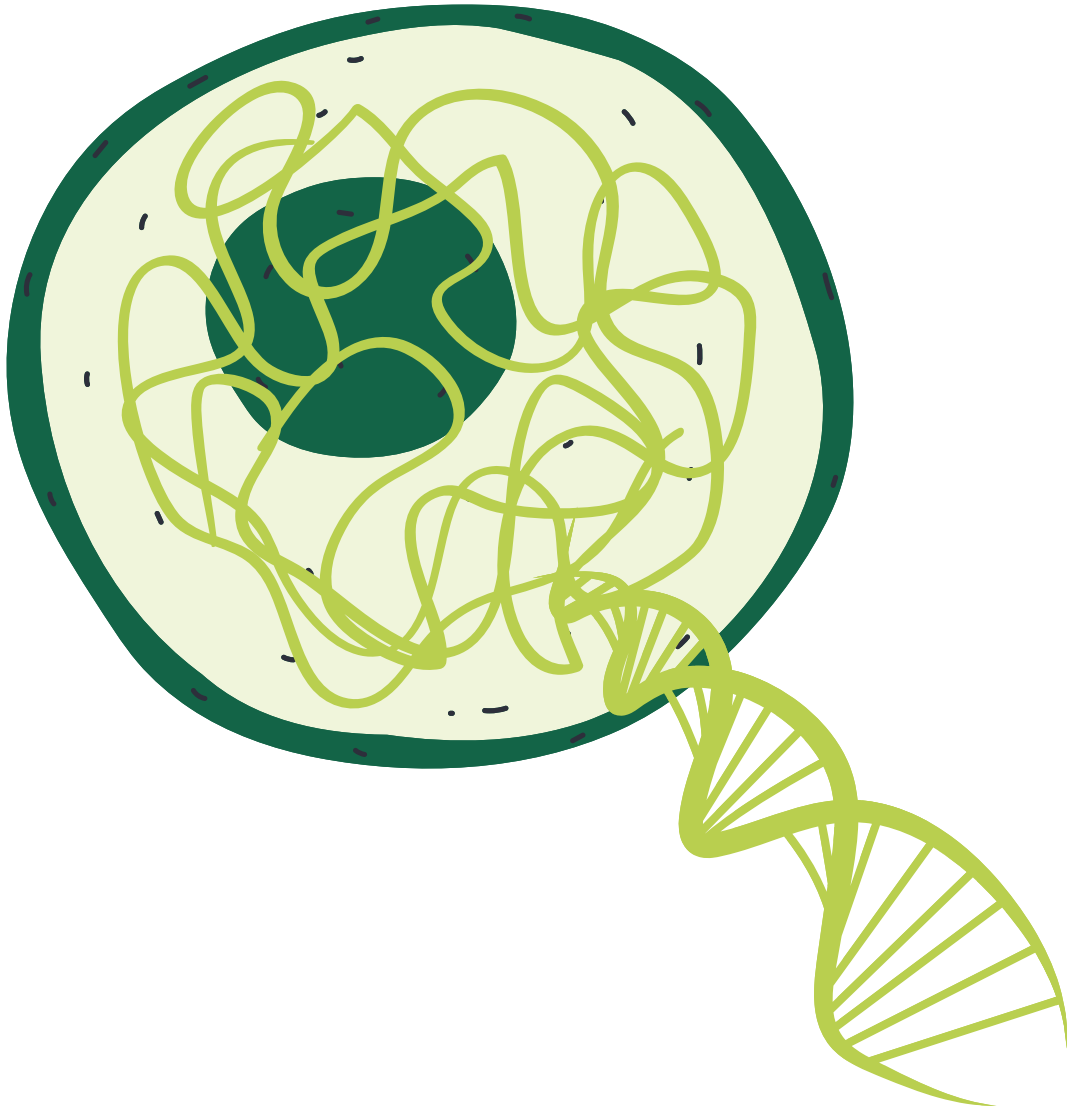
3. Cytoskeleton

The cytoskeleton provides motility and strength for the cell. It is the collective term for network of filaments and tubules that extends throughout the cell. The types of fibers comprising the cytoskeleton are as follows:

a. Microtubules are long, slender, protein tubes. They form the cytoskeleton or the framework of the cells.
b. Microfilaments support the cell to maintain its structure and shape, as it provides resiliency against forces that can alter its shape.

