Life Is Cellular

Section 7-1

- The invention of the microscope was key to the discovery of the cell.

Discovery of the Cell

- In 1665, Robert Hooke used an early compound microscope to look at a thin cork slice.
  - made of thousands of tiny, empty chambers
  - named "cells" because they reminded him of a monastery's tiny rooms

- In 1674, Anton van Leeuwenhoek used a single-lens microscope to observe pond water
- Observed a world of tiny living organisms that seemed to be everywhere

- In 1838, German botanist Matthias Schleiden concluded that all plants were made of cells
- In 1839, German biologist Theodor Schwann stated that all animals were made of cells.

Schleiden

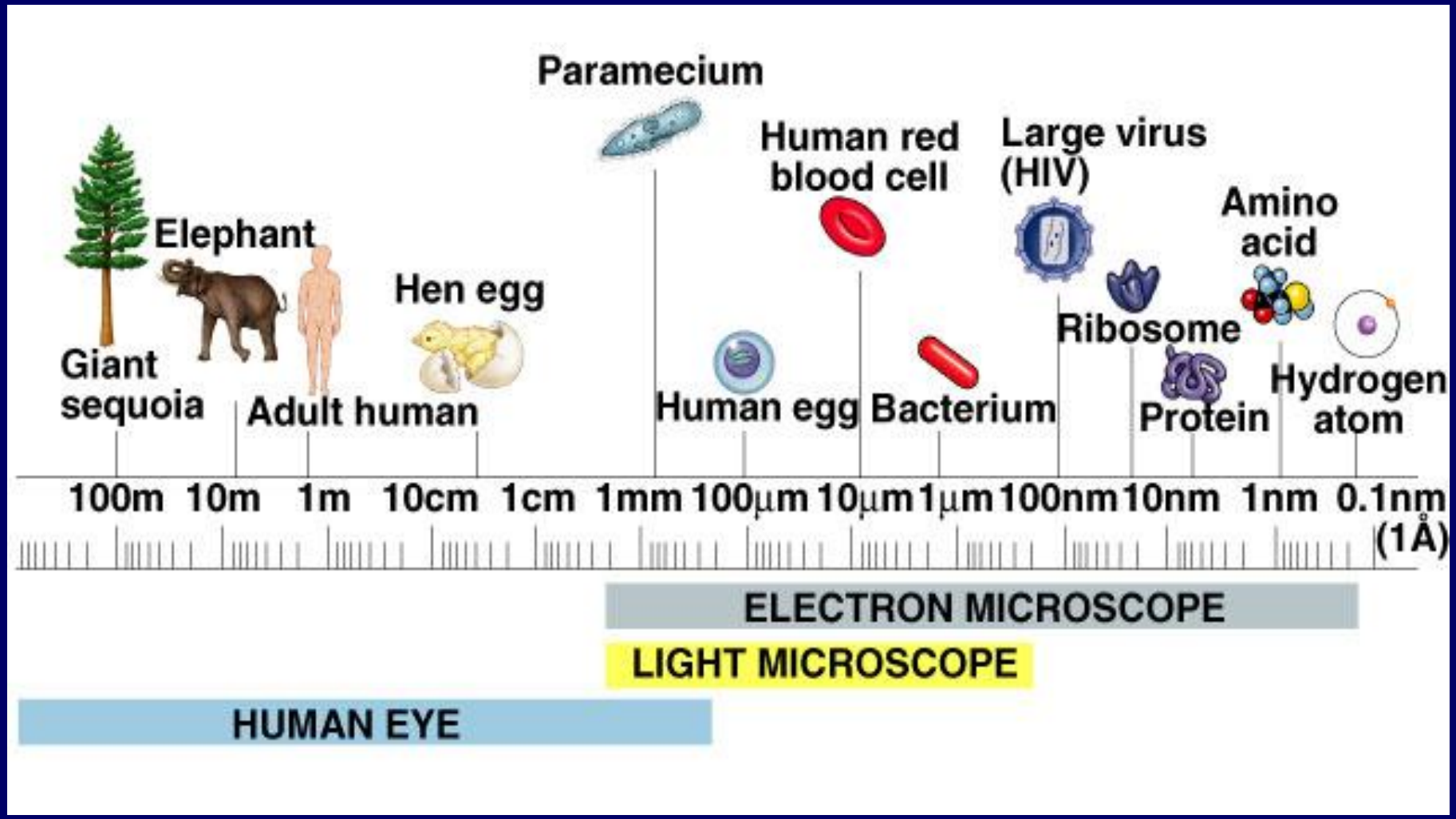
Schwann

- In 1855, German physician Rudolf Virchow concluded that new cells could be produced only from the division of existing cells.

Cell Theory

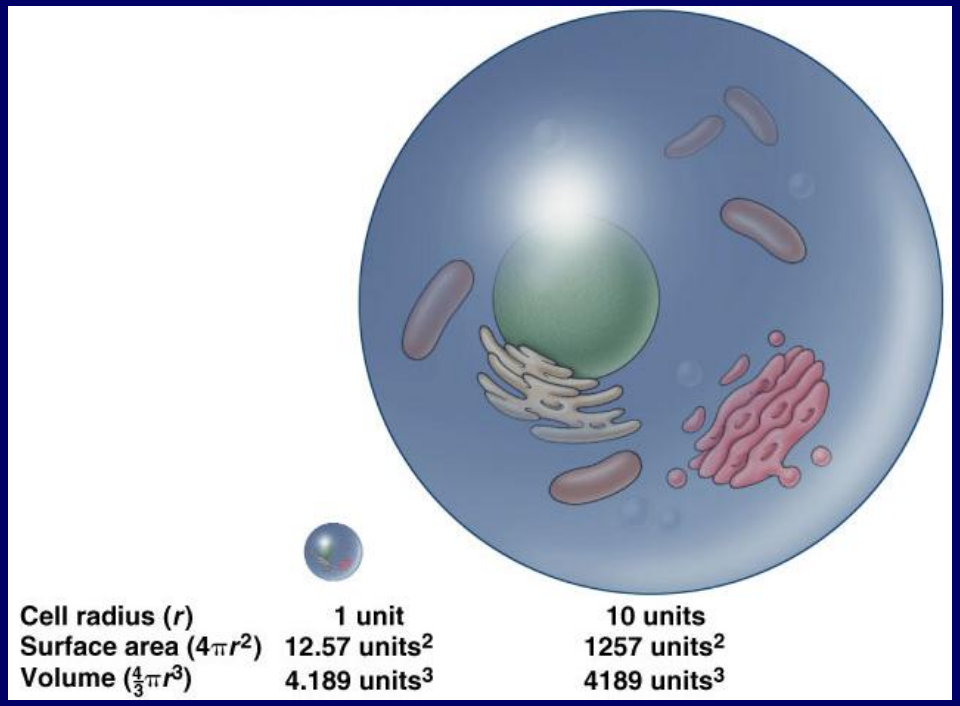
1. All living things are composed of cells.
2. Cells are the basic units of structure and function in living things.
3. New cells are produced from existing cells.

