

Cells
&
The Cell Theory

Introduction to Cells

Objectives

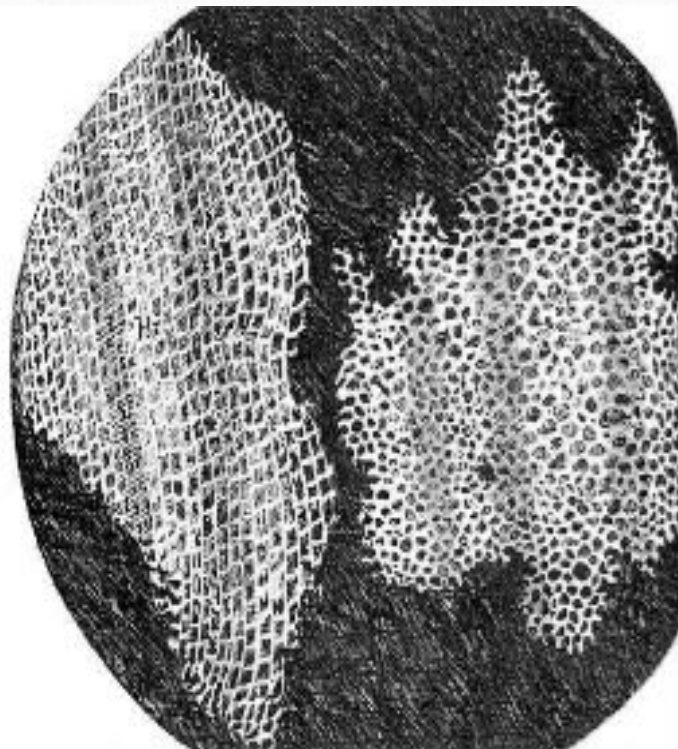
- Contributors of the cell theory
- Components of the cell theory
- Compare prokaryote and eukaryote cells
- Label/Compare plant and animal cell
- Understand the functions of the cell organelles

Review: Characteristics of Life

- Composed of one or more cells
- obtain and use energy
- grow and develop
- reproduce
- respond to the environment
- adapt to their environment

Early Contributions

- **Robert Hooke** - First person to see cells, he was looking at cork and noted that he saw "a great many boxes. (1665) - Hooke thought the boxes looked like prison cells



Hooke's original sketch



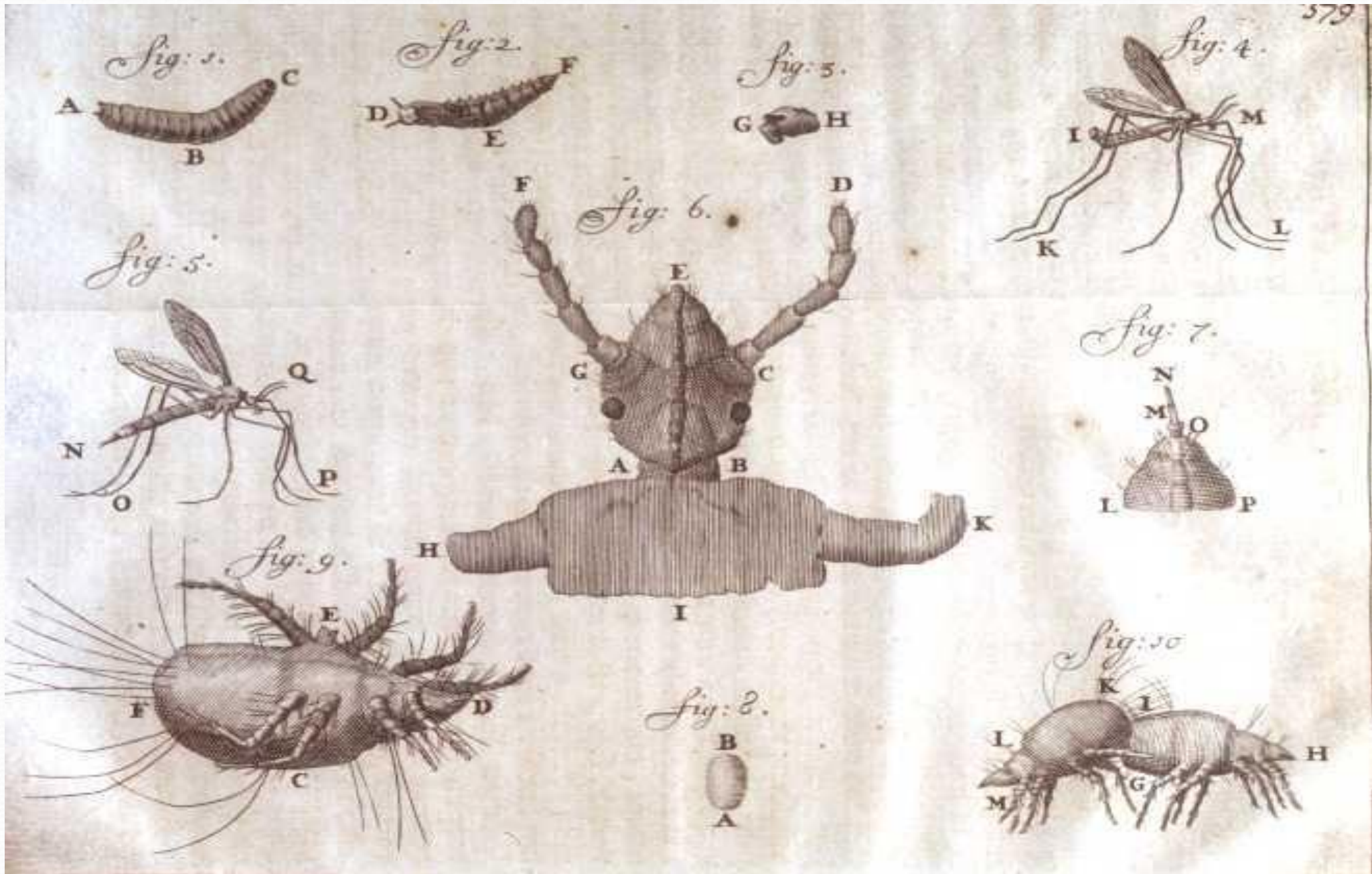
Early Contributions

Anton van Leeuwenhoek -
Observed living cells in pond water, which he called "animalcules" (Now called unicellular organisms/Leeuwenhoek is known as the Father of Microbiology) (1673) -
made improvements to the Microscope



Leeuwenhoek, Antonie Van 1632-1723. Dutch maker of microscopes. Gave the first detailed descriptions of bacteria, protozoa, red blood cells and capillary circulation. He is commonly known as the "Father of Microbiology". He also created over 400 different types of microscopes. Copyright Science Museum, London, UK. 2011 527

**This is what Leeuwenhoek saw
in the pond water.**



Early Contributions

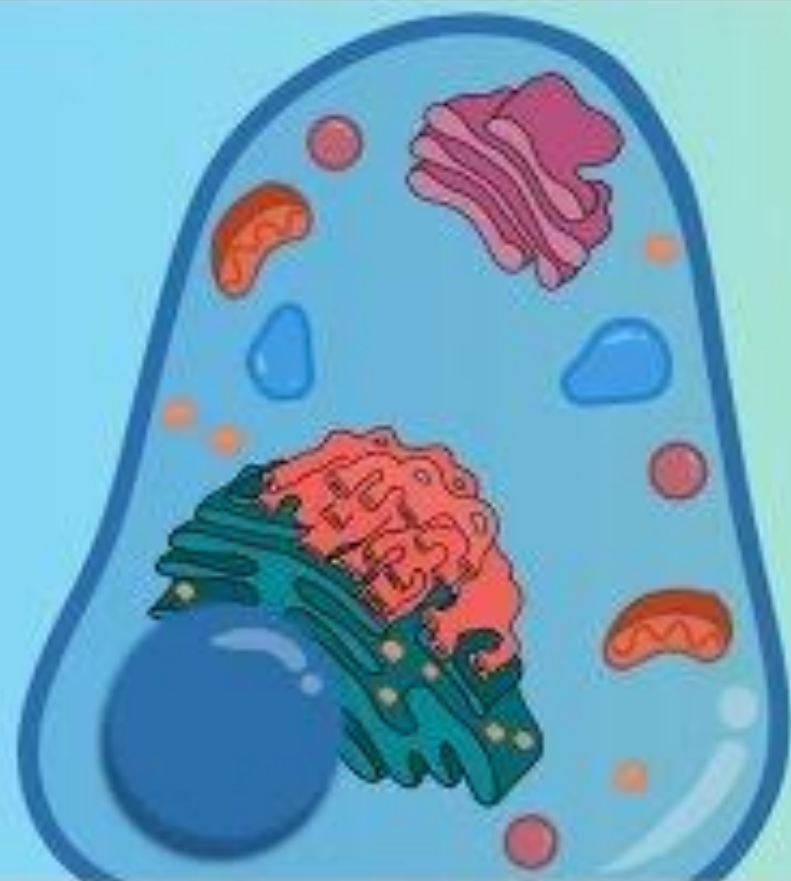
- **Theodor Schwann** - zoologist who observed tissues of **animals** had cells (1839)
- **Matthias Schleiden** - botanist, observed tissues of **plants** contained cells (1845)
- **Rudolf Virchow** - also reported that every living thing is made of up vital units, known as cells. He predicted that **cells come from other cells.** (1850)



Theodore Schwann



Matthias Schleiden



Introduction to Cells

with the Amoeba Sisters

The Cell Theory

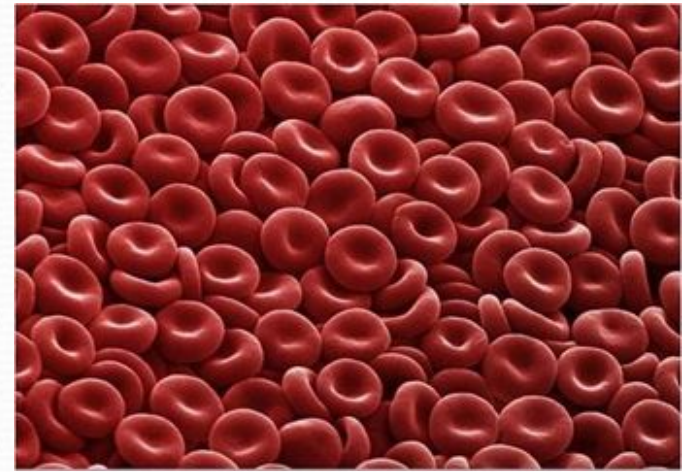
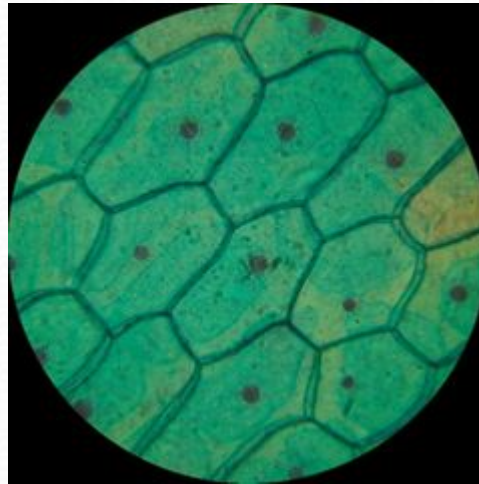
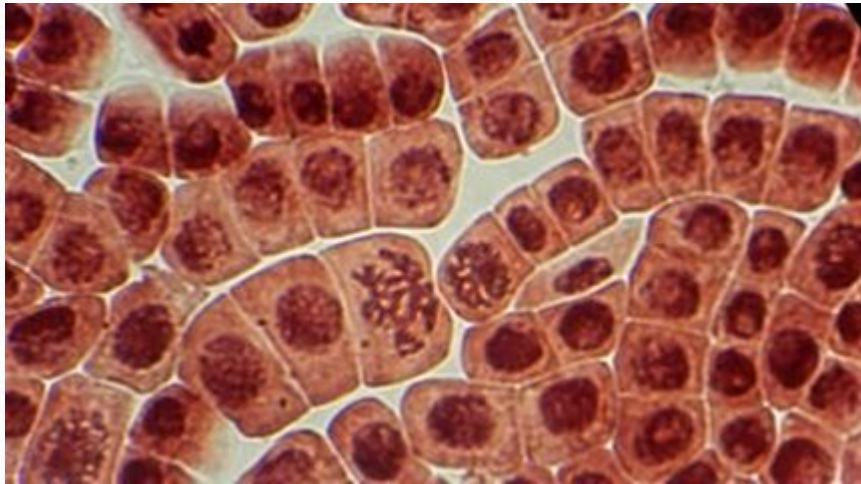
1. Every living organism is made of one or more cells.
2. The cell is the basic unit of structure and function.
3. All cells come from pre-existing cells.



*Why is the Cell Theory called a Theory?

What is a cell?

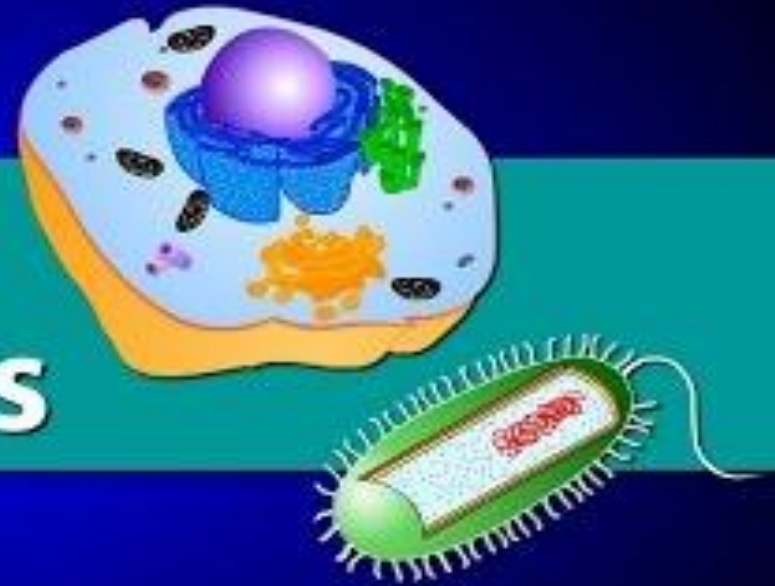
- A cell is the basic structural, functional, and biological unit of living organisms
 - “The building block of life.”
- You are made up of about 37 trillion cells!!!



Comparison: Eukaryotic & Prokaryotic Cells



Prokaryotes vs. Eukaryotes



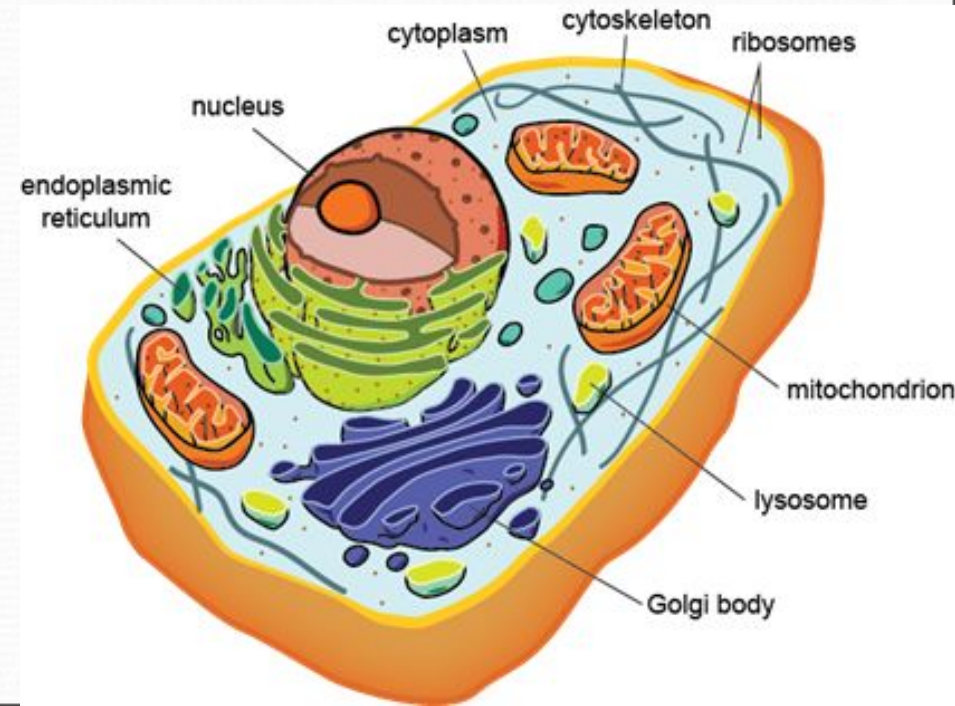
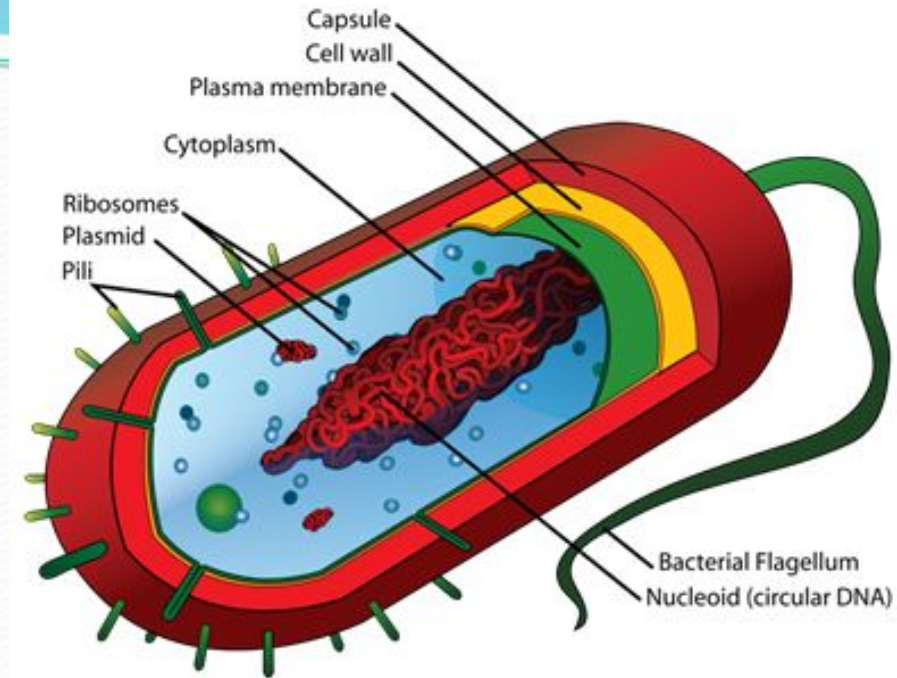
Types of Cells