4. Glycogen granules and Biological pigments

Glycogen granules, which are abundant in liver cells, play important role in glucose metabolism. **Biological pigments** are especially abundant in plant cells, particularly in photosynthetic cells. These are usually found in the plastids, such as the chloroplastids, where the chlorophyll pigments abound. In animals, pigments are mostly found in the cells of the skin, eyes, hair, and feathers.



Cell nucleus

The most visible part of a eukaryotic cell is the nucleus. In an animal cell, it is roughly spherical in shape, and is generally located at the center of the cell. It is the site where nucleic acids are synthesized. Some cells, however, such as red blood cells and platelets, lose their nucleus as they mature.

Nuclear Membrane

The **nuclear membrane** is composed of two layers which separate the nucleus from the cytoplasm. The dense, protein-rich substance inside the nucleus is the **nucleoplasm** in which the spherical, unbound **nucleolus** (structures responsible for ribosome formation) is suspended.

Nuclear Membrane

Nuclear pores are openings in the nuclear membrane. These act as selective channels between the cytoplasm and the inside of the nucleus, selectively allowing molecules that come in and out of the nucleus.

Found inside the nucleus is the chromatin, which is made up of DNA and proteins and forms chromosomes during cell division.

Cell Modifications and Adaptations

Cell modification refers to a process in which ordinary or genetic cell is transformed into a specialized cell in order to do a specific task for the body. This process has contributed much to the adaptation and survival of organisms. For instance, not all cells in the small intestine are the same in structure and functions. Microvilli are cytoplasmic extensions that increase the surface area of a cell, hence, increasing the absorption of nutrients.

Nerve cells, which are mostly elongated, facilitate the transmission of impulses from the brain to the spinal cord and different parts of the body.

Cell Modifications and Adaptations

Red blood cells (RBCs) have a biconcave-disc shape and are highly deformable. Red blood cells and platelets loss their nucleus as they mature. Losing the nucleus increases the surface area for gas exchange, enabling the optimal oxygenation of tissues in the body.

The ***sperm cell*** is another specialized cell with parts that help it carry out its function. Sperm cells have tail, the flagellum, which propels them toward the egg for fertilization.

The skin of some animals such as amphibians, squids, and octopuses contains ***chromatophores.***

Cell Modifications and Adaptations

Jellyfish and Hydra have ***nematocysts*** or stinging cells that contain a needle-like structure used to inject a toxic substance into the prey of interest.
In plant cells, there are also specialized cells such as ***root hairs***, which are elongated outgrowths from the outer layer of root cells that help absorb water and minerals. Plant cells also have ***plasmodesmata*** or small pits that link one plant cell to another. They facilitate the movement of molecules between adjoining cells. ***Guard cells*** are specialized to regulate the opening and closing of the stomata.

Cell Modifications and Adaptations

Another specialized modification in eukaryotic cells is the presence of cell-cell junctions, the point where two cells come together. Through the cell junctions, the cells are joined in long term associations, thus, forming tissues and organs.

Quiz 1.2

Directions: Choose the letter of the correct answer.

1. Which part of the cell is responsible for its motility and strength?

a. Cell membrane
b. Nuclear membrane
c. Cytoskeleton
d. Microvilli

2. Which of the following is not involved with secretory materials?

a. Ribosomes
b. Endoplasmic Reticulum
c. Golgi body
d. Mitochondria

3. If the nucleus of a cell will be removed, which of the process will be greatly affected?

a. Cell intake of nutrients, oxygen, and water
b. Recognition of chemical substances that blind to cells
c. Cell reproduction and growth
d. Cellular motion

4. Which of the following is not a cellular organelle?

a. Mitochondria
b. Chloroplast
c. Endoplasmic Reticulum
d. Ribosome

5. Upon maturity, most plants become tough and rigid. What cellular part is responsible for this?

a. Microtubules
b. Filaments
c. Cell wall
d. Resin

Application and Analysis

1. If you are examining a cell under the microscope, how would you know if it is an animal cell or a plant cell?
2. If the cell were a city, what could be the functions of the cell membrane, cytoskeleton, cytosol, lysosome, mitochondrion, nucleus, ribosome, and endoplasmic reticulum?

Thank you!

Any questions?