

CELL STRUCTURE & FUNCTION

UNIT 2

Vocabulary

- **Absorption-** The transport of dissolved substances into cells.
- **Aerobic-** Process that requires oxygen
- **Anaerobic-** Process that does not require oxygen
- **ATP (adenosine triphosphate)-** Main energy source that cells use for most of their work
- **Autotroph-** an organism that is able to form nutritional organic substances from simple inorganic substances such as carbon dioxide.
- **Cell membrane-** A cell structure that controls which substances can enter or leave the cell.
- **Cell wall-** A rigid structure that surrounds the cell membrane of plant, fungi, and prokaryotic cells and provides support to the cell
- **Cellular respiration-** Process that releases energy by breaking down glucose and other food molecules in the presence of oxygen
- **Chloroplast-** An organelle found in plant and algae cells where photosynthesis occurs
- **Chromatin-** The material of which the chromosomes of organisms other than bacteria (i.e., eukaryotes) are composed. DNA not condensed.
- **Chromosome-** DNA molecule packaged into thread-like structures. Condensed DNA.
- **Cilia-** Hairlike projections that extend from the plasma membrane and are used for locomotion
- **Cytoplasm-** the portion of the cell outside the nucleus
- **DNA-** A complex molecule containing the genetic information that makes up the chromosomes.
- **Endoplasmic Reticulum (ER)-** An extensive membranous network in eukaryotic cells, continuous with the outer nuclear membrane and composed of ribosome-studded (rough) and ribosome-free (smooth) regions. Forms vesicles.
- **Eukaryote-** A cell that contains a nucleus and membrane bound organelles
- **Flagella-** A long, whip-like filament that helps in cell motility. Many bacteria are flagellated, and sperm are flagellated.
- **Golgi apparatus-** A system of membranes that modifies and packages proteins for export by the cell by forming vesicles.
- **Homeostasis-** relatively constant internal physical and chemical conditions that organisms maintain
- **Lysosome-** cell organelle filled with enzymes needed to break down certain materials in the cell
- **Membrane-** A thin covering
- **Microfilament-** Long, thin fibers that function in the movement and support of the cell
- **Microtubule-** Straight, hollow tube of proteins that gives rigidity, shape, and organization to a cell
- **Mitochondria-** Organelle that is the site of cellular respiration or ATP (energy) production
- **Nuclear membrane (envelope)-** Surrounds the nucleolus and DNA. Controls what enters and leaves the nucleus.
- **Nucleolus-** Found inside the nucleus and produces ribosomes
- **Nucleus-** A part of the cell containing DNA and RNA and responsible for growth and reproduction
- **Organelle-** A tiny cell structure that carries out a specific function within the cell
- **Organism-** An individual living thing
- **Photosynthesis-** Conversion of light energy from the sun into chemical energy.
- **Plasmid-** Small, circular piece of DNA located in the cytoplasm of many bacteria
- **Prokaryote-** Unicellular organism that lacks a nucleus
- **Ribosome-** Cytoplasmic organelles at which proteins are synthesized.
- **Theory-** A hypothesis that has been tested with a significant amount of data
- **Vacuole-** Cell organelle that stores materials such as water, salts, proteins, and carbohydrates



Microscopes

Compound Microscope

1. Inexpensive
2. Can see live organisms
3. Portable
4. Poor resolution
5. Light source below specimen

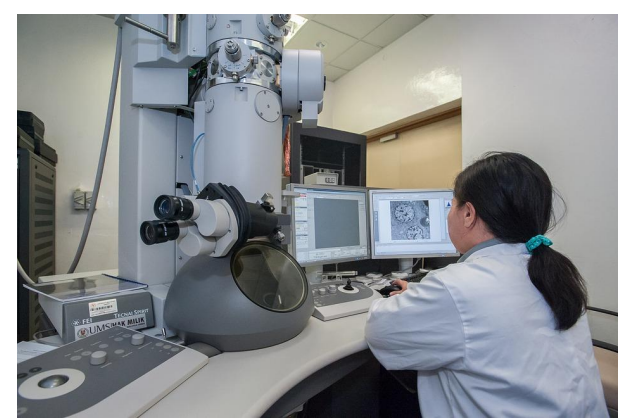
Dissecting Microscope

1. Low magnification
2. Large workspace required
3. Light source above specimen



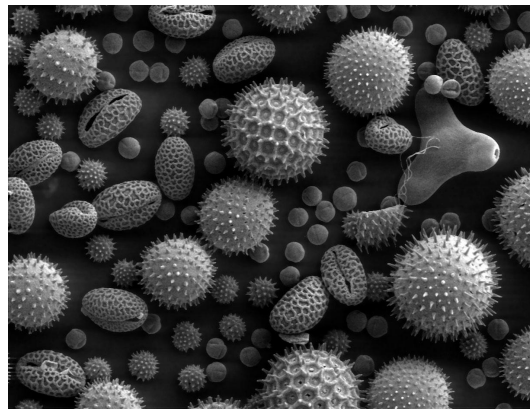


Microscopes



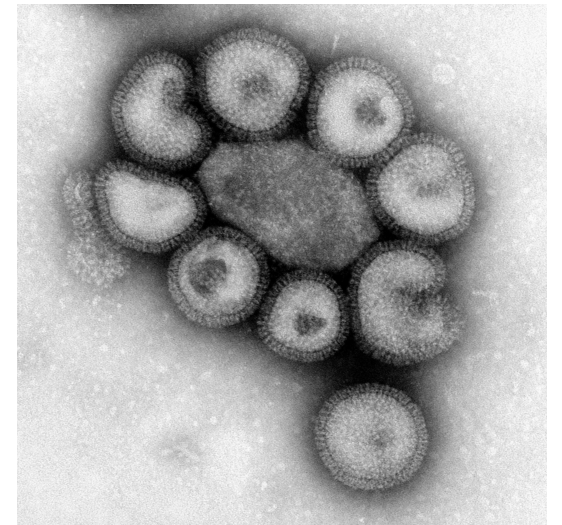
Scanning Electron Microscope

1. Beam of electrons scan surface
2. Specimen does not need to be thin
3. 3-D images



Transmission Electron Microscope

1. Beam of electrons must pass through
2. Specimen must be cut very thin
3. 2-D images



Development of a Theory

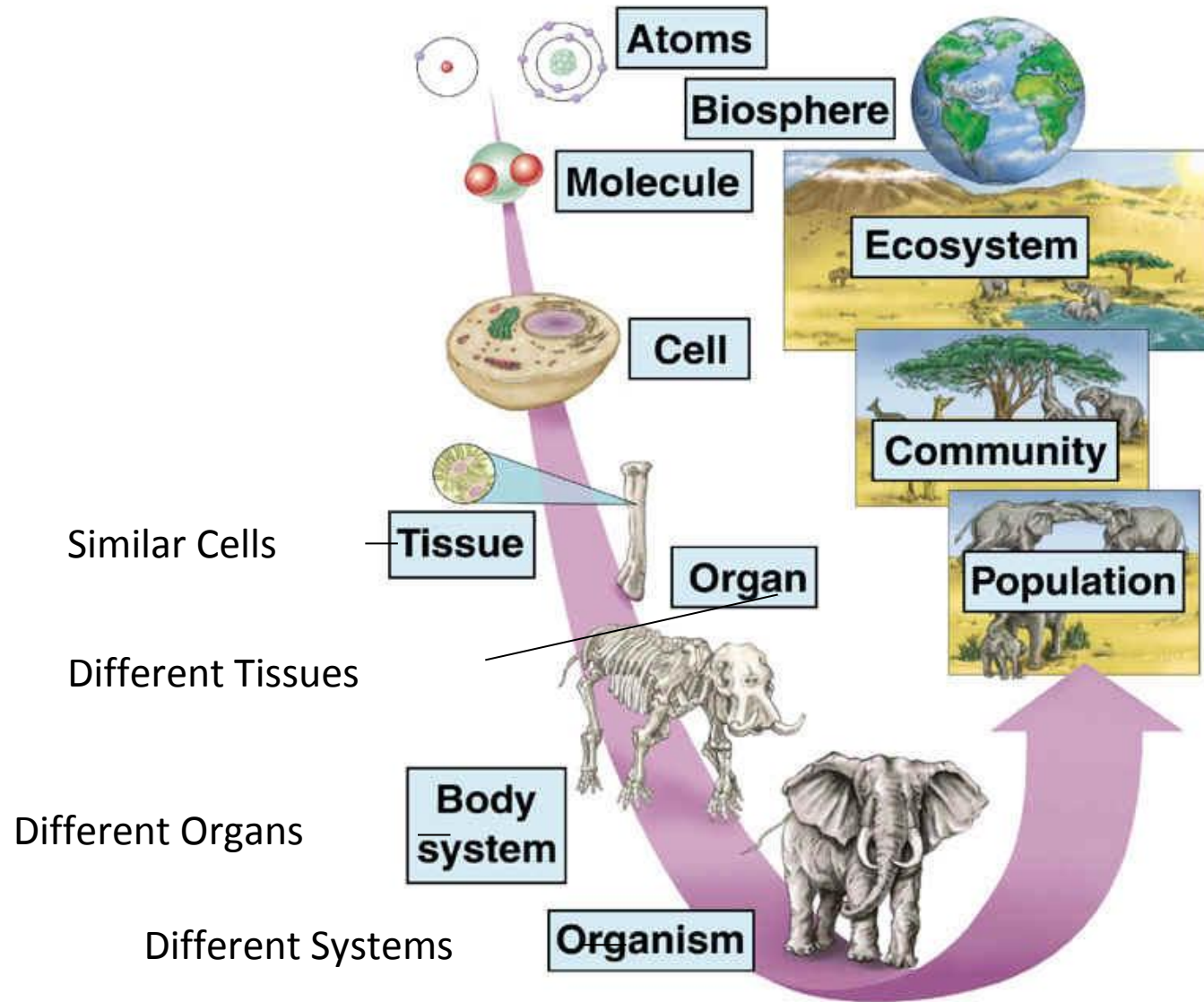
- A theory is a scientific explanation that has withstood vigorous testing.
- By continuing to test hypotheses and being unable to find evidence against them, it makes the idea stronger and more valid. This is when the hypothesis becomes a theory.
- This is what has happened with regard to the Cell Theory. With new microscopes that are stronger than ever and over a century of testing, investigating, and gaining new information it has strengthened the theory.

Cell Theory and People Involved

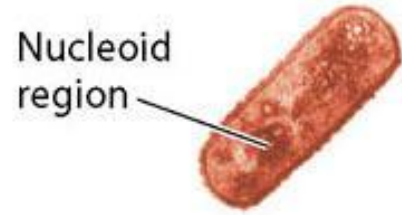
1. All living things are made up of cells
 - a. Schleiden- all plants are made up of cells
 - b. Schwann- all animals are made up of cells
2. All cells come from pre-existing cells
 - a. Virchow- cells can only be produced from other cells
3. Cells are the smallest unit of life
 - a. Even with advanced technology, no living thing smaller has been found

Cell Theory- role of microscopes

- Original microscopes were many magnifying lenses put together.
- Made it possible to see images that were too small to see with human eye.
- Robert Hooke- looked at slices of cork (plant cells) with microscopes. Looked like chambers in a monastery which were called cells.
- Anton van Leeuwenhoek- looked at pond water with simple microscopes.

