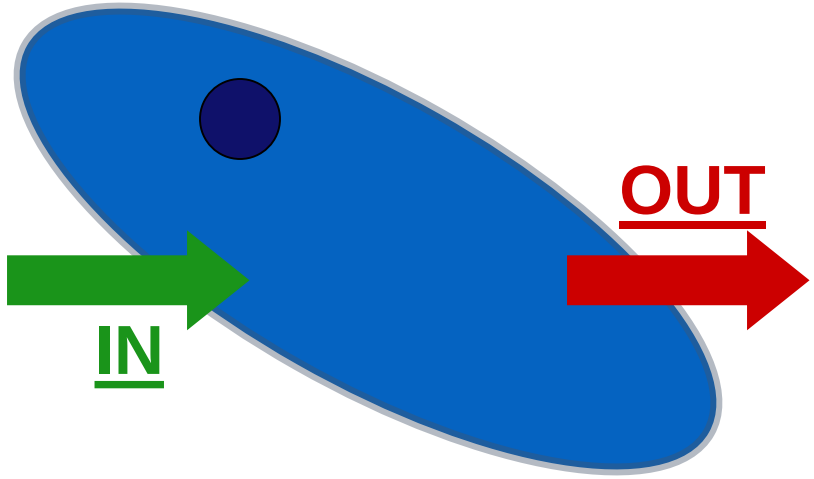
Cell membrane cont……

Permeability across cell membrane

- Cell membrane is the boundary between inside & outside…
  - separates cell from its environment

Can it be an impenetrable boundary? **NO!**

IN
food
carbohydrates
sugars, proteins
amino acids
lipids
salts, O_2, H_2O



OUT
waste
ammonia
salts
CO_2
H_2O
products

cell needs materials in & products or waste out

Permeability Factors

- Lipid solubility
- Size
- Charge
- Presence of channels and transporters

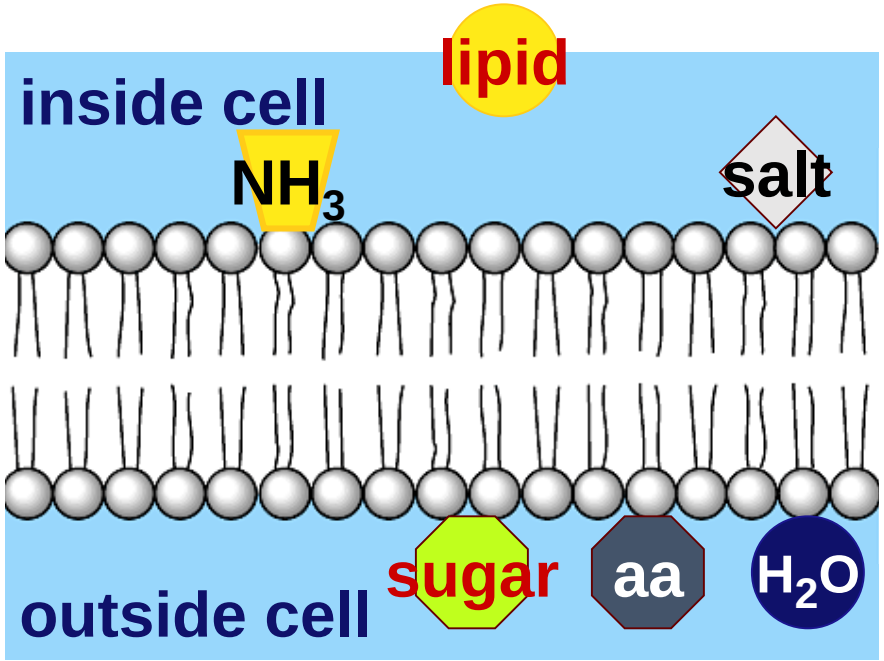
-**Hydrophobic molecules** are lipid soluble and can **pass** through the membrane rapidly

-**Polar molecules** do **not** cross the membrane rapidly

-**Transport proteins** allow passage of **hydrophilic** substances across the membrane

