THE CELL

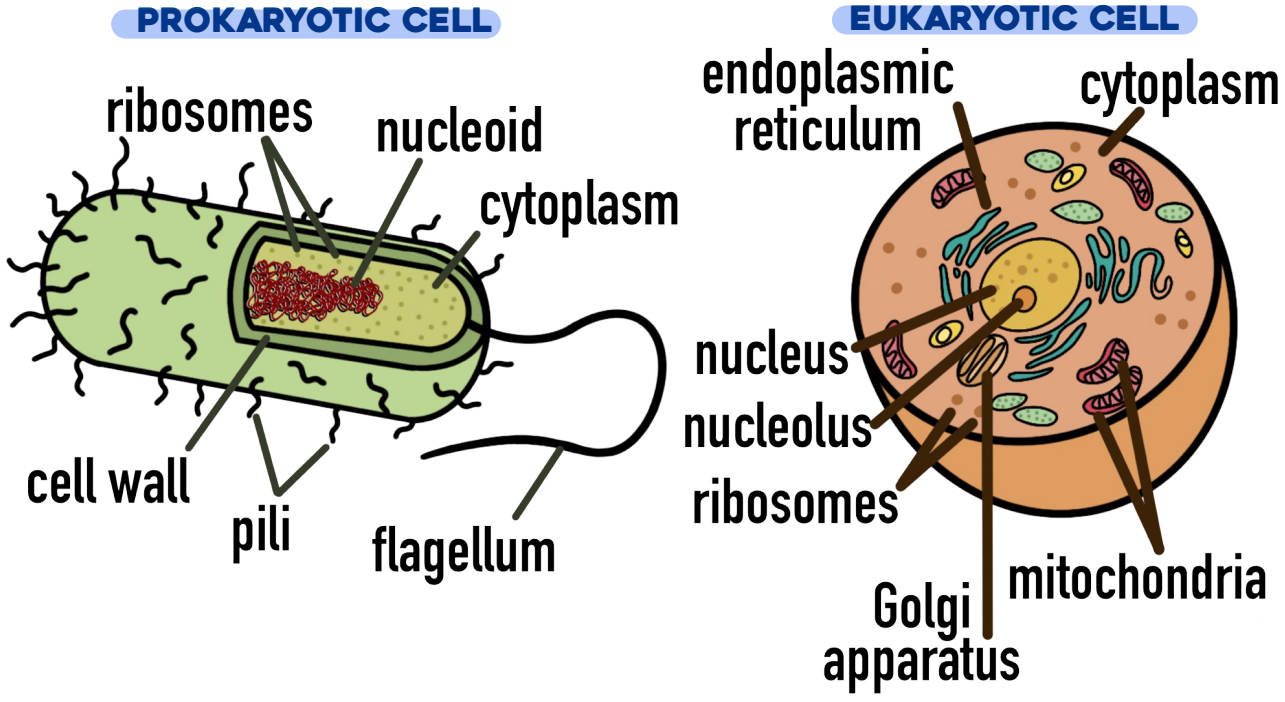
The cell is the basic structural and functional unit of all organisms. All cells share 4 common components: 1) a plasma membrane; 2) a cytoplasm; 3) genetic material; and 4) ribosomes.

There are 2 distinct types of cells: prokaryotic and eukaryotic. Organisms that lack a nucleus and other membrane-bound organelles are called prokaryotes (pro- = before; -karyon = nucleus). On the other hand, organisms with a membrane-bound nucleus and other membrane-bound organelles are called eukaryotes (eu- = true; -karyon = nucleus). Prokaryotes evolved before eukaryotes.