❖Cells come in a great variety of shapes and amazing range of sizes.



- Most cells are relatively small because as size increases, volume increases much more rapidly.

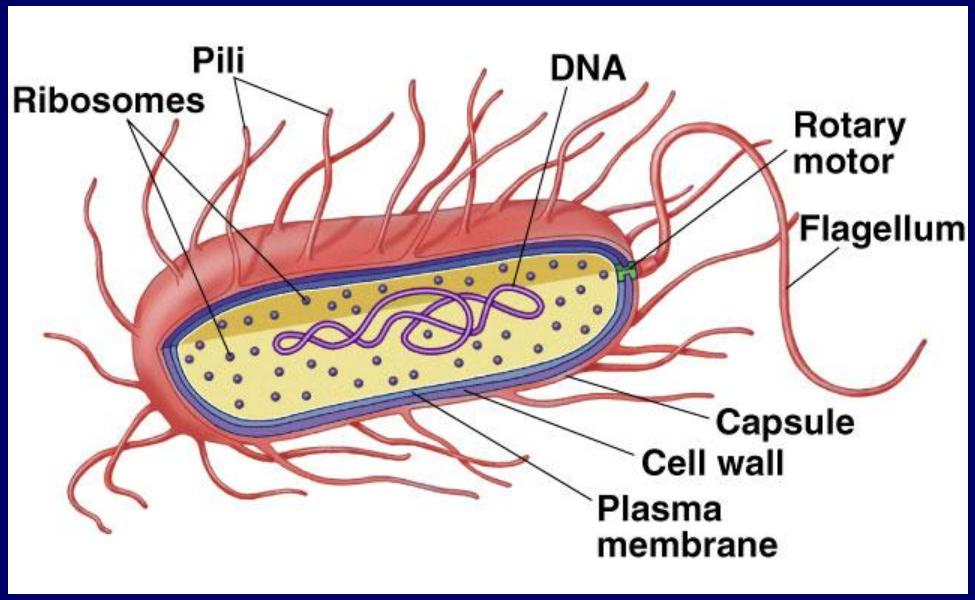
- Cells range from 5 to 50 micrometers in diameter with smallest being 0.2 micrometers across



- All cells have two characteristics in common:
  - They are surrounded by a barrier called a cell membrane.
  - They contain the molecule that carries genetic information - DNA.
- Cells fall into two categories depending on whether they contain a nucleus.
- The nucleus is a large membrane-enclosed structure that contains the cell's genetic material in the form of DNA.

Prokaryotes

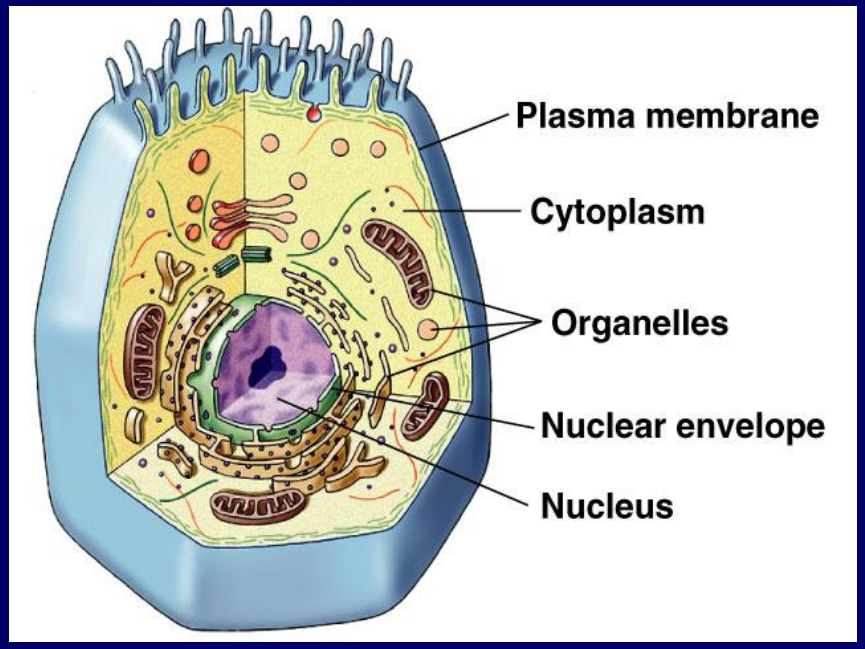
- Genetic material is not contained in a nucleus.
- Smaller and simpler than eukaryotes.
- Carry out every activity associated with living things (grow, reproduce, respond)



- All bacteria are prokaryotes.

Eukaryotes

- Genetic material is contained within a nucleus and is separated from the rest of the cell.
- Highly specialized
- Contains dozens of structures and internal membranes