Diffusion through phospholipid bilayer

- What molecules can get through directly?
  - fats & other lipids

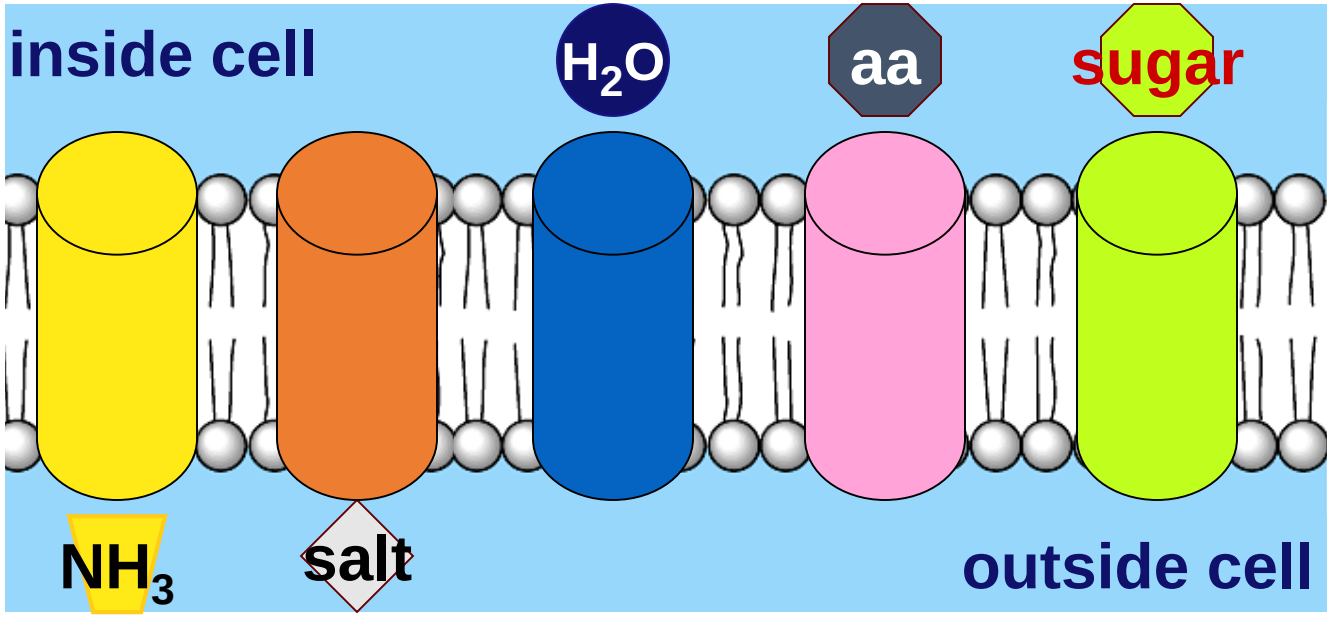


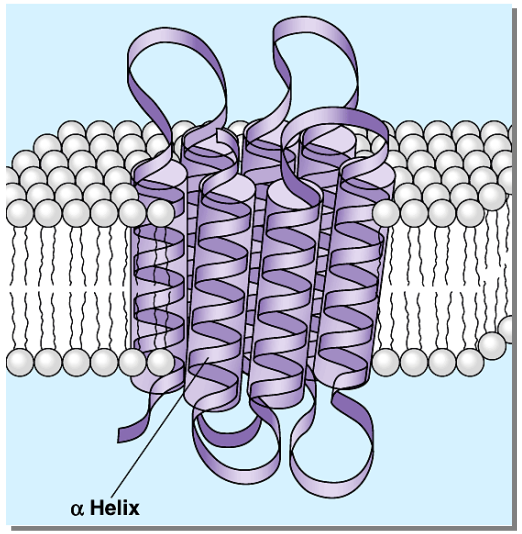
- What molecules can NOT get through directly?
  - polar molecules
    - H_2O
  - ions
    - salts, ammonia
  - large molecules

    starches, proteins •

Channels through cell membrane

- Membrane becomes semi-permeable with protein channels
  - specific channels allow specific material across cell membrane





Membrane permeability

The plasma membrane is **selectively permeable**, it allows some substances to cross it more easily than others

Types of Cellular Transport

Passive Transport
cell **does not** use energy
molecules move randomly, molecules spread out from an area of **high** concentration to an area of **low** concentration

- Diffusion
- Facilitated Diffusion
- Osmosis

Active Transport
cell does **use energy**

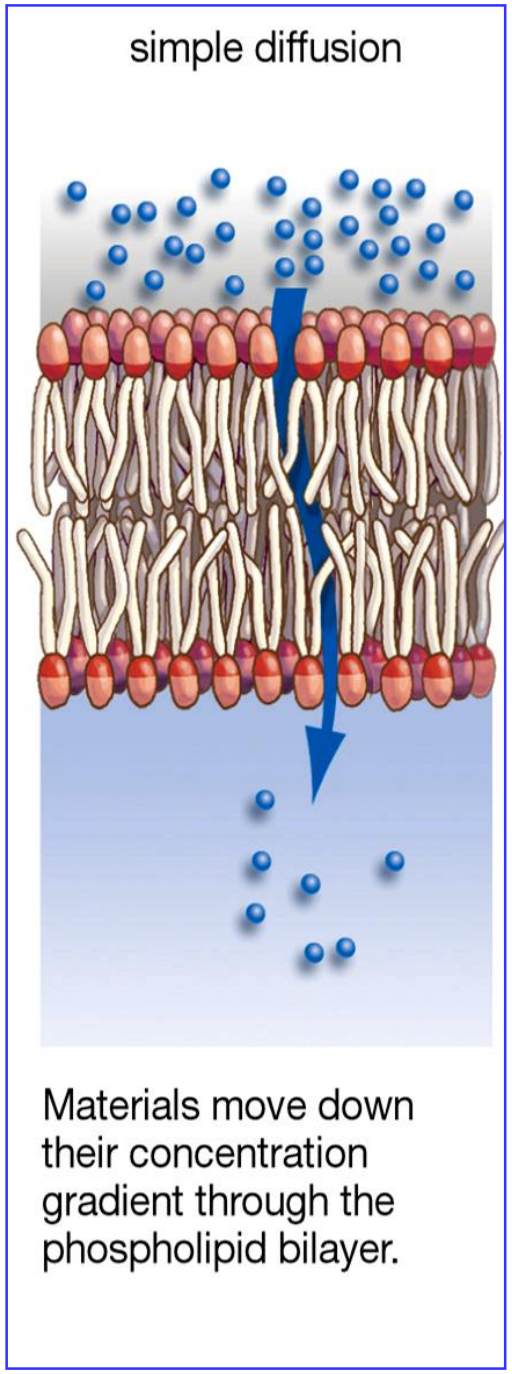
- Protein Pumps
- Endocytosis
- Exocytosis

Passive Transport

Diffusion: random passive movement of particles from an area of **high concentration** to an area of **low concentration** until ***equilibrium*** is reached. (***High to Low***)

diffusion of nonpolar, hydrophobic molecules

Example: **lipid** and **gases**, oxygen diffusing into a cell and carbon dioxide diffusing out.



Facilitative Diffusion

diffusion of specific particles (**high** to **low** concentration)

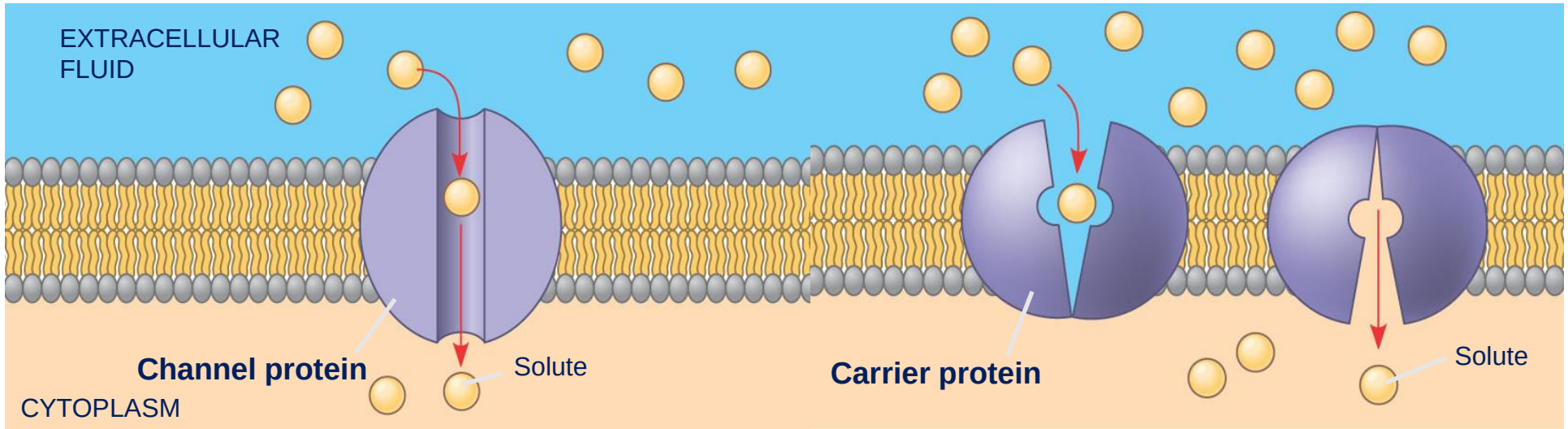
- **Diffusion through protein channels**
- **no energy** needed

diffusion of polar, hydrophilic molecules

Two types of transport proteins can help ions and large polar molecules diffuse through cell membranes:

- **Channel proteins** – provide a narrow channel for the substance to pass through.
- **Carrier proteins** – physically bind to the substance on one side of membrane and release it on the other.