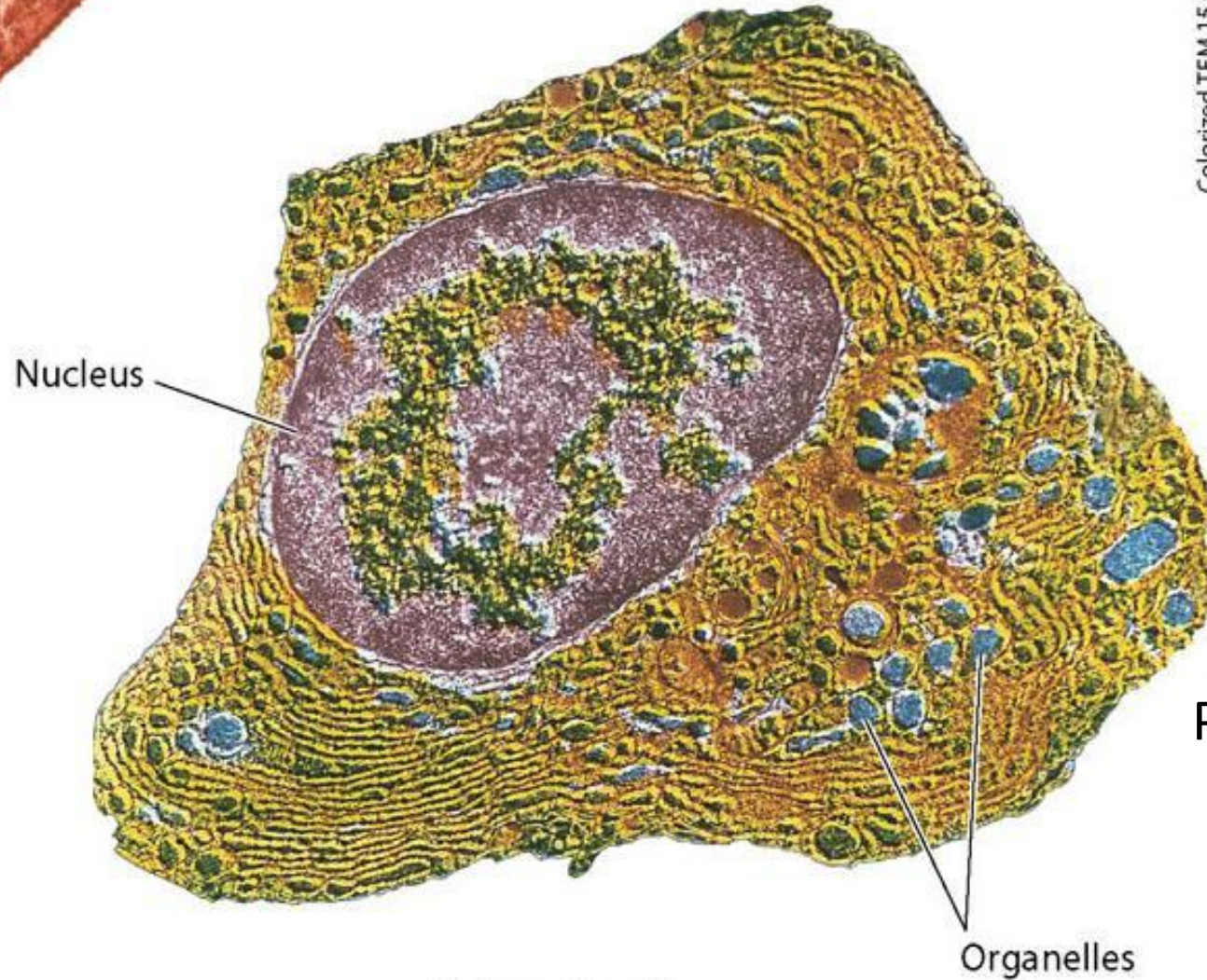


Prokaryotic cell



Bacteria

Colorized TEM 15,000×

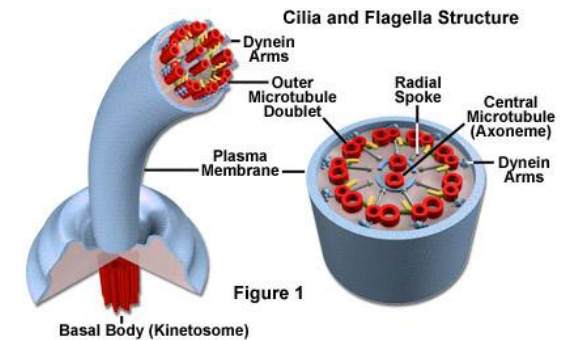


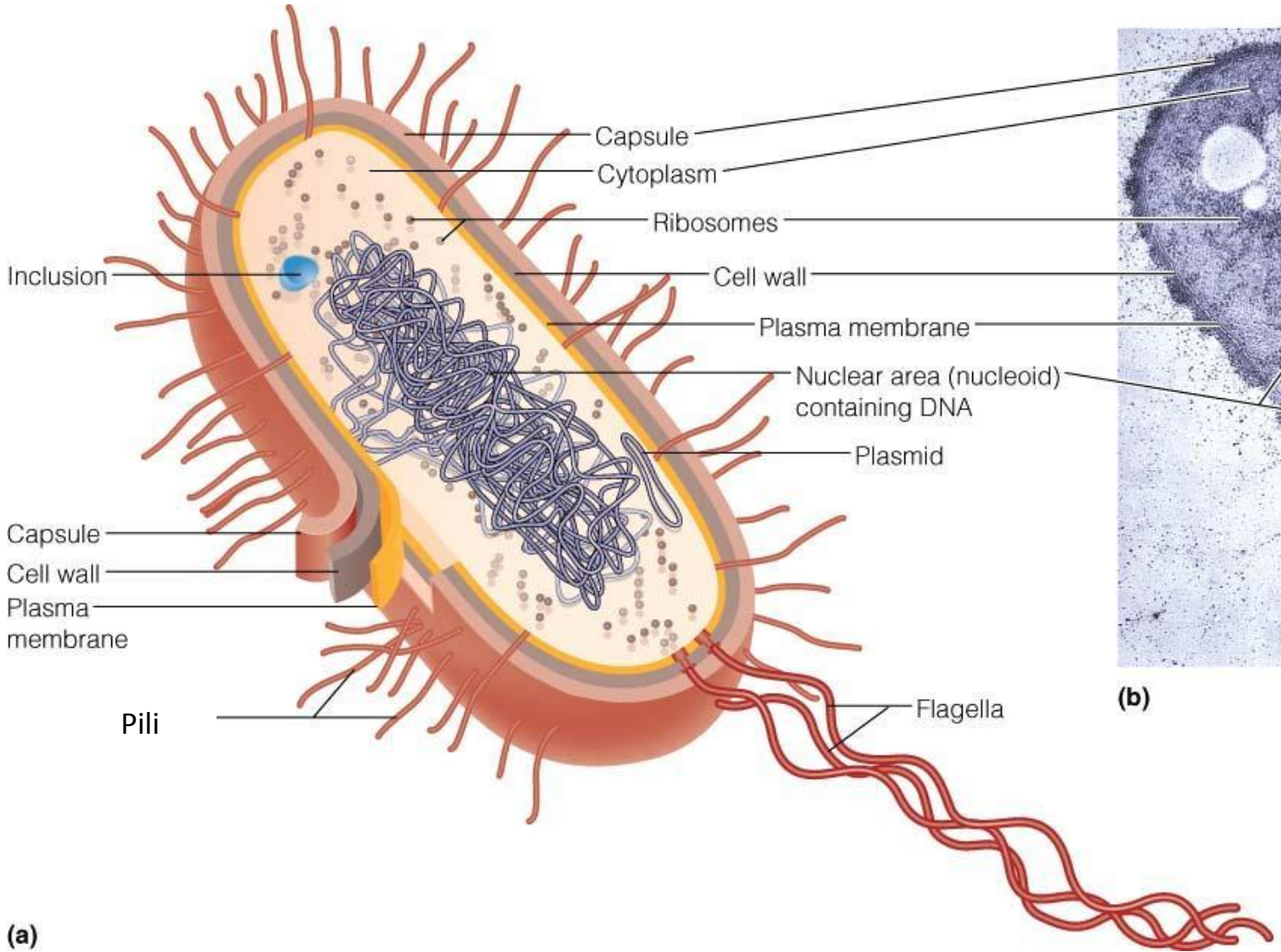
Eukaryotic cell

Plant, Animal, & Fungi

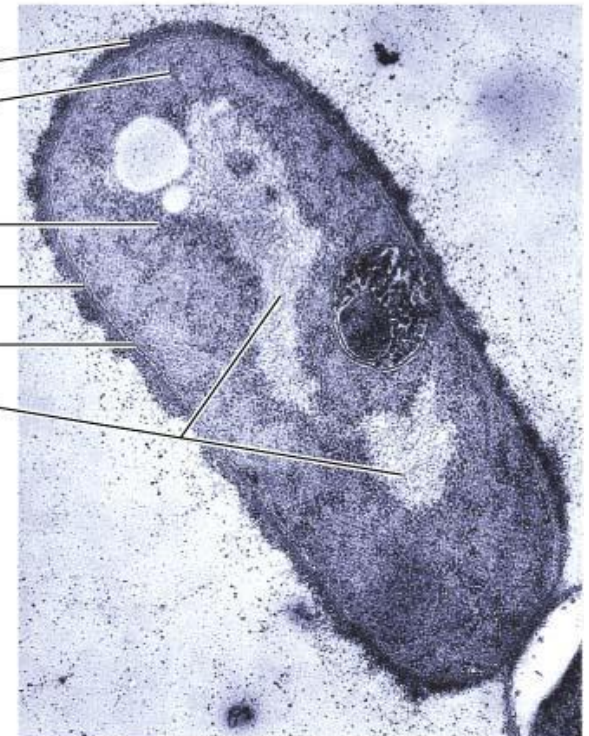
Prokaryotic Cell Structures and Functions (no compartments)

- Cell wall- not cellulose
- Naked DNA- no proteins
- Plasma membrane
- Cytoplasm
- Ribosomes- smaller than eukaryotes
- Pili- attach to surfaces and other bacteria
- Flagella- movement/ motility





(a)



