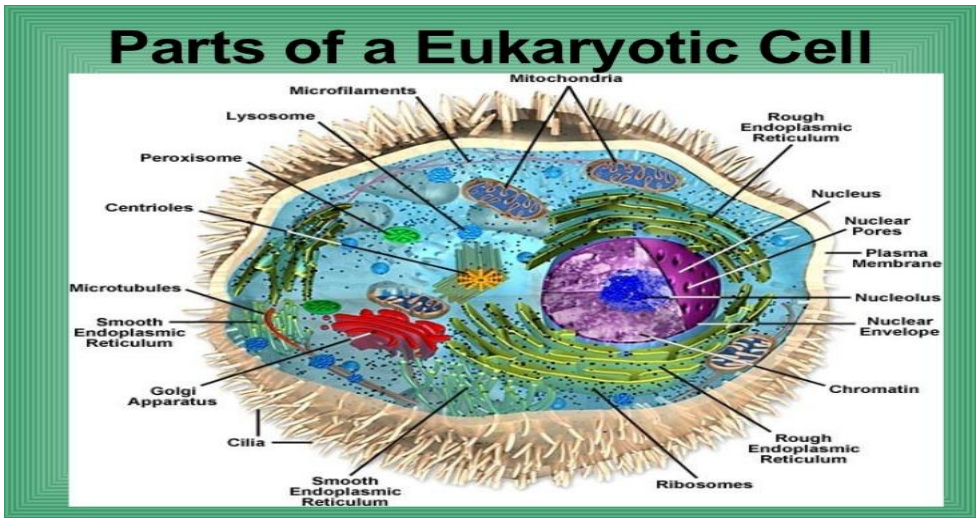
Cell Structure

Eukaryotic Cell Structure

The Nucleus

The **nucleus** contains the cell's genome. It is bounded by membrane that consists of a pair of unit membranes separated by a space of variable thickness. The **nuclear membrane** exhibits selective permeability due to pores, which consist of a complex of several proteins whose function is to import substances into and export substances out of the nucleus. The chromosomes of eukaryotic cells contain linear DNA macromolecules arranged as a double helix. Eukaryotic DNA macromolecules are associated with basic proteins called **histones** that bind to the DNA by ionic interactions.

A structure often visible within the nucleus is the **nucleolus** an area rich in RNA that is the site of ribosomal RNA synthesis. Ribosomal proteins synthesized in the cytoplasm are transported into nucleolus and combine with ribosomal RNA to form the small and large subunits of the eukaryotic ribosome. These are then exported to the cytoplasm where they associate to form an intact ribosome that can function in protein synthesis.