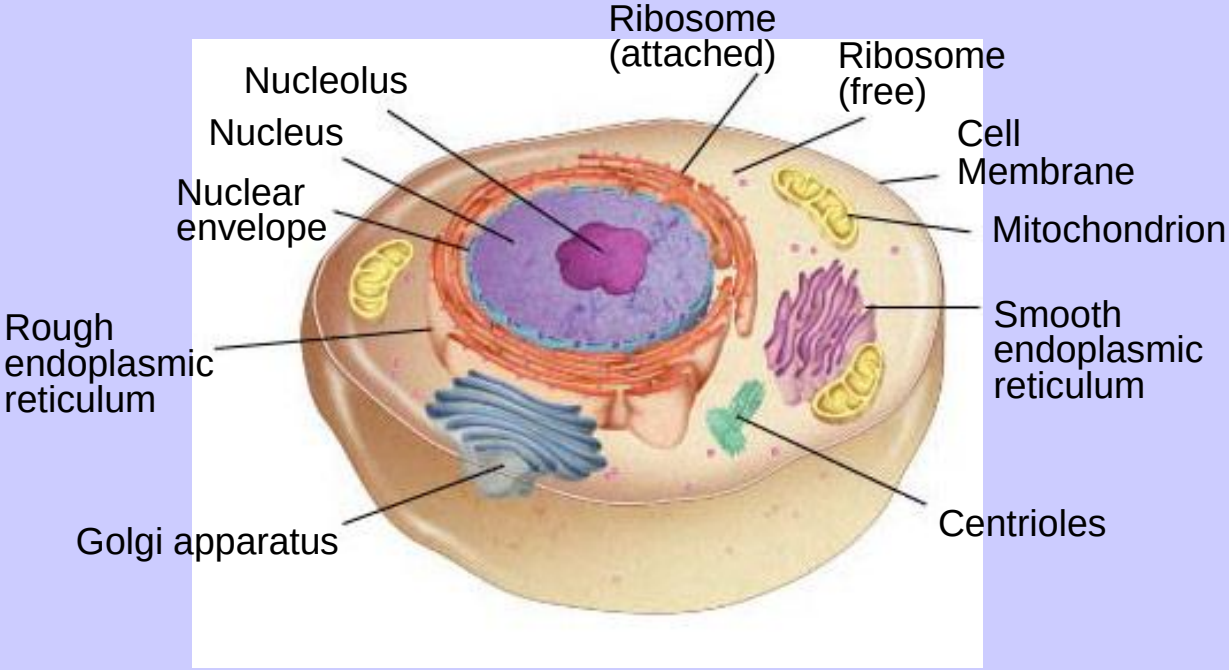
- Protists, Fungi, Plants, Animals

Processes of the Cells

1. Nutrition
   - Food is needed to supply energy and for building materials.
2. Digestion
   - Food is broken down into simpler forms so cells can use them.
3. Absorption
   - Intake of water, food, ions and other needed materials from the environment
4. Excretion
   - Wastes are given off from the cells activities.

5. Biosynthesis
   - Cells make organic molecules like carbohydrates, fats and proteins.
6. Respiration
   - The release of energy from food. Food burns O_2 and used CO_2 is given off.
7. Secretion
   - Vitamins and hormones are made by special cells.
8. Response
   - Change due to stimuli such as heat, light, pressure
9. Reproduction
   - Cell division to increase cell number or more organisms

Eukaryotic Cell Structure



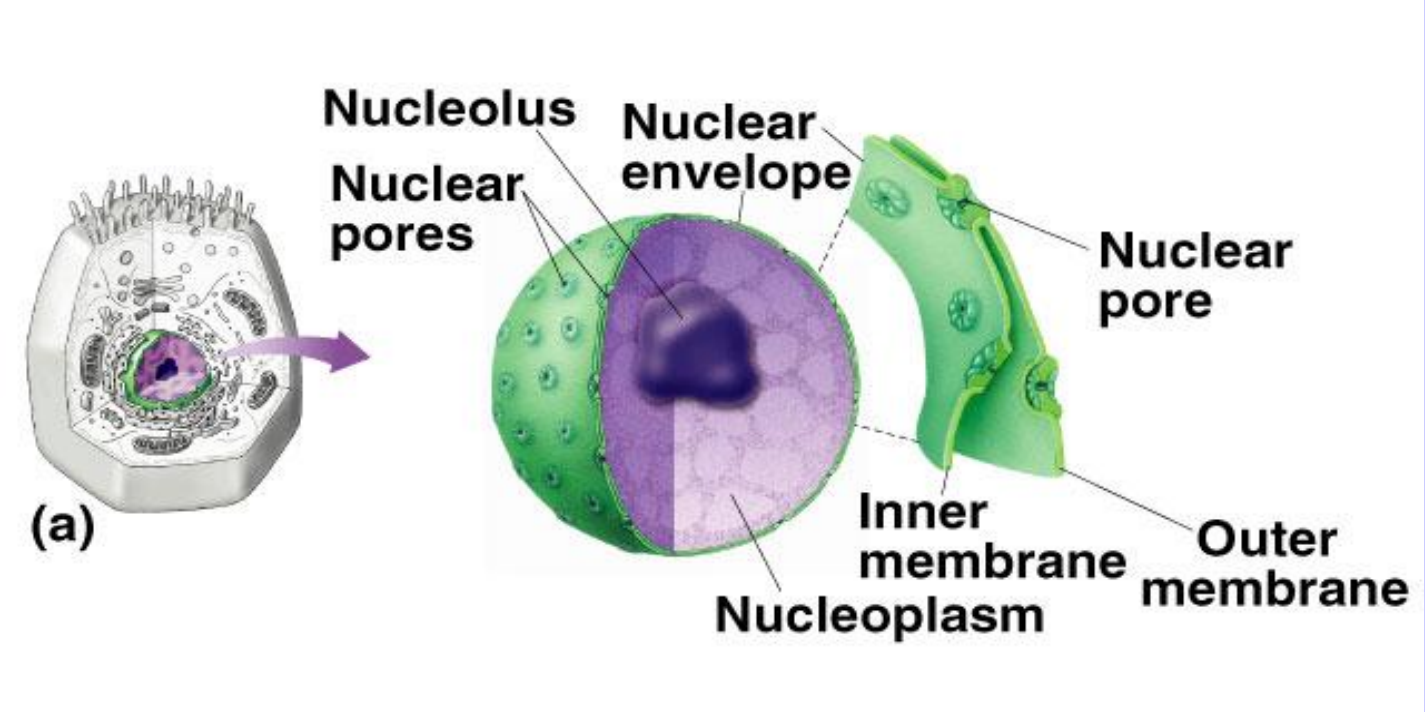
Section 7-2

Comparing the Cell to a Factory

- Organelles are "little organs" which carry out specialized functions within a cell.
- A eukaryotic cell is divided into two parts:
  - nucleus
  - cytoplasm
- The cytoplasm is the portion of the cell outside the nucleus.
  - a colloidal suspension, clear thick fluid
  - in motion and appears to be streaming
  - contains organelles and stores nutrients

Nucleus

- "Main office" which controls a large factory
- The nucleus is the control center of the cell.



- Contains all the cell's DNA
- The nuclear envelope surrounds the nucleus.
  - contains pores which allow material to move into and out of the nucleus
  - "messages or instructions" move through the nuclear pores
- Chromatin is granular material in the nucleus consisting of DNA bound to protein.