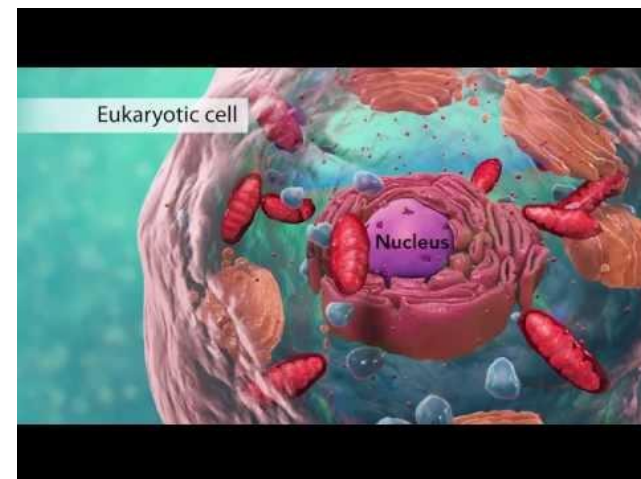
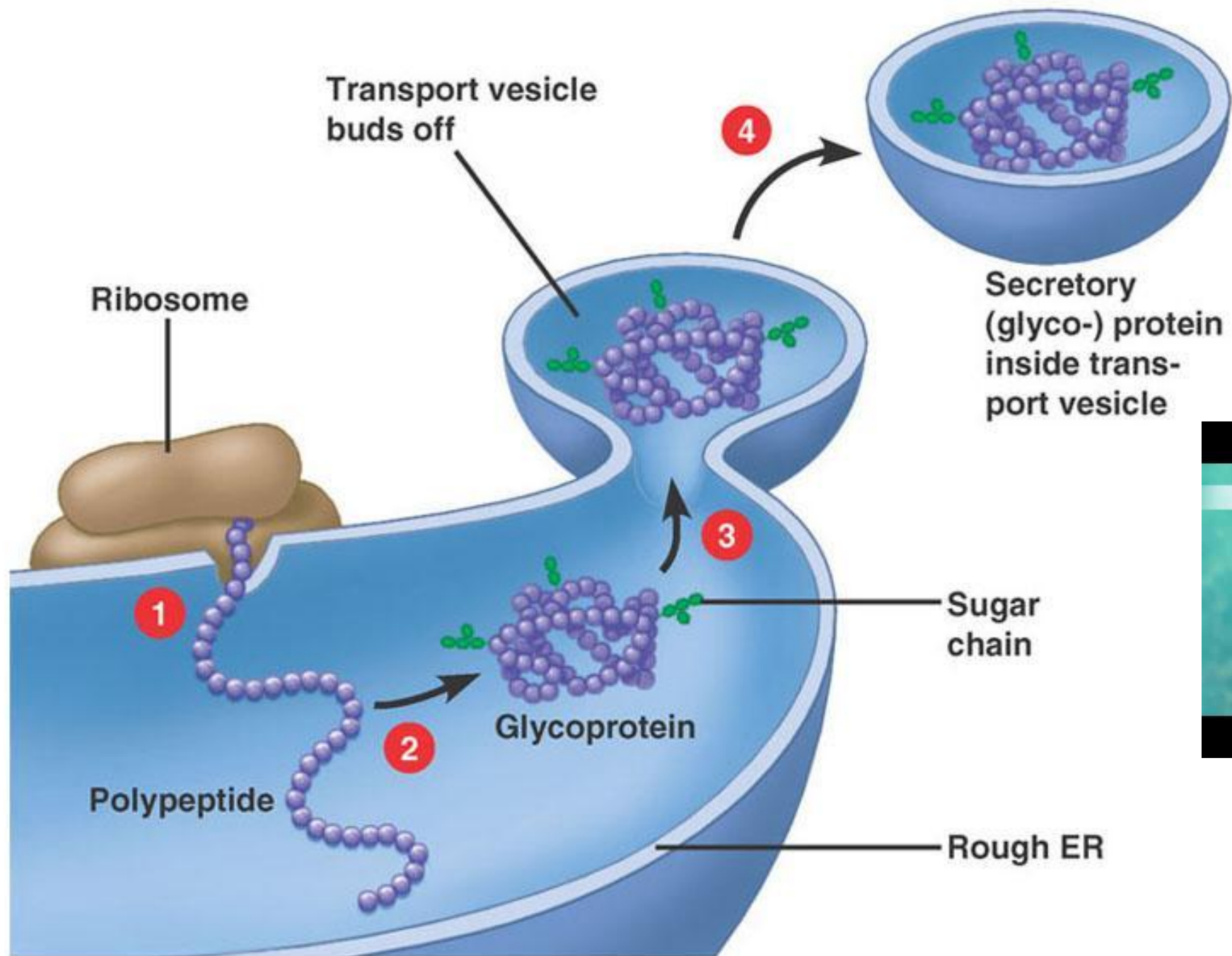
(b)

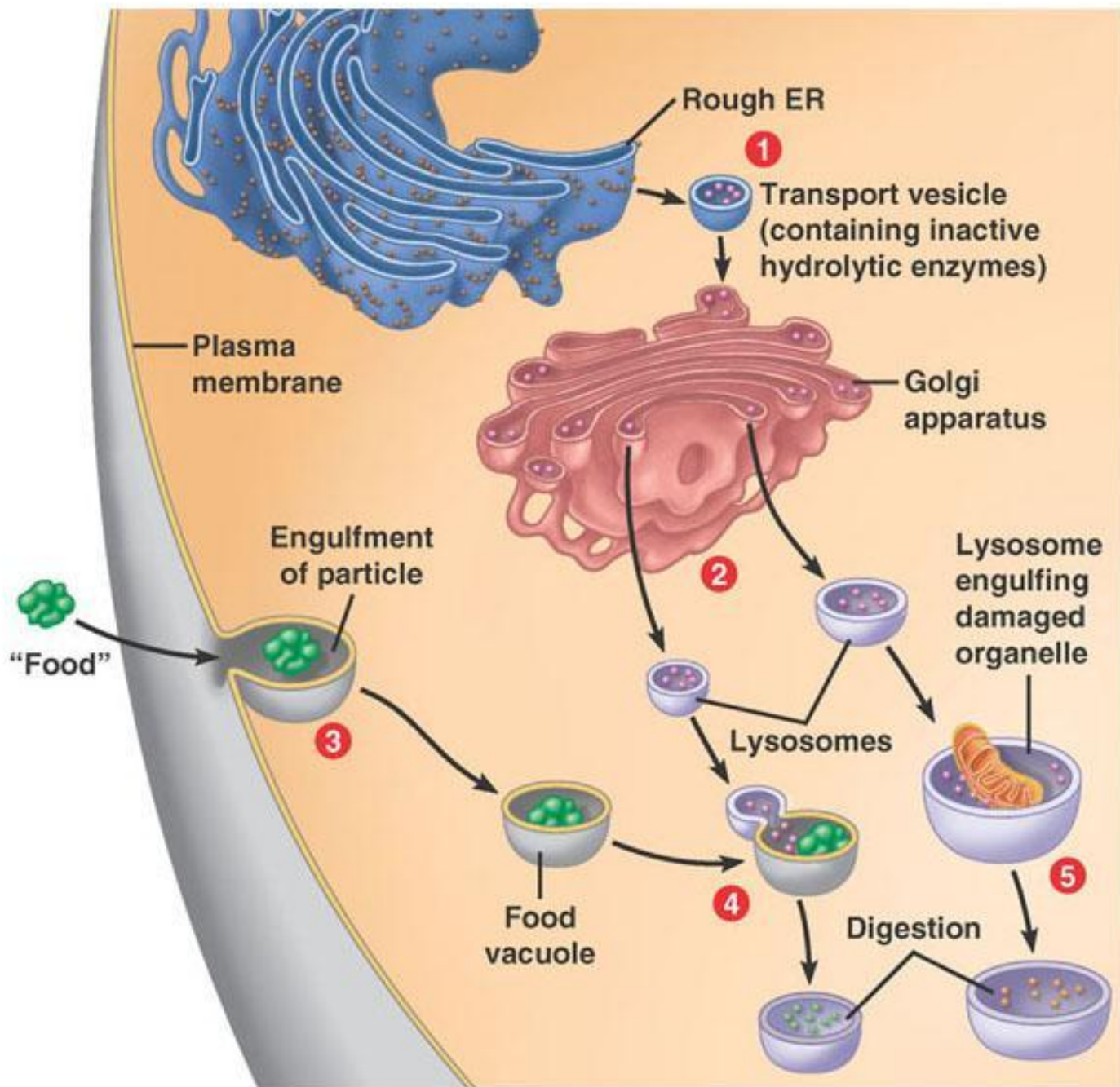
TEM | 0.5 μ m

Eukaryotic Organelles and Functions

(compartmentalized with organelles)

- Nucleolus- produce ribosomes and RNA nucleotides
- Nucleus- house genetic material
- Ribosome- protein synthesis
- RER- houses ribosomes; protein synthesis on ribosomes & forms vesicles for transport out of cell or to Golgi Apparatus
- SER- detoxification
- Golgi Apparatus- specialize and package proteins; forms vesicles for transport
- Lysosome- intracellular digestion
- Microtubules- structural support & movement
- Mitochondria- aerobic respiration
- Chloroplast- photosynthesis
- Central Vacuole- similar to lysosome but in plants, storage of water and waste

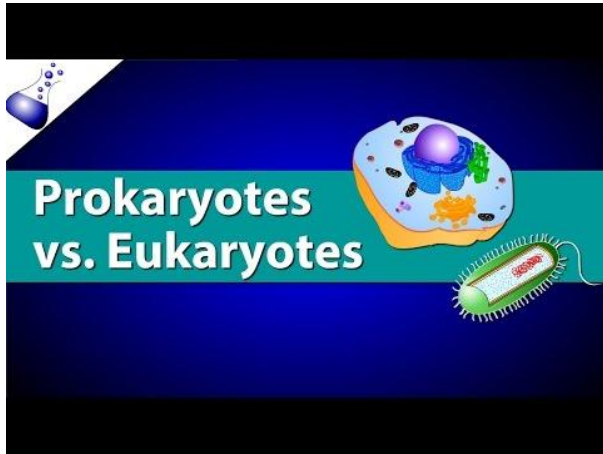




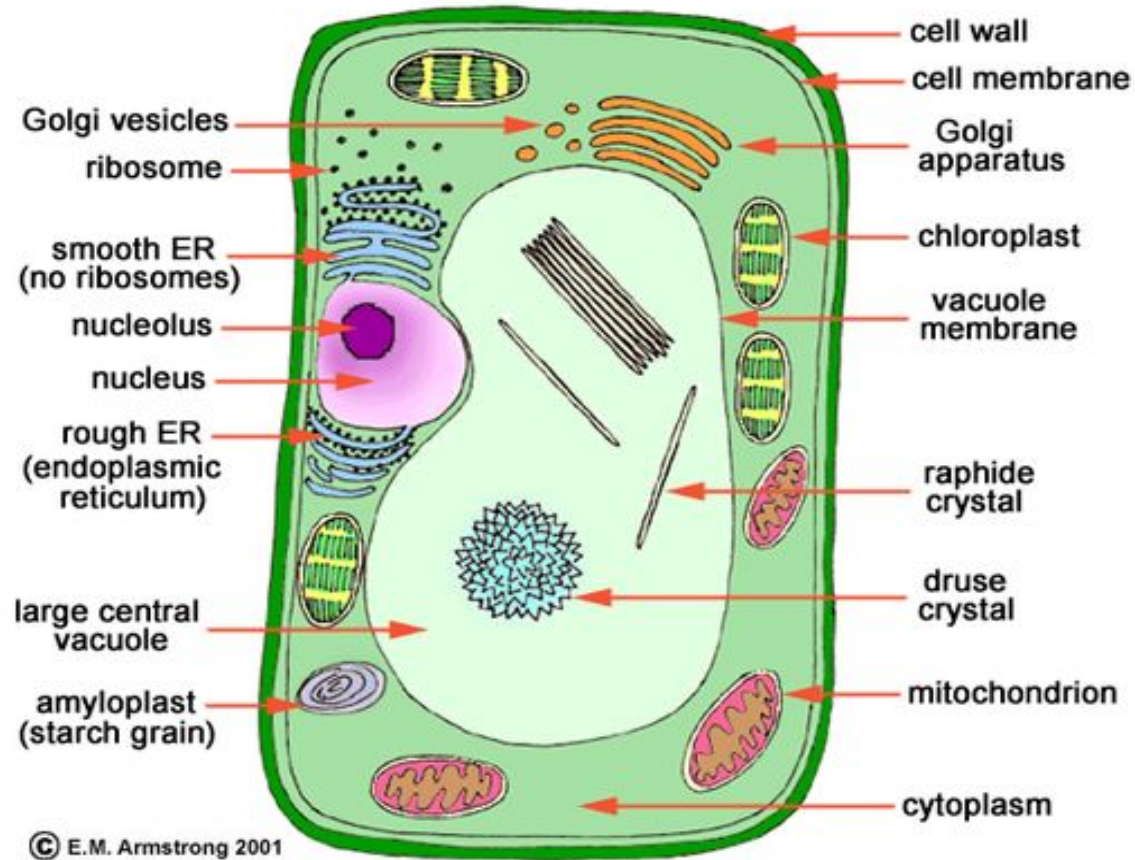
Prokaryotic vs. Eukaryotic

- Genetic material in a loop of DNA located in cytoplasm
- Naked DNA
- Mitochondria not present
- Ribosomes small (70S)
- Few or no organelles present