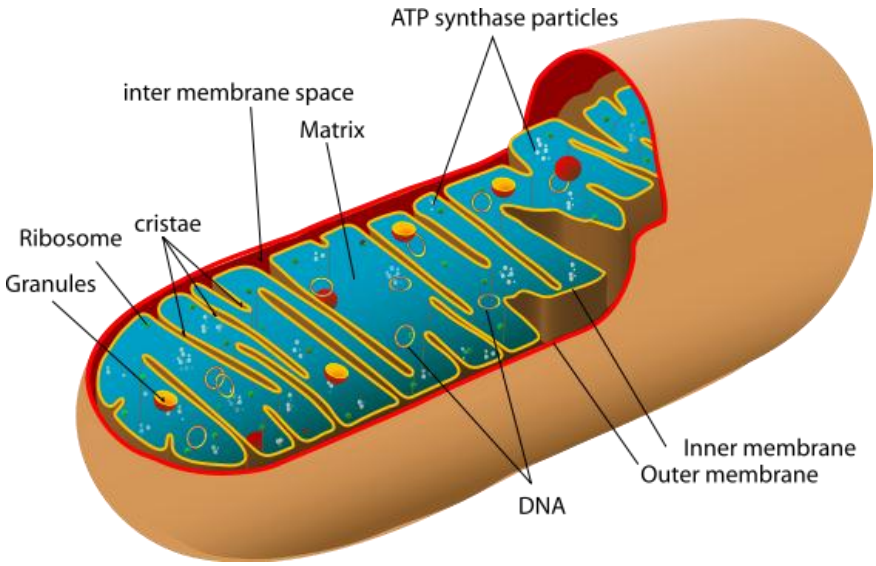


Cytoplasmic Structure

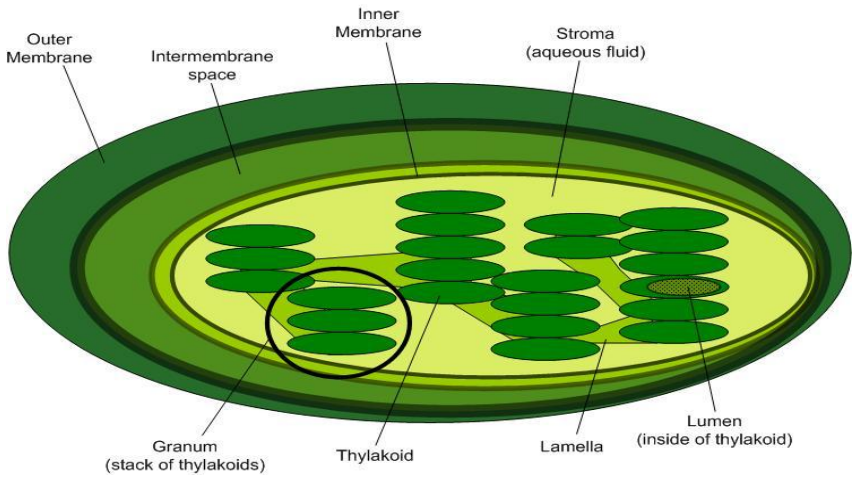
The cytoplasm of eukaryotic cells is characterized by the presence of an endoplasmic reticulum, vacuoles, self-reproducing plastids, and an elaborate cytoskeleton composed of microtubules, microfilaments, and intermediate filaments.

The **endoplasmic reticulum (ER)** is a network of membrane-bound channels continuous with the nuclear membrane. Two types of endoplasmic reticulum are recognized: **rough**, which contains attached 80S ribosomes, and **smooth**, which does not. The **Golgi apparatus** consists of a stack of membranes that function in concert with the ER to chemically modify and sort products of the ER into those destined to be secreted and those that function in other membranous structures of the cell.

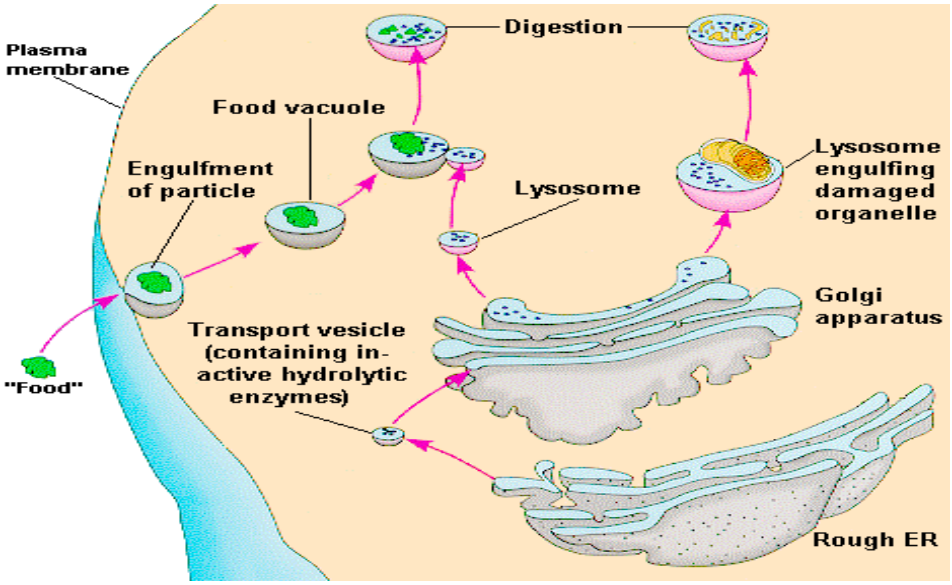
The plastids include **mitochondria** and **chloroplasts**. Mitochondria contain two sits of membranes. The outermost membrane is rather permeable having numerous minute channels that allow passage of ions and small molecules(eg, ATP). Invagination of the outer membrane forms a system of inner folded membranes called **cristae**. The cristae are the sits of enzymes involved in respiration and ATP production. Cristae also contain specific transport proteins that regulate passage of metabolites into and out of the mitochondrial **matrix**. The matrix contains a number of enzymes, in particular those of the citric acid cycle.



Chloroplasts are photosynthetic cell organelles that are capable of converting the energy of sunlight into chemical energy through photosynthesis. Chlorophyll and all other components needed for photosynthesis are located in a series of flattened membrane discs called **thylakoids**. Mitochondria and chloroplasts contain their own DNA, which exists in a covalently closed circular form and codes for some (not all) of their constituent proteins and transfer RNAs. Mitochondria and chloroplasts also contain 70S ribosomes, the same as those of prokaryotes.



Lysosomes are membrane-enclosed sacs that contain various digestive enzymes that the cell uses to digest macromolecules such as proteins, fats, and polysaccharides.