- Prokaryotic - simple

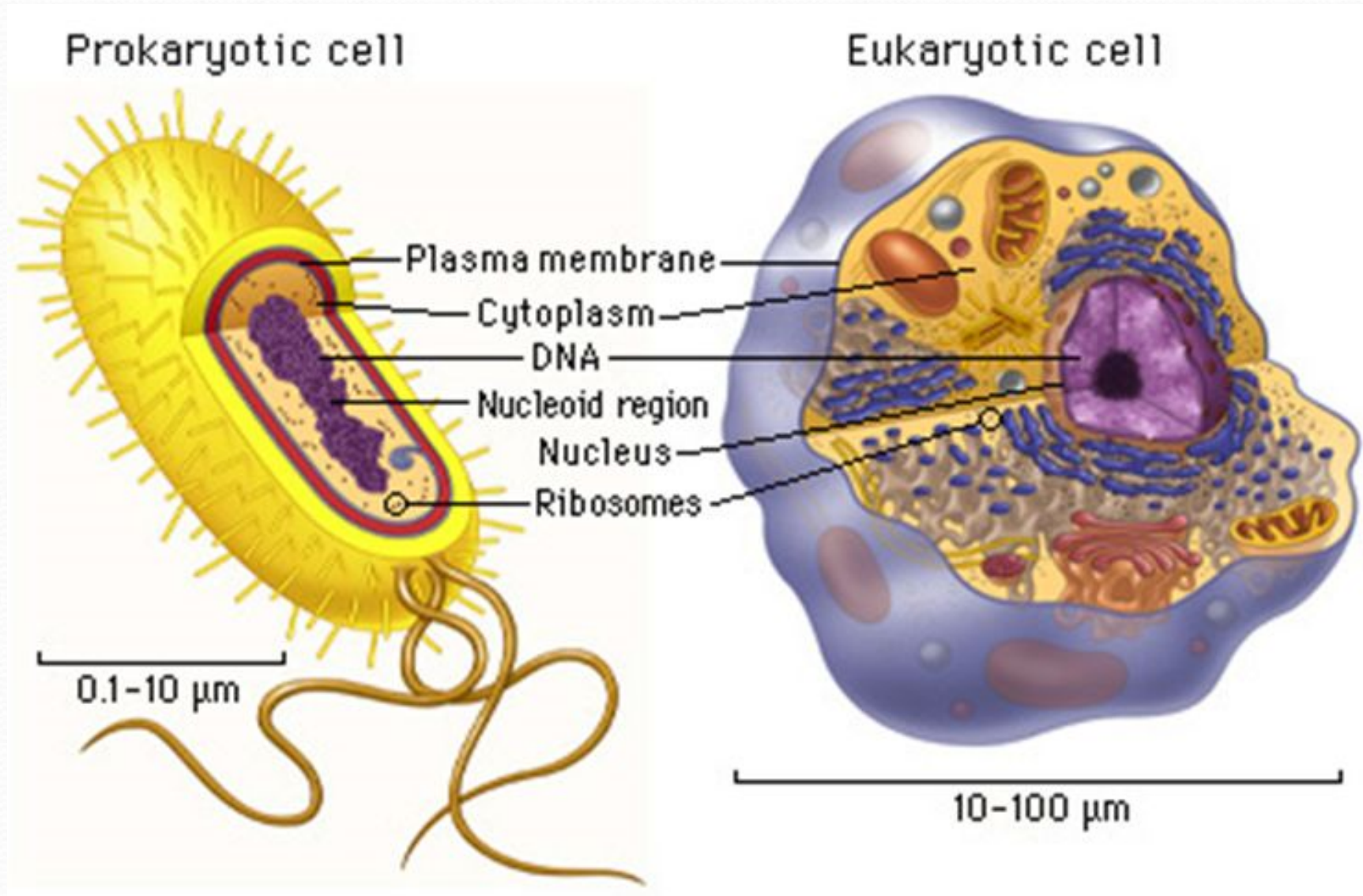
- *Pro = before*
- *Karyo = nucleus*

- Eukaryotic - complex

- *Eu = true*
- *Karyo = nucleus*



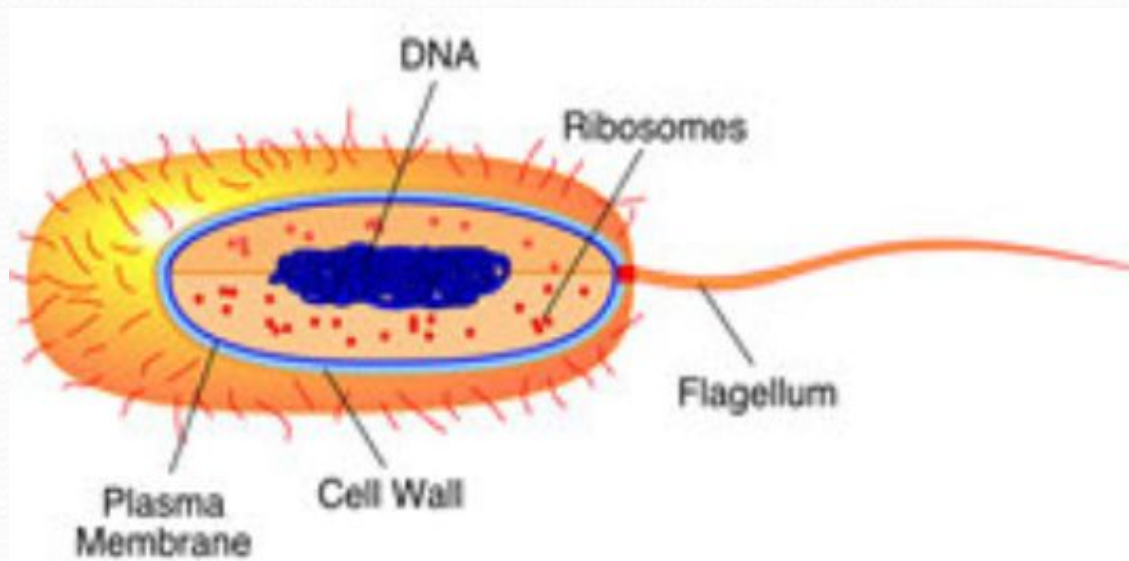
Comparison: Eukaryotic & Prokaryotic Cells



μm - means micrometer (which is one millionth of a meter)

Prokaryotic Cells

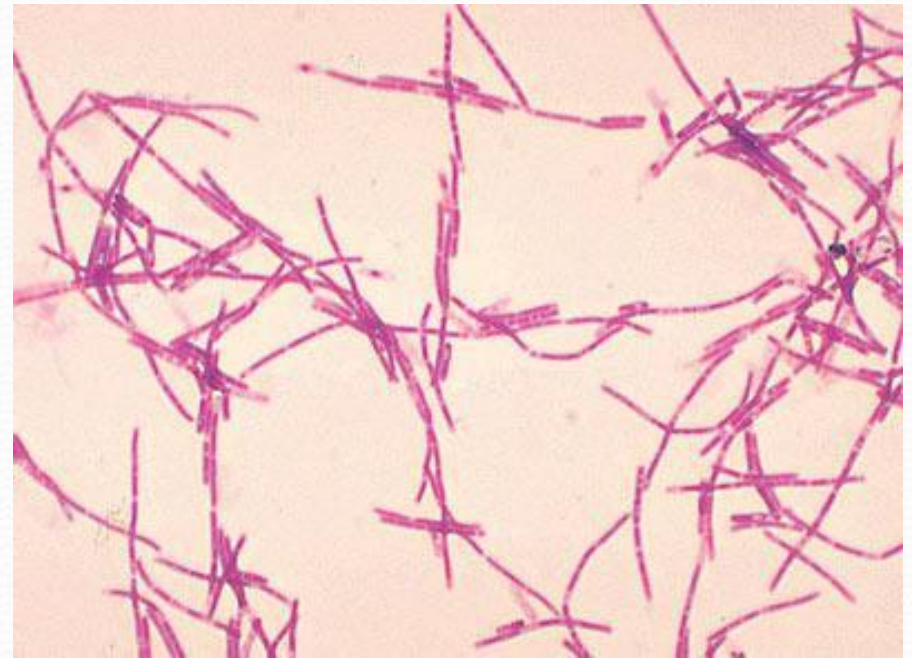
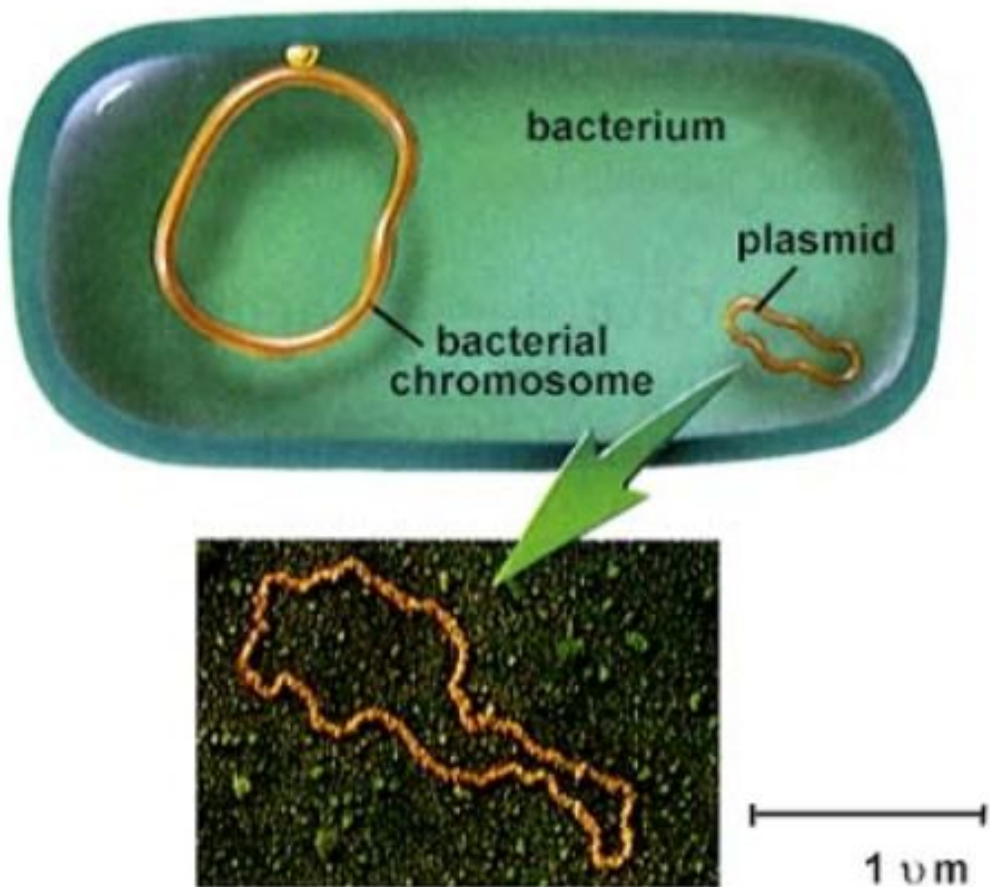
- Simple Cells, small in size
- Bacteria
- These cells do NOT have a nucleus, their DNA is circular and floats in the cytoplasm



Some bacteria have a tail-like structure called a flagella, that helps it to move.

A capsule surrounds some bacteria and helps them avoid the body's immune system

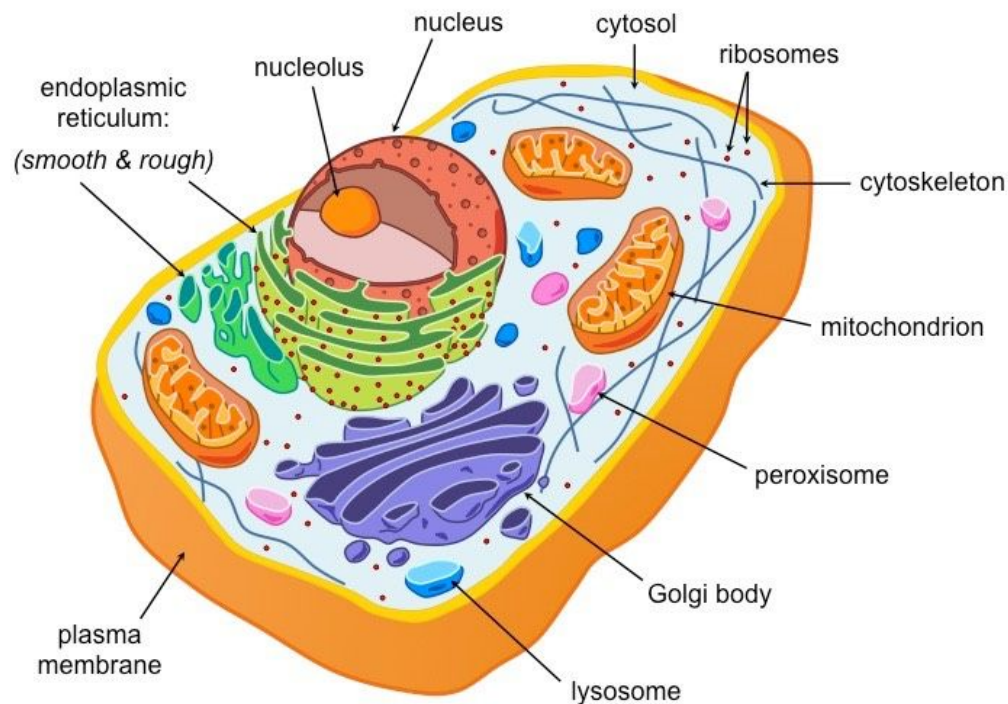
Bacteria Images



Bacteria that causes Anthrax

Eukaryotic Cells

- More complex, made up of membrane bound organelles (tiny organs)
- Plants and Animals
- Have a nucleus that contains the DNA information

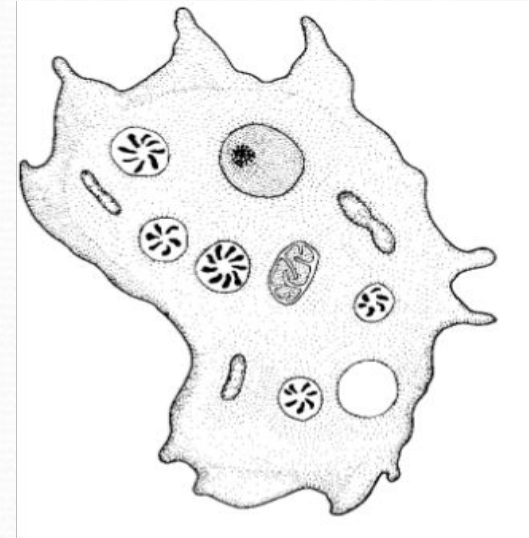


Eukaryotic Cells

Cells found in plants, animals, protists, and fungi

The cell is composed of 4 main parts:

1. Cell membrane
2. Cytoplasm
3. Nucleus
4. Organelles



Cell Features

ALL cells have...

- **Ribosomes** – make protein for use by the organism, *Protein Factory*
- **Cytoplasm** – jelly-like fluid found in the cell
- **DNA** – genetic material
- **Cytoskeleton** – internal framework of the cell, gives the shape and structure
- **Cell Membrane** – outer boundary, the "gate" controls what comes in and out of the cell