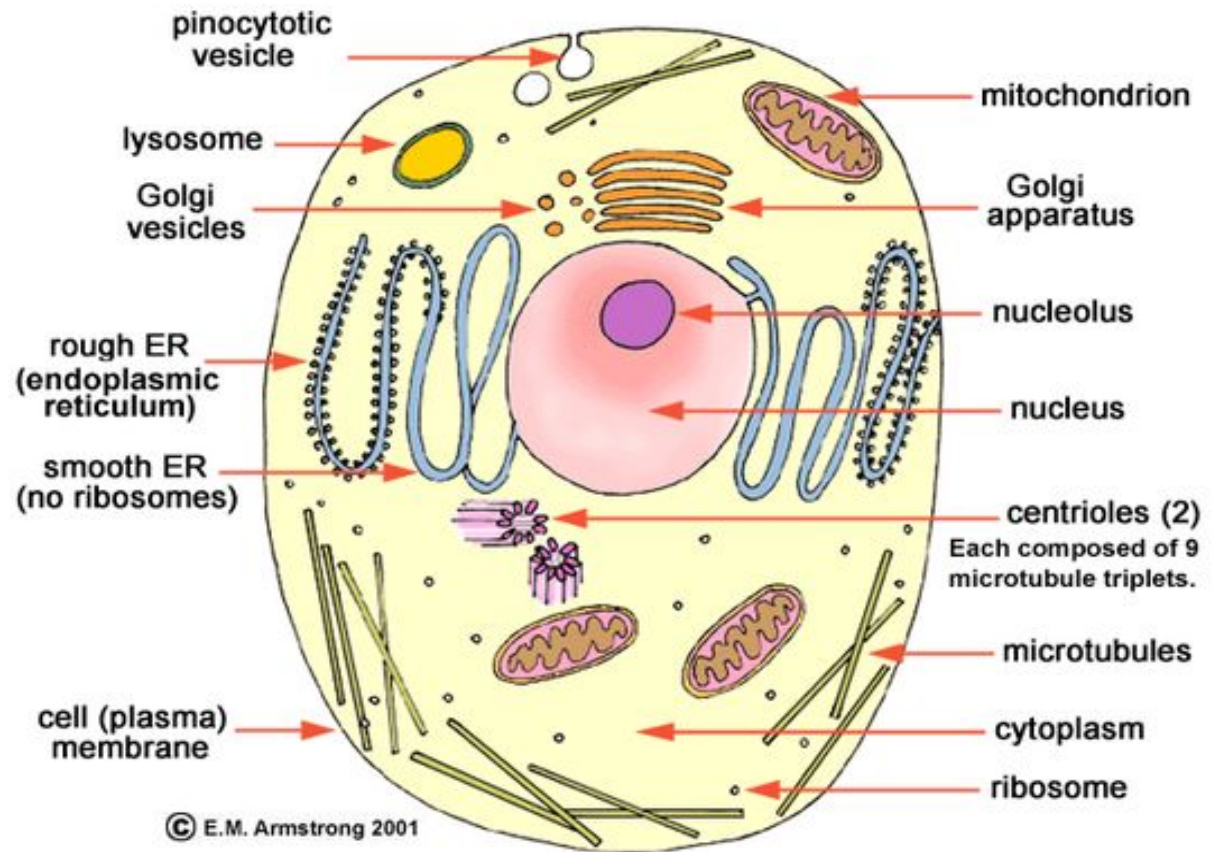
- Genetic material in strands of DNA located in a contained nucleus
- Chromosomes of DNA and proteins
- Mitochondria always present
- Ribosomes large (80S)
- Many organelles to compartmentalize functions



Plant Cell



Animal Cell



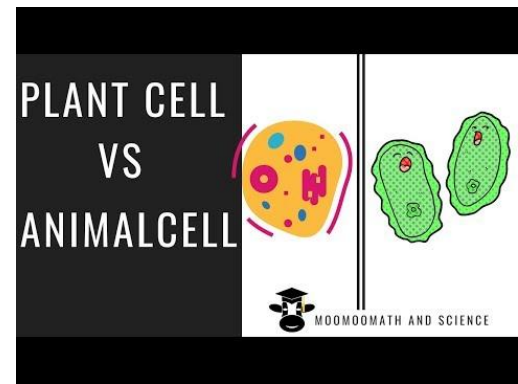
Comparing Plant & Animal Cells

Plants

- Cell wall of cellulose
- Central vacuole- large; similar to lysosome
- Chloroplasts for photosynthesis
- No centrioles
- Rigid shape
- Carbohydrates stored as starch

Animals

- No cell wall
- No large central vacuole
- No chloroplast
- Centrioles
- Globular shape
- Carbohydrates stored as glycogen



Cell Membrane

Fluid Mosaic Model

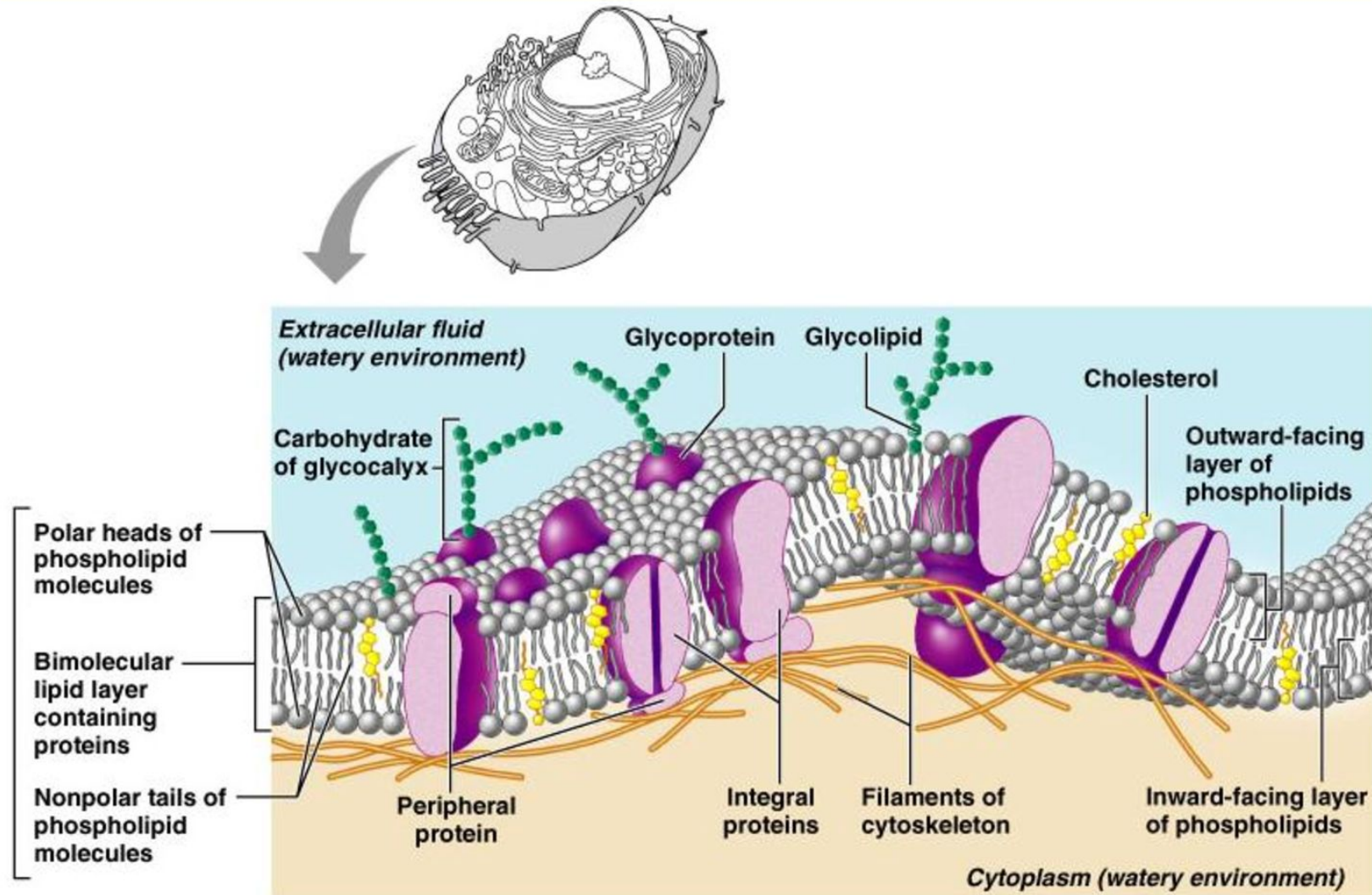
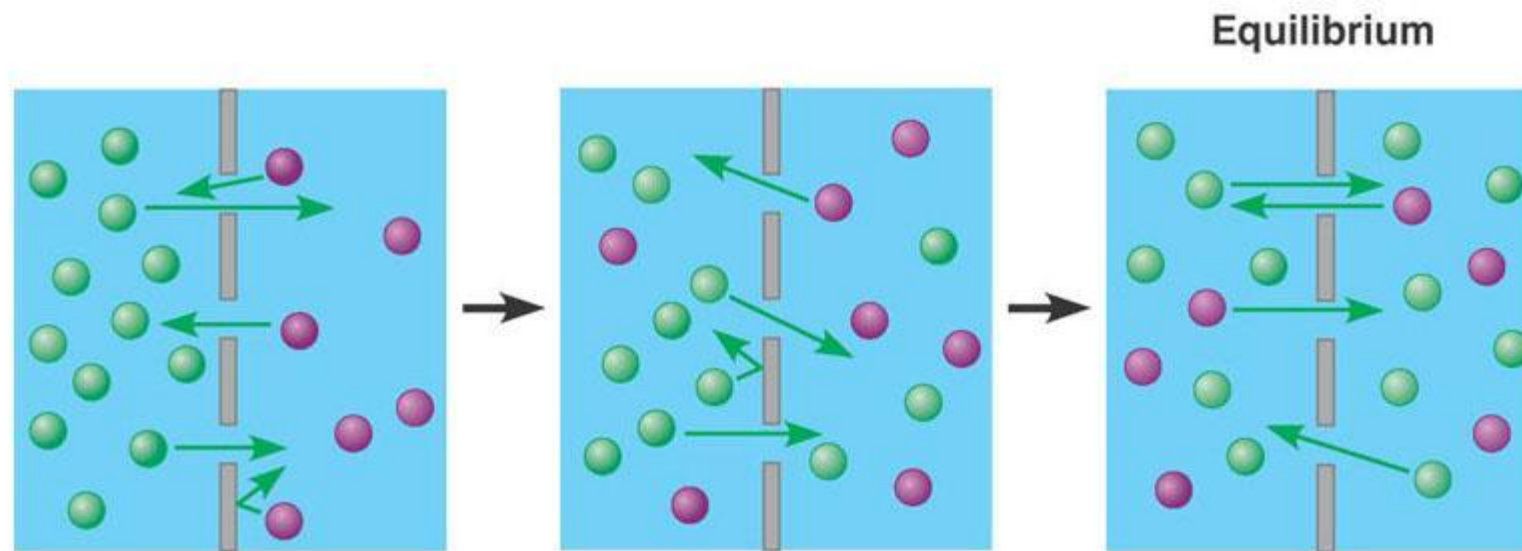
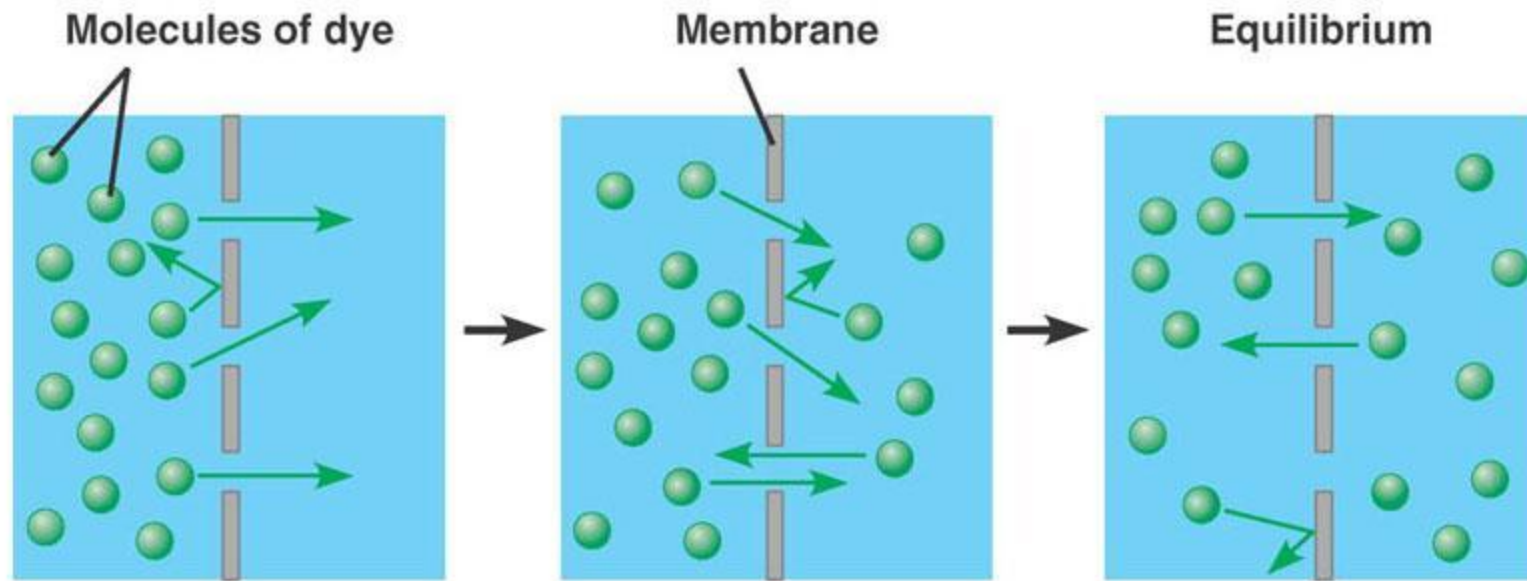