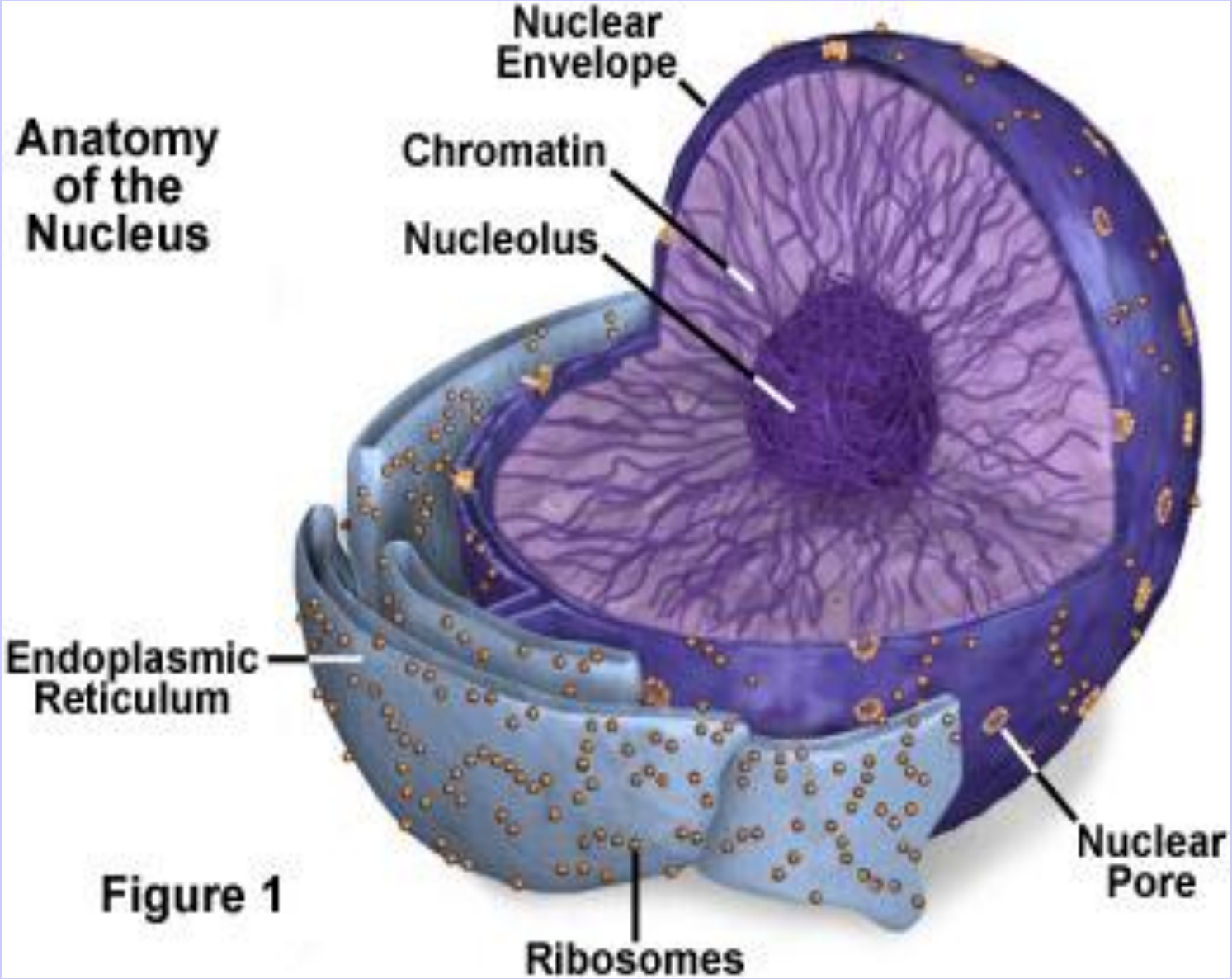
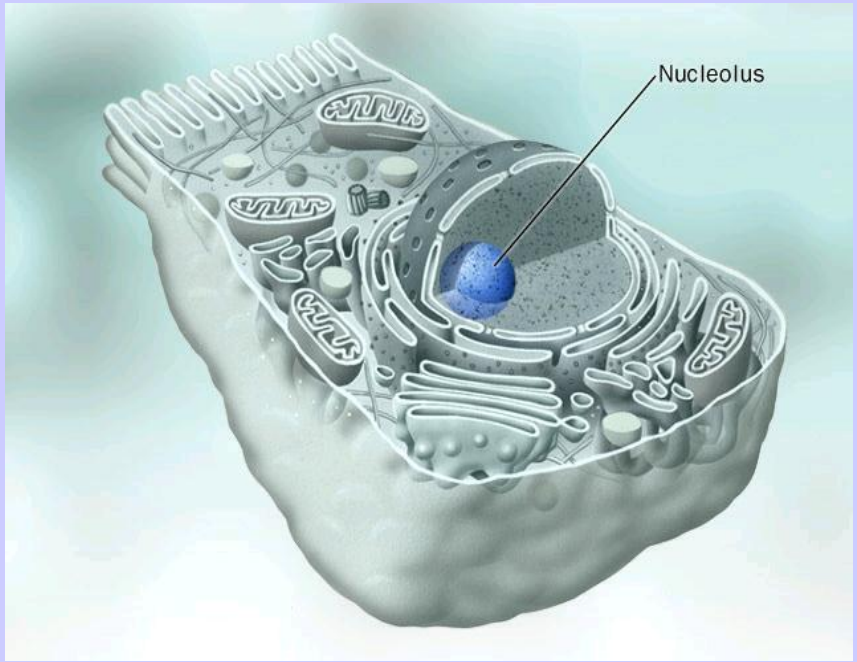
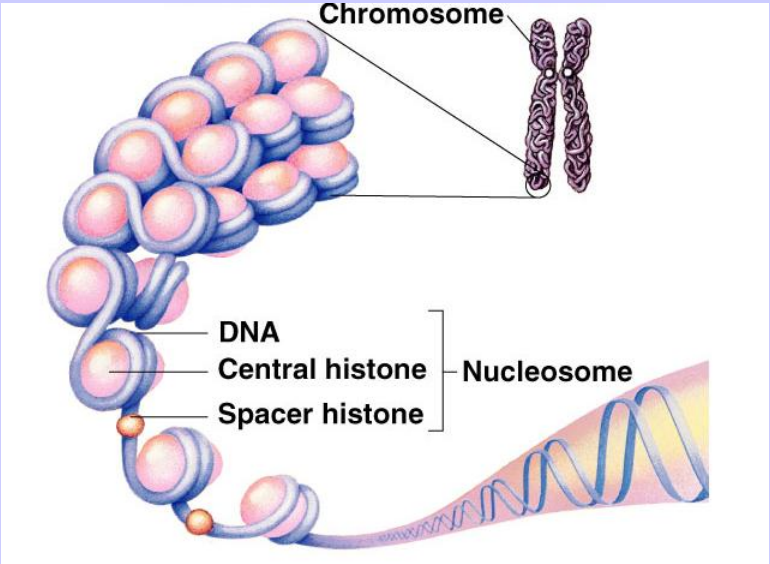

Anatomy of the Nucleus
Nuclear Envelope
Chromatin
Nucleolus
Endoplasmic Reticulum
Nuclear Pore
Ribosomes

Figure 1

- Chromosomes condensed chromatin, threadlike structures that contain genetic info.
- The nucleolus is inside the nucleus and is where the assembly of ribosomes begins.

