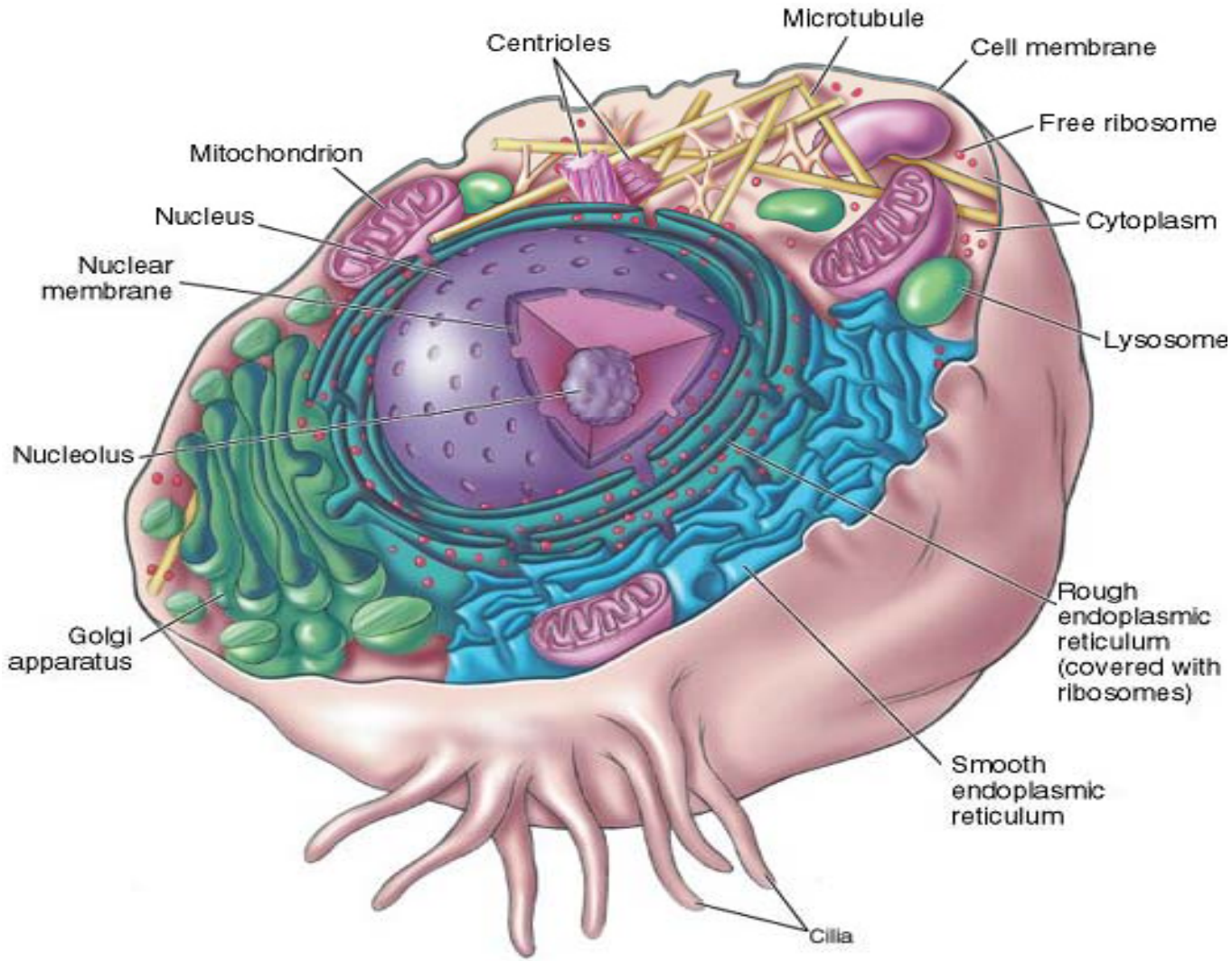
CELLS

Rita Carey-Nita

Cells

- A cell
  - is the structural and functional unit of all living matter.
  - makes up all living organisms
  - each cell has a specific activity in the body
  - Makes up tissues that make up organs