Figure 3.3

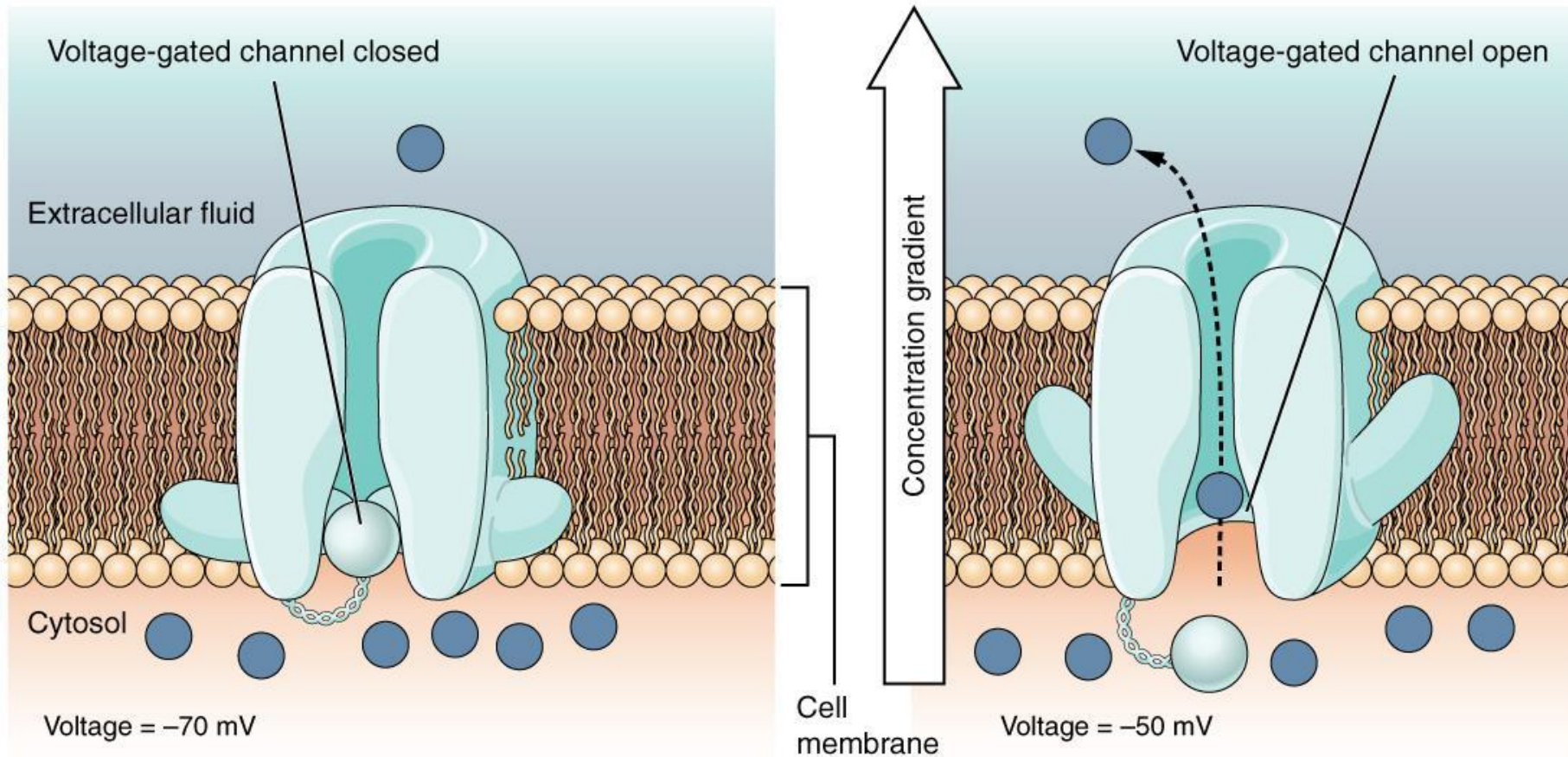
Simple Diffusion

- Movement of particles from area of **high** concentration **to** area of **low** concentration.
- Greater difference in concentration= faster rate of diffusion.
- Charged and large molecules **cannot** cross through the plasma membrane without transport protein.



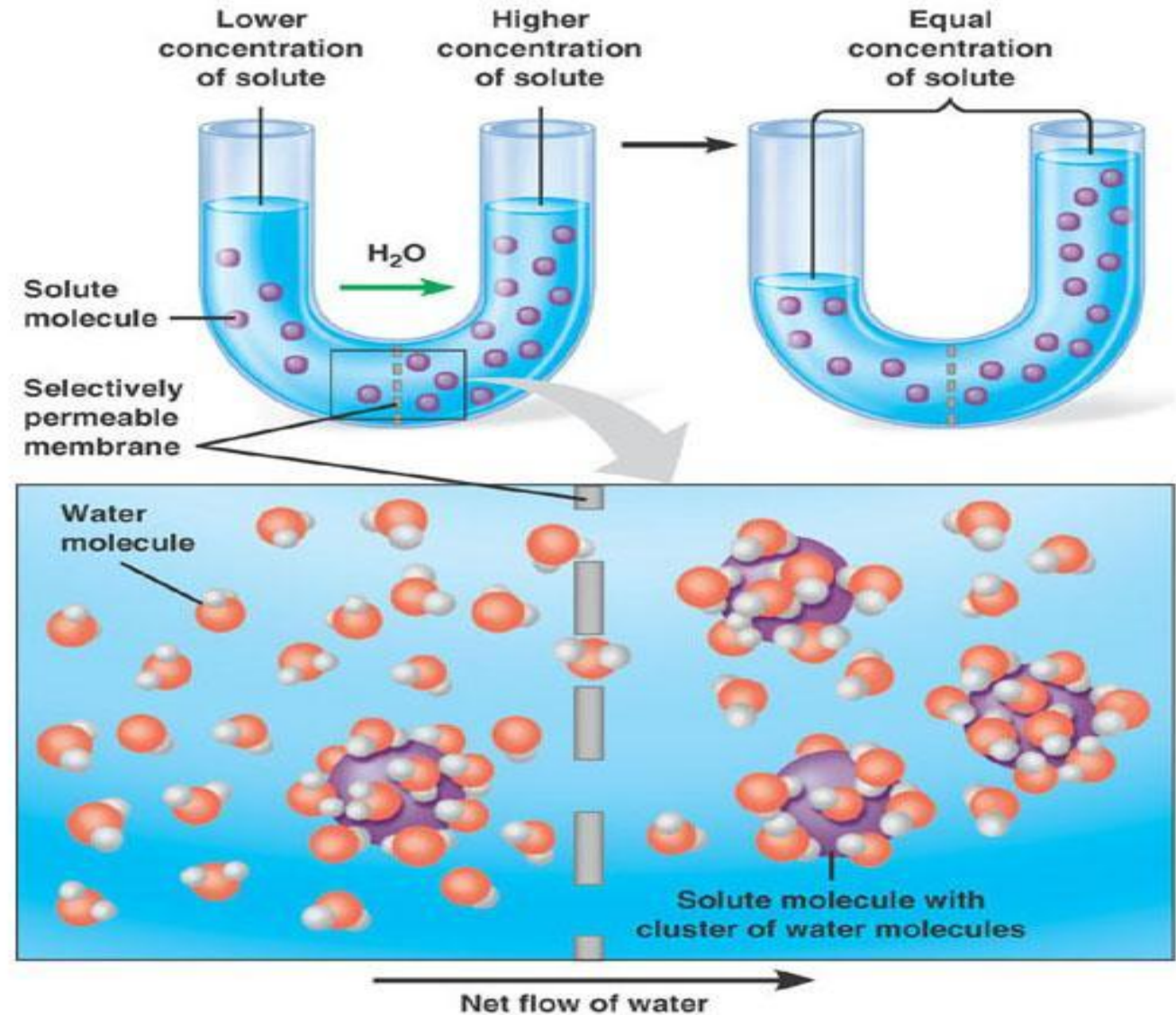
Facilitated Diffusion

- Large and charged molecules can still move by *diffusion* but require use of a transport protein to act as a tunnel to *facilitate* them through the plasma membrane.



