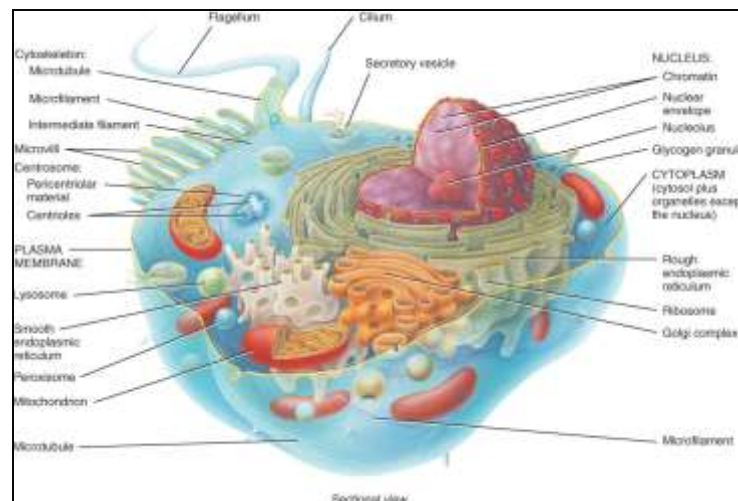


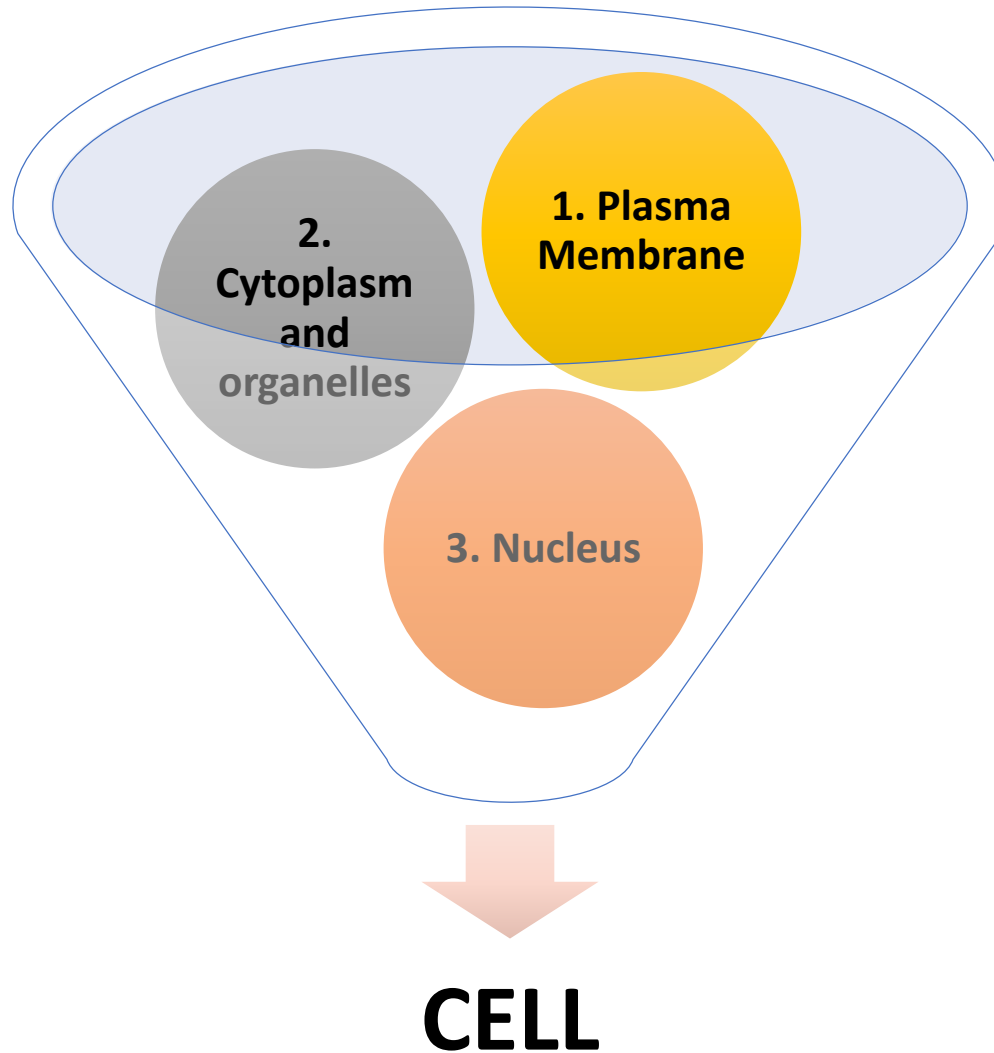
Chapter 3 – Cellular Level

INTRODUCTION

- ◆ A cell is the basic, living, structural, and functional unit of the body.
- ◆ Cytology is the study of cell structure, and cell physiology is the study of cell function.