Microtubule
Centrioles
Cell membrane
Free ribosome
Mitochondrion
Nucleus
Cytoplasm
Nuclear membrane
Lysosome
Nucleolus
Rough endoplasmic reticulum (covered with ribosomes)
Golgi apparatus
Smooth endoplasmic reticulum
Cilia

Cells

- Cells vary in shape, size and function

  Examples:

  – RBC's tiny, frisbee shaped & flexible allowing them to squeeze through small vessels

  – Nerve cell are very long and their shape allows them to conduct impulses

Cells

- Despite differences there are many similarities:
  - Cell membrane
  - Cytoplasm
  - Nucleus (except RBC's)

Cell Structure

- Cell membrane:
  - surrounds or encases the cell
  - separates the intracellular material from the extracellular material
  - holds the cell together

  * Think of a grape

Cell Structure

- Cell membrane acts as a gait keeper
- Cell membrane allows certain substances to enter and leave the cell
- This is considered selectively permeable or **Semipermeable**

Cell Structure

- Membrane is composed of:
  - Phosolipids (in two layers)
  - Protein
- Proteins function is:
  - Provide structural support
  - Binding site for hormones
  - Poke holes or pores creating channels for water and dissolved substances to pass

Cell Structure

- Inside the cell is the
  - Cytoplasm
  - Nucleus
  - Cytoplasmic organelles

*Think of an egg: yolk being the nucleus and the cytoplasm being the white

Cell Structure

- Nucleus:
  - Small sphere in the center of the cell
  - Control center
  - Controls work of whole cell

Cell Structure

- Nucleus:
  - Surrounded by a double layered nuclear membrane AKA nuclear envelope
  - Nuclear membrane contains large pores that allow free movement of certain substances between the nucleus and the cytoplasm.
  - Nucleus is filled with a gel-like substance called nucleoplasm

Cells Structure

- Nucleus contains:
  - Nucleous which is concerned with the synthesis of ribosomes
  - Chromatin which are threadlike structures that contain proteins & chromosomes (DNA)

Cell Structure

- Cytoplasm is gel-like substance within the cell but outside the nucleus
- Composed of primarily water, electrolytes & nutrients
- Contains organelles and inclusion bodies

Cell Structure

- Inclusion bodies appear and disappear & include:
  - water vacuoles
  - secretory vesicles
  - various granules

Cyoplasmic Organelles

- Organelles listed have specific jobs:
  - Mitochondria
  - Ribosomes
  - Endoplasmic reticulum
  - Golgi apparatus
  - Lysosomes
  - Cytoskeleton
  - Centrioles

Cytoplasmic Organelles

- Mitochondria
  - Power plant of the cell; “power house”
  - Two layers: smooth outer & folds (cristae) on inner
  - The more metabolically active a cell is the more mitochondria
  - Produces ATP (adenosine triphosphate) which is energy in the body

Cytoplasmic Organelles

Ribosomes:

- Concerned with protein synthesis
- Some float freely in the cytoplasm
- Others are attached to the endoplasmic reticulum

Cytoplasmic Organelles

- Endoplasmic Reticulum
  - Network of long folded membranes
  - Forms channels which substances move inside the cell
- Two types:
  - Rough: sandpaper appearance due to ribosomes that concerned with protein synthesis
  - Smooth: no ribosomes so smooth in appearance concerned with lipid and steroid synthesis

Cytoplasmic Organelles

- Golgi Apparatus:
  - Flattened membranous sacs
  - Packages protein for secretion
- Lysosomes:
  - Membranous sacs containing powerful enzymes
  - Enzymes break down intracellular waste & debris; clean house
  - Participate in phagocytosis