Osmosis

- Diffusion of water rather than solute; From **high to low solvent**.
- Requires a semi-permeable membrane



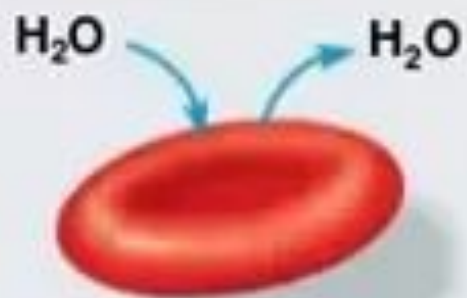
(a) Animal cell

Hypotonic



Lysed

Isotonic



Normal

Hypertonic



Shriveled

(b) Plant cell

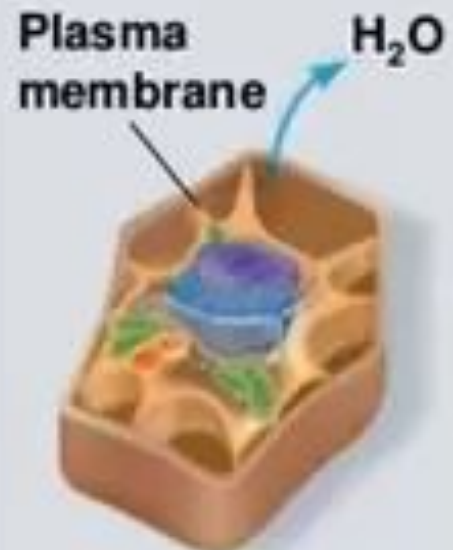
Plasma membrane
Cell wall
 H_2O



Turgid (normal)



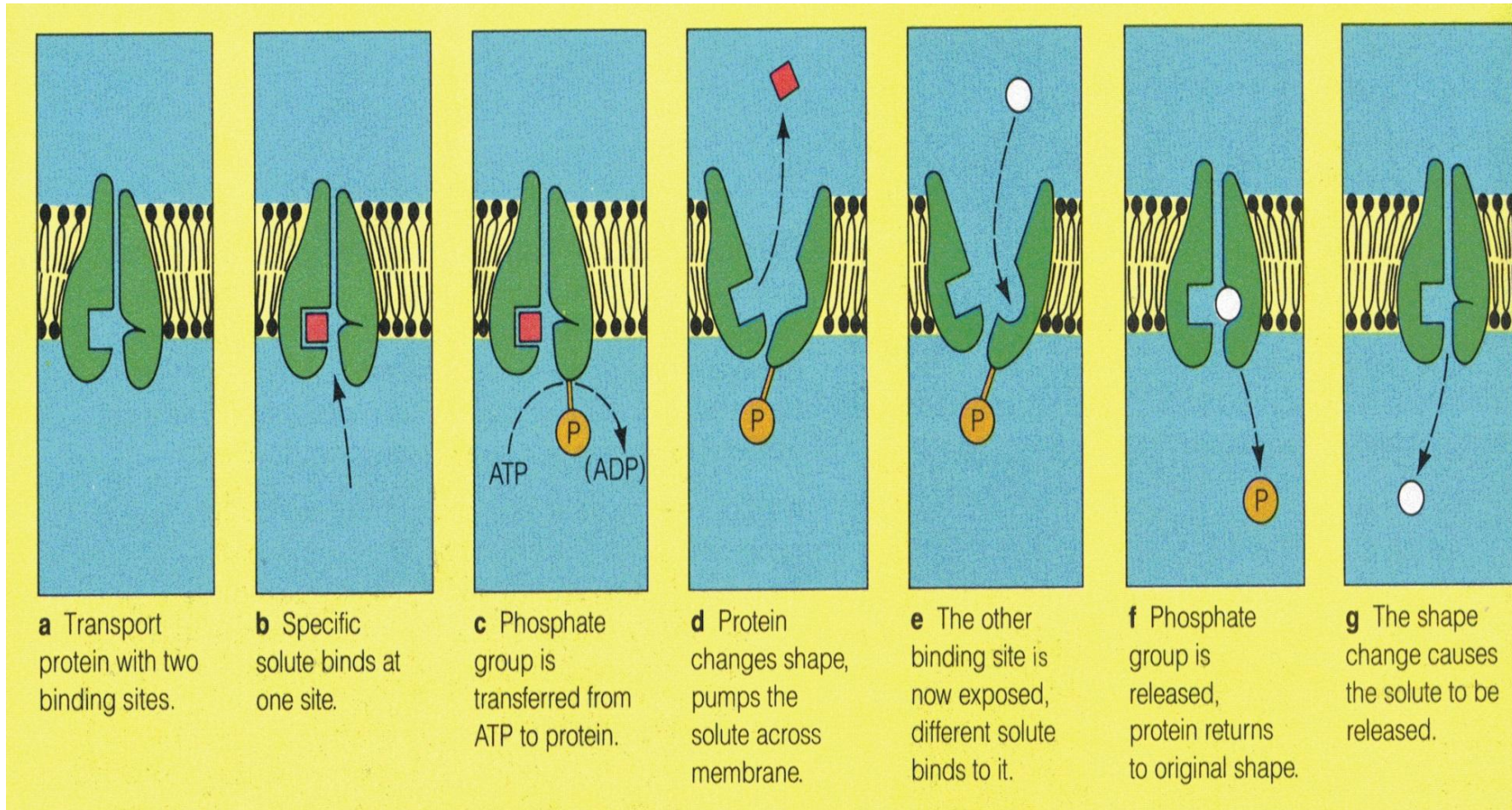
Flaccid



Plasmolyzed

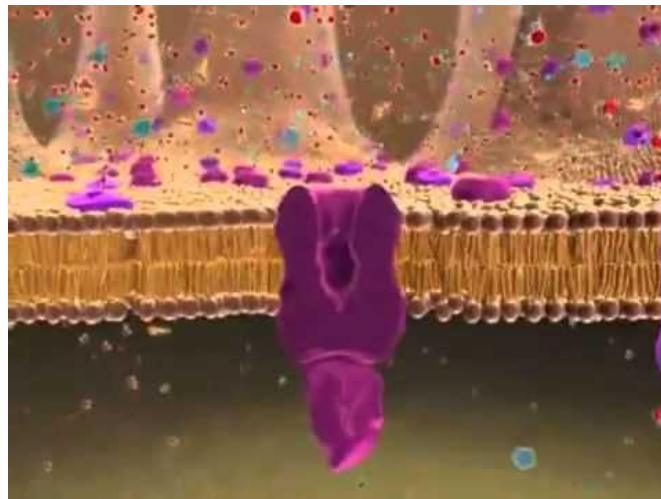
Active Transport

- Membrane proteins use energy in the form of ATP to pump molecules/solutes from low concentration to high concentration (against concentration gradient). Protein changes shape in the process.

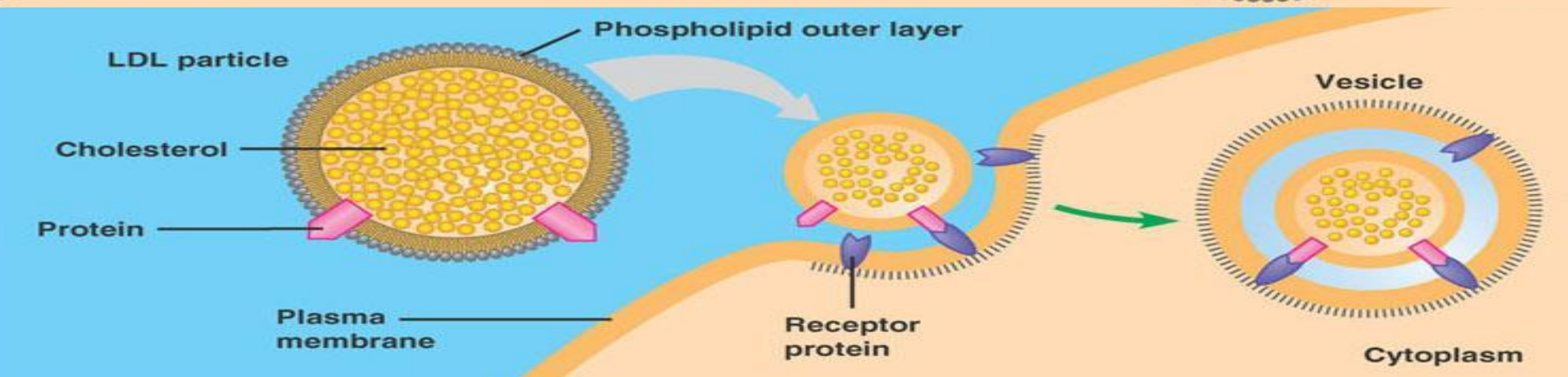
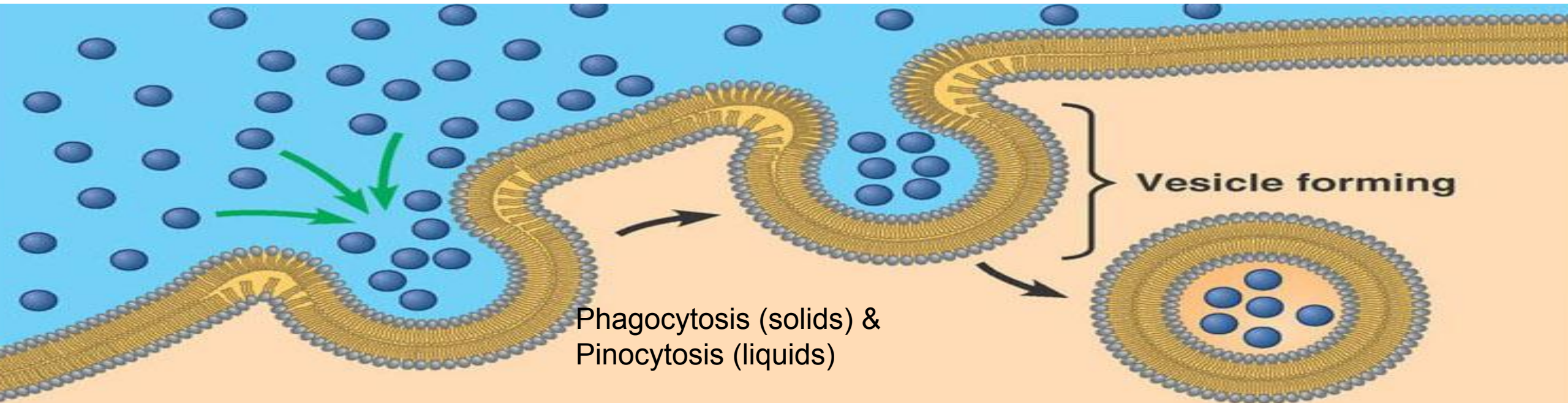