Parts of a Cell

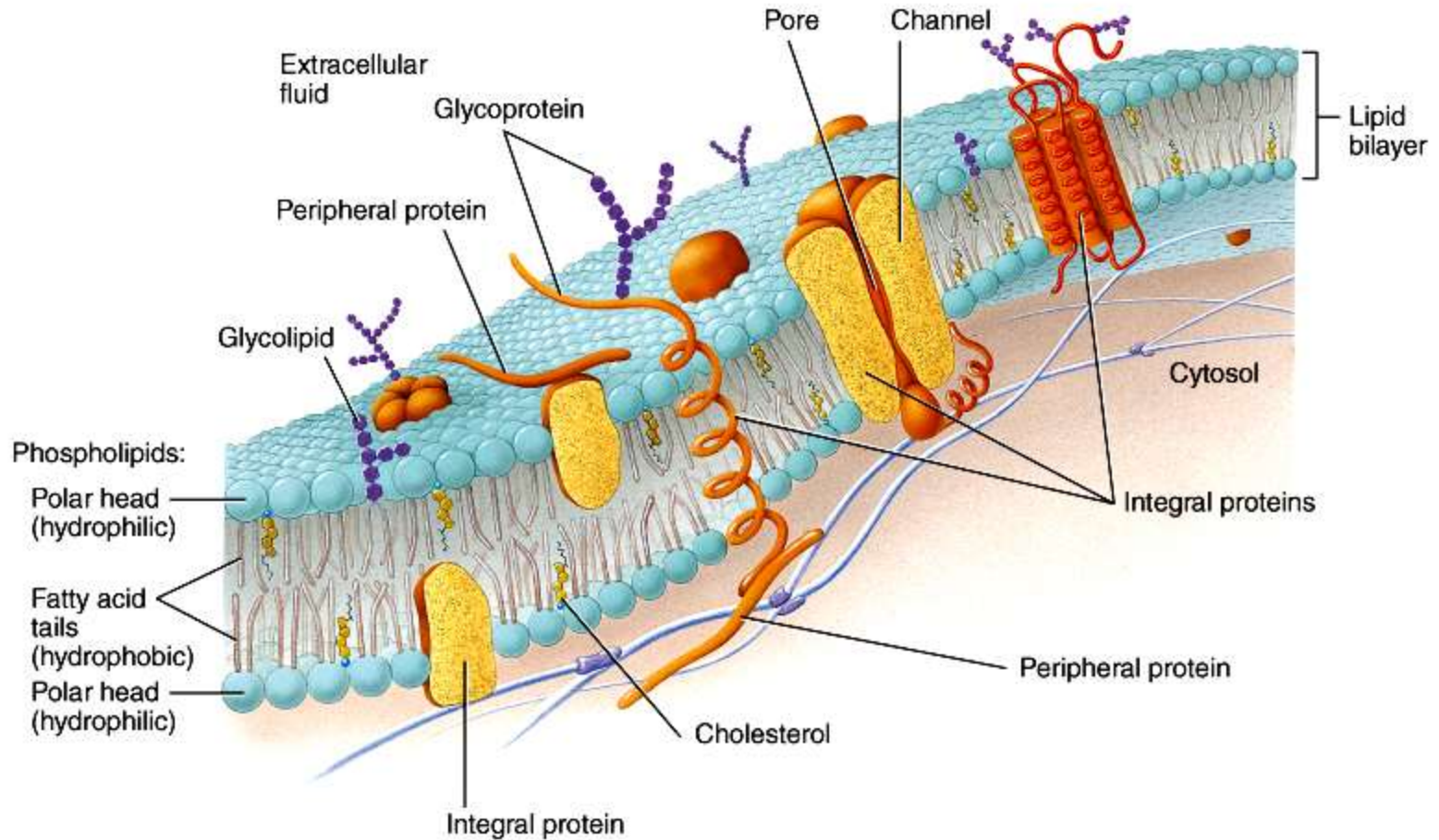


1. Plasma Membrane

- Parts
- Functions
- Membrane permeability
 1. Concentration gradients
 2. Active
 3. Passive transport