Cytoplasmic Organelles

- Cytoskeleton:
  - Threadlike structures called microtubules or microfilaments
  - Helps cell maintain shape
  - Assist in cellular movement

  Example is in muscle cells containing many microfilaments
- Centrioles:
  - Rod shaped microtubules
  - Play key role in cellular reproduction

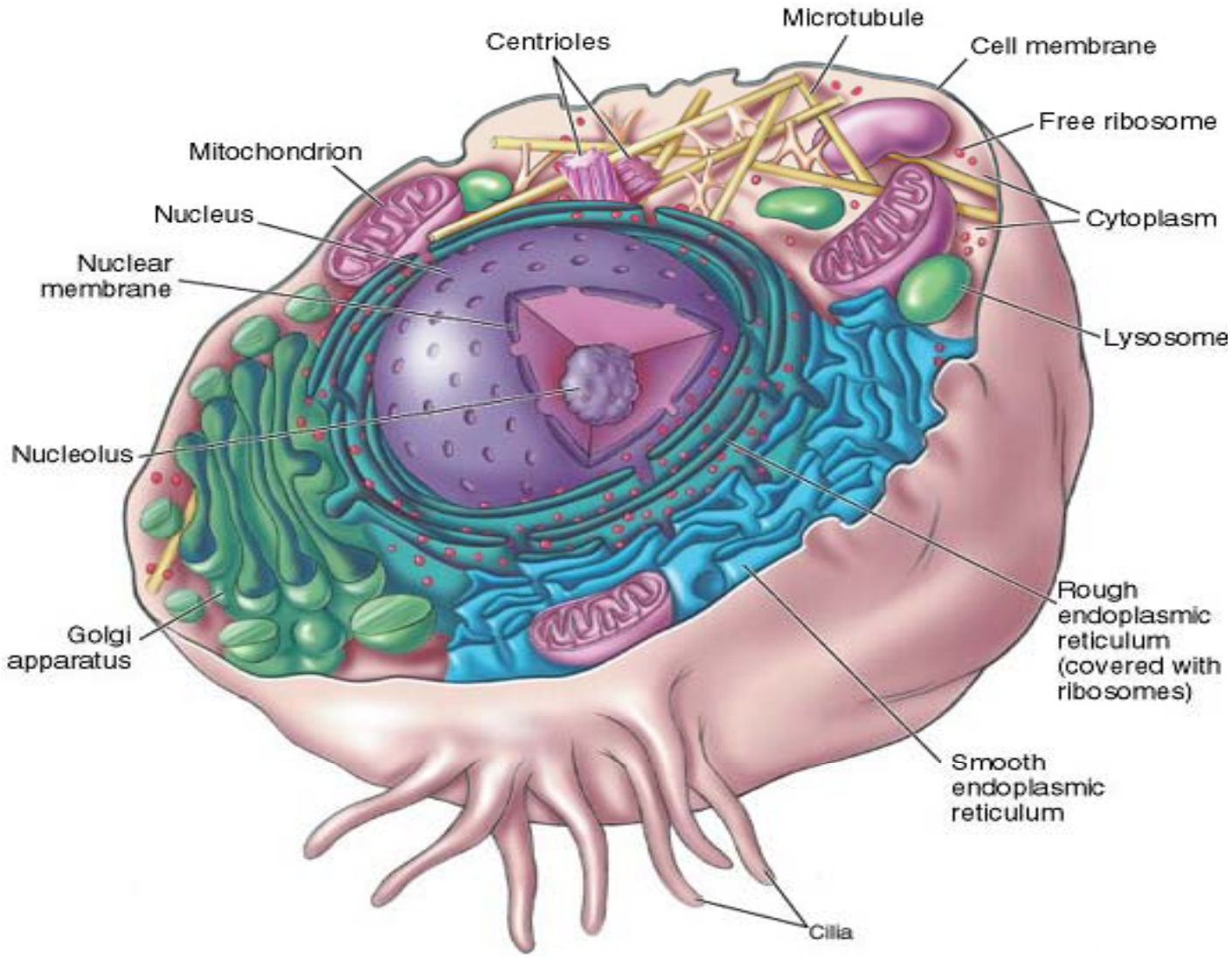
On the Cell Membrane

- Cilia: short hair-like projections on the outer surface of the cell; wave-like motion moves substances across the cell

Examples: fallopian tube and resp. Tract

- Flagella: hair-like projections, thicker & longer that help cell move.