PROKARYOTIC CELLS

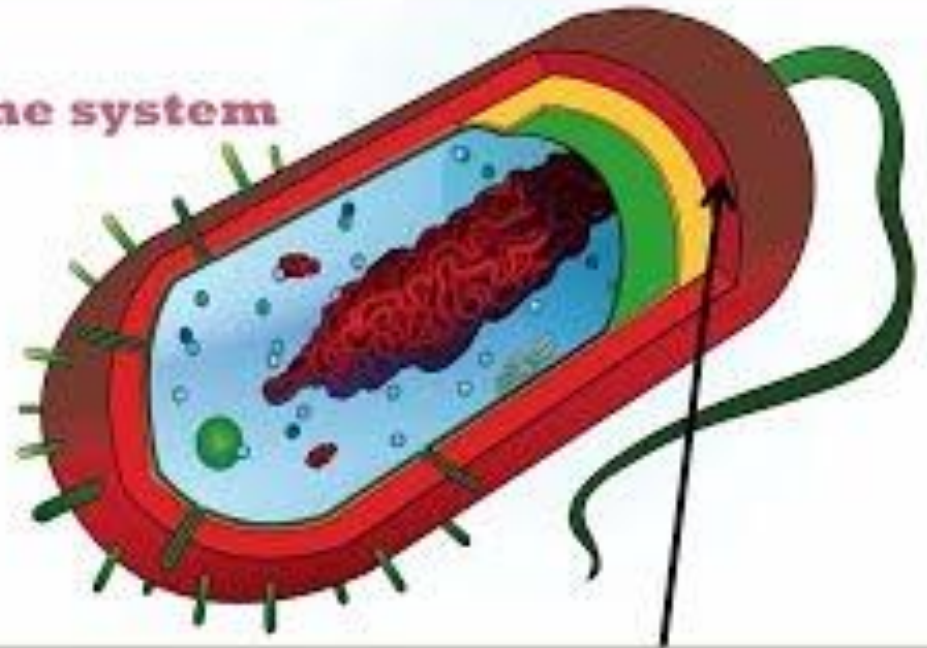
Starch or glycolipid

Desiccation

Immune system

Adhesion

Bacteria

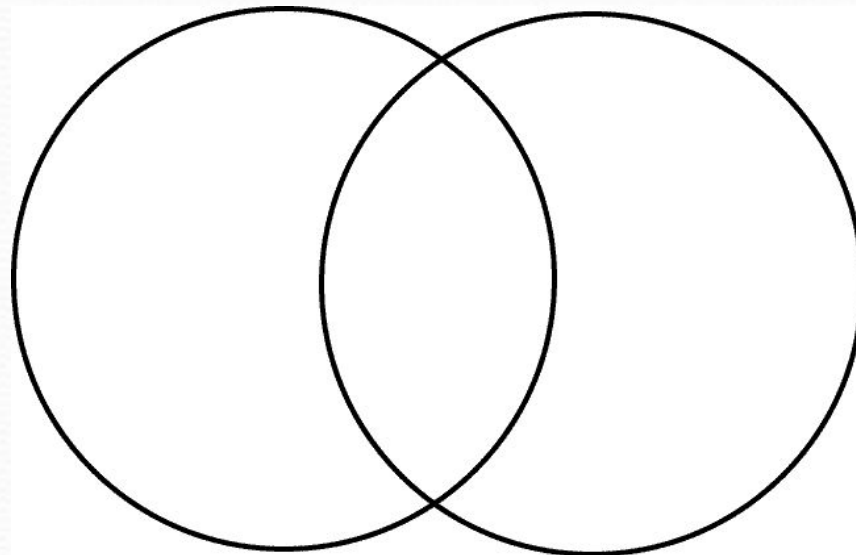


MrExham.com • Making Sense Of Biology

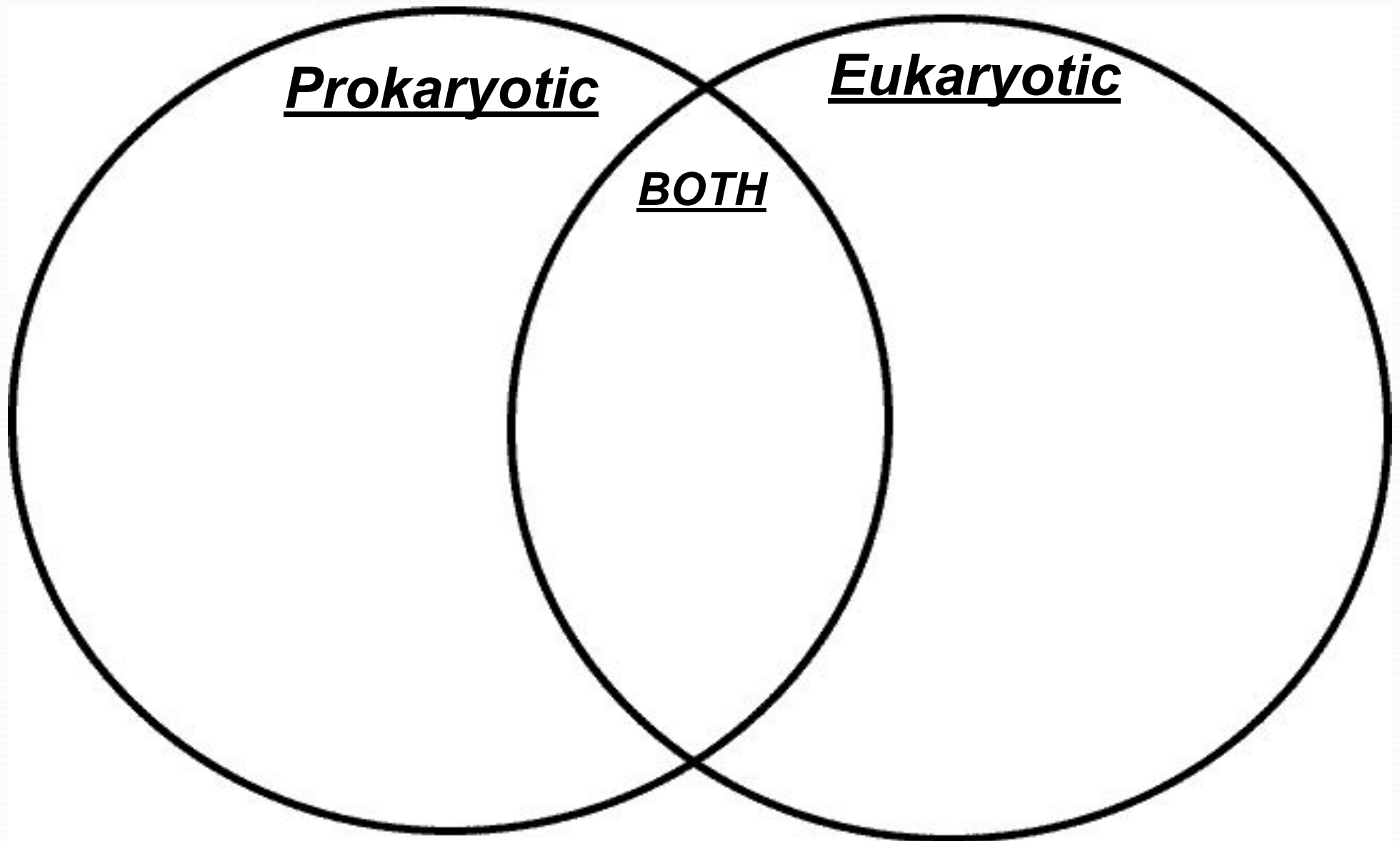
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Comparison: Eukaryotic & Prokaryotic Cells

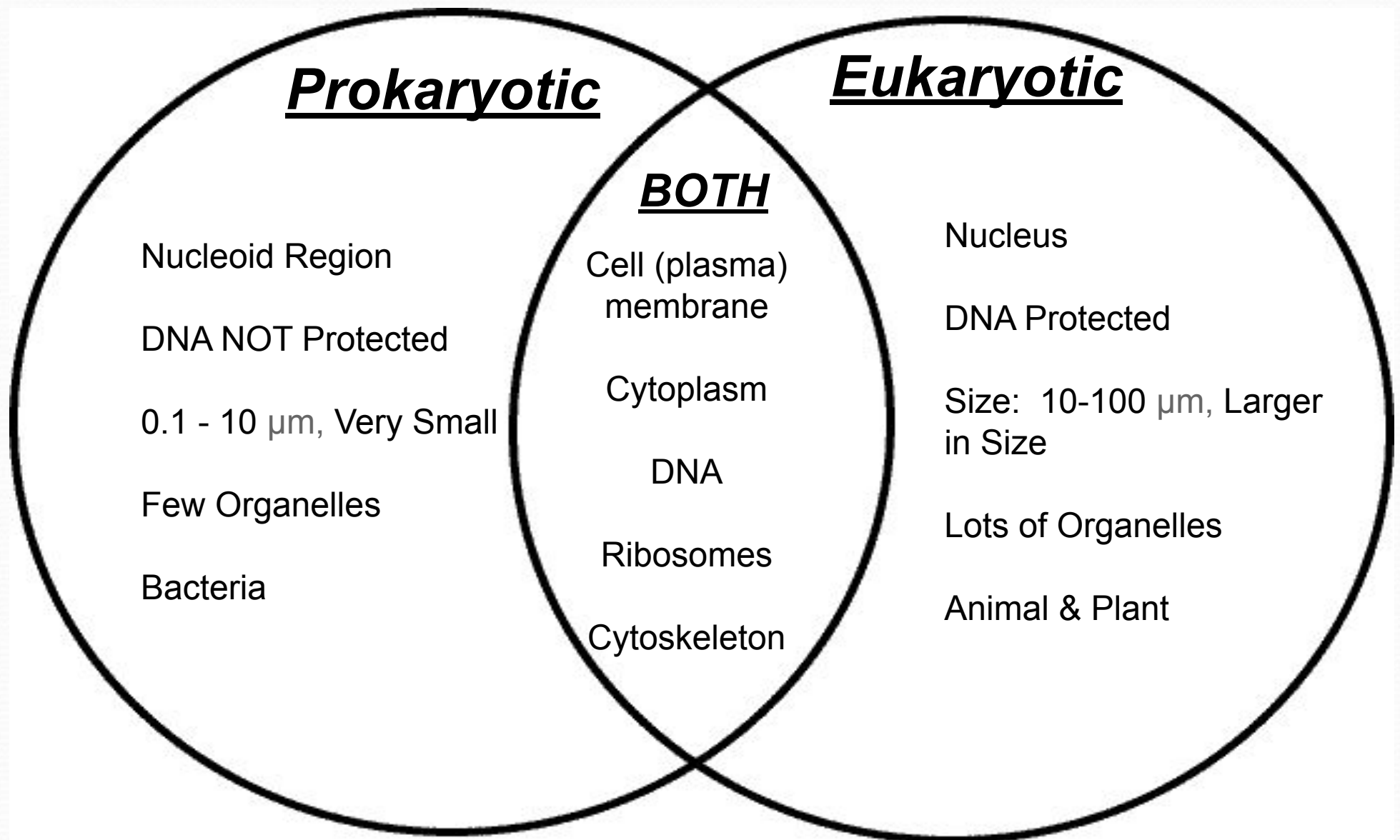
Complete the Venn Diagram
making a comparison of what is
found in each cell.



Comparison: Eukaryotic & Prokaryotic Cells

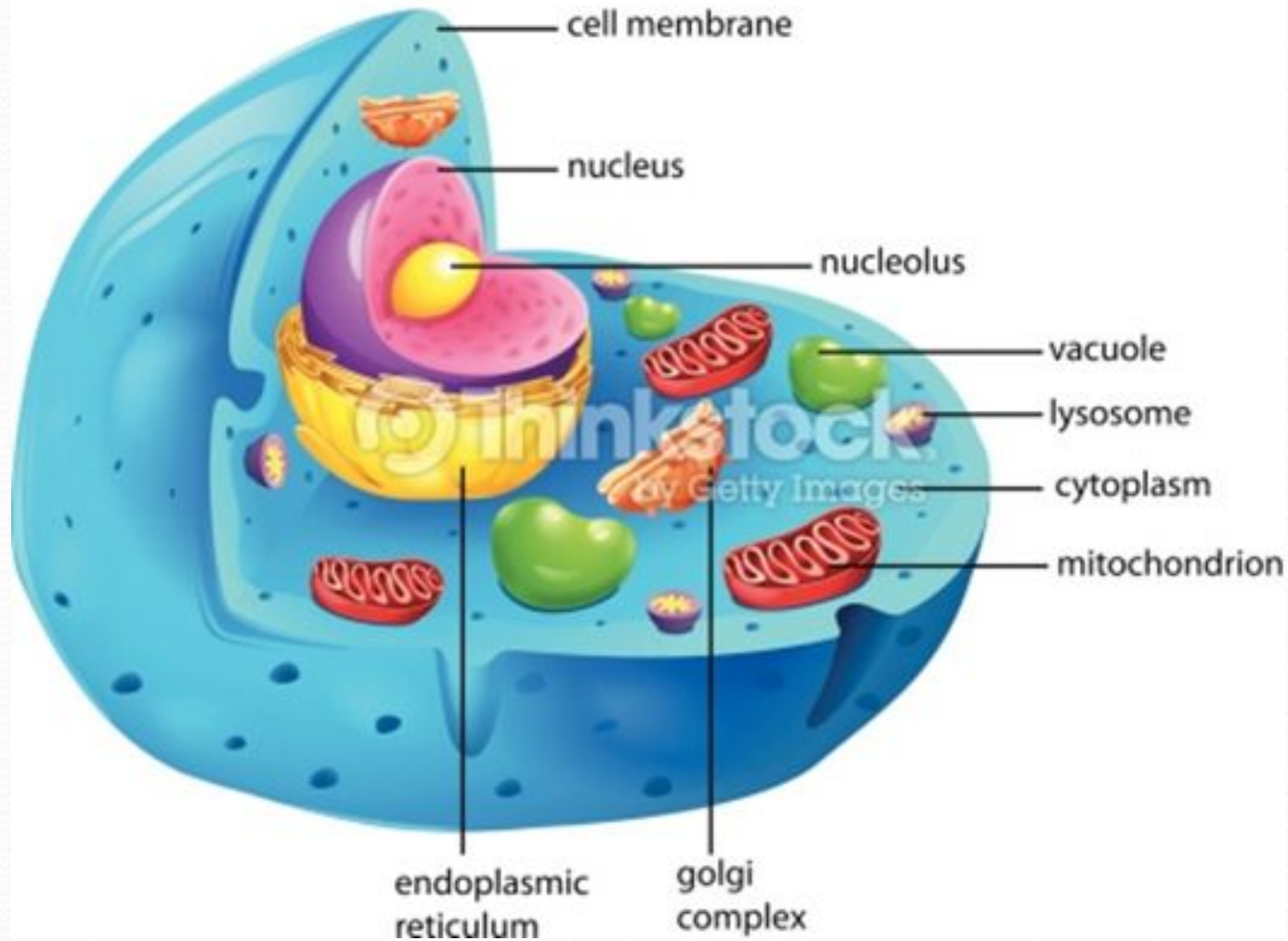


Comparison: Eukaryotic & Prokaryotic Cells

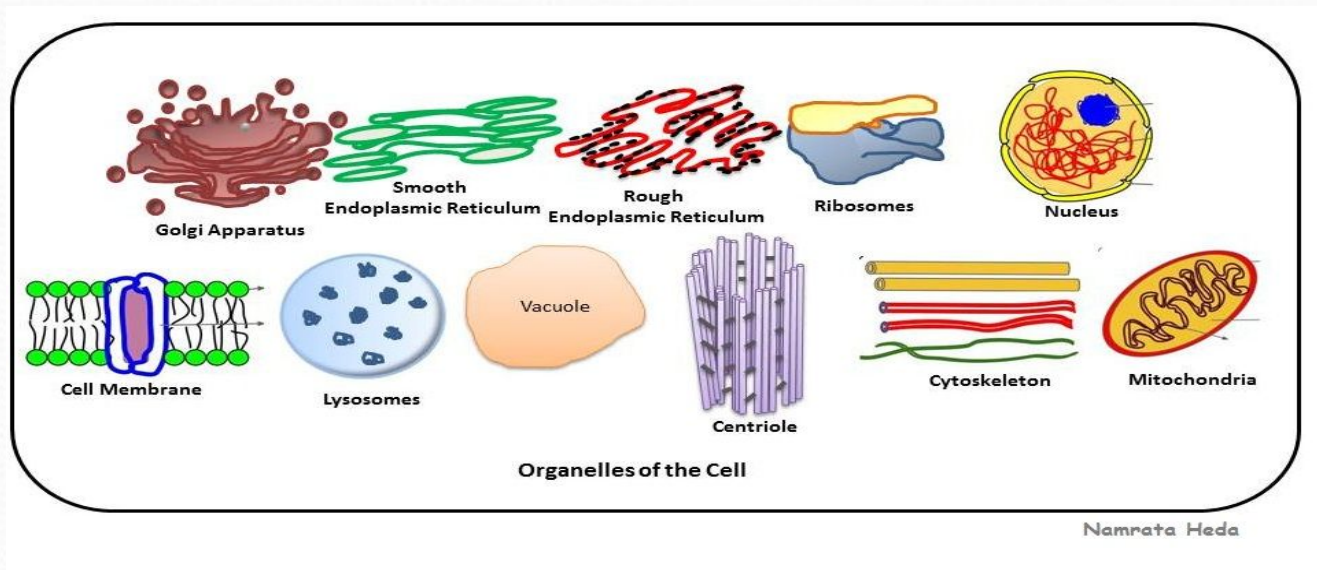


THE ANIMAL CELL

Anatomy of an Animal Cell



Organelles

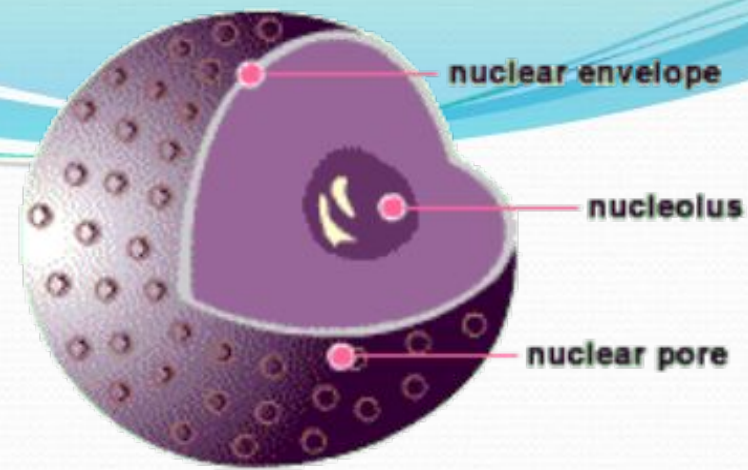


Similar to tiny organs inside of the cells

Cell Organelles

Nucleus - brain of the cell,
controls cells activities

- Usually found at center of cell
- Has a nuclear membrane (or nuclear envelope) - hold the DNA in place and keeps it safe
- Has nuclear pores - regulate what goes into the nucleus
- Contains the cells DNA
- Nucleolus - inside of the Nucleus - makes ribosomes (rRNA) - dark spot inside of the nucleus



Cell Organelles

Mitochondria – energy center; turns food into a chemical energy called ATP (Adenosine triphosphate)

ATP is a major fuel for all cell activities

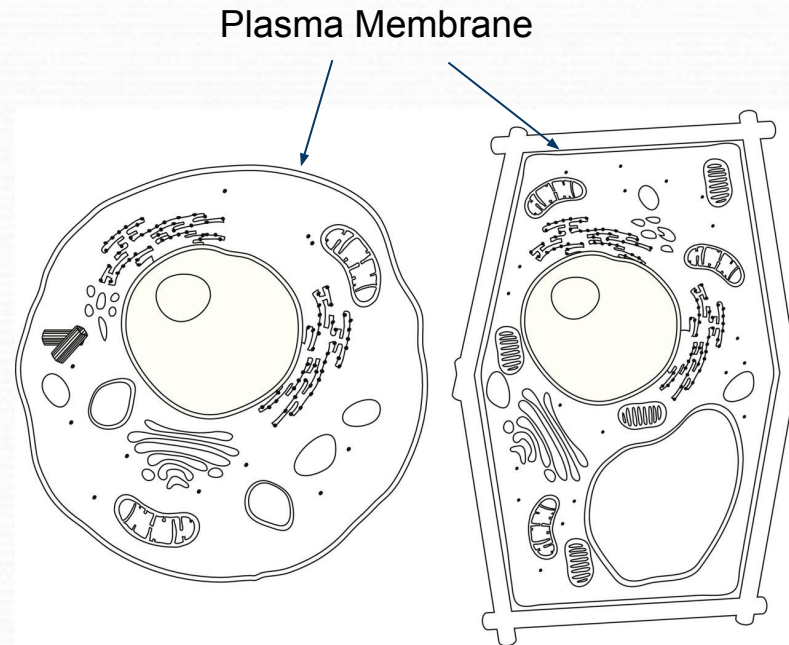
- The mitochondria is sometimes called the “powerhouse” of the cell
- Folded inner membrane increases surface area for energy production during respiration



Cell Organelles

Cell (Plasma) Membrane - the gate of the cell

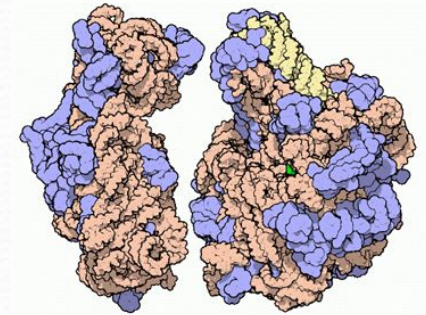
- Double membrane that controls what enters and leaves the cell