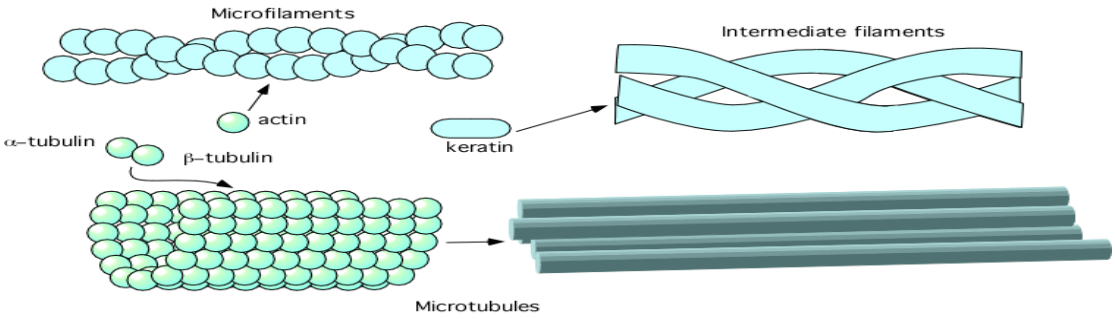
The **peroxisome** is a membrane-enclosed structure whose function is to produce H_2O_2 from the reduction of O_2 by various hydrogen donors. The H_2O_2 produced in the peroxisome is subsequently degraded to H_2O and O_2 by the enzyme **catalase**.

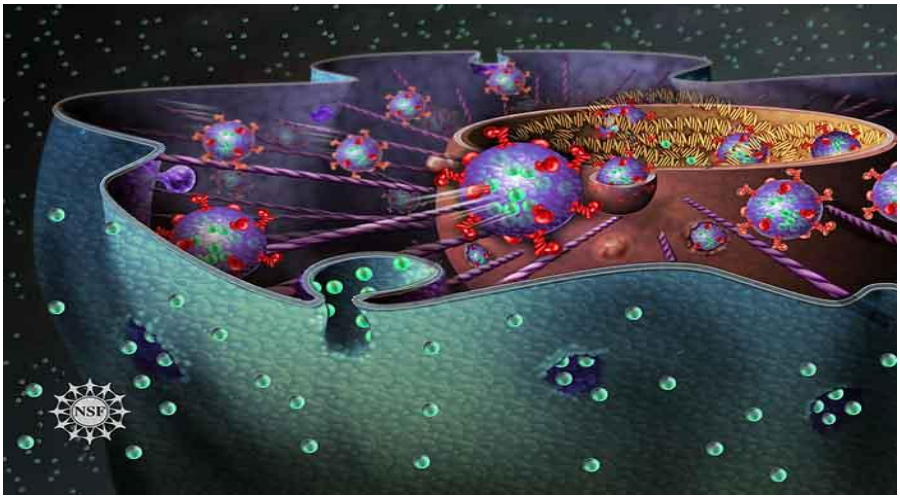
The **cytoskeleton** is a three-dimensional structure that fills the cytoplasm. The primary types of fibers comprising the cytoskeleton are **microfilaments, intermediate filaments,** and **microtubules.** Microfilaments are about 3-6 nm in diameter and are a polymers composed of subunits of the protein **actin**. These fibers form scaffolds throughout the cell defining and maintaining the shape of the cell. Microfilaments can also carry out cellular movements including gliding, contraction, and cytokinesis.

Microtubules are cylindrical tubes, 20-25 nm in diameter and are composed of subunits of the protein **tubulin**. Microtubules assist

microfilaments in maintaining cell structure, form the spindle fibers for separating chromosomes during mitosis, and also play an important role in cell motility.

Intermediate filaments are about 10 nm in diameter and provide tensile strength for the cell.





Surface Layers

The cytoplasm is enclosed with in a plasma membrane composed of protein and phospholipid, similar to the prokaryotic cell membrane. Most animal cells have no other surface layers; however, plant cells have an outer cell wall composed of cellulose. Many eukaryotic microorganisms also have an outer **cell wall**, which may be composed of a polysaccharide such as cellulose or chitin or may be inorganic, eg, the silica wall of diatoms.

Motility Organelles

Many eukaryotic microorganisms have organelles called **flagella** (eg, *Trichomonas vaginalis*) or **cilia** (eg, *Balantidium coli*) the move with a wave-like motion to propel the cell through water. Eukaryotic flagella emanate from the polar region of the cell, whereas cilia, which are shorter than flagella, surround the cell. Both the flagella and cilia of eukaryotic cells have the same basic structure and biochemical composition. Both consist of a series of microtubules, hollow protein cylinders composed of a protein called **tubulin**, surrounded by a membrane. The arrangement of the microtubules is called the "9+2 system" because it consists of nine peripheral pairs of microtubules surrounding two single central microtubules.