Examples: **Glucose** or **amino acids** moving from blood into a cell.



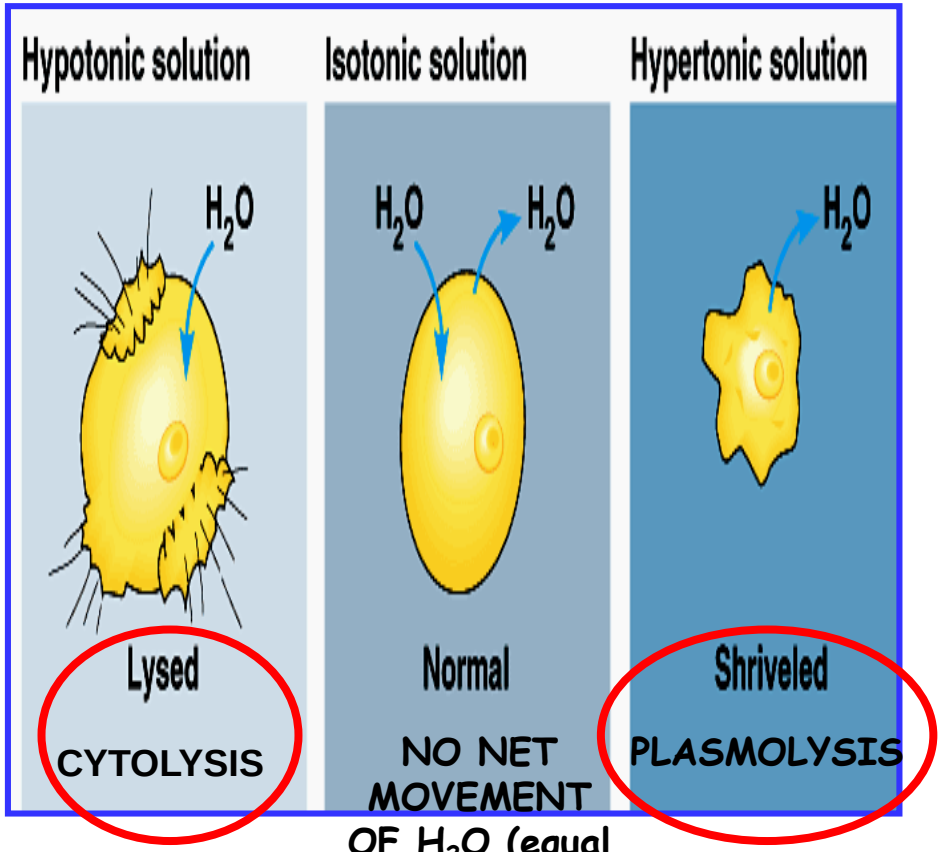
Osmosis

Osmosis is the **diffusion of water** across a semi-permeable membrane from a hypotonic solution to a hypertonic solution
Direction of osmosis is determined by comparing total solute concentrations (Tonicity)

Hypertonic (low water potential) - more solute, less water
Hypotonic (high water potential)- less solute, more water
Isotonic - equal solute, equal water

Water can diffuse across plasma membrane--- Moves from HIGH water potential (low solute concentration) to LOW water potential (high solute concentration)

Aquaporins (water channels) are proteins embedded in the cell membrane that regulate the flow of water only.
Homeostasis (equilibrium)



-Active Transport

***//* Protein Pumps** -transport proteins that require **energy** to do work (**low to high** concentration) **AGAINST concentration gradient**

2 types:

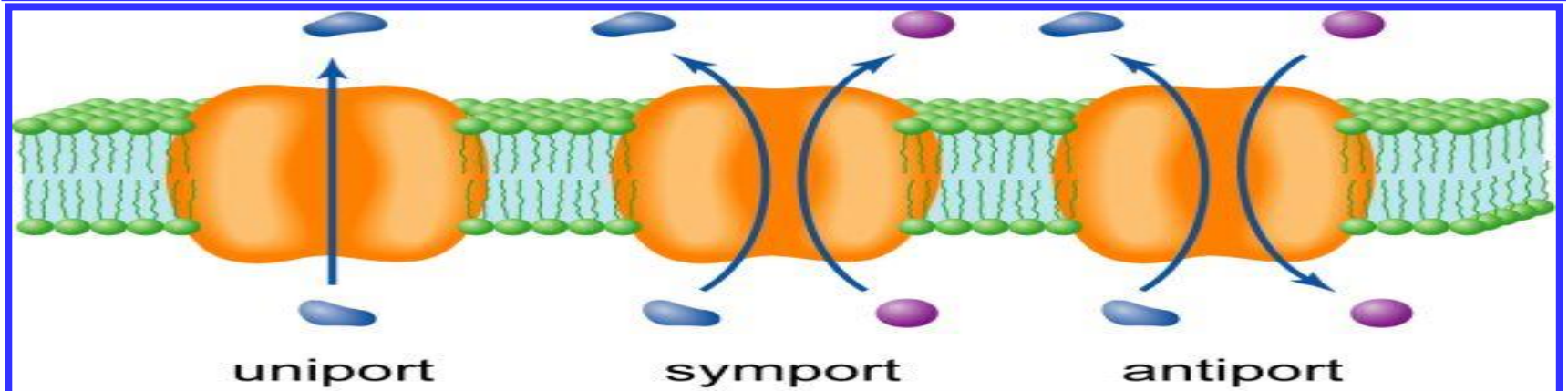
- **Primary active transport (** directly uses metabolic energy/ energy is derived directly from the breakdown of ATP)**: Membrane pump** (protein-mediated active transport) example **Na+/K+ Pump**

- **Secondary active transport**: (electrochemical potential difference created by pumping/ energy is derived secondarily from energy that has been stored in the form of ionic concentration differences between the two sides of a membrane.)