Example: sperm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Movement Across Cell Membrane

- Substances enter and leave the cell continuously
- Nutrients enter and waste products exit
- Mechanism assist in the movement of water and dissolved substances across the cell membrane

- Two transport mechanisms:
  - Passive Transport
  - Active Transport
- Passive transport requires no energy in the form of ATP
- Active transport requires energy in the form of ATP

Passive Transport

- Diffusion: movement from area of higher concentration to an area of lower concentration

Example: sugar cube in cup of water

- Facilitated Diffusion: substances move from a higher concentration to lower concentration across the membrane with the help of a molecule in the membrane

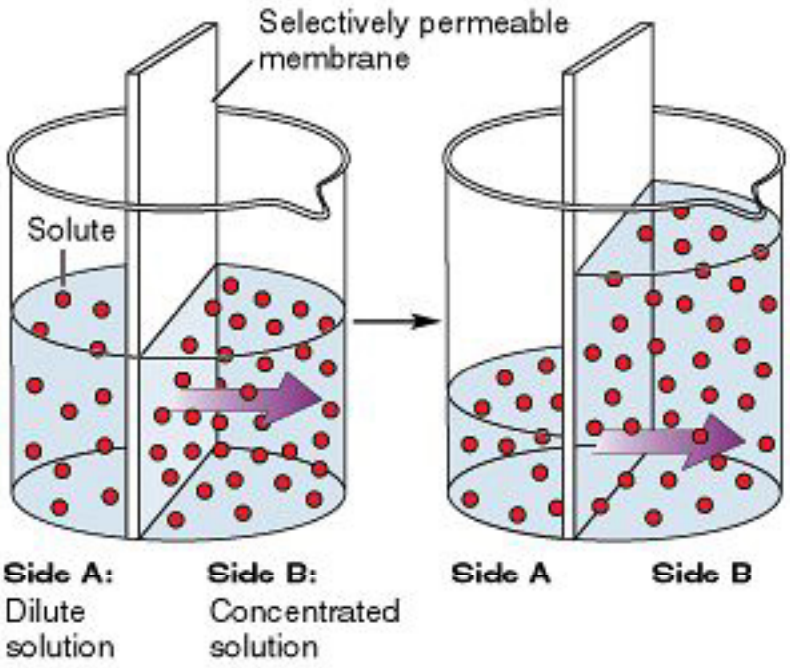
Passive Transport

- Osmosis: special case of diffusion. Diffusion of water through a selectively permeable membrane. Water moves from an area of more to an area of less. Dissolved substances do not move.
- When dissolved substances such as protein and glucose are confined in a space by selectively permeable membrane they can pull water into the compartment. This is called **OSMOTIC PRESSURE**

Passive Transport

- Example of Osmotic Pressure:
  - Tissue injury causes leakage & accumulation of proteins within the tissue space.
  - The protein within the tissue space acts osmotically and pulls water toward them.
  - The accumulation of water is edema.