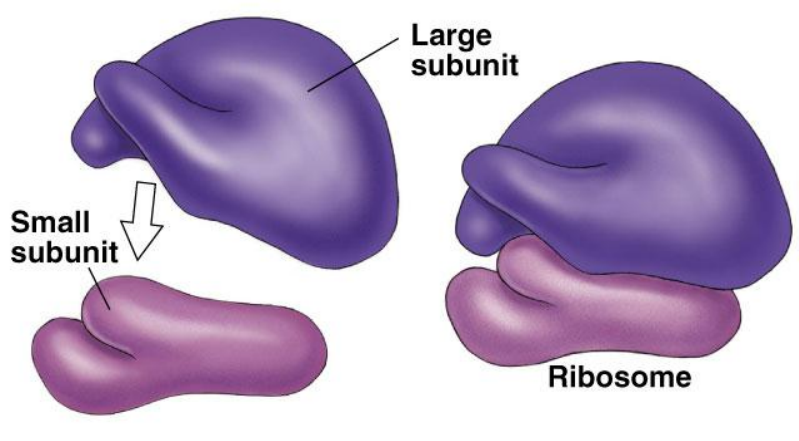




Ribosomes

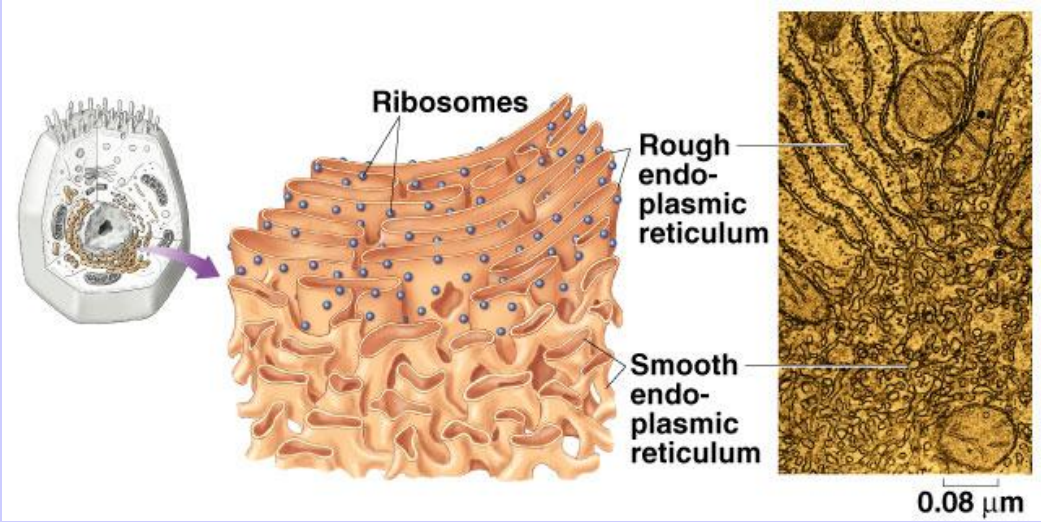
- Ribosomes are small particles of RNA and protein found in the cytoplasm.
- Proteins are assembled on ribosomes.
- Found scattered in the cytoplasm or on the endoplasmic reticulum.

- Each ribosome is like a "small machine that makes proteins on orders that come from its boss - the nucleus".

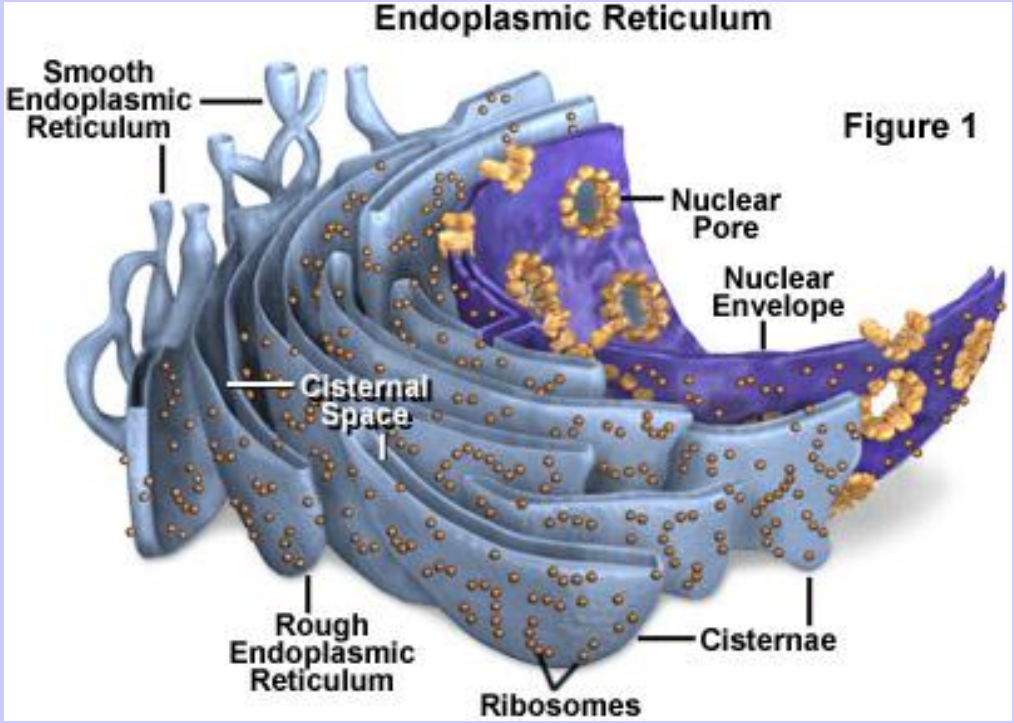


Endoplasmic Reticulum

- The endoplasmic reticulum or ER is an internal membrane system (subway system).
- Lipid components are assembled and then exported from the cell.

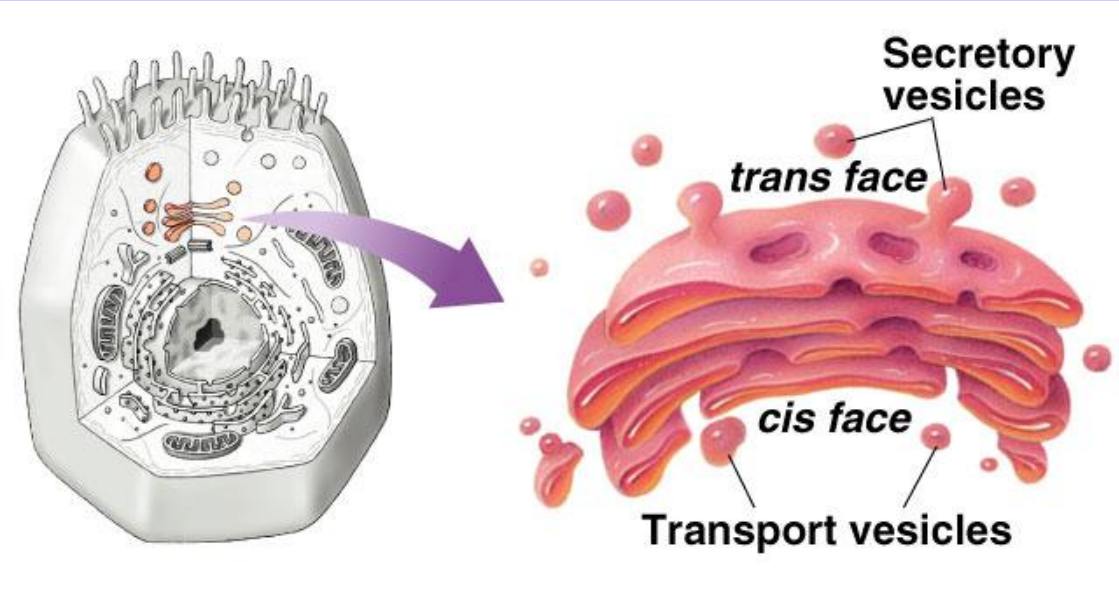


- Rough ER is involved with protein synthesis because ribosomes are found on its surface.
- Smooth ER contains enzymes that help synthesize lipids and detoxify drugs (No ribosomes!)
- Liver cells contain a large amount of smooth ER.