Coupled transport (cotransport)

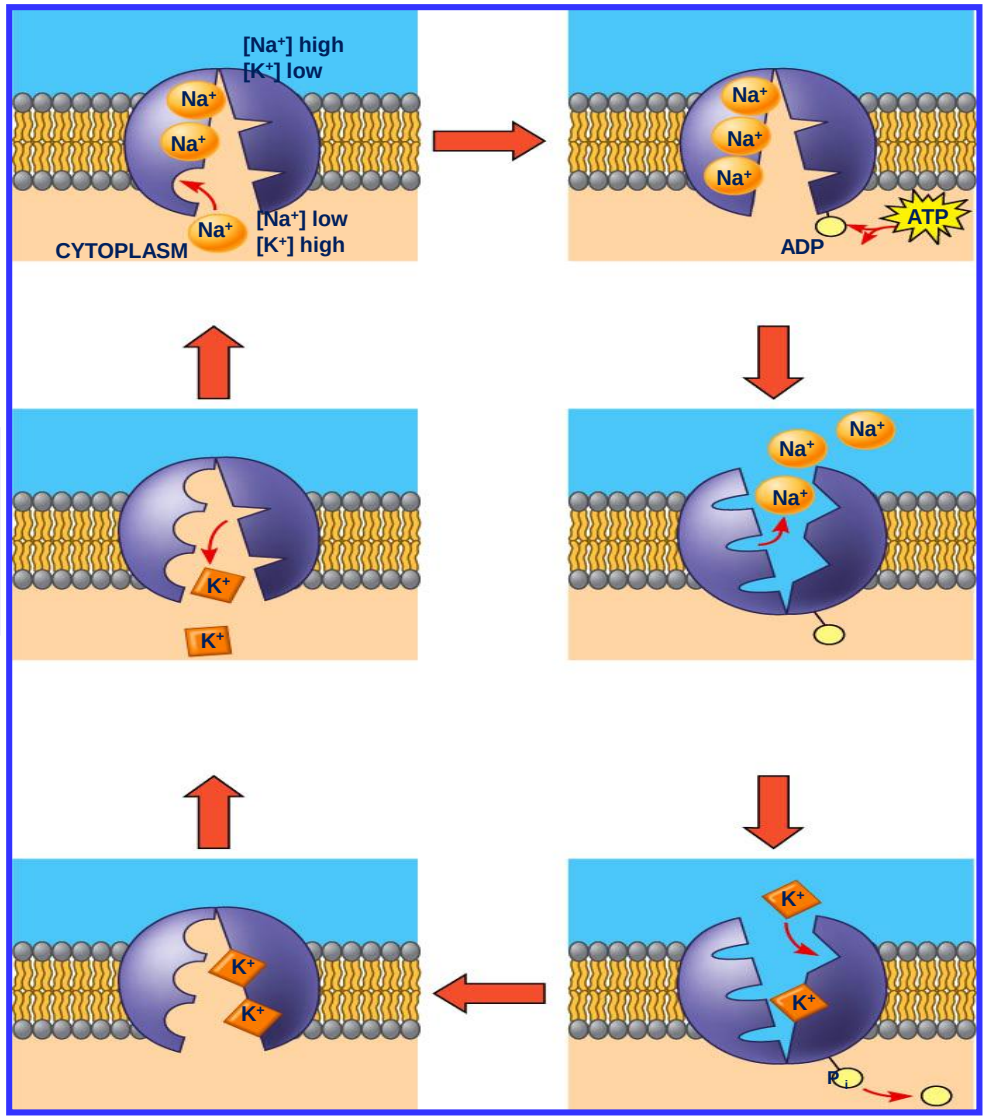
-symport transport two substances simultaneously in the same direction example **glucose symporter** (glucose and sodium)

-antiport transport two substances in opposite directions example **sodium-calcium exchanger** or **antiporter**



The Sodium-potassium Pump

1. Cytoplasmic Na^+ binds to the sodium-potassium pump.



2. Na+ binding stimulates phosphorylation by ATP.

3. Phosphorylation causes the protein to change its conformation, expelling Na^+ to the outside.

4. Extracellular K^+ binds to the protein, triggering release of the Phosphate group.

5. Loss of the phosphate restores the protein's original conformation.

6. K^+ is released and Na^+ sites are receptive again;
the cycle repeats.

Organelles cont…..