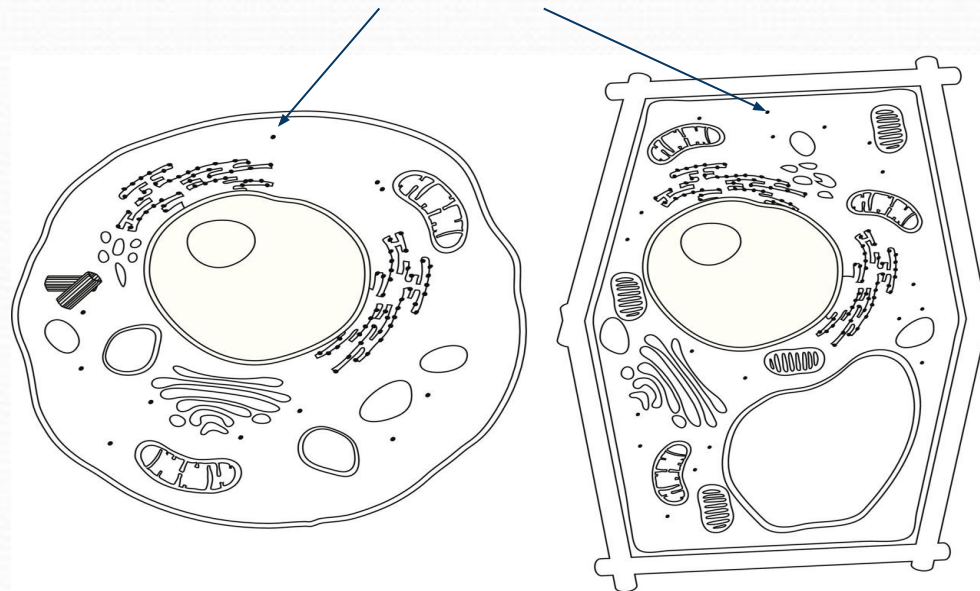
Cell Organelles

Ribosome - protein producer

- make the proteins in the cell from amino acids



Ribosome



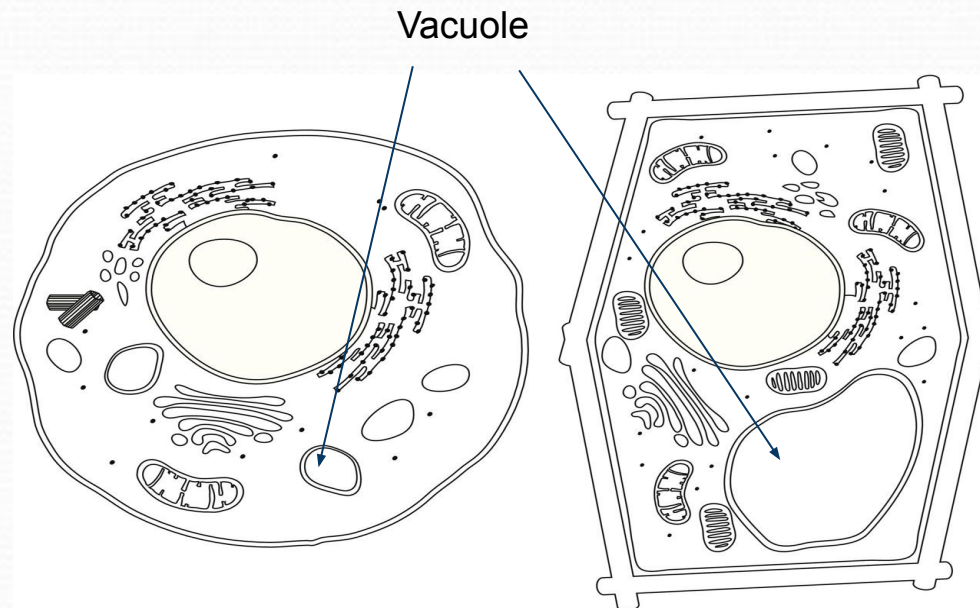
Cell Organelles

Vacuole - Storage tanks

- stores food, water and chemicals in the cell
- Plant Vacuoles, *aka Central Vacuole* are much larger, keep the plant from wilting

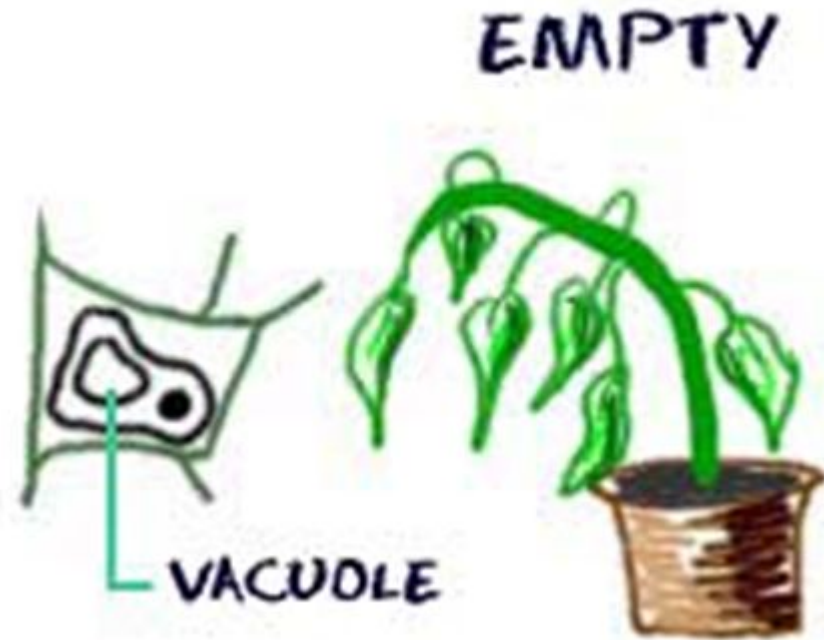
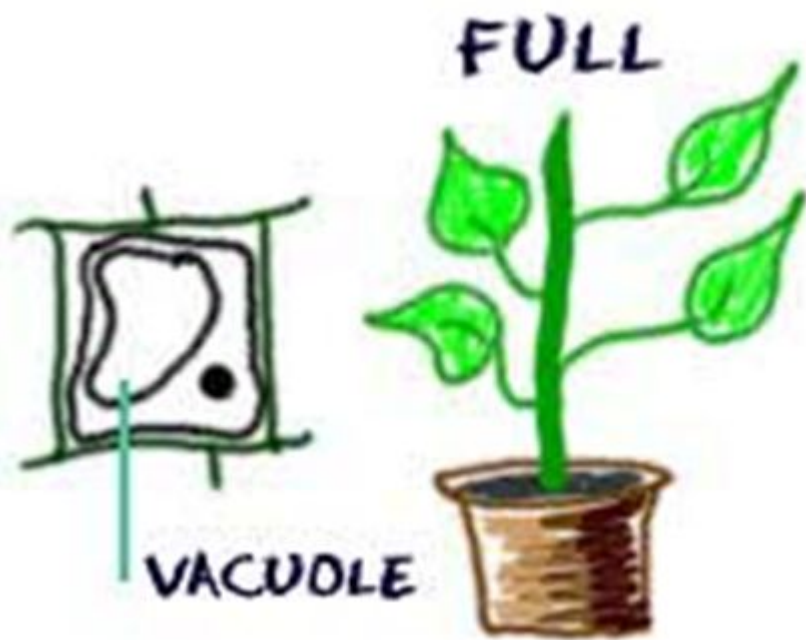


Figure 1



Cell Organelles

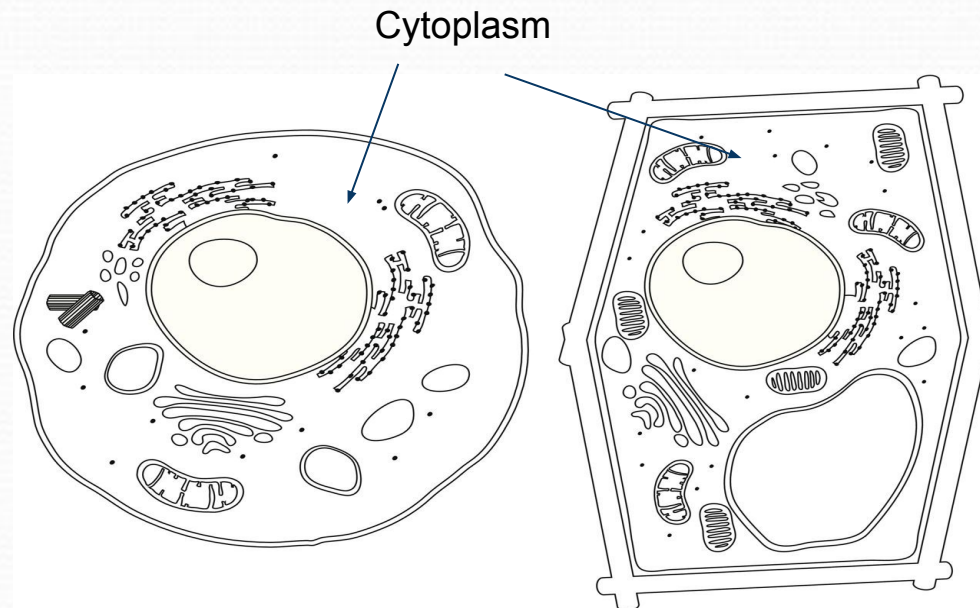
Vacuole



Cell Organelles

Cytoplasm - Jelly/gel

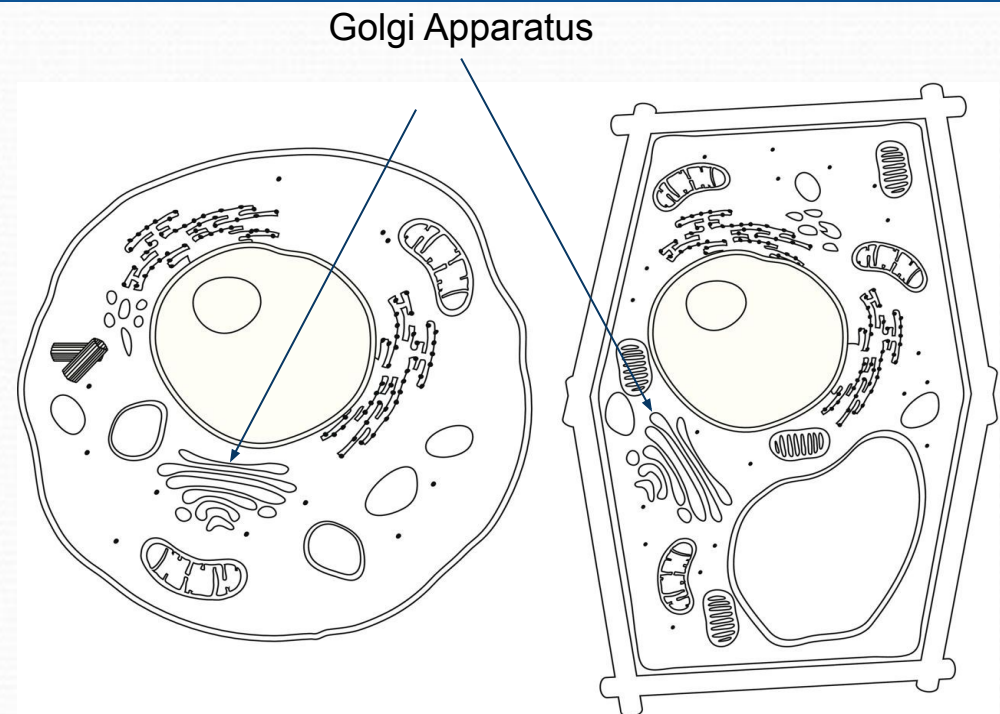
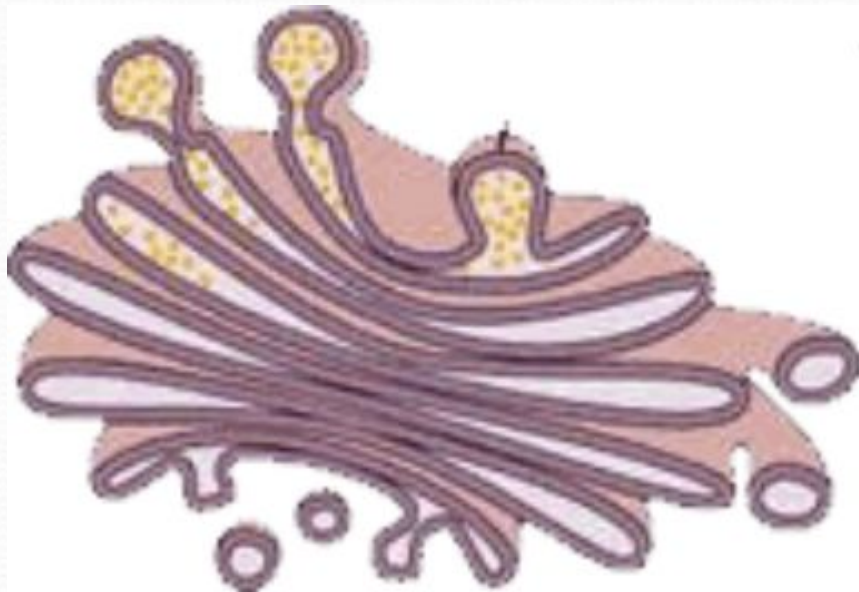
- liquid/gel like substance that surrounds the organelles
- protects the organelles
- contains water and chemicals the cell needs



Cell Organelles

Golgi Apparatus (aka Golgi Body) – processes, packages and secretes proteins.

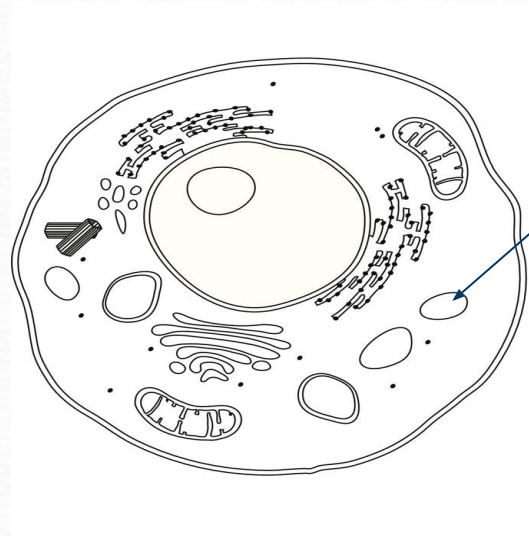
- It is comparable to a factory or a post office.



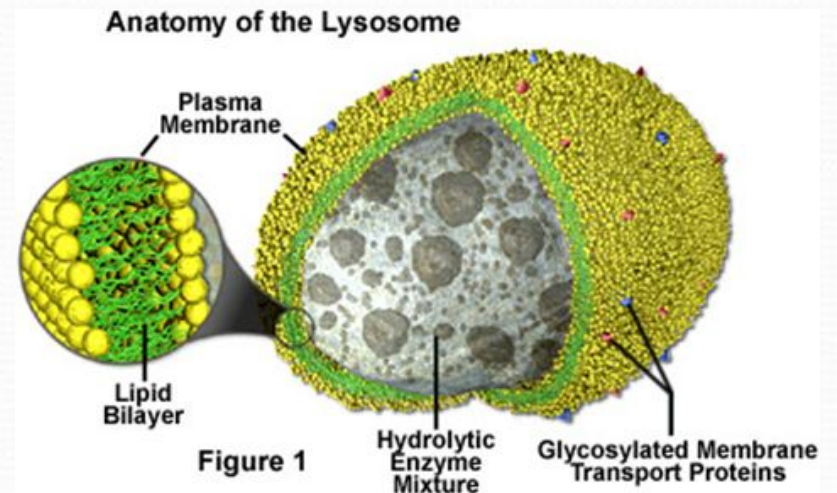
Cell Organelles

Lysosome - garbage cans

- break down and digest waste products using enzymes



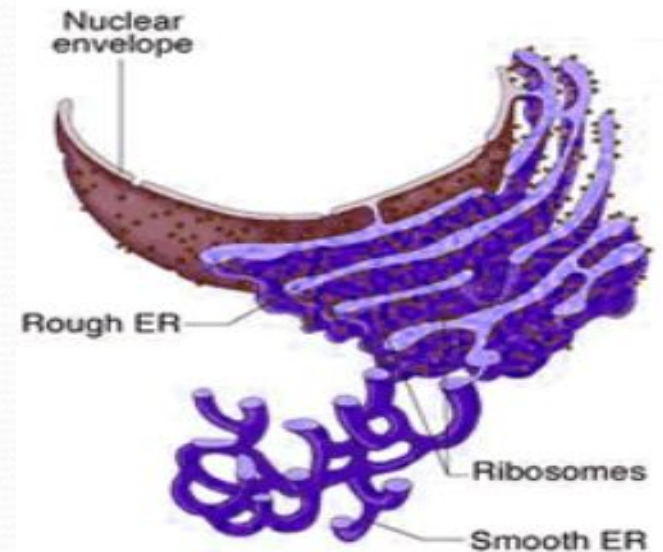
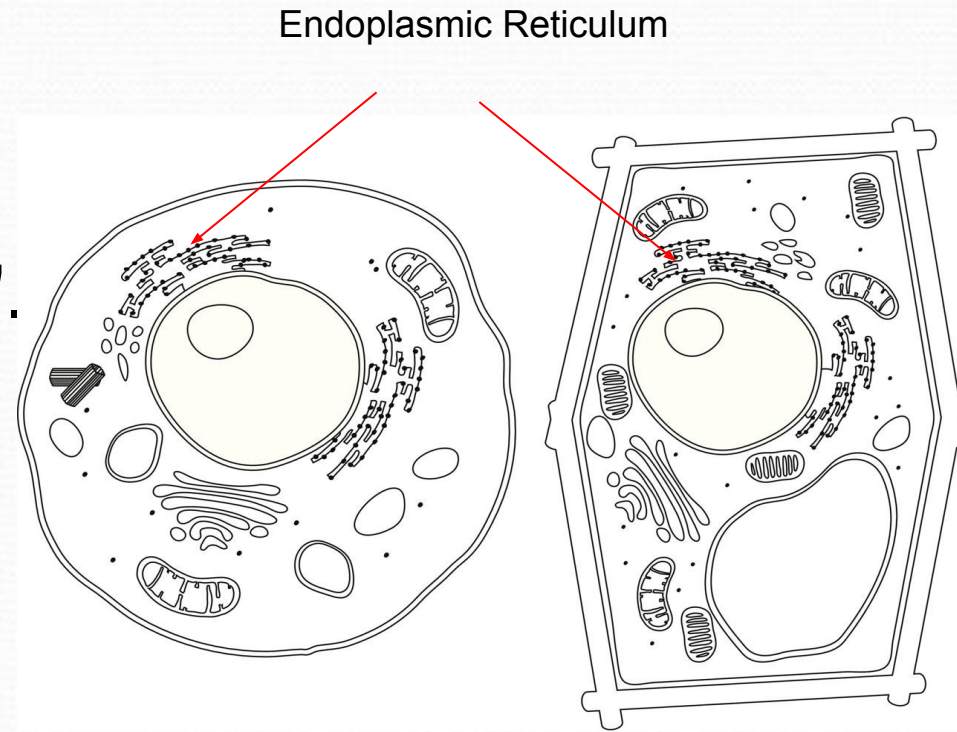
Lysosome



Cell Organelles

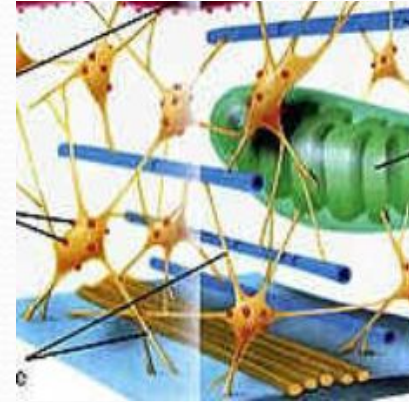
Endoplasmic Reticulum (ER) –
Transport, "intracellular highway".