Vesicles

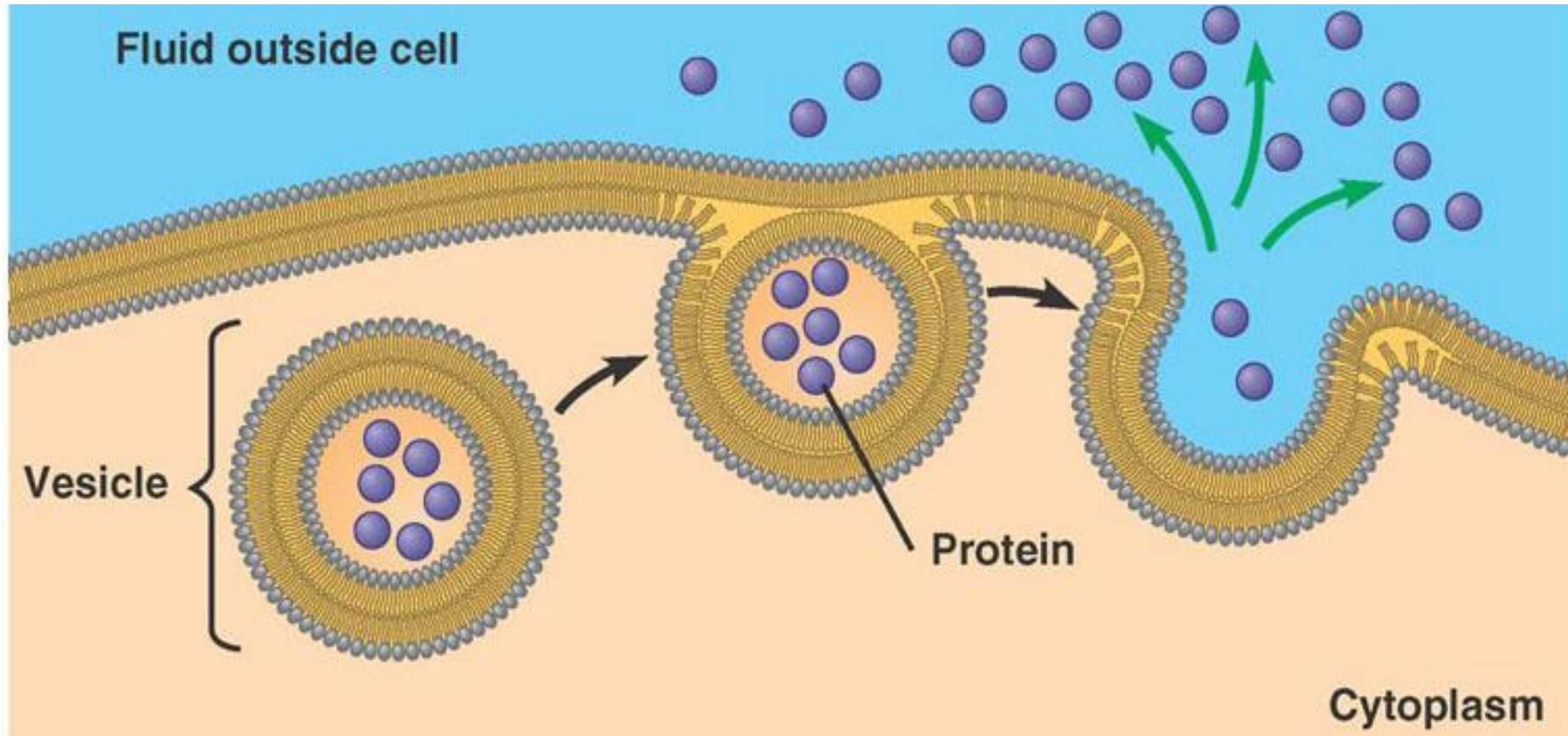
- The **fluidity** of the membrane allows a vesicle to be made by pinching off a piece of membrane.
- Vesicles can be used to transport material around the **inside** of cells.
- Proteins are transported in vesicles from the RER to the Golgi apparatus and from the Golgi apparatus to the plasma membrane.



Endocytosis



Exocytosis



Plant Tissues & Organs

Leaf

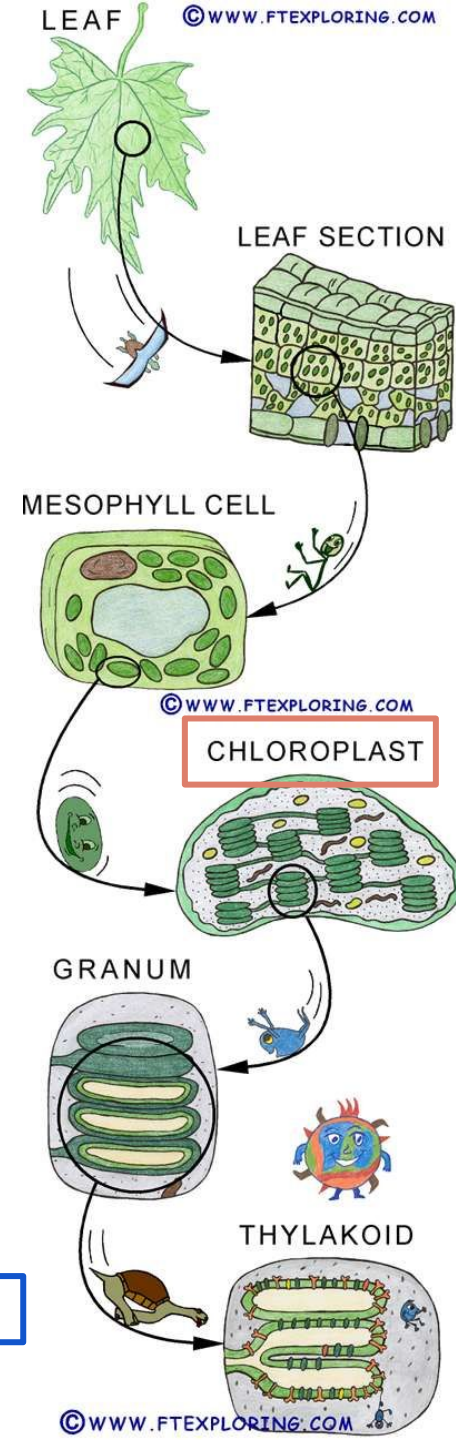
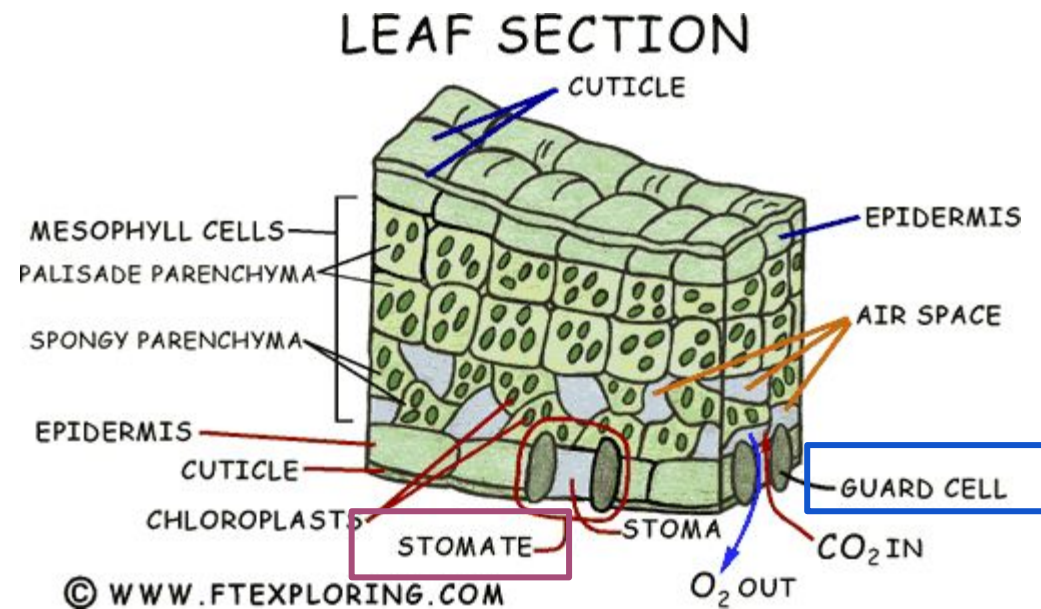
Guard Cells: open and close stomata

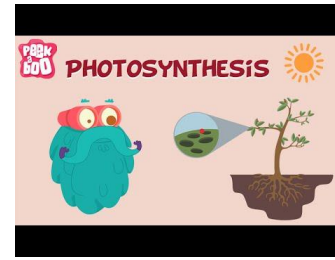
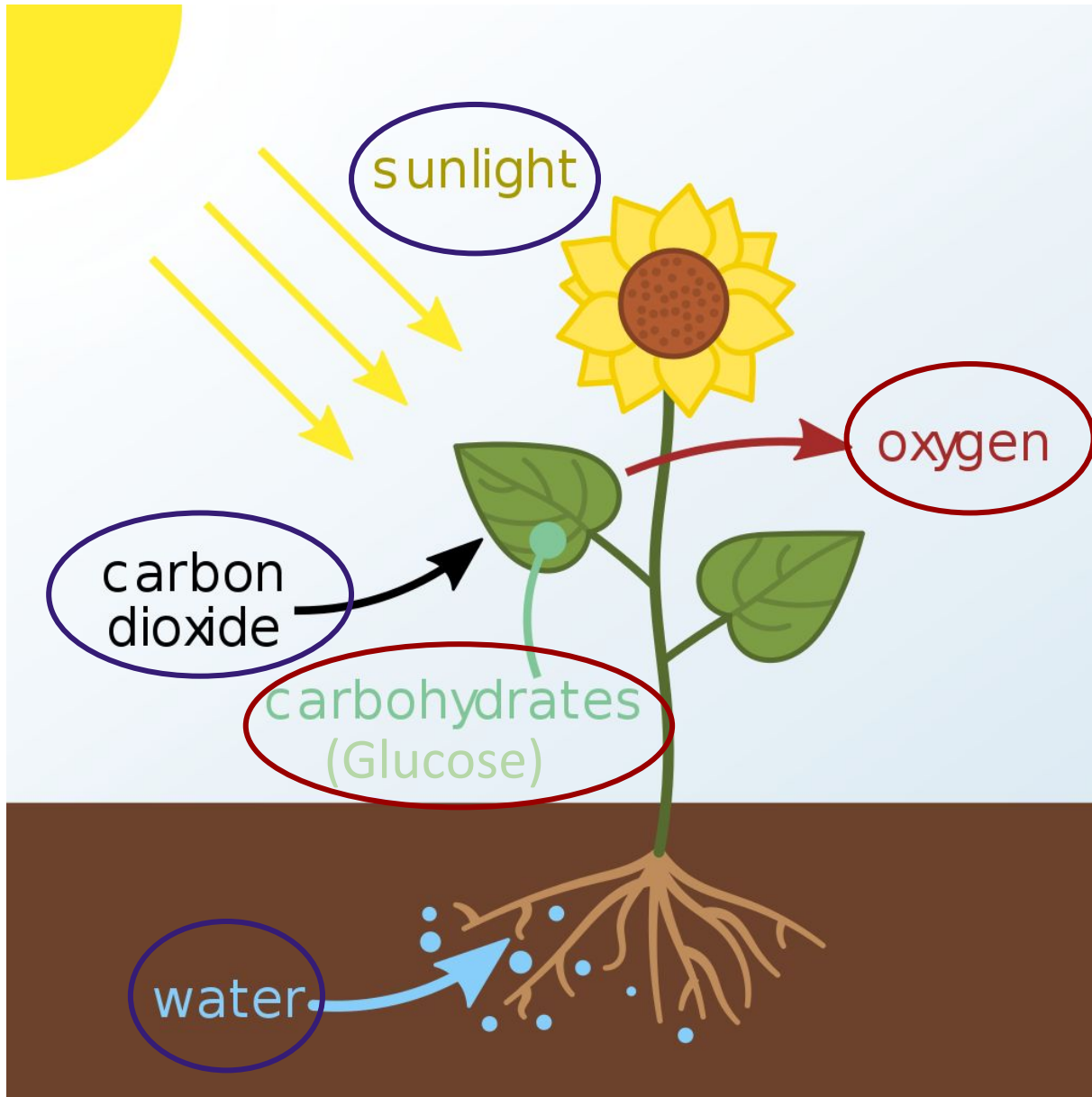
Stomata: pores for gases and water