Osmosis


Selectively permeable membrane
Solute
Side A:
Dilute solution
Side B:
Concentrated solution
Side A
Side B

Passive Transport

- Tonicity: when two compartments containing different concentrations of solute interact water movement is effected in three ways:
  - Isotonic
  - Hypertonic
  - Hypotonic

Passive Transport

- Isotonic: means same; concentration are the same on both sides; intracellular & extracellular; cell does not gain or lose water
  - Isotonic solutions administered intravenously include: Normal Saline & Dextrose in Water

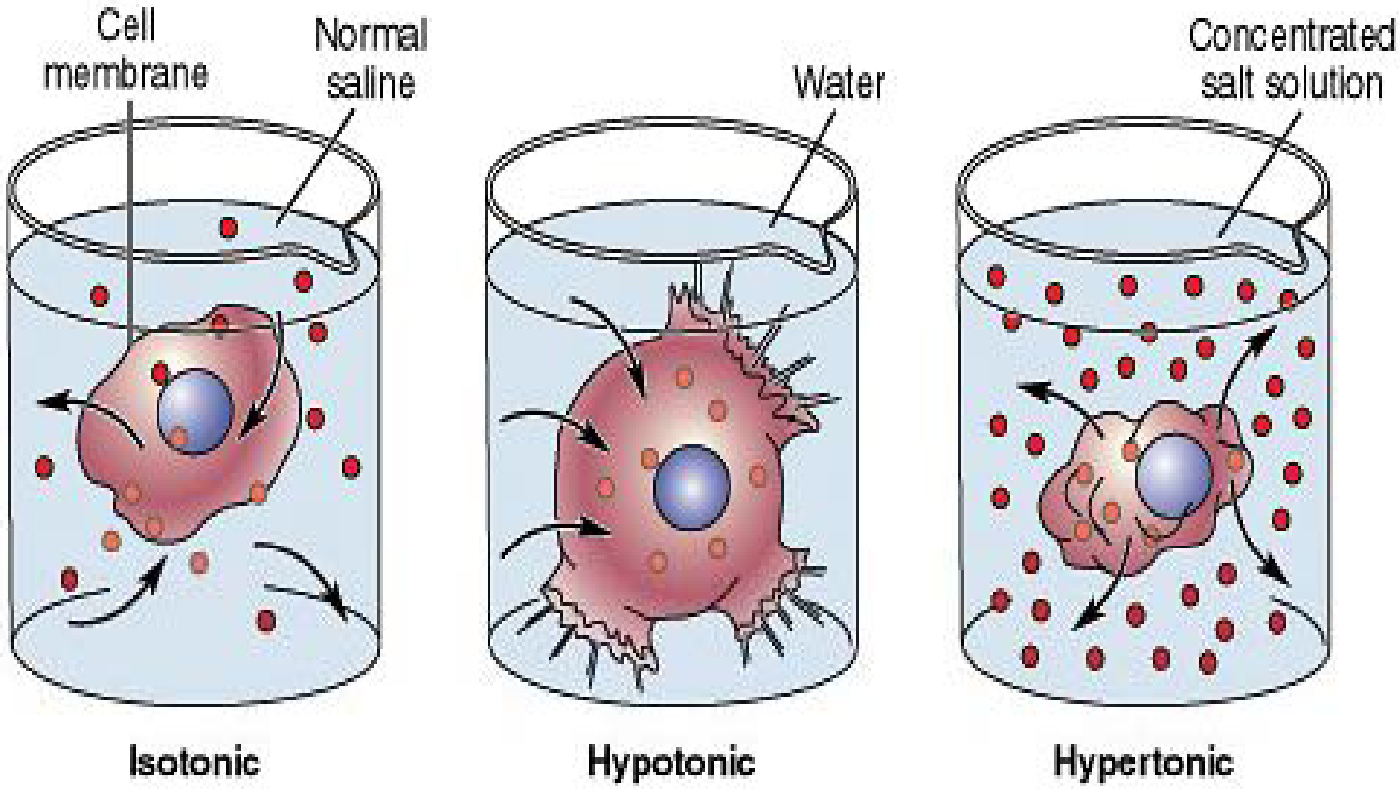
Passive Transport

- Hypotonic: water moves to more concentrated area; water moves from extracellular to intracellular; the solution the cell is placed in is less concentrated than inside the cell

Example: if RBC's is placed in pure water the water moves into cell by osmosis causing it to burst called HEMOLYSIS.