- **Rough ER** contains many ribosomes, involved in protein synthesis
- **Smooth ER** no ribosomes, synthesizes lipids, phospholipids and steroids



Cytoskeleton – Helps cell maintain support & shape; movement

a. microtubules - hollow tubes



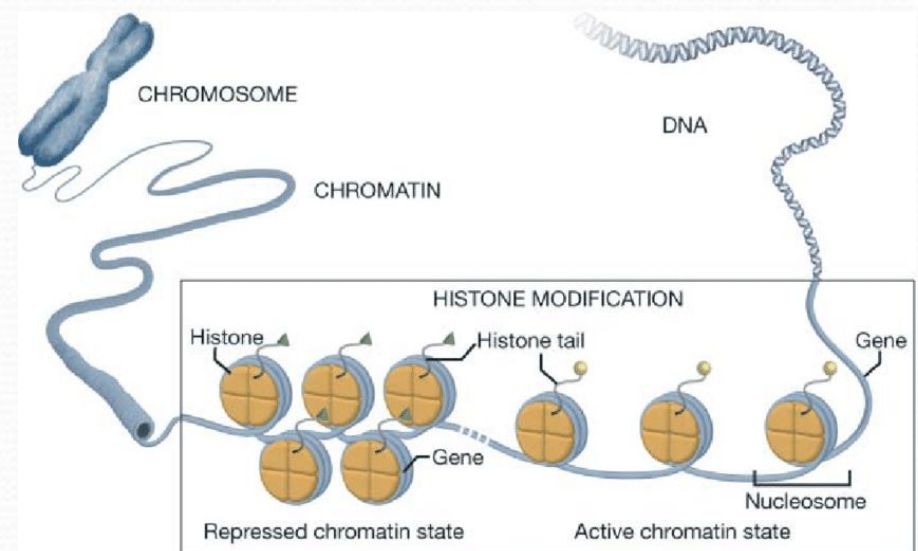
b. microfilaments - threadlike

c. centrioles- only in animal cells; used during cell division (paired)



Cell Organelles

Chromatin – unwound chromosomes inside of the cell



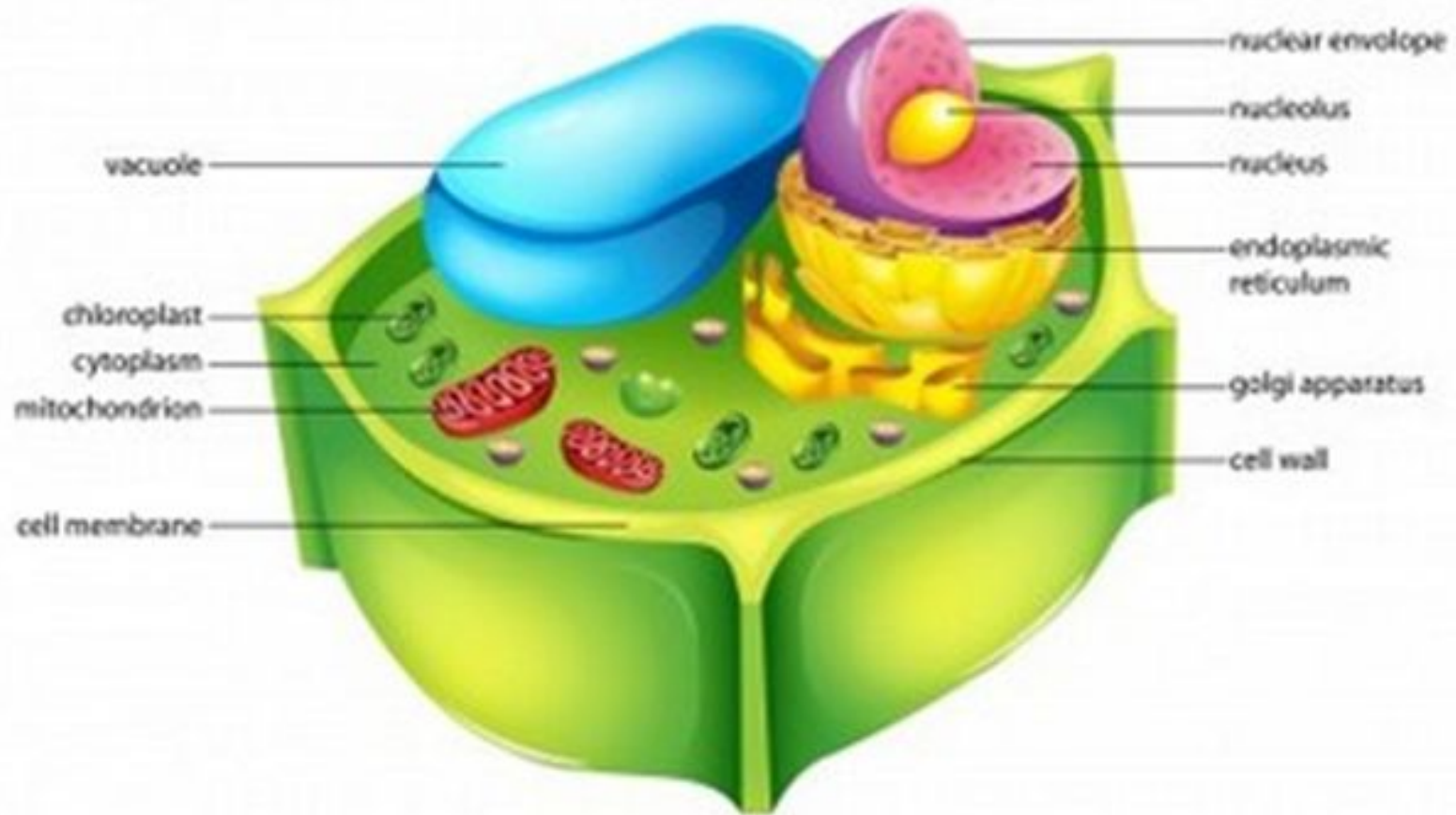
Protein Production

The cell is like a factory. It produces **protein** which goes to serve different functions in the body.

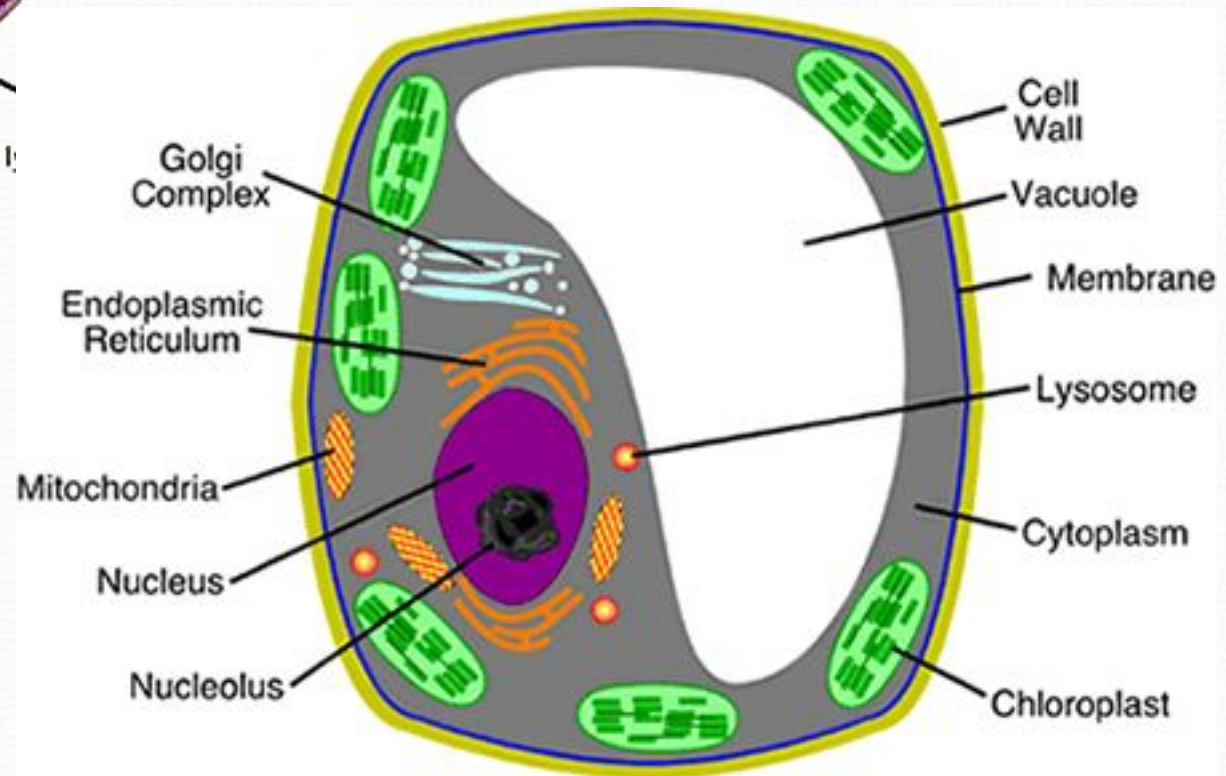
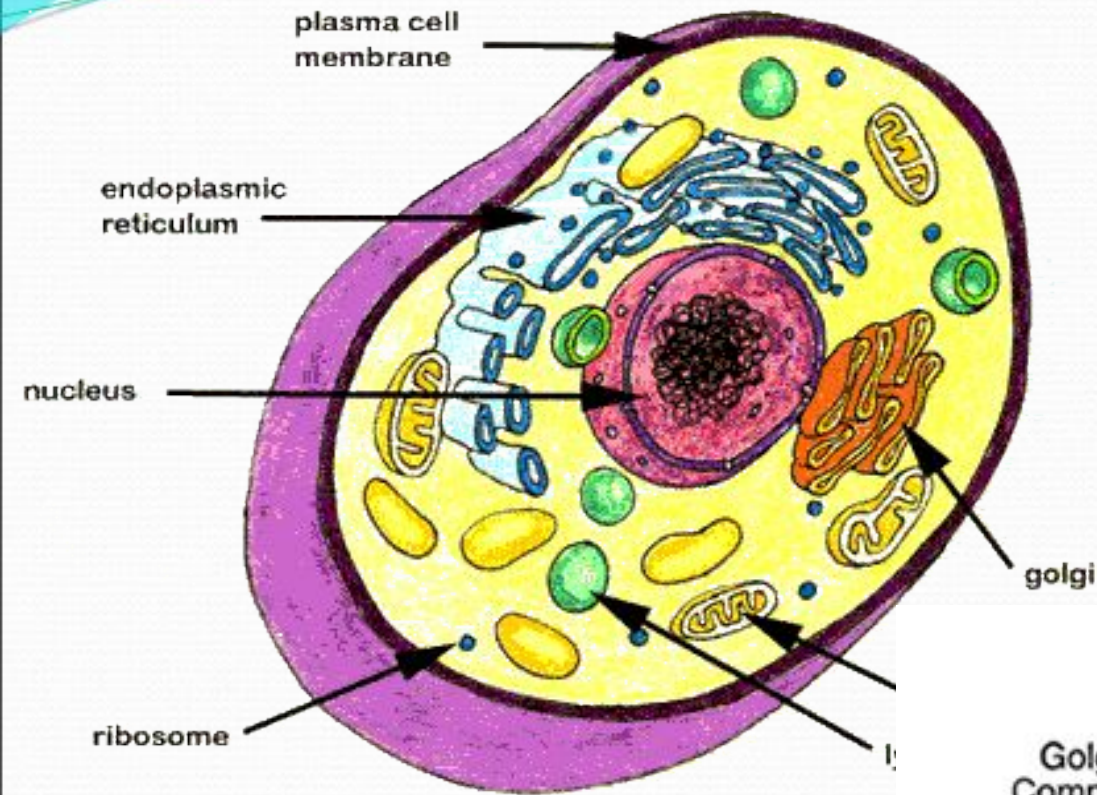
1. DNA has instructions to build protein
2. Instructions are sent to ribosomes
3. The ribosomes build protein and sends protein through ER
4. The proteins go to golgi-apparatus where they are packaged to export

THE PLANT CELL

Plant Cell Anatomy



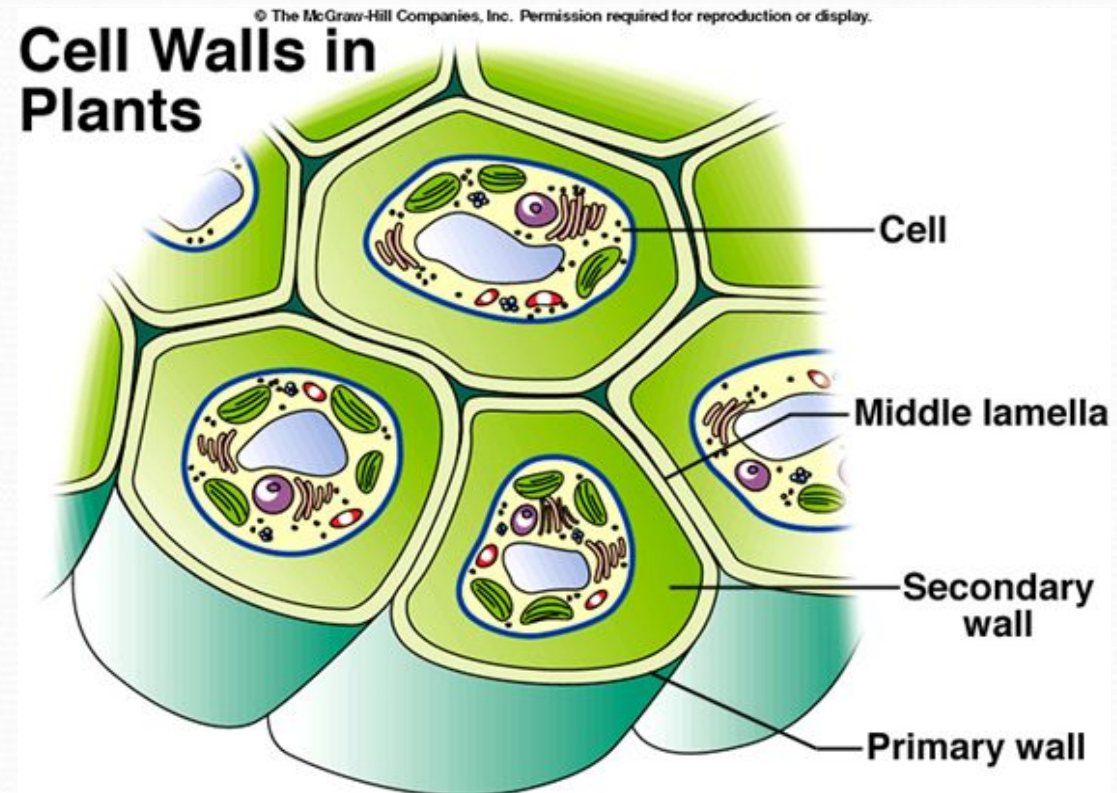
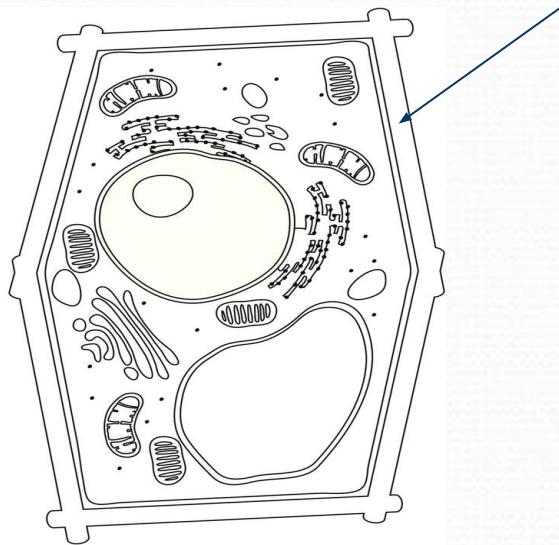
Animal Cell vs Plant Cell



Plant Cells (ONLY)

CELL WALL

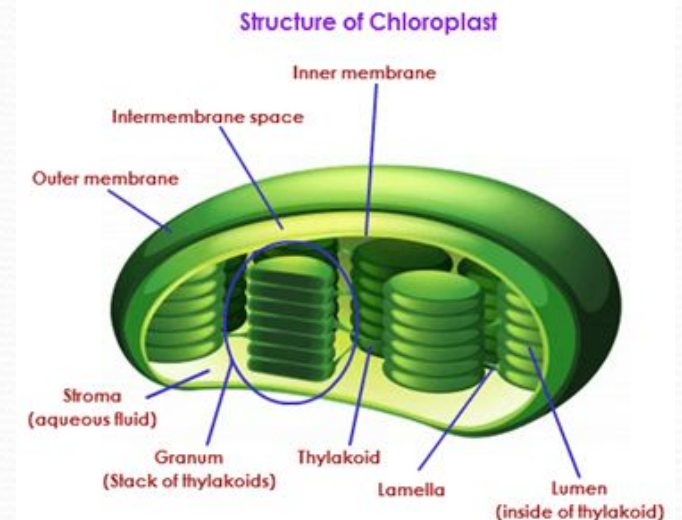
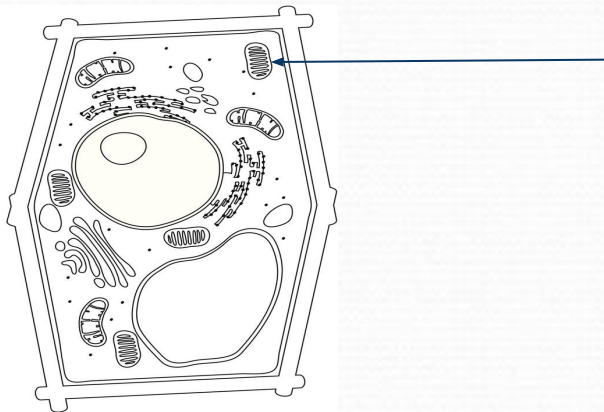
- supporter/protector
- provides shape



Plant Cells (ONLY)