Chloroplast: site of photosynthesis

Chlorophyll: pigment in chloroplast that absorbs light

Root: anchors plant &
absorbs water





Photosynthesis

Reactants (what goes in)- CO_2 ,
Water, Light

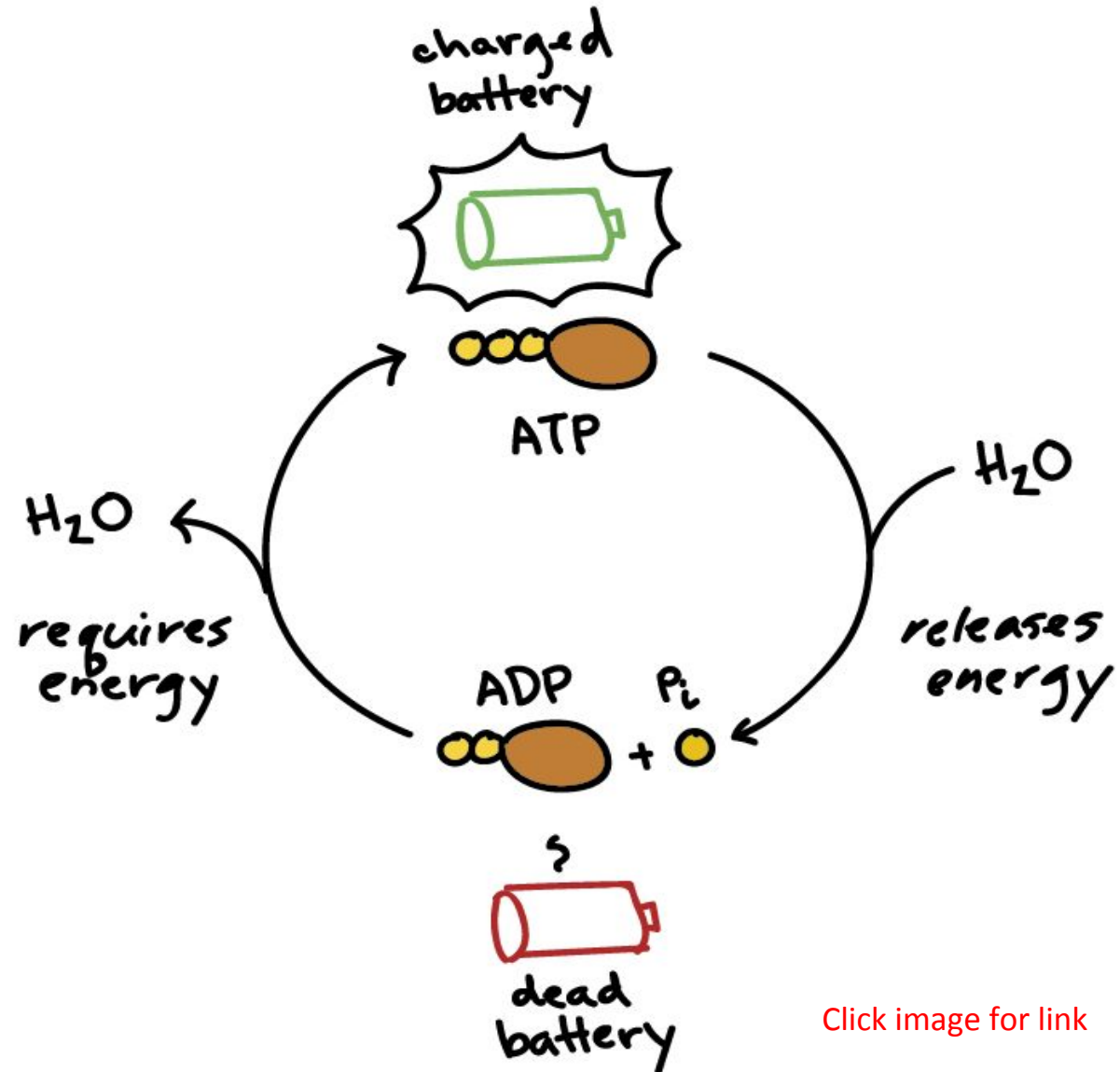
Products (what comes out)-
Oxygen and Glucose

- Glucose can be stored as starch or used to make cell walls as cellulose.



ATP & ADP

- ATP is an energy transfer.
- For our purposes, energy is stored in the bonds within a molecule (DO NOT say this next year in chemistry, they get mad).
- The bond that attaches the third phosphate has energy that is transferred for reactions to occur.
- When it's transferred, the bond breaks, it loses a phosphate, and is $\text{ADP} + \text{P}_i$



[Click image for link](#)

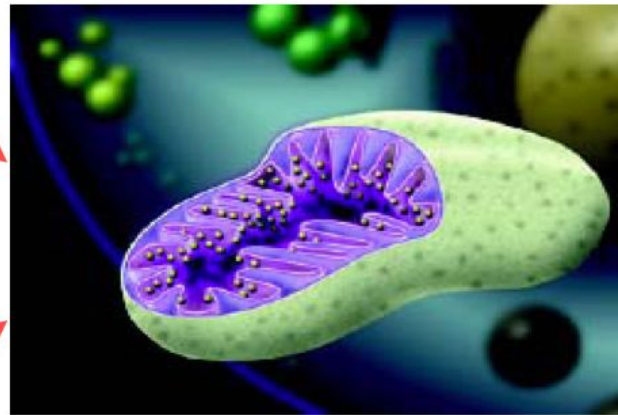
Cellular Respiration- Aerobic (with oxygen)

Reactants

Glucose
($C_6H_{12}O_6$)

Oxygen
(O_2)

Simple View



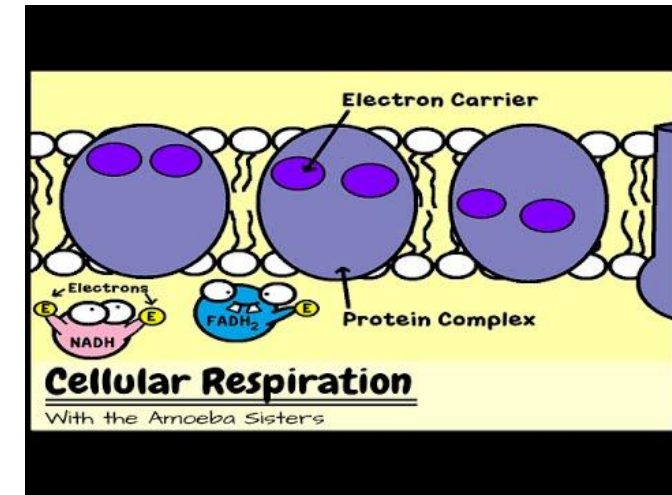
In the Mitochondria

Products

Carbon
Dioxide
(CO_2)

Water
(H_2O)

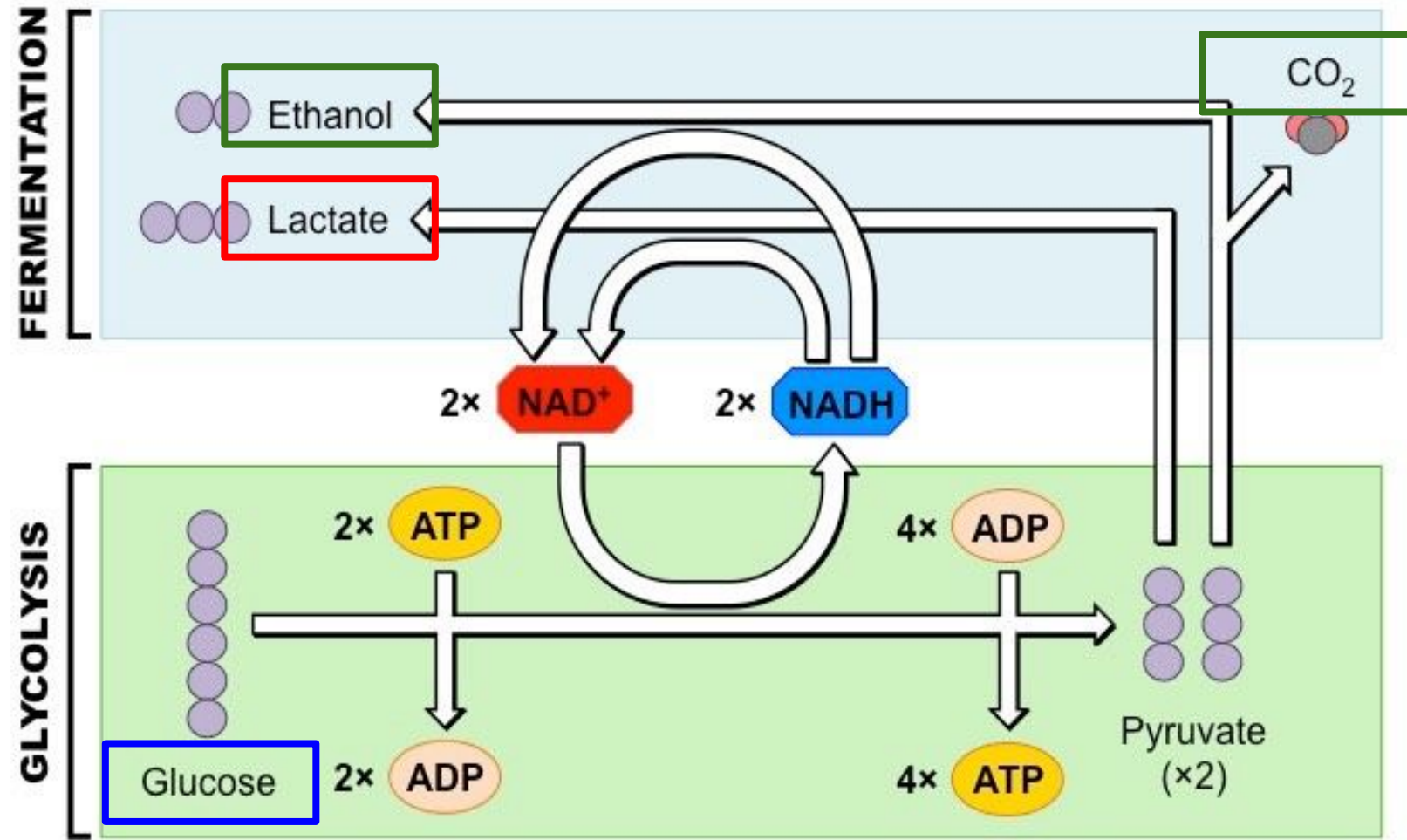
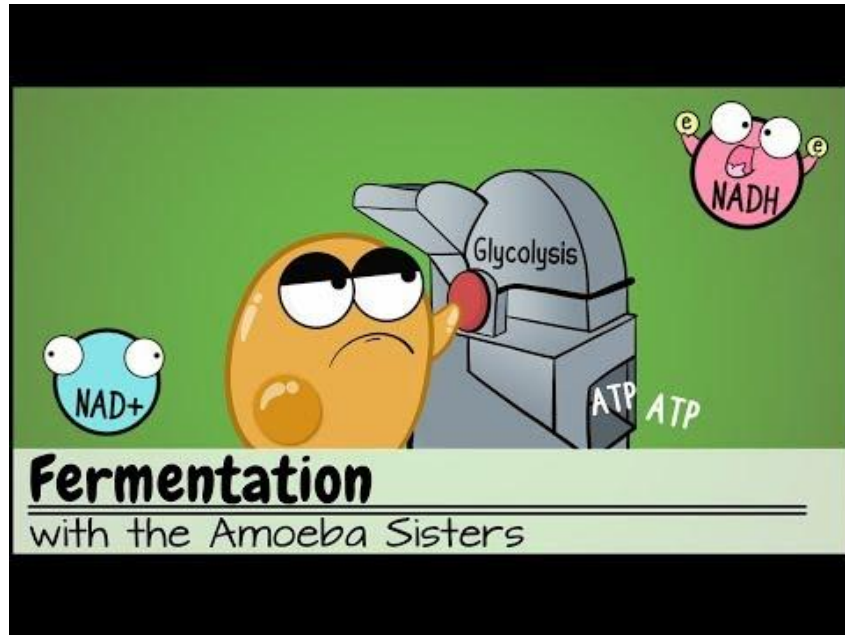
Energy
(ATP)



Releases energy from
organic compounds.



Cellular Respiration- Anaerobic (without oxygen)/ Fermentation



In Cytoplasm

Plants and yeast produce ethanol & CO₂ from glucose when no oxygen is present

Animals produce lactate/ lactic acid from glucose when no oxygen is present

Relationship Between Photosynthesis & Cell Respiration