Golgi Apparatus

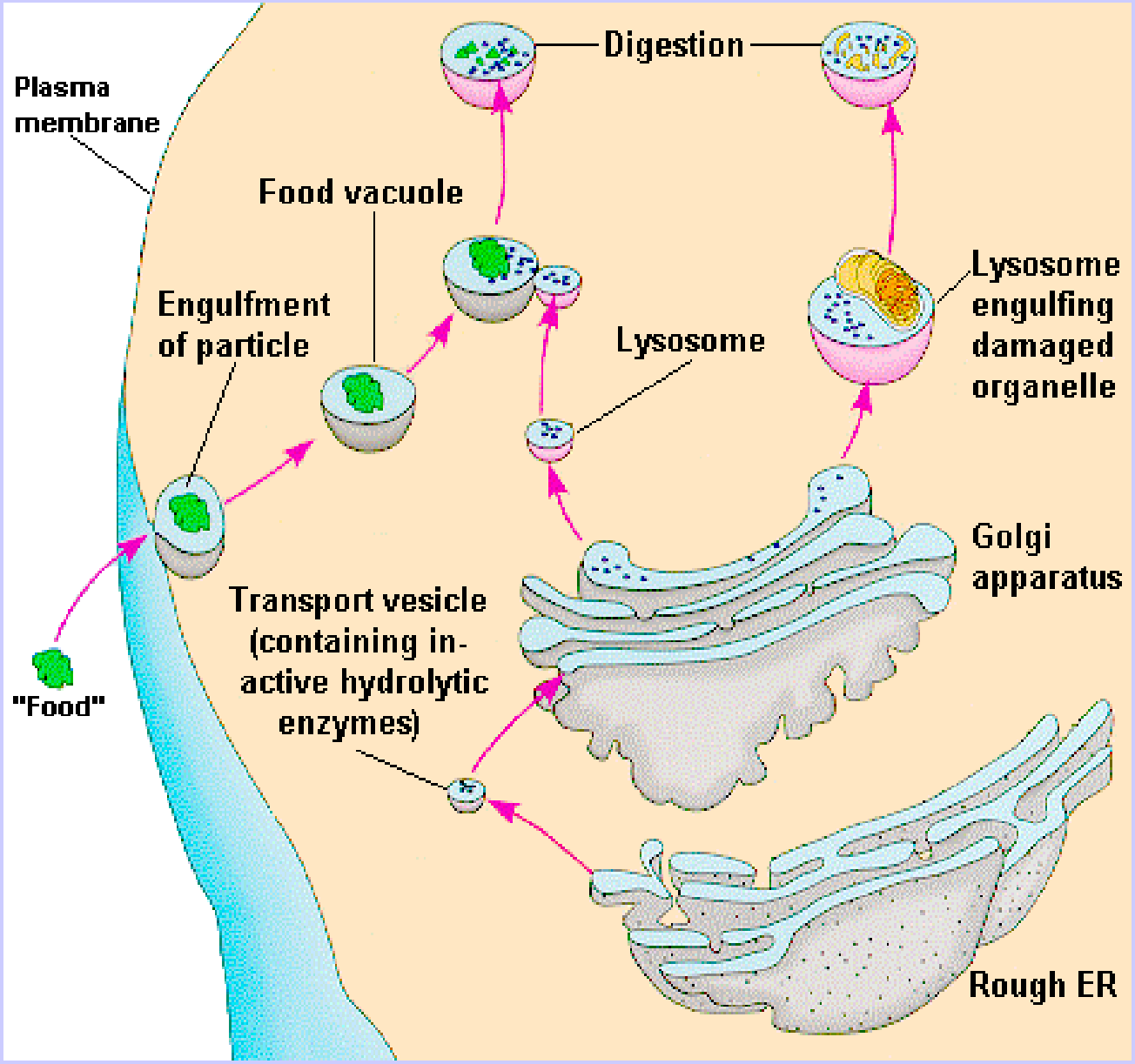
- The Golgi apparatus receives proteins produced in the rough ER.
- Looks like flattened sacs piled on one another.



- Protein-packaging factory which modifies, sorts and packages proteins for storage or secretion outside the cell.
- Wraps protein molecules to be exported from cell surface like hair, skin and tears.
- Puts the "finishing touches on proteins before they are ready to leave the factory".
- Proteins are "shipped" from the Golgi apparatus to their final destinations.

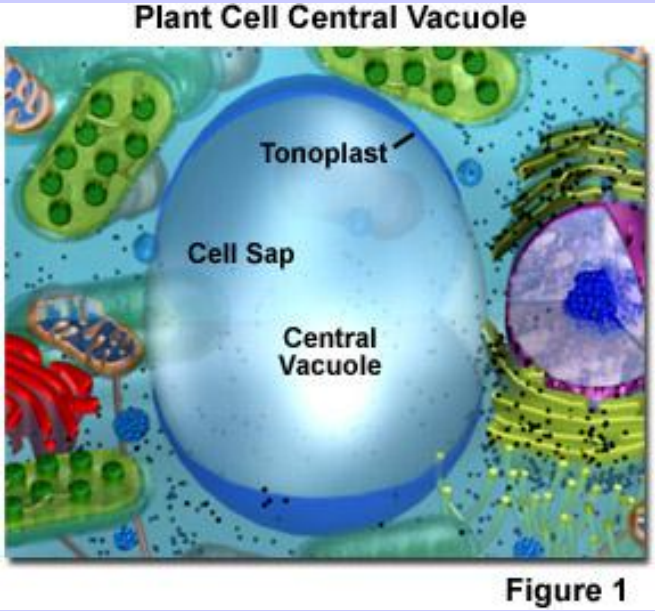
Lysosomes

- Lysosomes act like a "cleanup crew".
- Lysosomes are small organelles filled with enzymes that breakdown or digest large molecules.
- Lysosomes remove the "junk" that might otherwise accumulate in the cell.
  - Bruise yourself, lysosomes digest dead RBC, and WBC make new cells.