Passive Transport

- Hypertonic: solution is more concentrated; water moves from intracellular to extracellular; area of less concentration to area of more concentration
- Causes cell to shrink: CRENATION


Cell membrane
Normal saline
Water
Concentrated salt solution
Isotonic
Hypotonic
Hypertonic

Passive Transport

- Filtration
  - Water and dissolved substances move across the membrane in response to differences in pressure
  - Pushing power
  - Pressure in the capillaries pushes water and dissolved substances out of the blood into the tissue space

Active Transport Mechanism

- Requires input of energy (ATP)
- Amount of substance in the cell is already great so in order to add substances need to pump them in
- Movement from an area of low concentration to an area of high concentration

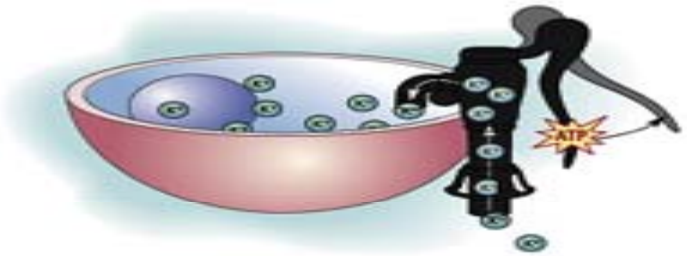
Active Transport

- Endocytosis: active transport mechanism that involves the intake of food or liquids by a cell membrane.
- The particle is too large to move across the membrane.
- It is engulfed by the membrane and taken inside the cell.

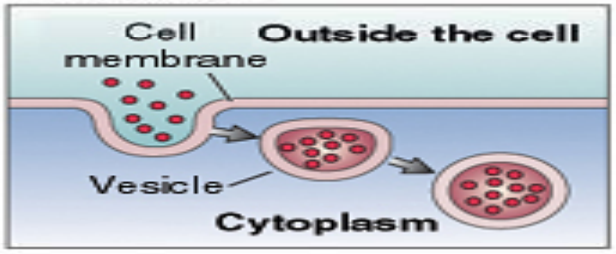
Active Transport

- Two types of Endocytosis:
  - Phagocytosis: involves solid particles
  - Pinocytosis: involves ingestion of liquid
- Exocytosis: movement of substance out of the cell.

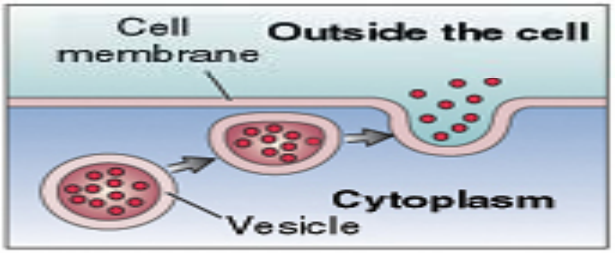
Example: cells of pancreas make proteins for use outside the pancreas



Endocytosis



Exocytosis



Cellular Division

- Necessary for bodily growth and repair
- Two types:
  - Meiosis: occurs only in sex cells
  - Mitosis: occurs with body growth & repair
    - splitting of one mother cell into two identical daughter cells

Cellular Division

- Mitosis occurs in five phases:
  - Interphase: chromosomes double, longest phase for cell, resting phase even though cell is active and growing
  - Prophase-Metaphase-Anaphase: pairs of chromosomes line up in middle; spindles attach and pull each pair to right or left, results in seperation of chromosomes into two identical sets
  - Telephase: outer membrane constricts and pinches the cell in half forming two identical cells.

Cell Differentiation

- Cell Differentiation:
  - Cells start to specialize.
  - Exact way is unknown
  - Cells that fail to differentiate are indicative of malignant cells