CHLOROPLASTS

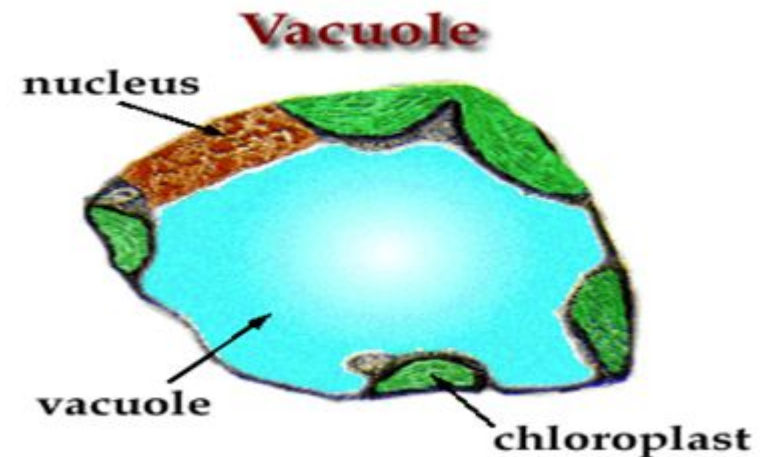
- Contains green chlorophyll (gives a plant color)
- Traps energy from the sun and converts it to chemical energy, *photosynthesis for food for the plant*
- *Glucose - sugar produced, chemical energy that was converted from light energy, used by the cell as food*



Plant Cells (ONLY)

CENTRAL VACUOLE

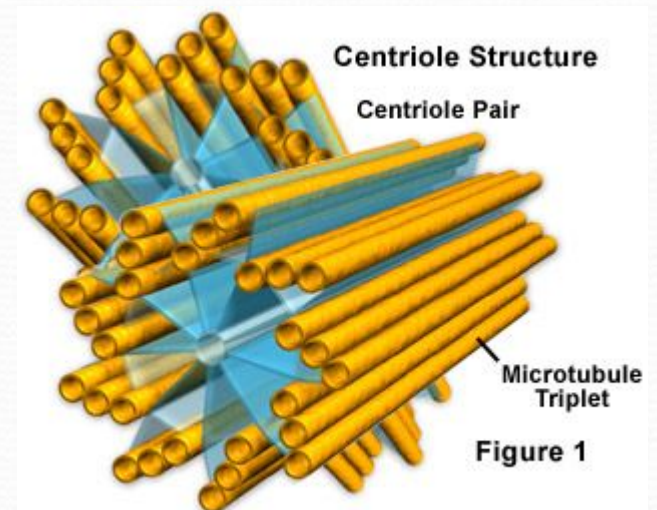
- LARGE water storage container
- keeps plant from wilting when full of water



Animal Cells (ONLY)

Centrioles

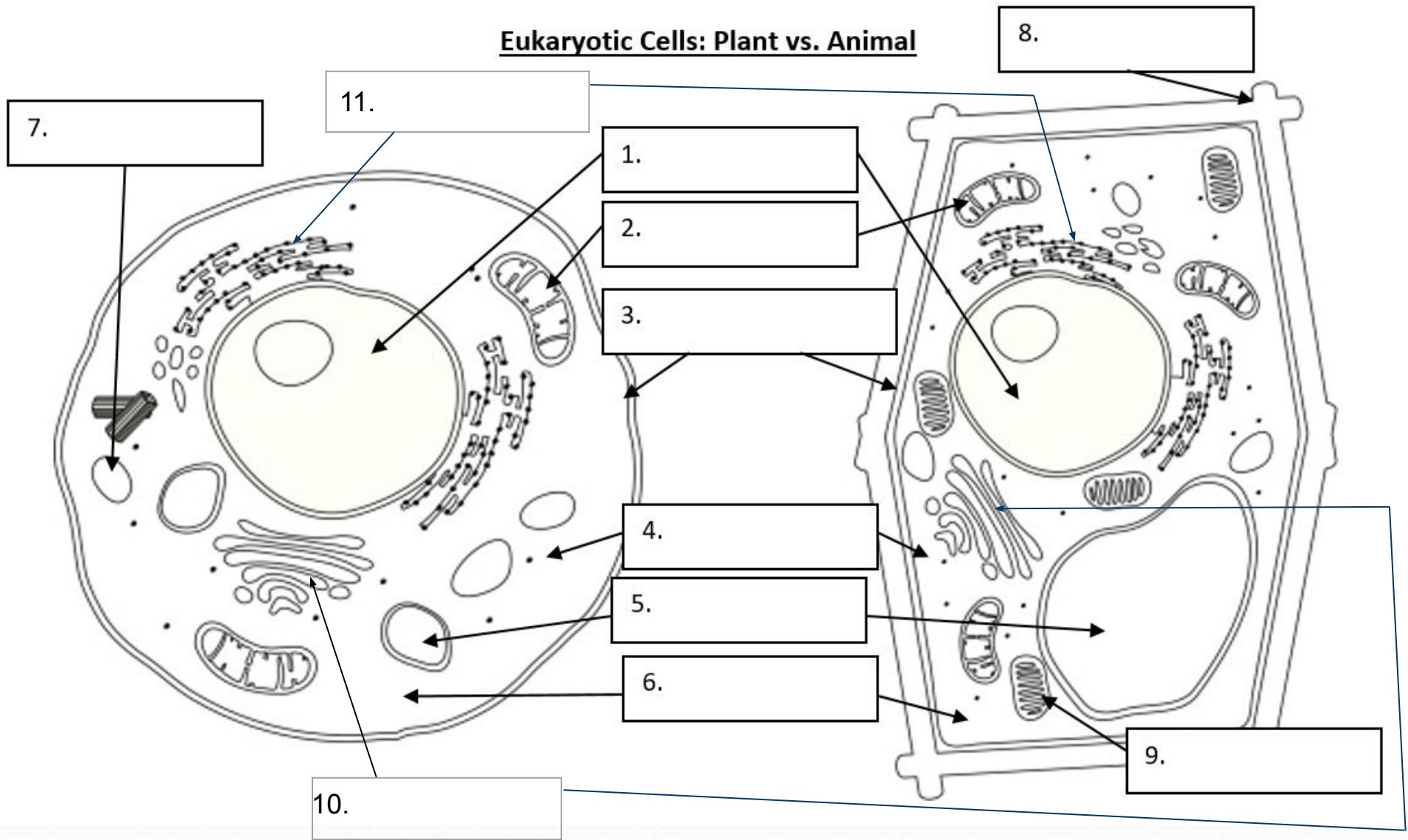
- mass that serves as an organizing center for microtubules
- play a notable role in cell division



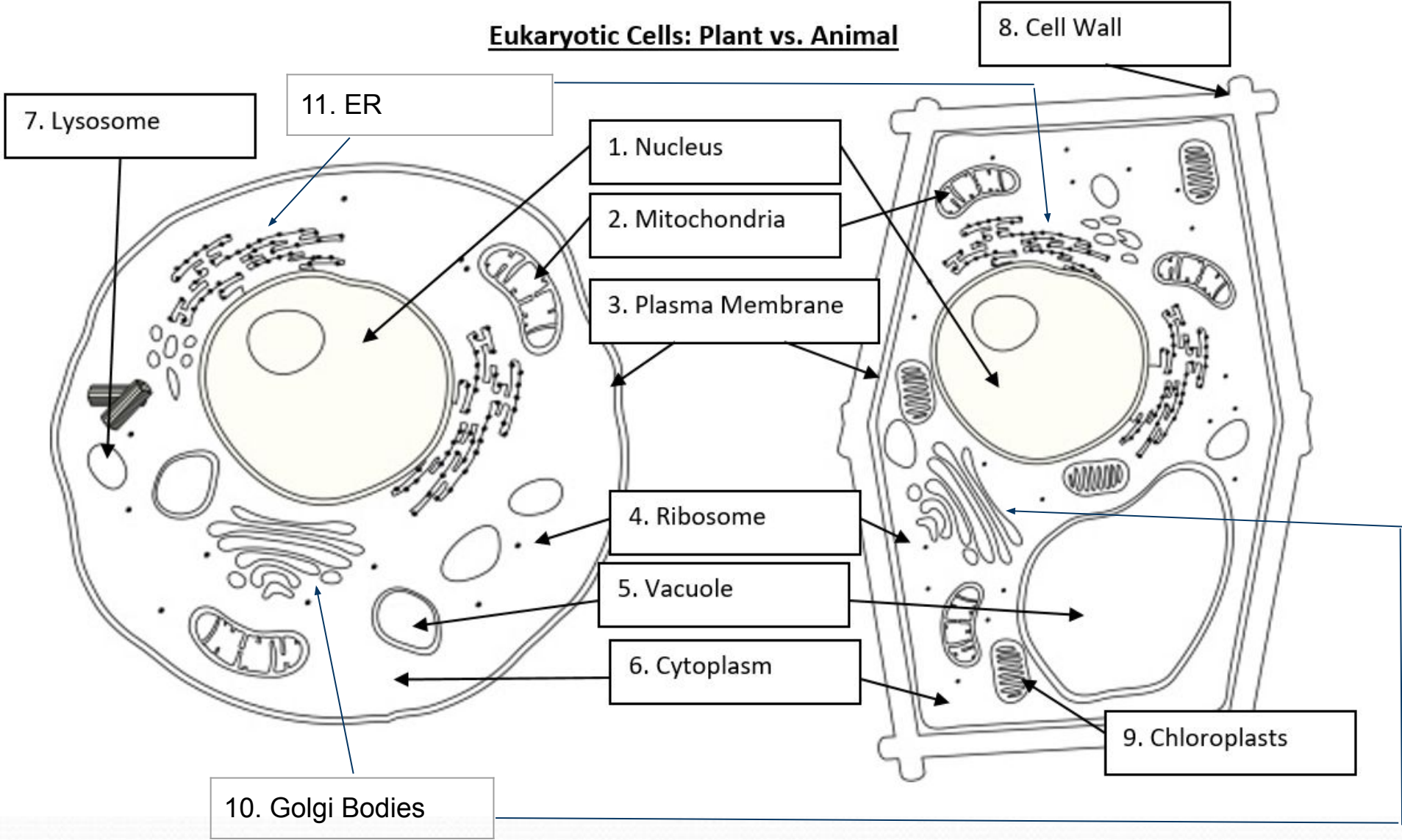
Organelle Interactions

- All these organelles work together to keep the cell running!