Vesicles - small membrane bound sacs

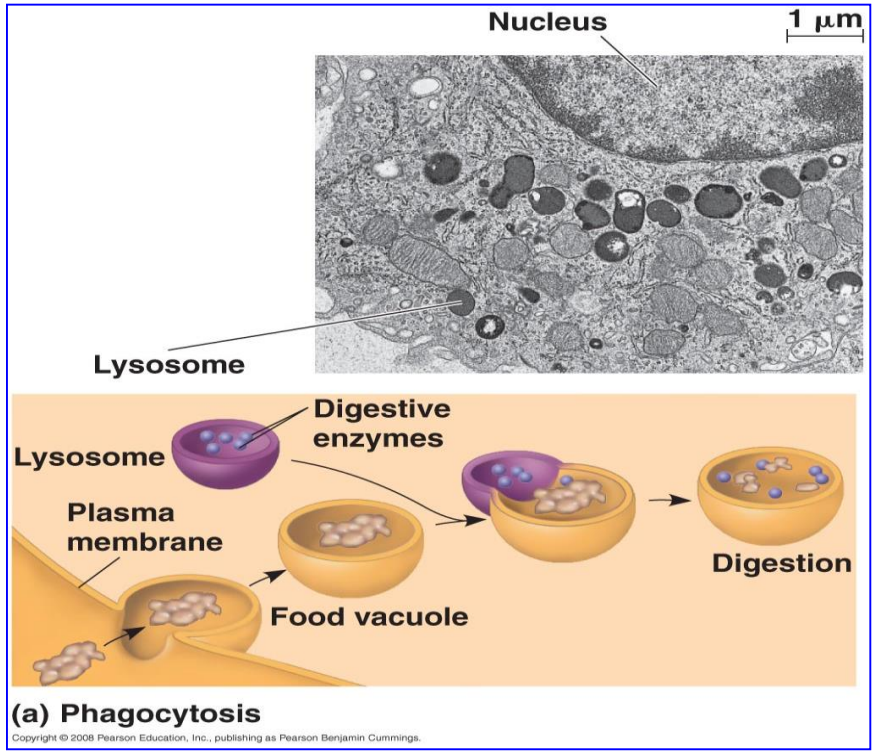
Examples

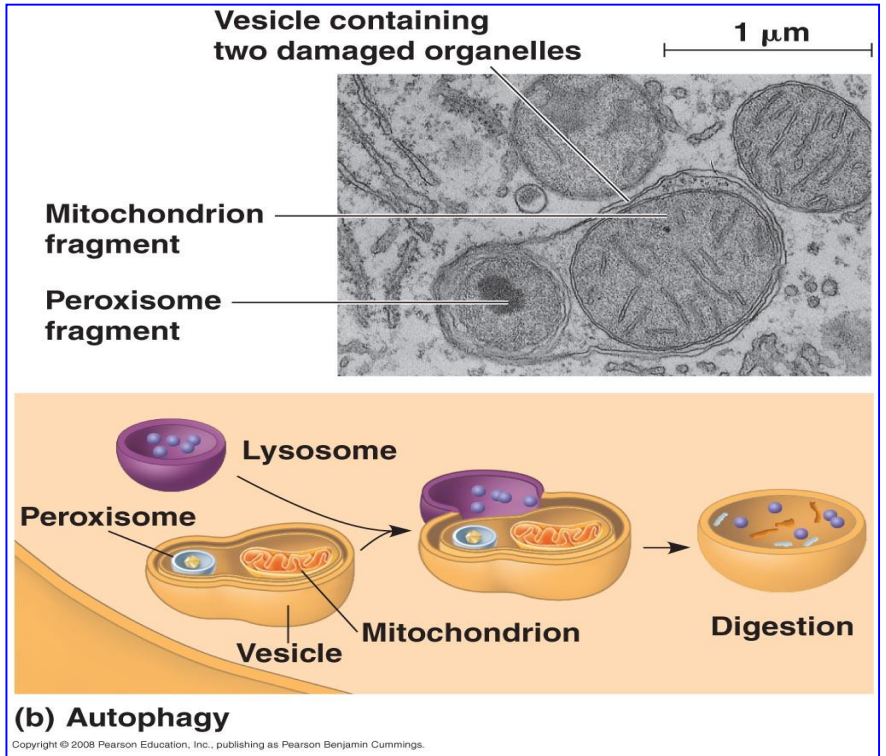
- Golgi and ER transport and secretory vesicles
- Peroxisome
  - -Where **fatty acids** are metabolized
  - -Where **hydrogen peroxide** is **detoxified**
- Lysosome
  - -contains digestive **enzymes**
  - -Digests unwanted cell parts and other wastes
- Vacuoles
  - - is a membrane-bound organelle which is present in all plant and fungal cells and some protist, animal and bacterial cells
  - - **larger** forms of vesicles
  - - Animal vacuoles are **smaller** that their plant counterparts but also usually greater in **number** // **exocytosis** and **endocytosis**

Lysosomes

Structure: Small membrane-bound organelles , but **bigger** than ribosomes (packets of hydrolytic enzymes that break down materials in a cell),
Function:

- Breaks down (**digests**) food, bacteria and waste
- **Autophagy –** Breaks down damaged organelles
- **Programmed for cell death** break down the cell when it dies, called **"suicidal bags"** of the cell