DIFFERENCES BETWEEN EUKARYOTIC AND PROKARYOTIC CELLS

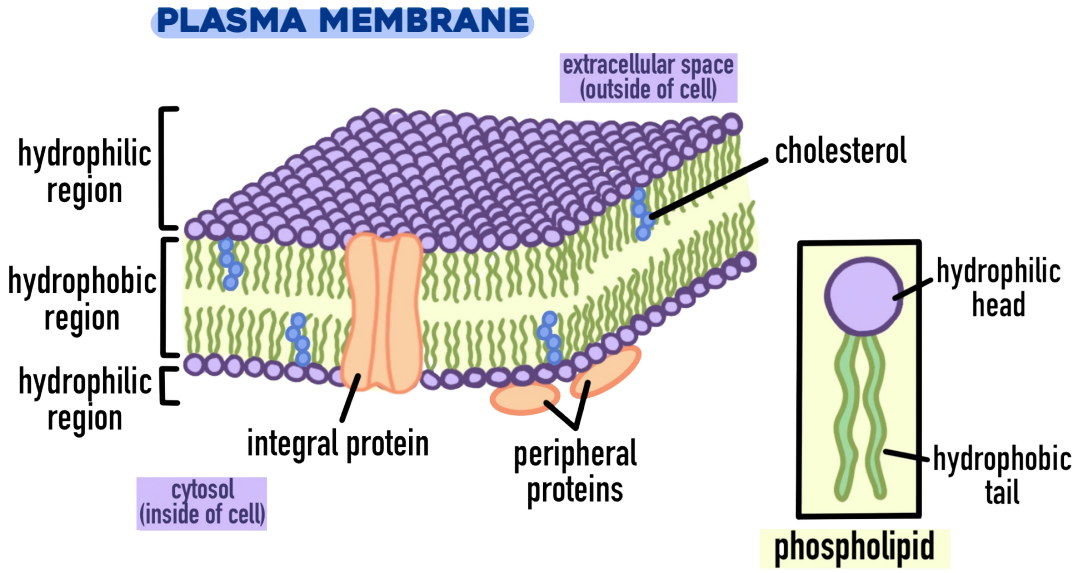
In eukaryotic cells, the DNA is found within an organelle called the nucleus, which is bound by a double membrane. In prokaryotic cells, the DNA is concentrated in a region called then nucleoid, which is not enclosed by a membrane.

The interior of cells is called the cytoplasm. In eukaryotic cells, the cytoplasm refers only to the region between the nucleus and the plasma membrane. Within the cytoplasm of eukaryotic cells are a variety of organelles with specialized form and function. Membrane-bound organelles are found in eukaryotes and absent in prokaryotes. In addition, eukaryotic cells are generally larger than prokaryotic cells.



PLASMA MEMBRANE

The plasma membrane is a phospholipid bilayer with embedded proteins. It separates the cell's internal contents from the external environment. The plasma membrane functions as a selective barrier and regulates the passage of substances. It is semipermeable because it only allows some molecules to diffuse into the cell. Small hydrophobic molecules and gases like oxygen and carbon dioxide are able to cross the plasma membrane. Small polar molecules like water can also pass through. On the other hand, large and/or charged molecules like sugars and amino acids cannot diffuse into cells and rely on transport proteins.



EUKARYOTIC CELLS

NUCLEUS

Contains most of the genes in the eukaryotic cell (although some genes are located in the mitochondria and chloroplast).

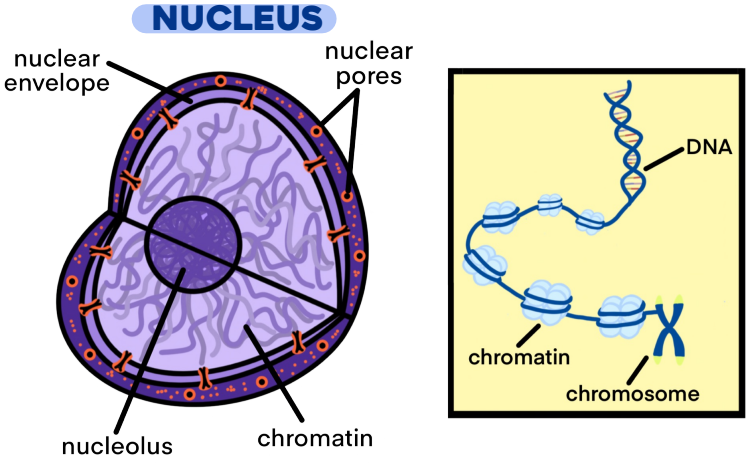
The nuclear envelope is a double membrane that encloses the nucleus. The nuclear side of the envelope is lined by the nuclear lamina, a netlike array of protein filaments that maintain the shape of the nucleus by mechanically supporting the nuclear envelope.