Digestion
Plasma membrane
Food vacuole
Engulfment of particle
Lysosome
Lysosome engulfing damaged organelle
Golgi apparatus
Transport vesicle (containing in-active hydrolytic enzymes)
"Food"
Rough ER

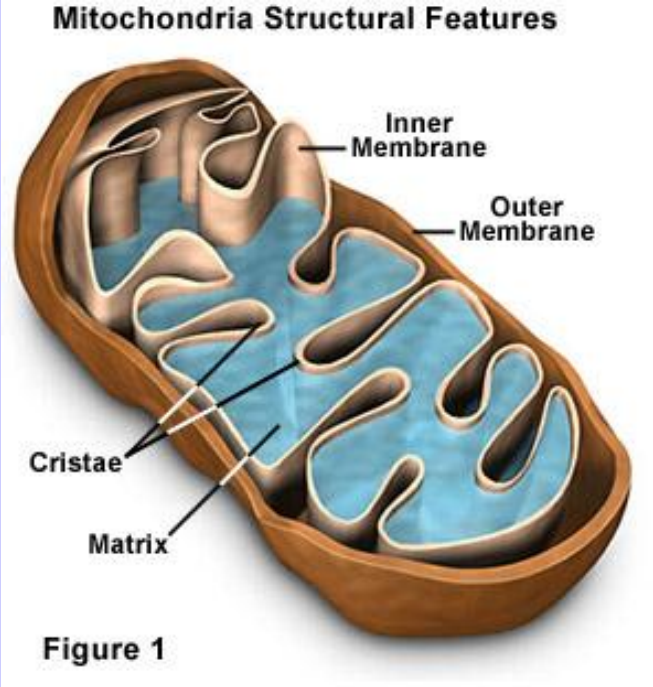
Vacuoles

- Vacuoles are saclike structures that store materials such as water, salts, proteins, and carbs.
- In plant cells, there is a single, large central vacuole filled with liquid.
- Contractile vacuoles are found in single-celled organisms and pump excess water out of the cell.



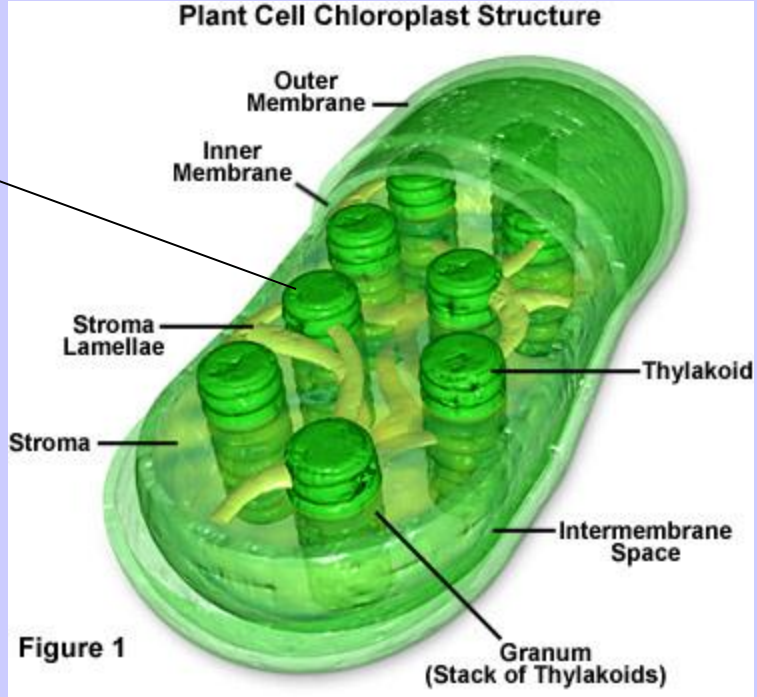
Mitochondria and Chloroplasts

- Most cells get energy in two ways - from food molecules or from the sun.
- Mitochondria convert the chemical energy stored in food into ATP.
- Enclosed by two membranes - an outer and an inner with a matrix in the center.



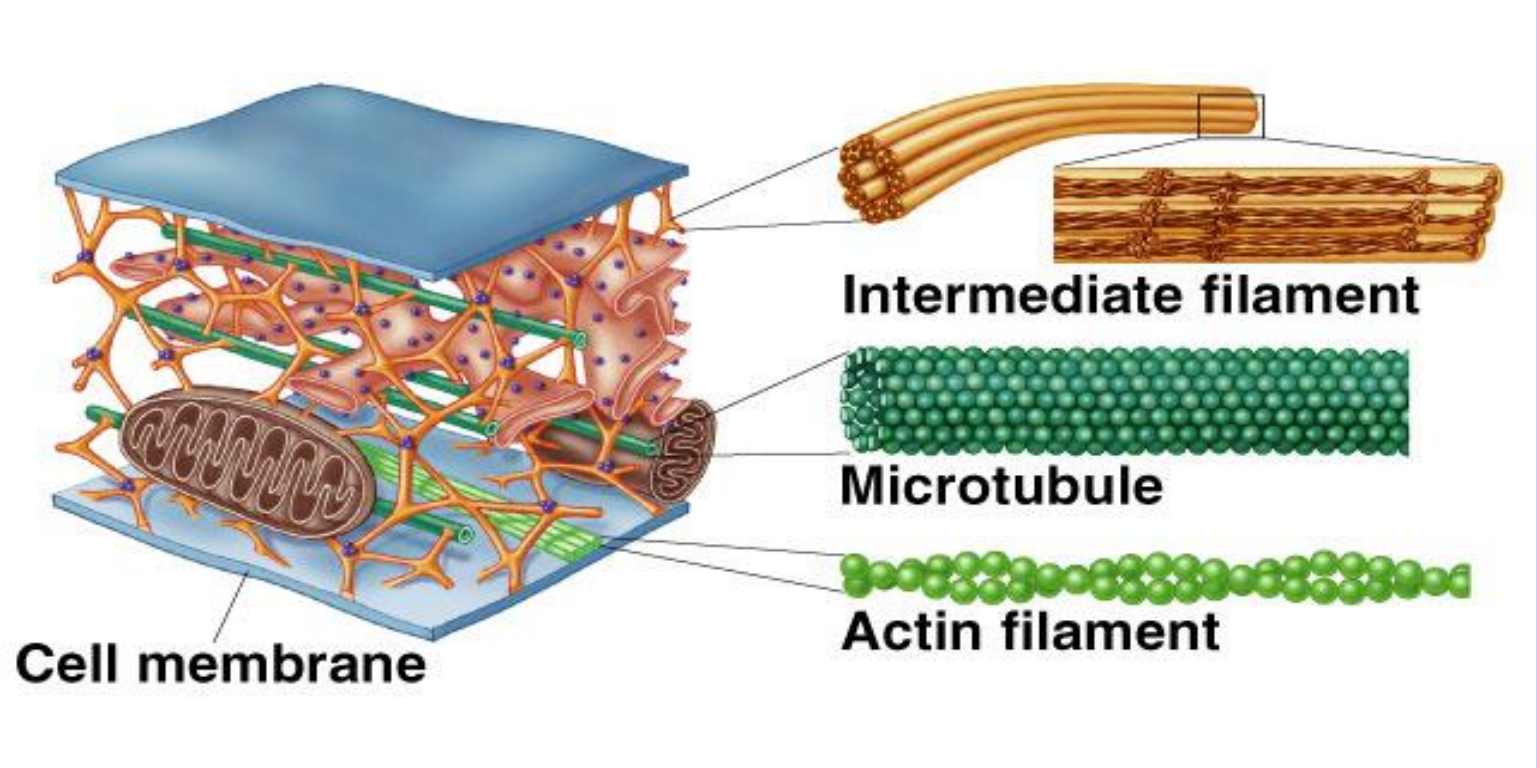
- The outer separates the mitochondria from the cytoplasm.
- The inner has many folds called cristae which add surface area for reactions to occur.
- Most numerous in cells that use a lot of energy, such as muscle cells.
- All or nearly all of our mitochondria comes from the cytoplasm of the egg cell. (Mom!)