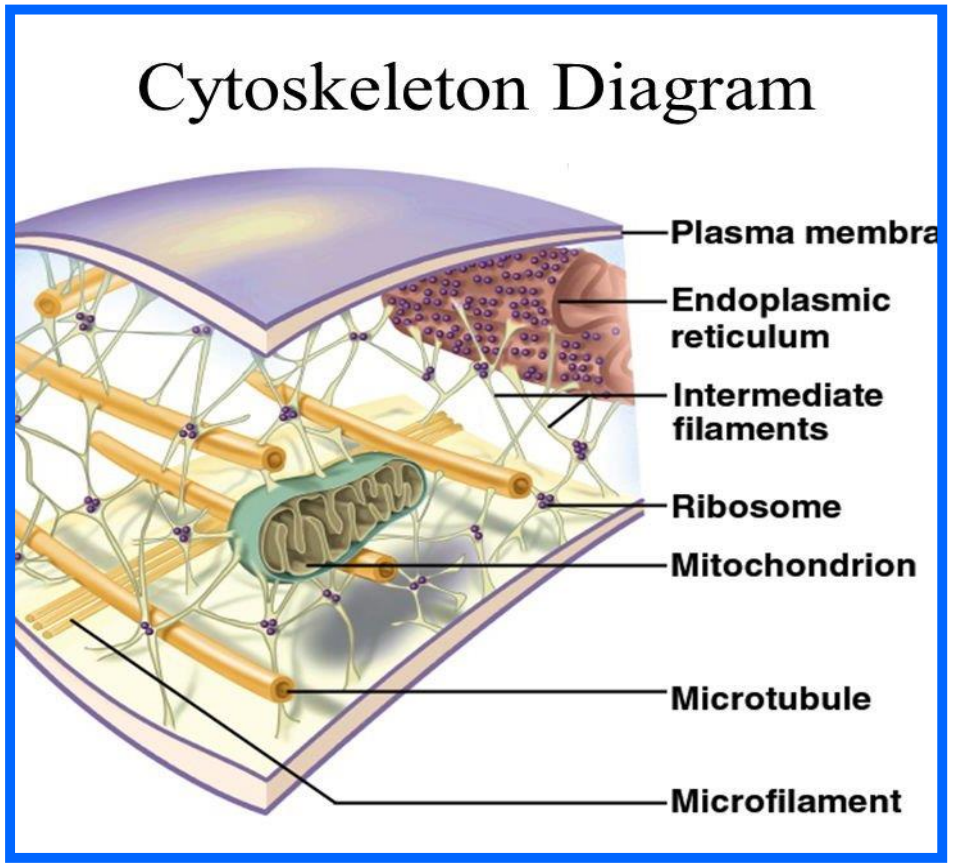
Support & Movement

***Cytoskeleton** ***Centrioles** ***Cilia & Flagella**

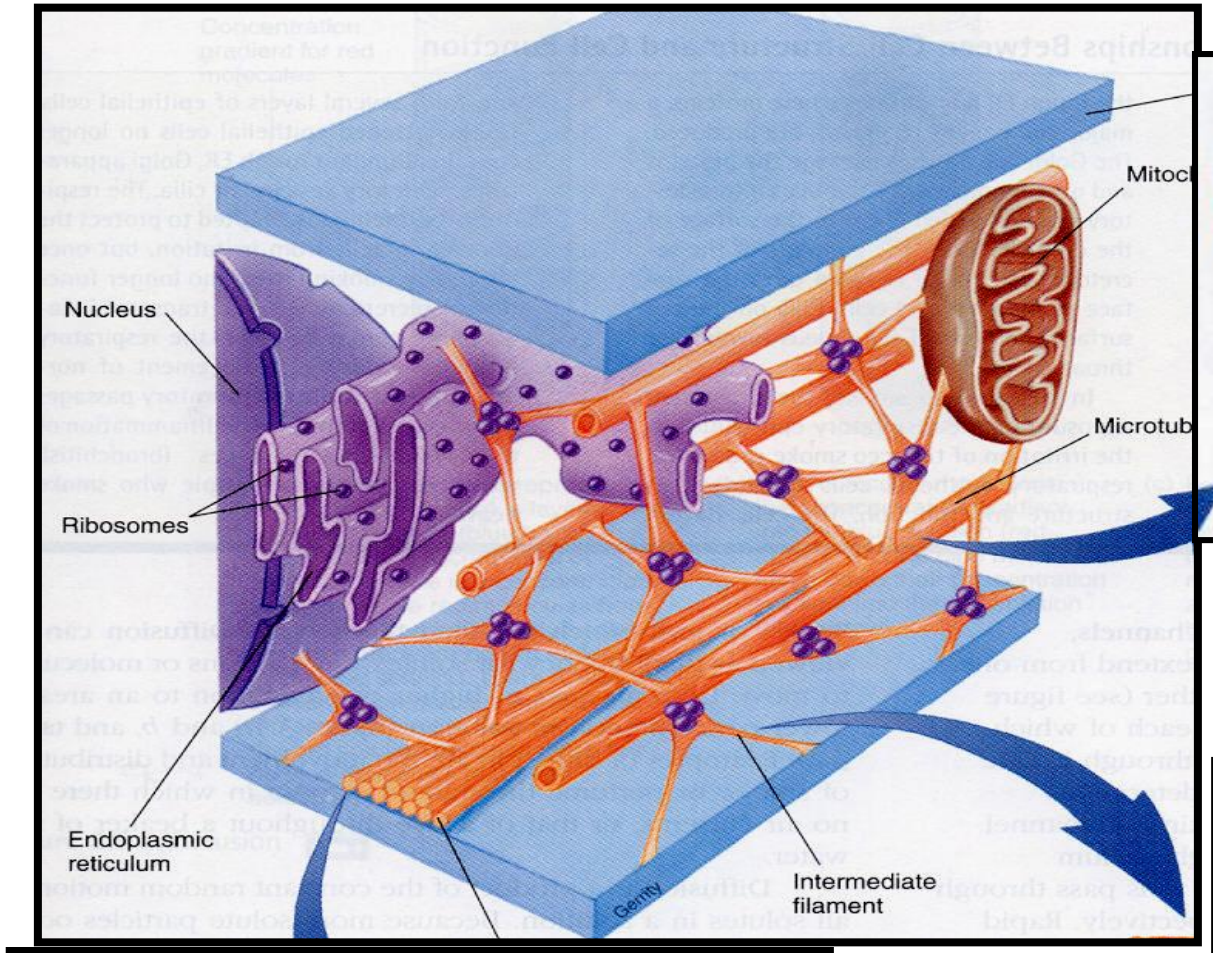
Cytoskeleton

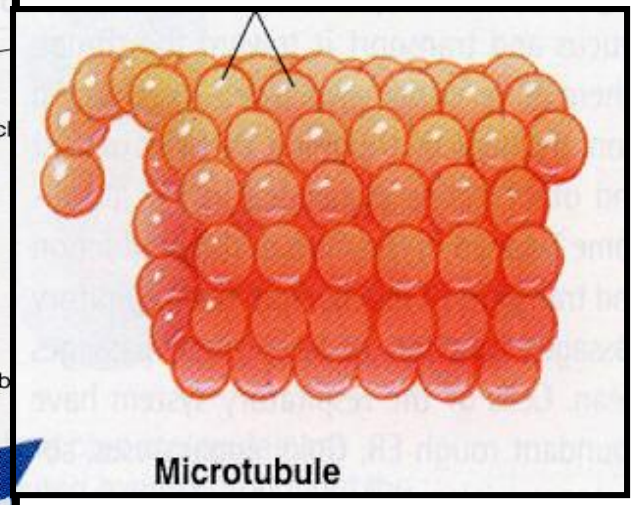
Proteins that **support** the cell, **hold** organelles in place, enable cell to **change shape**

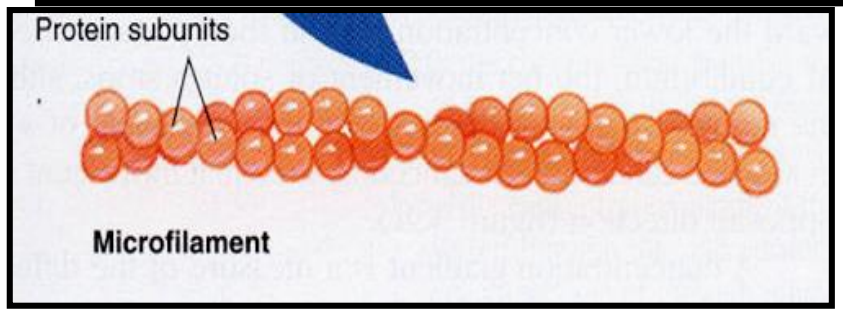
- **Function**
  - Support
  - Motility
  - Regulation of internal structure
- **Types**
  - Microtubules
  - Microfilaments
  - Intermediate Filaments