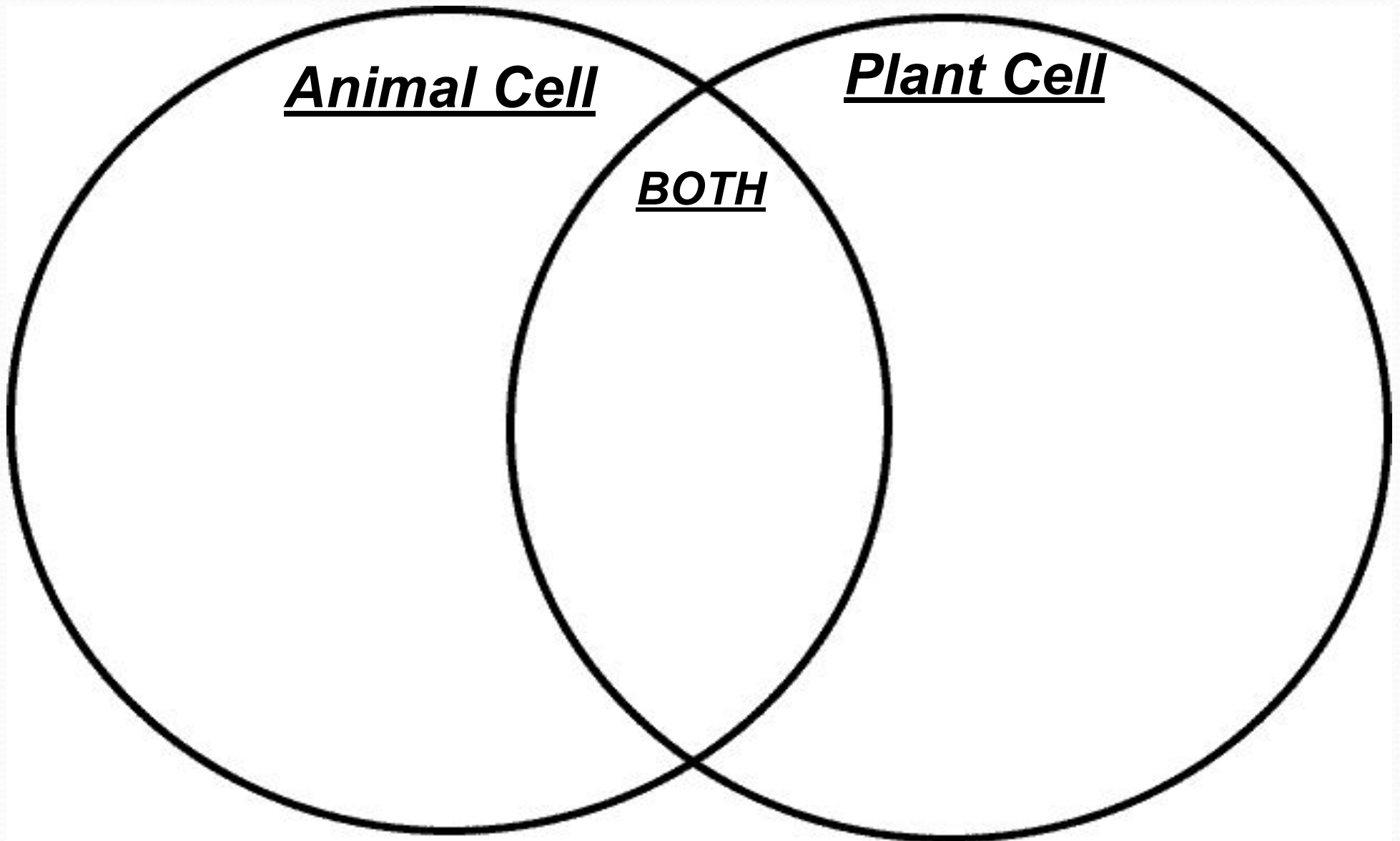
Eukaryotic Cells: Plant vs. Animal



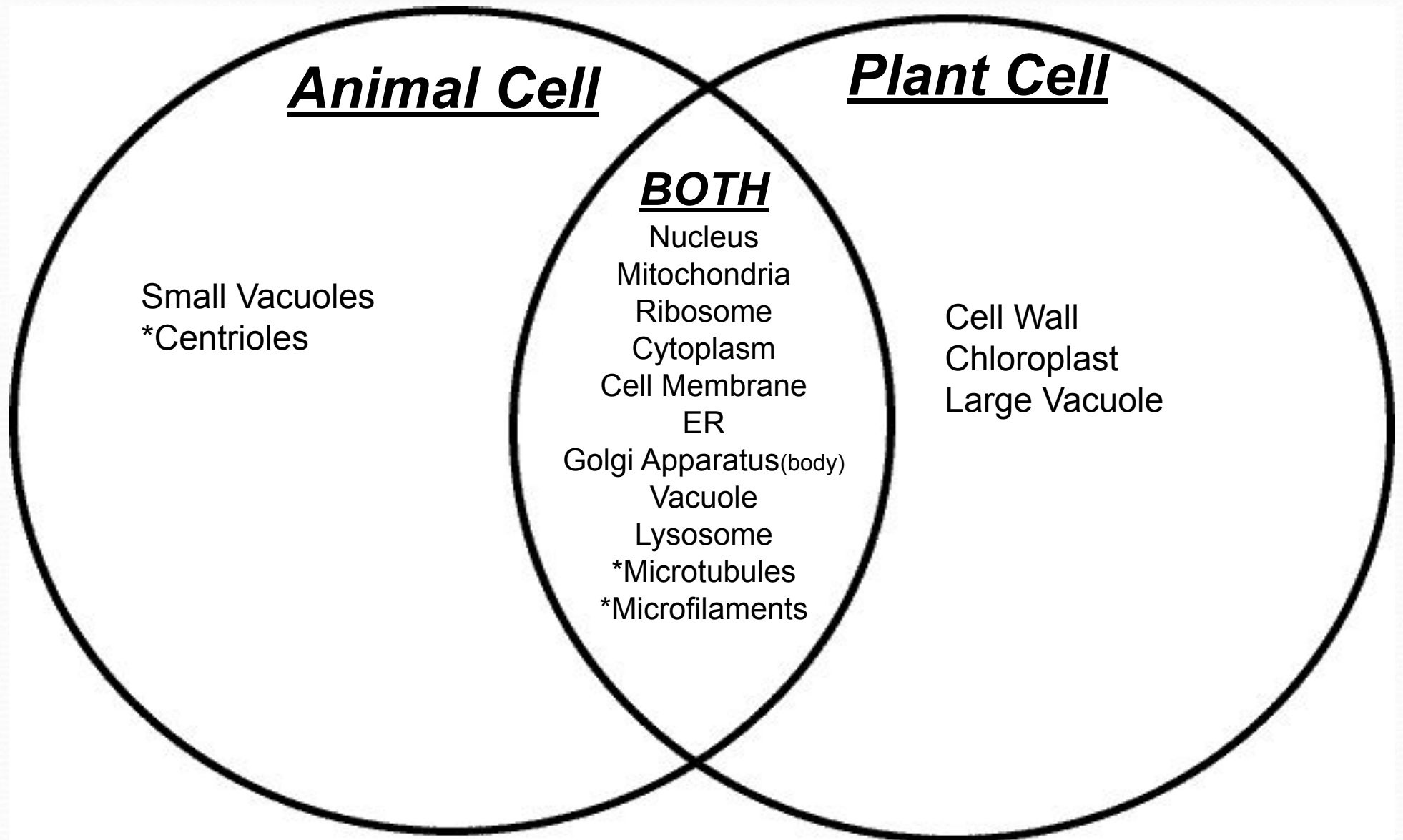
Eukaryotic Cells: Plant vs. Animal



Comparison: Animal & Plant Cells



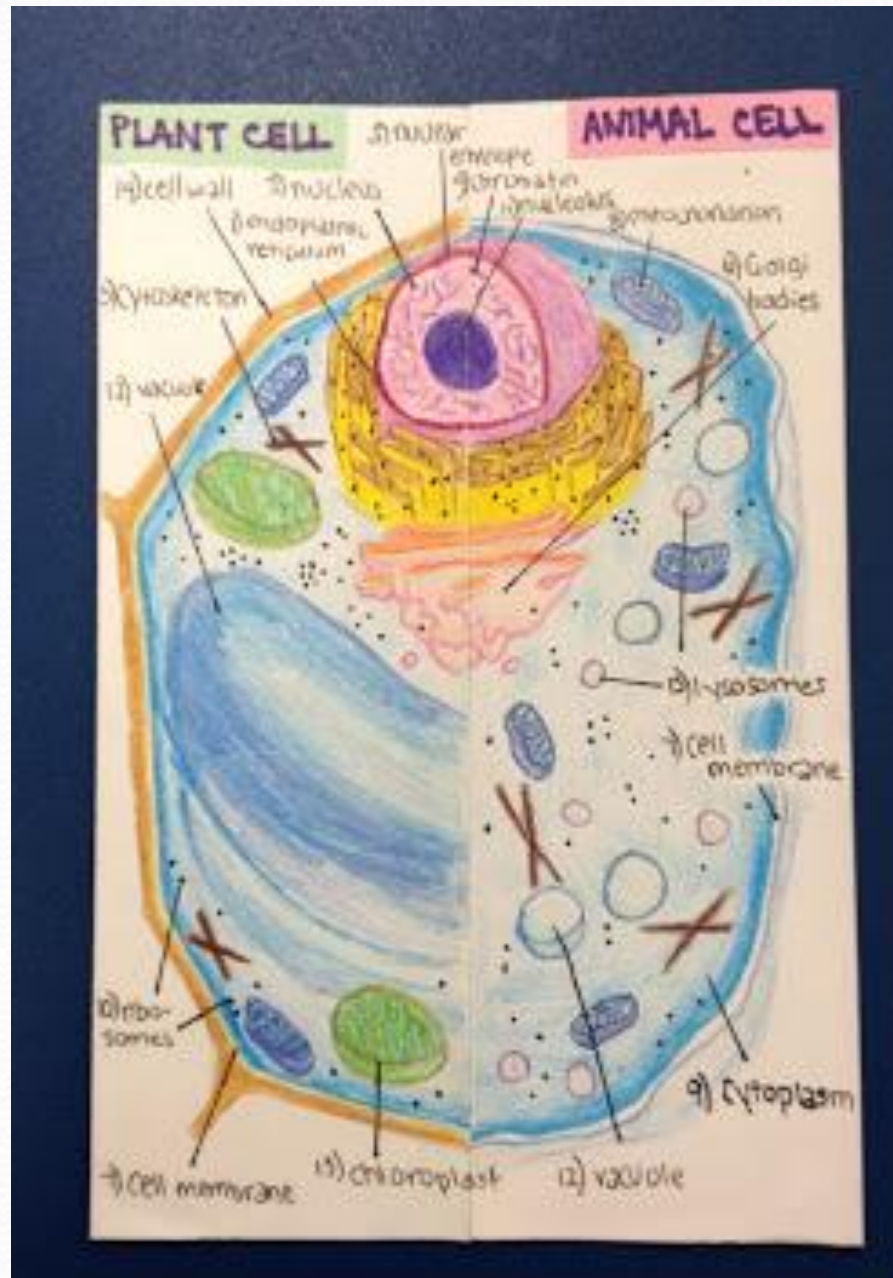
Comparison: Animal & Plant Cells





Cell Foldable

Cell Foldable Example



Cell Foldable Example

PLANT CELL Differences

- 1) **Cell Wall** - is a stiff wall surrounding the cell membrane, giving plant cells a rigid, box-like shape. Animal cells do not have cell walls.
- 2) **Chloroplast** - is an organelle that captures energy from sunlight and uses it to produce food for the cell. This also makes plants green.
- 3) **Lysosome** - an organelle that contains chemicals that break down food particles and worn out cell parts. These are only found in some plant cells.
- 4) **Vacuole** - an organelle that stores water, food, and waste products. Plant cells have only one large vacuole that takes up 90% of the space in a plant cell.

PLANT CELLS & ANIMAL CELLS Similarities

- 1) **Endoplasmic Reticulum** - a network of passages that carries materials throughout the cell and help form proteins.
- 2) **Nucleus** - a large oval structure that acts as the control center of the cell, directing all activities.
- 3) **Nuclear Envelope** - a thin membrane that surrounds the nucleus. It has tiny pores for materials entering and exiting the nucleus.
- 4) **Chromatin** - thin strands floating in the nucleus, containing genetic material used to instruct the cell, making
- 5) **Golgi Body** - organized sacs and tubes that receive newly formed materials from the endoplasmic reticulum and package and distribute them to other parts of the cell.
- 6) **Cell Membrane** - a thin membrane that surrounds the cell. It controls what enters and leaves the cell.
- 7) **Mitochondrion** - an organelle that converts food molecules into energy the cell can use to carry out its functions.
- 8) **Cytoplasm** - includes gel-like fluid in which many different organelles are found.
- 9) **Ribosomes** - small structures that function as factories to produce proteins. They may be attached to the ER or they may float in the cytoplasm.
- 10) **Nucleolus** - a round structure in the nucleus that produces ribosomes and sends them to the E.R.

ANIMAL CELL Differences

- 1) **Lysosomes** - are organelles containing chemicals that break down food particles and worn out cell parts. These are found in all animal cells and also are more numerous in animal cells than plant cells.
- 2) **Vacuole** - some animal cells have vacuoles that store food, water, waste, and other materials. Unlike plant cells, with one gigantic vacuole, animal cells have smaller vacuoles and more than one.
- 3) **Cytoskeleton** - a type of protein framework inside of animal cells to give them their shape. Unlike plant cells, which have cell walls for shape, animal cells need cytoskeleton for shape and cell motility (locomotion and muscle fiber contraction).

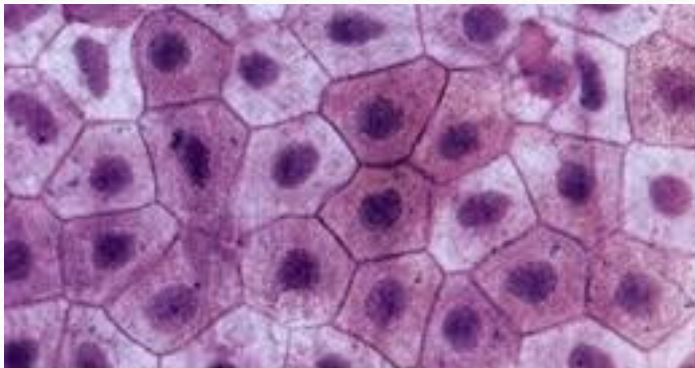


Microscopes

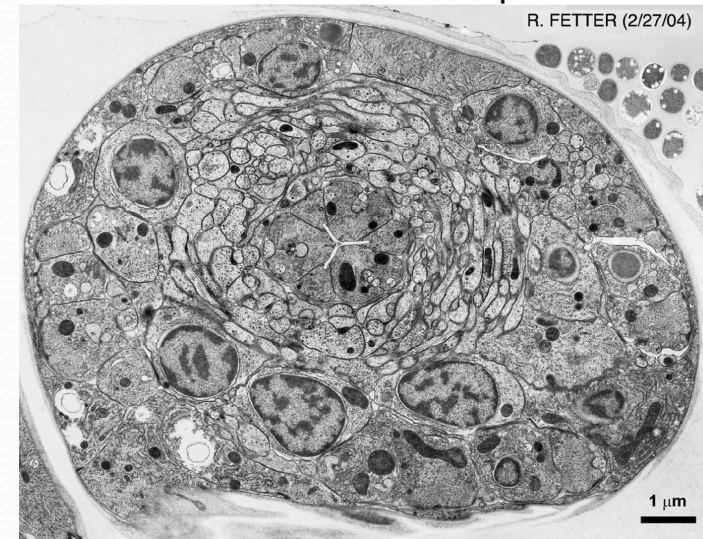
Using a Microscope

- Used to observe cells in greater detail
- Light Microscope - limited magnification
- Advanced Microscopes - Electron (Scanning and Transmission), can see much greater detail

Light Microscope



Electron Microscope



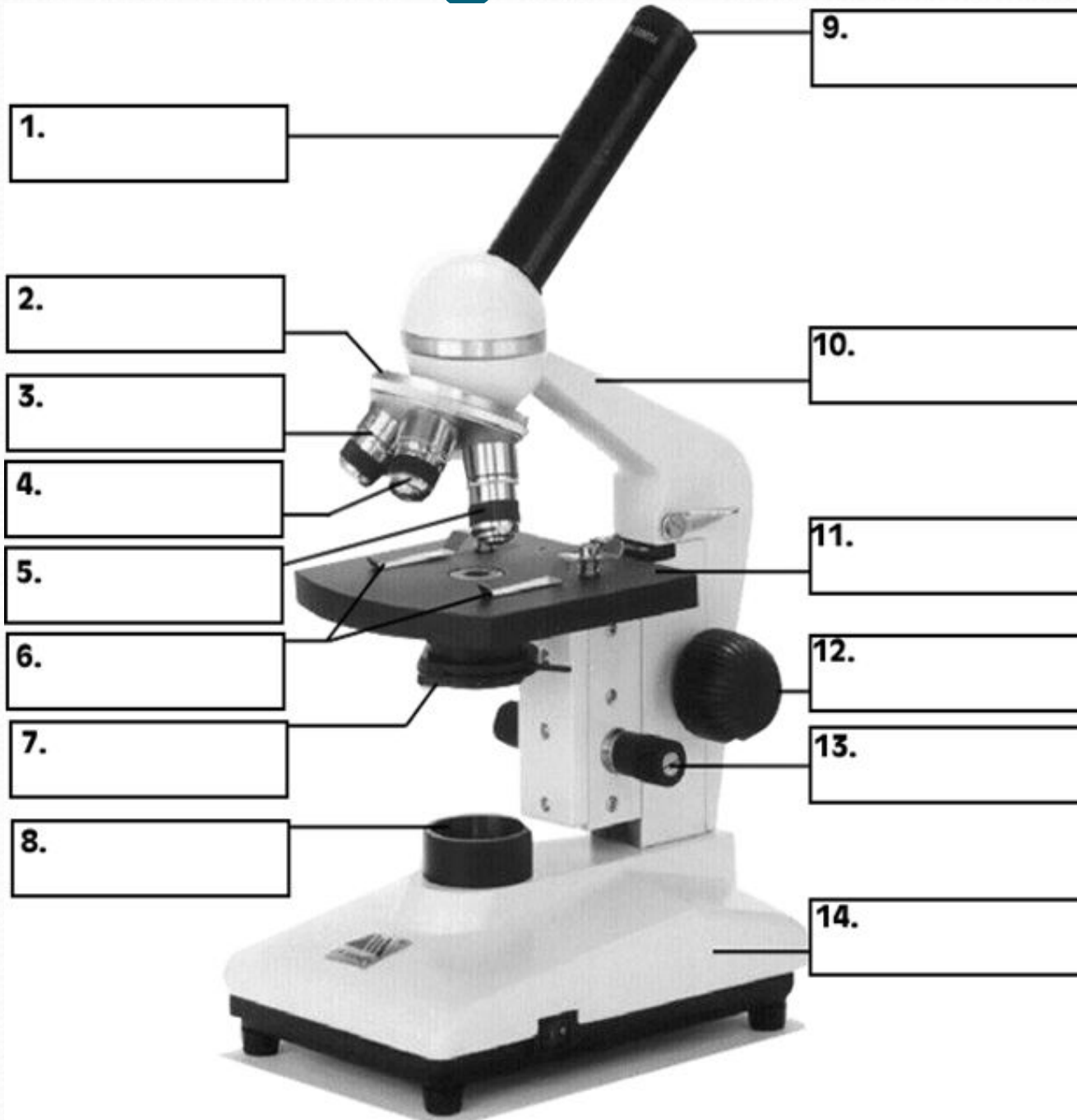
Microscope: Total Power Magnification

- To find this, multiply the power of the objective lens (4X, 10X, 40X), by the power of the eyepiece (usually 10X)
- Example: A student is viewing a slide using an objective lens with a power of 4X. What is the total power magnification?

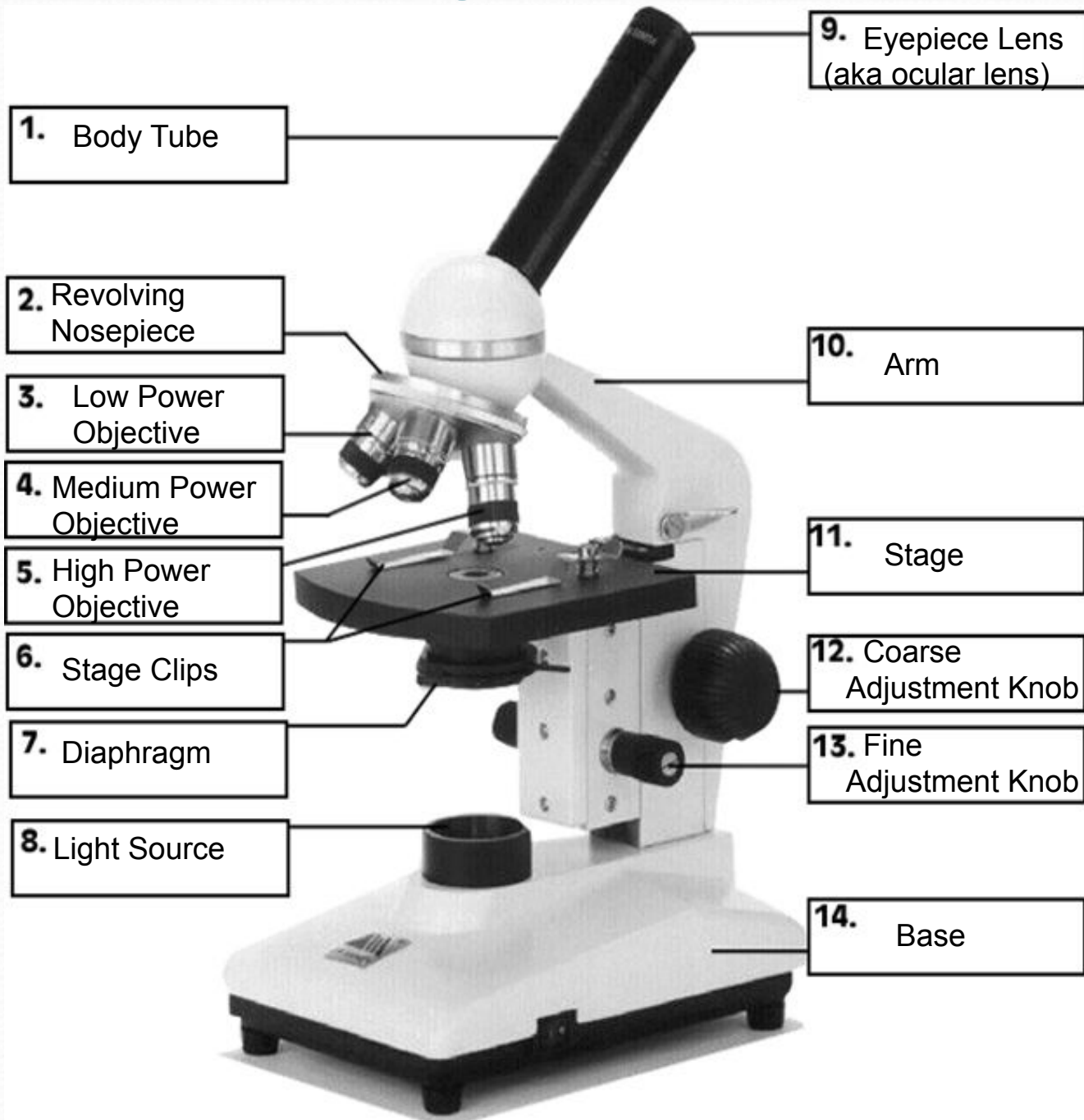
Example:

- A student is viewing a slide using an objective lens and a eyepiece with a power of 4X. What is the total power magnification?
 - Objective Lens (4) x Eyepiece (10)
 - $4 \times 10 = 40x$

Parts of a Light Microscope



Parts of a Light Microscope



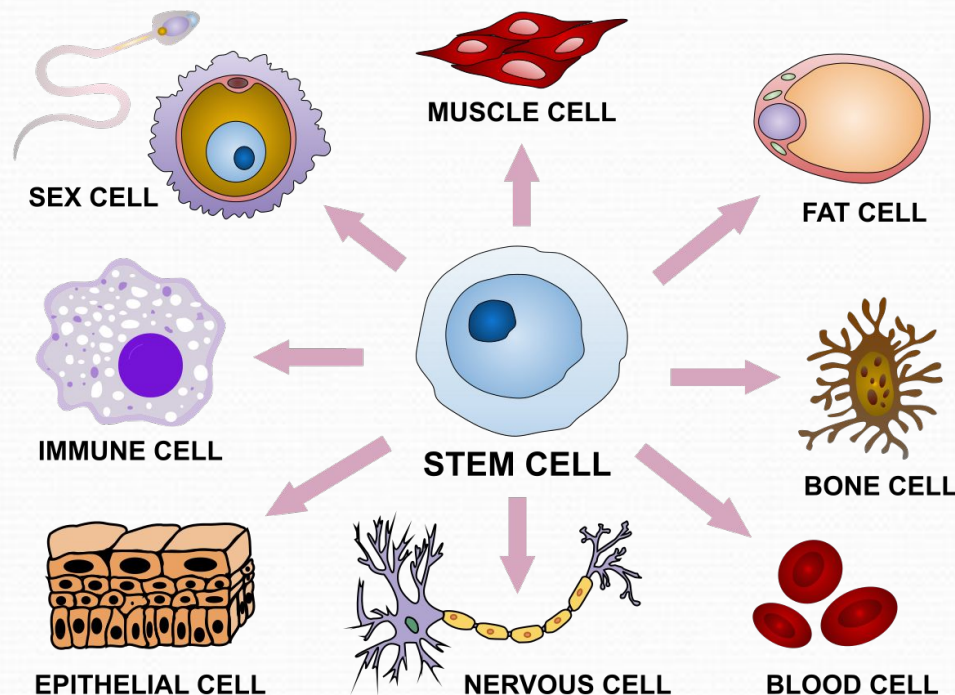
Specialization of Cells

- Cells all begin as undifferentiated - DNA and genetics play a role in determining the type of cell they become (ex. nerve, muscle, blood...)



Specialization of Cells

- Our cells work independently to perform different functions, so we have many different cell types that help us survive.