Within the nucleus, the DNA is organized into discrete units called chromosomes which carry the organism's genetic information. Each chromosome contains one long DNA molecule associated with many proteins. Some of the proteins help coil the DNA molecule of each chromosome, reducing its length and allowing it to fit into the nucleus. The complex of DNA and proteins making up chromosomes is called chromatin.

Each eukaryotic species has a characteristic number of chromosomes. For example, a typical human cell has 46 chromosomes in its nucleus, except for sex cells (egg and sperm) which only have 23.

Within the nucleus is the nucleolus, where a type of RNA (ribosomal RNA or rRNA) is synthesized following the "instructions" found in DNA.

The nucleus directs protein synthesis by first synthesizing messenger RNA (mRNA) based on the instructions found in DNA. The mRNA is then transported to the cytoplasm of the cell via nuclear pores. Once in the cytoplasm, the mRNA's genetic message is translated by the ribosomes into the primary structure of a specific polypeptide.



RIBOSOMES

Complexes made of ribosomal RNA and protein where protein synthesis takes place.

Free ribosomes are suspended in the cytosol. On the other hand, bound ribosomes are attached on the outside of the endoplasmic reticulum (ER) or nuclear envelope.

Most proteins are synthesis in free ribosomes within the cytosol. Bound ribosomes generally make proteins that are destined for insertion into membranes, for secretion or for packaging within organelles.

ENDOPLASMIC RETICULUM (ER)

Extensive network of membranes. The internal compartment of the endoplasmic reticulum, called the ER lumen, is separated from the cytosol by an ER membrane. This membrane is continuous with the nuclear envelope.

The smooth ER lacks ribosomes on its outer surface and is involved in many processes, including lipid synthesis, carbohydrate metabolism and calcium ion storage. The rough ER is studded with ribosomes which are involved in protein synthesis.

GOLGI APPARATUS

Organelle responsible for receiving, sorting, packaging and exporting ER products such as proteins.

LYSOSOME

Membranous sac of hydrolytic enzymes that animal cells using to digest (or hydrolyze) macromolecules. Lysosomes also use their hydrolytic enzymes to recycle the cell's own organic material in a process called autophagy.

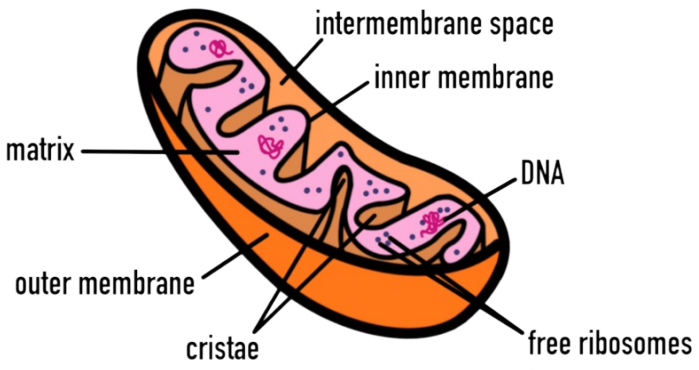
MITOCHONDRION AND CHLOROPLAST

Mitochondria (singular: mitochondrion) are membrane-bound cell organelles, found in nearly all eukaryotic cells, where cellular respiration takes place. In this process, oxygen is used to make energy in the form of ATP. Chloroplasts are membrane-bound organelles, found in algae and plants, where photosynthesis takes place. In this process, solar energy is converted to chemical energy using sunlight, carbon dioxide and water.

Mitochondria are enclosed by 2 membranes: the outer membrane and the inner membrane. The outer membrane is smooth whereas the inner membrane is convoluted with infoldings called cristae. The inner membrane divides the mitochondrion into 2 internal compartments: the intermembrane space and the matrix.

Chloroplasts are enclosed by 2 membranes: the outer membrane and the inner membrane. Inside chloroplasts, there is another membranous system called thylakoids. These membrane-bound compartments are made up of a thylakoid membrane surrounding a thylakoid lumen. The fluid outside the thylakoids is called the stroma and contains DNA, ribosomes and enzymes. Chloroplasts contain a green pigment called chlorophyll which, along with enzymes and other molecules, plays a role in photosynthesis.

MITOCHONDRION



CHLOROPLAST