- Chloroplasts are organelles that capture energy from sunlight and convert it into chemical energy by photosynthesis.
- "Biological solar power plants"
- They are surrounded by two membranes with stacks of membranes inside which contain the green pigment chlorophyll.

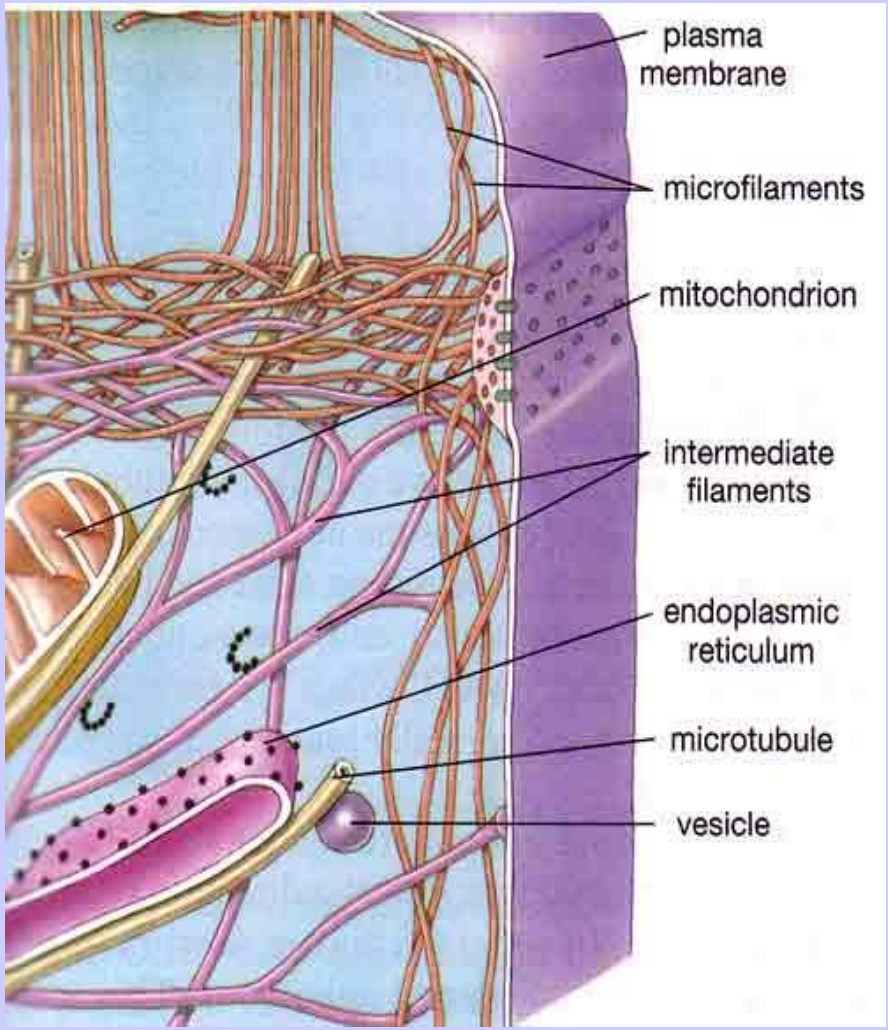


Cytoskeleton

- The cytoskeleton gives support and structure to the eukaryotic cell, just like a factory building is supported by steel or cement beams.



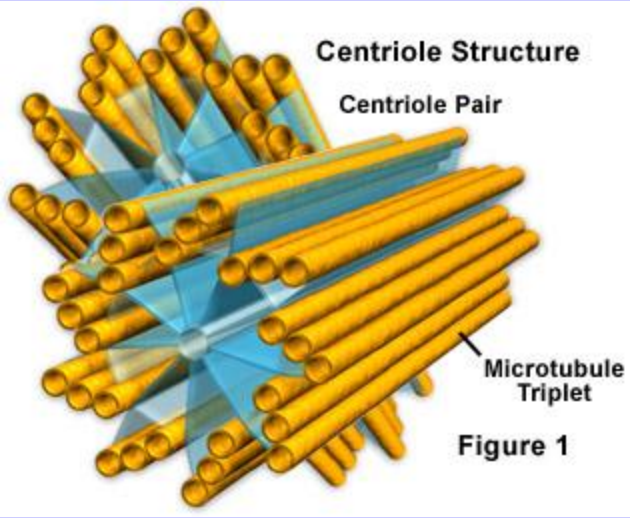
- The cytoskeleton is a network of protein filaments that helps the cell to maintain its shape.
- The cytoskeleton is also involved in movement.
- The principle protein filaments are:
  - microfilaments
  - microtubules



- Microfilaments are threadlike structures made up of a protein called actin.
- They form the framework and their assembly and disassembly are responsible for cytoplasmic movement.
- Microtubules are hollow structures made up of proteins known as tubulins.
- They maintain shape and are important in cell division where they form mitotic spindles that help separate the chromosomes.

Centrioles

- Centrioles are located near the nucleus and help to organize cell division.
- Centrioles are **not** found in plant cells!
- Microtubules build projections from the cell surface:
  - Cilia
  - Flagella
- These enable cells to swim rapidly through liquid.



Plant Cell

- Plant cells have:
  - Cell Wall
  - Chloroplasts
  - Central Vacuole
- Plant cells do NOT have:
  - Centrioles