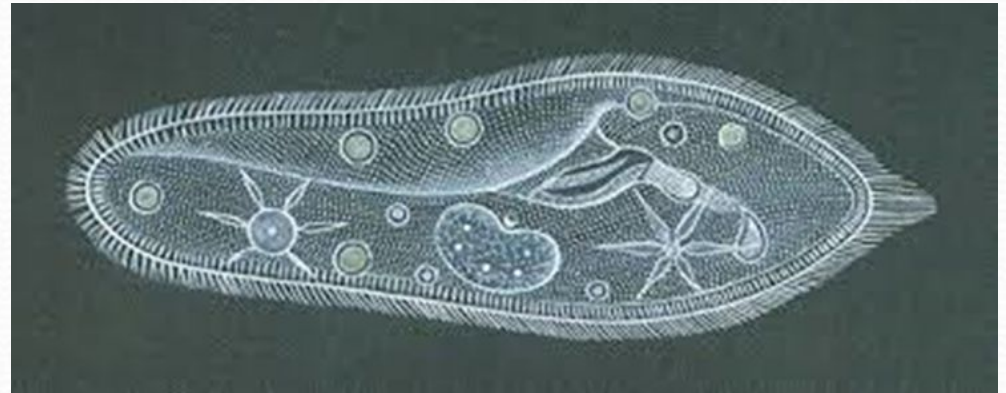
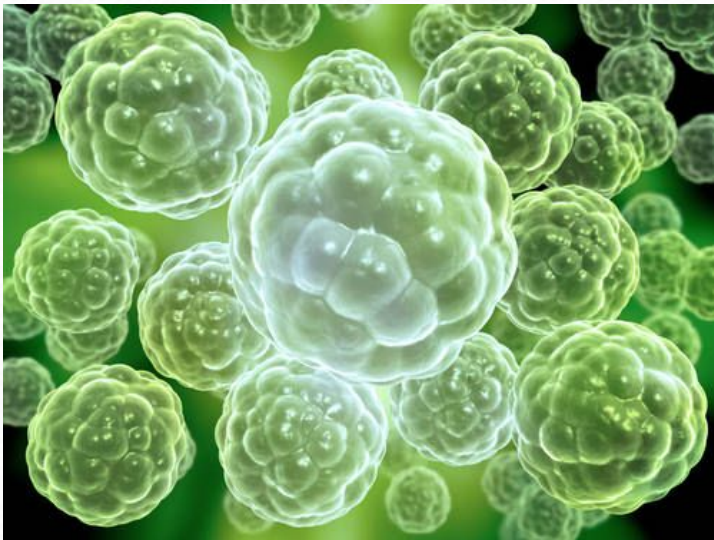


First things first, there's two different types



Multicellular and Unicellular Organisms

Structures and Adaptations



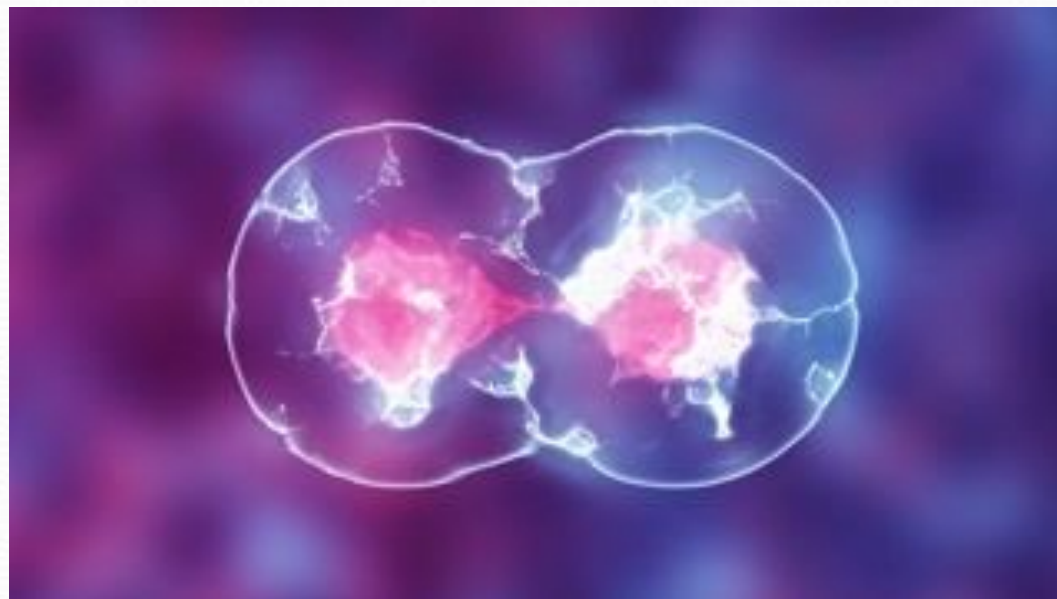
Multicellular and Unicellular Organisms

- A multicellular organism is composed of many cells (ex. you - plant and animal cells)
- Unicellular (uni means one) - means they are composed of a single cell (ex. Bacteria, Protozoa, Euglena)



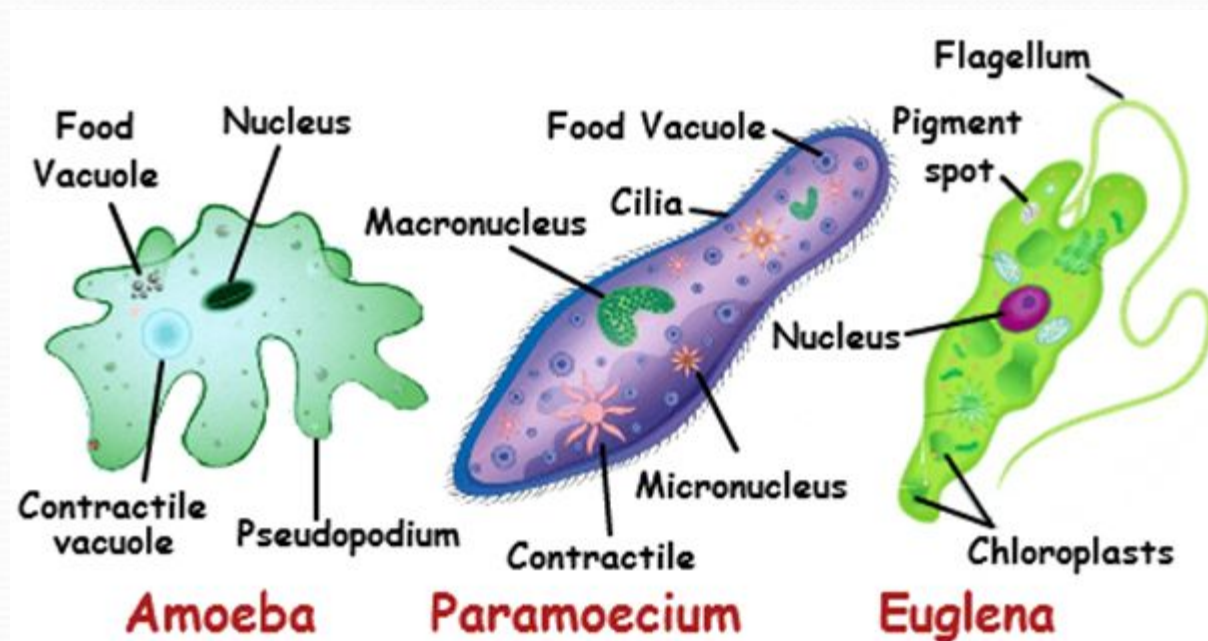
Multicellular Organisms

****Every plant and animal starts out as a single cell. The one cell divides and multiplies to form a multicellular organism!***



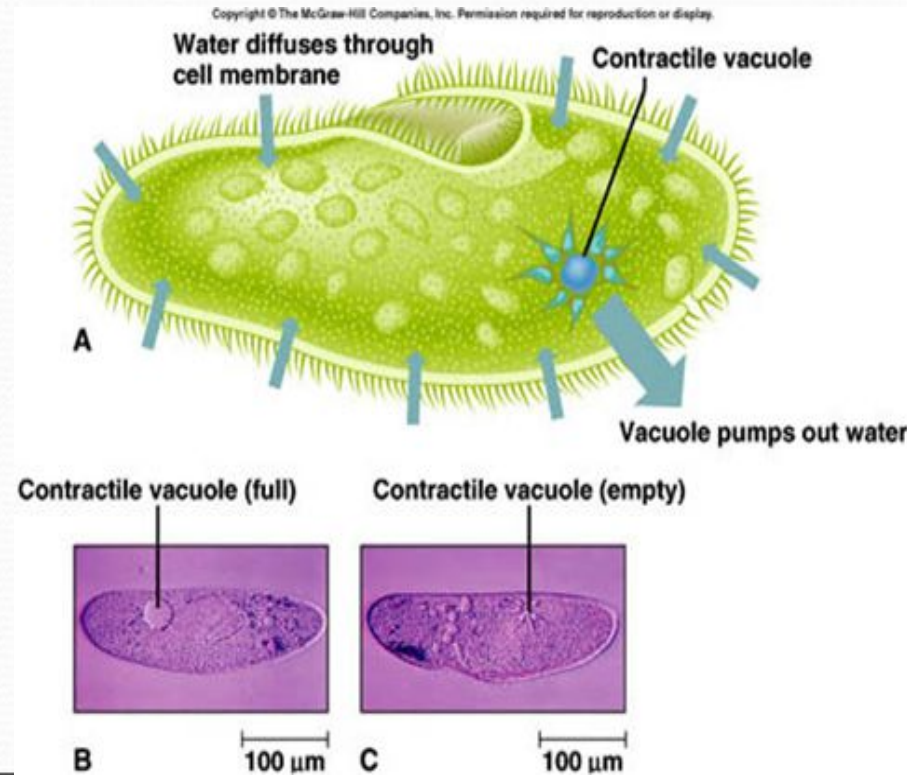
Unicellular Organisms

- Unicellular organisms have many structures that help them survive
 - Contractile Vacuoles
 - Cilia or Cilium
 - Flagella
 - Pseudopods
 - Eyespots



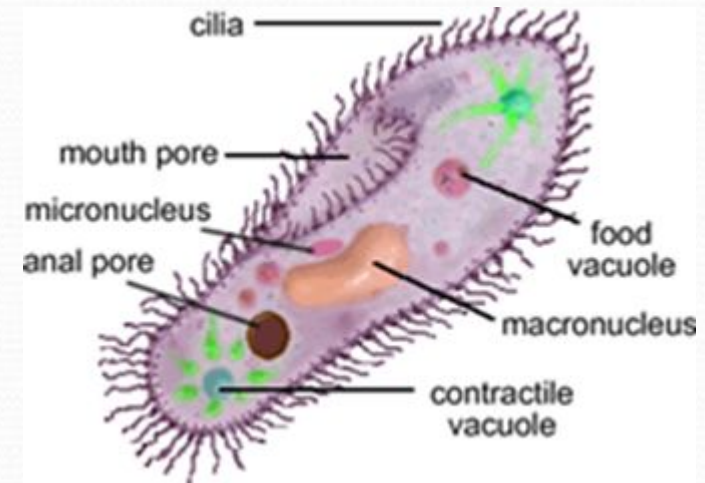
Contractile Vacuoles

- Store excess water that enters the cell, and expels it to the exterior
 - It expands when filling with water, then contracts to release it out again
 - Protists and some algae



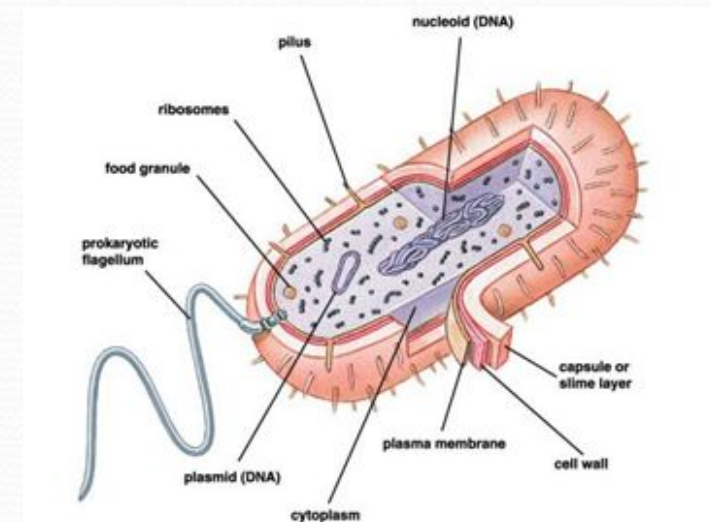
Movement

- Cilia
 - many hairlike structures
 - used for movement
 - the non-motile cilia serve as sensory organelles
 - Paramecium

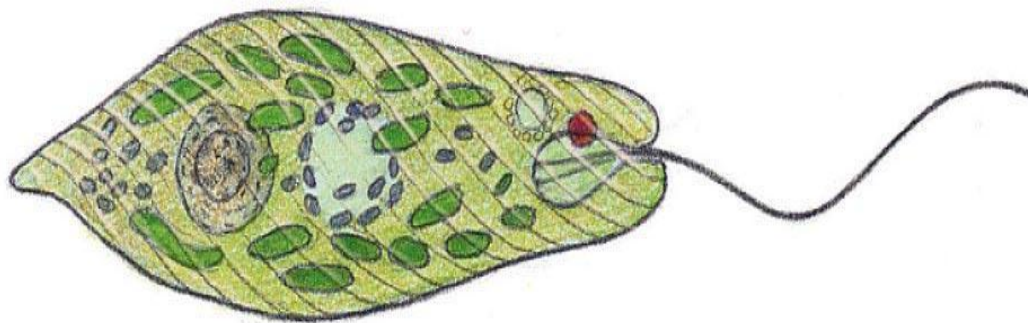


Movement

- Flagella
 - single, whiplike tail used for movement
 - found in bacteria, protists, specialized plant, animal and fungi cells

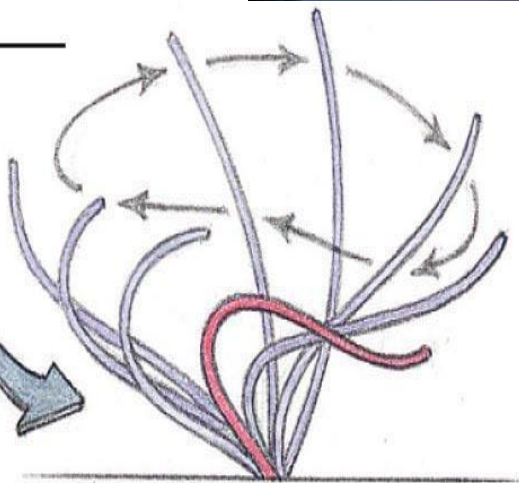
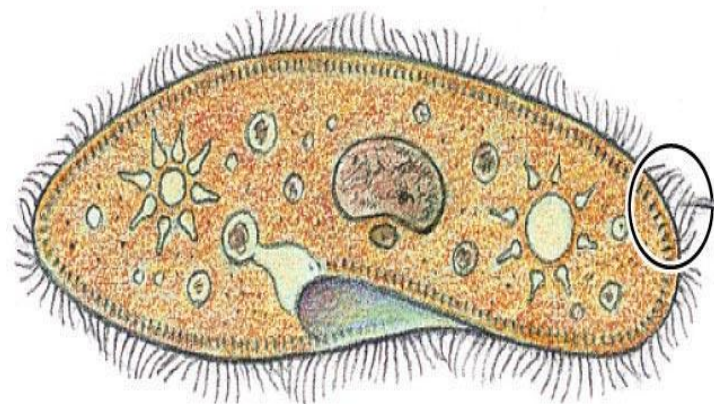


Direction of motion



(a) Flagella

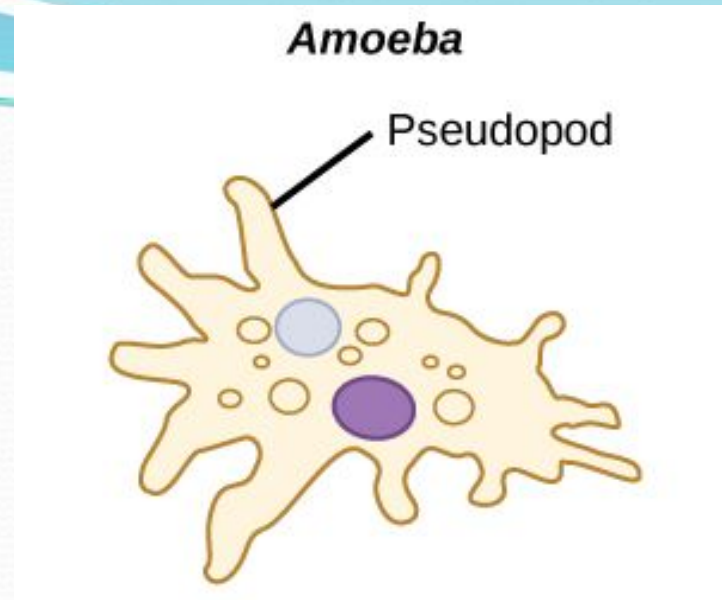
Direction of motion



(b) Cilia

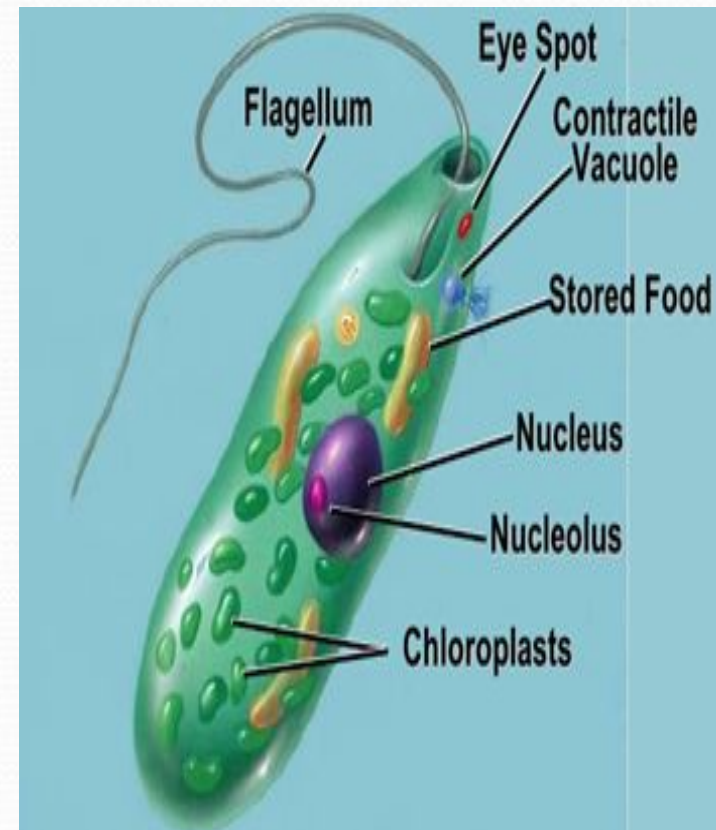
Movement

- Pseudopods
 - False foot that help the unicellular organism move
 - sometimes used to obtain food
 - Amoeba



Eyespots

- A dark area that functions in light reception; influences motion so that the organism can move toward or away from light
 - Toward - positive phototaxis
 - Away - negative phototaxis
 - found in green algae



Adaptive Behaviors

- Remember “taxis” - an innate behavior in response to an outside stimuli



Chemotaxis

- Movement in response to chemicals (chemo)
- some unicellular organisms direct movement according to chemicals in their environment
 - fine food particles
 - flee from poisons

Phototaxis (as discussed with the Eyespots)

- Movement toward or away from light
- Many plant like unicellular organisms will move toward light to better photosynthesis, just like a plant that tilts toward the window
 - Positive Phototaxis - toward the light
 - Negative Phototaxis - away from the light