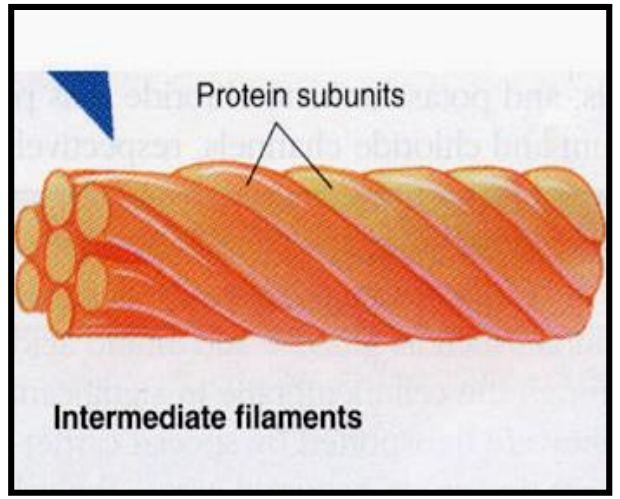


Cytoskeleton







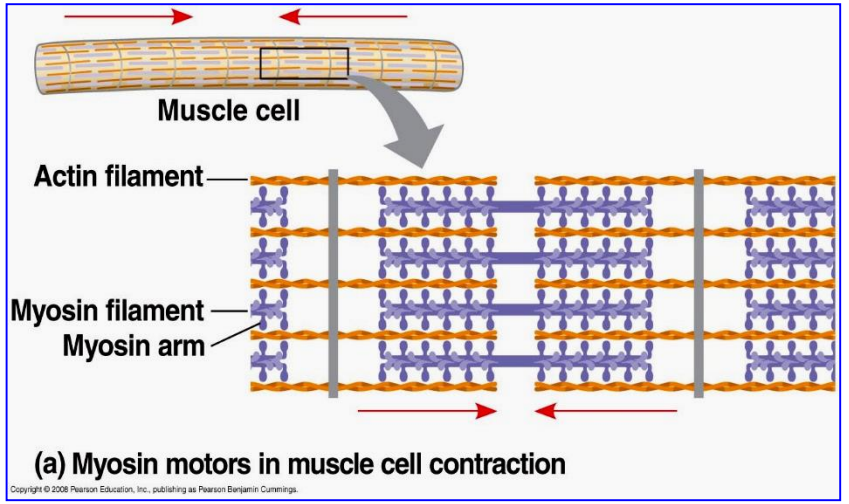


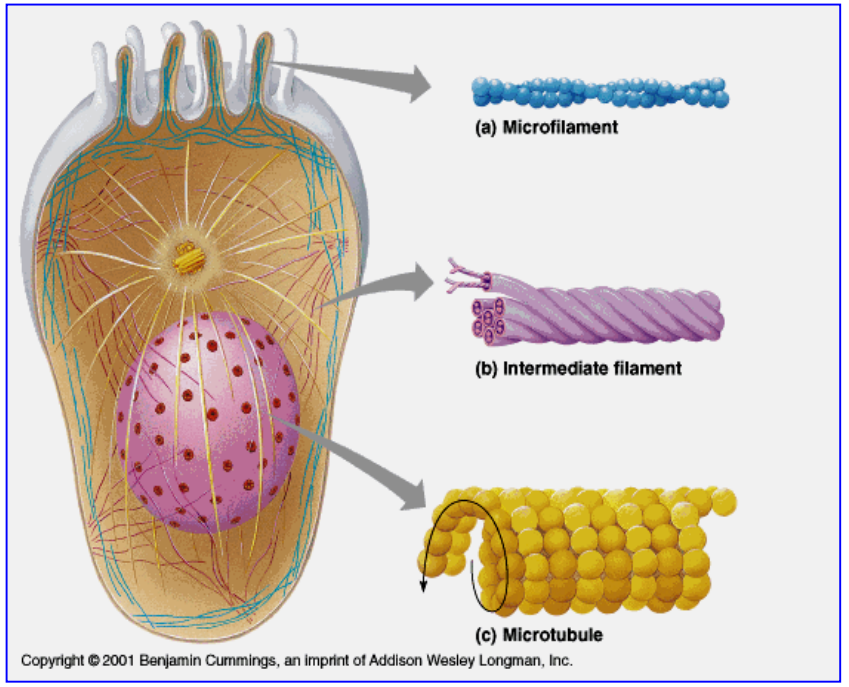
The cytoskeleton of eukaryotic cells is **not stable**, but is always being **assembled** & **disassembled**

Microfilaments: are **threadlike** composed of the proteins **actin *//*myosin**. Provide for structural **support**. Involved in **cell movement muscle cell contraction**, **changes** in cell membrane **shape**- amoeba; Movement of cilia & flagella

Microtubules: are **tube-like &** made of **TUBULIN** i.e. hollow structures helps provide **support** to cytoplasm. **Forms** organelles such as **cilia & flagella** & **centrioles**.

Intermediate Filaments: Bigger than microfilaments but smaller than microtubules, provides **tension bearing Permanent fixtures** of cells (**do not move**) Present only in **animal cells** of certain tissues





Cilia & Flagella

Function: provides **movement** for the **cell** or **objects** moving by the cell

Microtubules wrapped in an extension of the plasma membrane (**9 + 2 double** arrangement of microtubules) **(axoneme)**

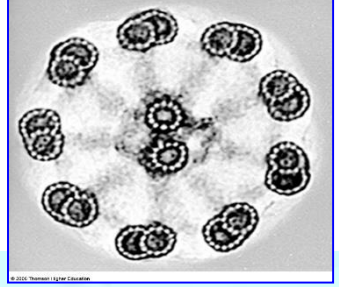
Cilia (cilium) **:** project from cell surface, cylindrical in shape & enclosed by membrane.

Contain microtubules. **Numerous** in certain cells e.g. cells that line **respiratory tract**

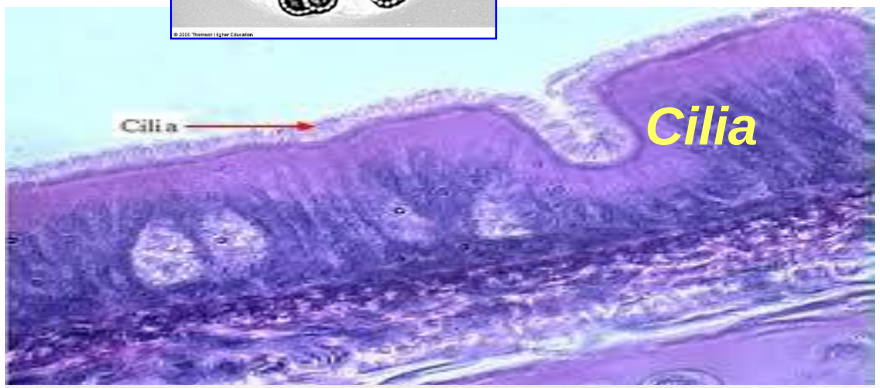
Flagella (flagellum) **:** structure similar to cilia but longer (whip-like). Usually **one-three** in certain cells e.g. **sperm**

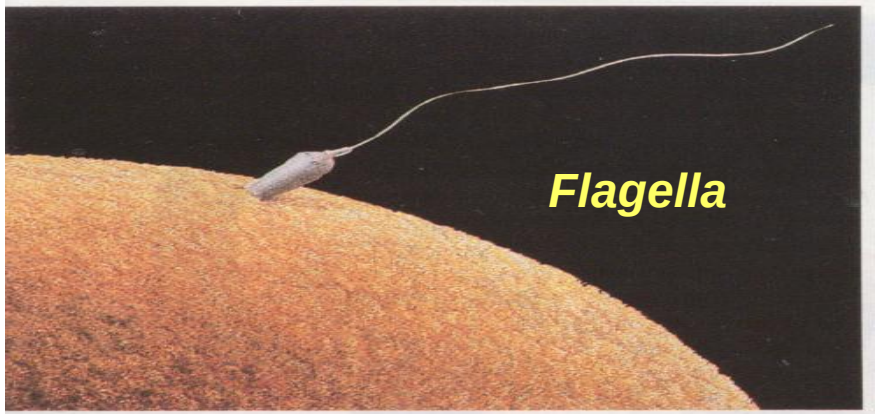
Microvilli (microvillus) : specialized extensions of cell membrane & contain **microfilaments**

Do not move. Function is to **increase surface area** esp. in cells that are used to **absorb** e.g. **intestines, kidney**



9+2 MT

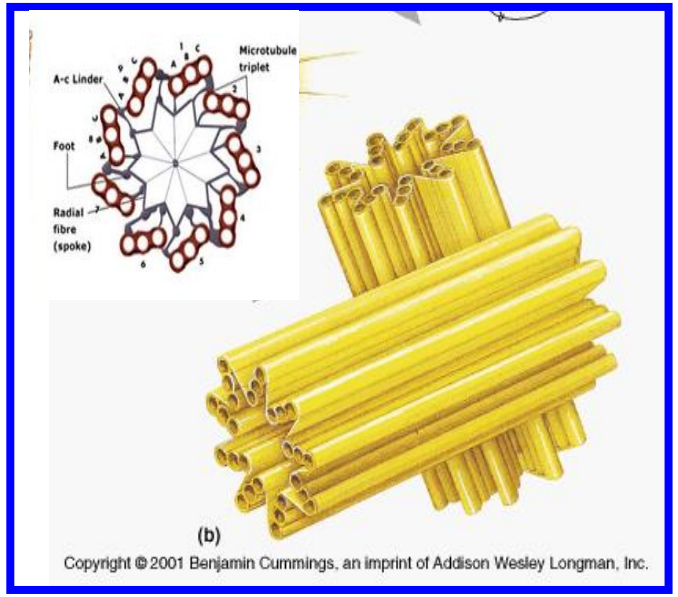


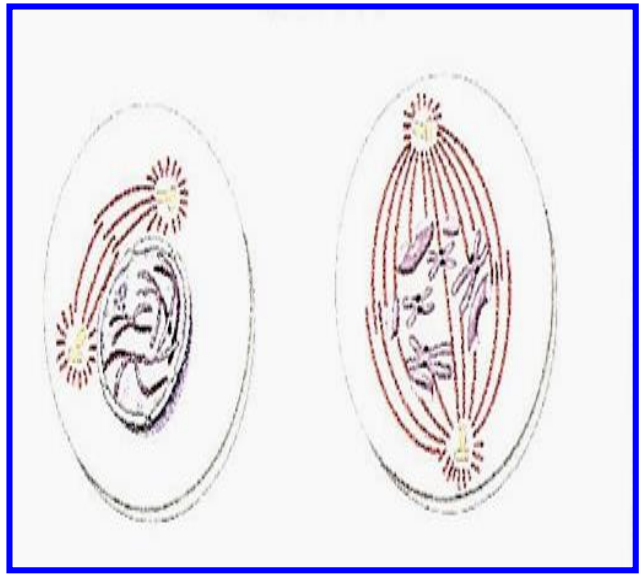


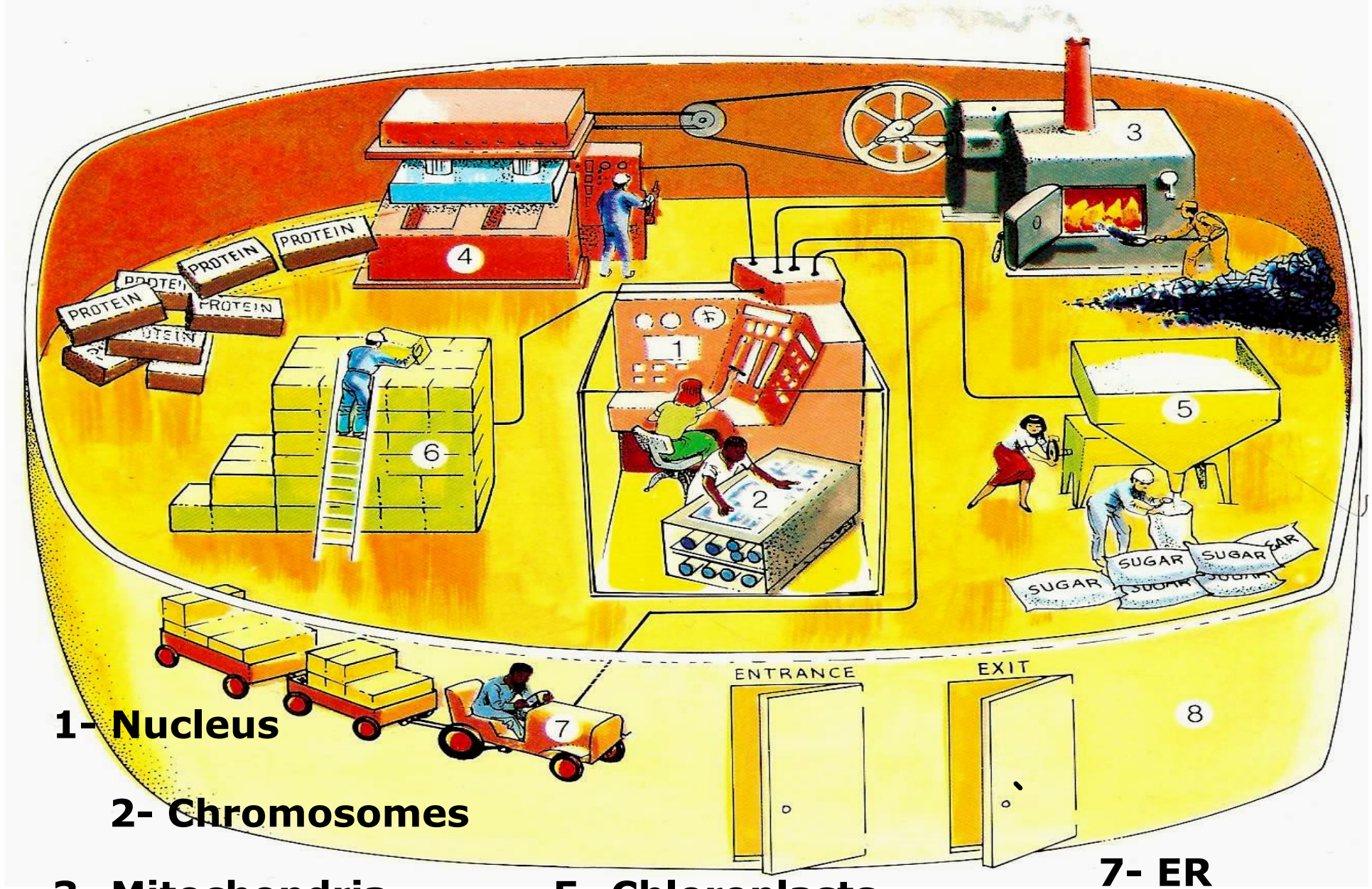
Centrioles

Function: **microtubules** that help divide the cell during cell division via **mitotic spindle// generally appear in animal cells**

Structure: An associated **pair** of centrioles, arranged **perpendicularly** to each other each composed of sets of **microtubules** arranges to form a cylinder. The walls of each centriole are usually composed of **nine triplets** of microtubules







1- Nucleus

2- Chromosomes

3- Mitochondria

4- Ribosomes

5- Chloroplasts

6- Vacuoles

7- ER

8- Cell Membrane