Plasma Membrane Parts

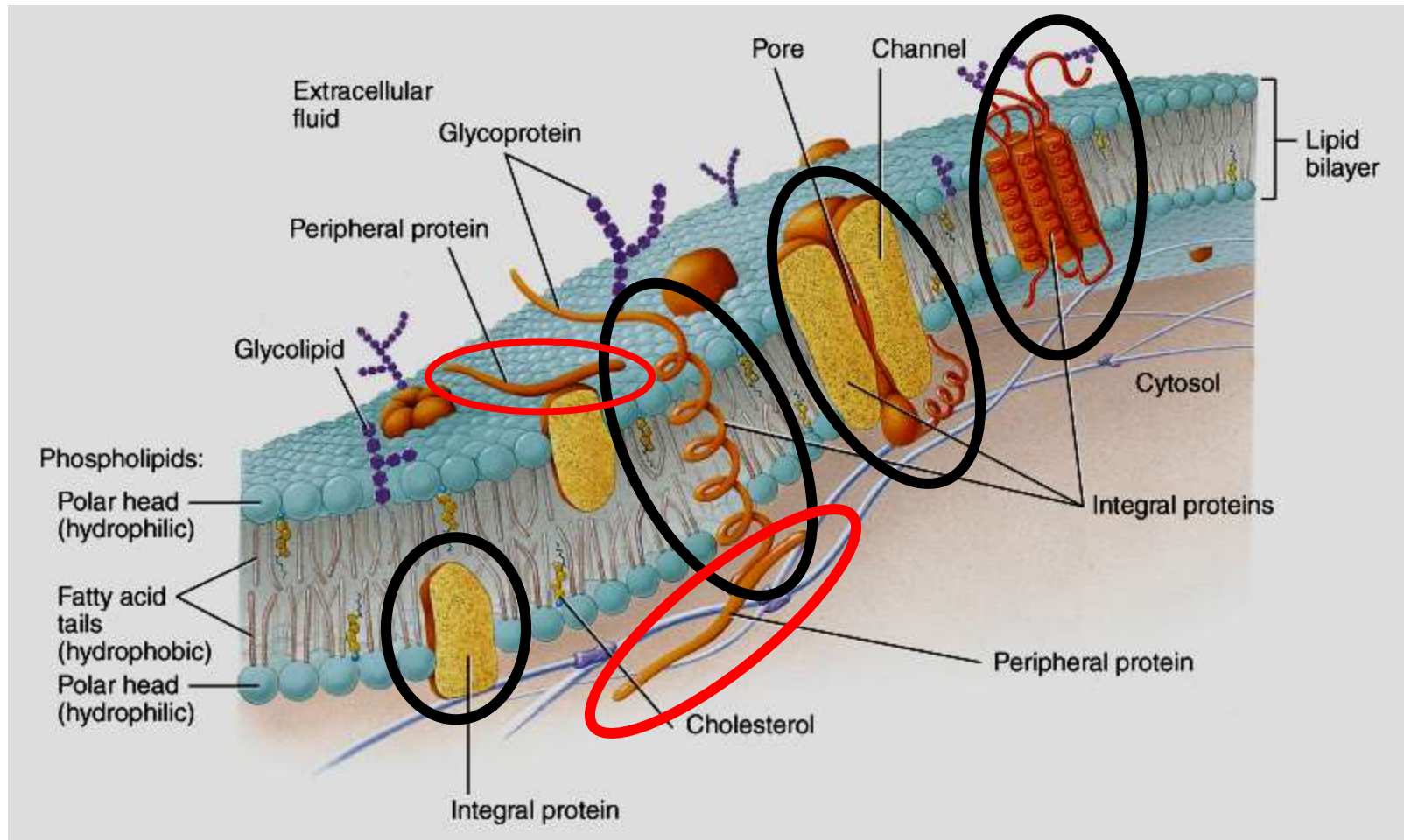


◆ Fluid Mosaic Model

◆ Two back-to-back layers of 3 types of lipid molecules:

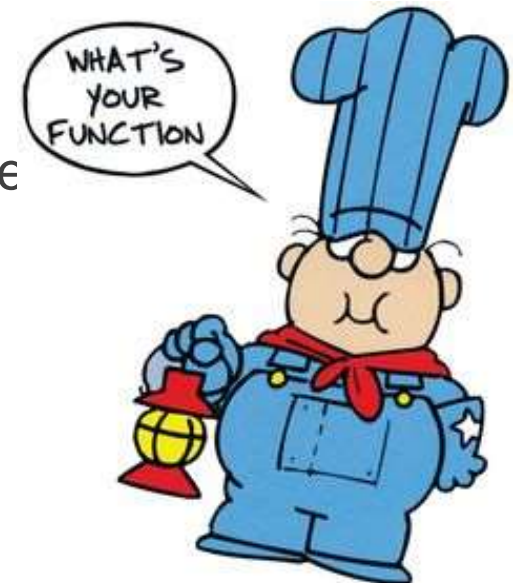
- ◆ Cholesterol and glycolipids scattered among a double row of phospholipid molecules

Plasma Membrane Parts - Integral versus Peripheral Proteins



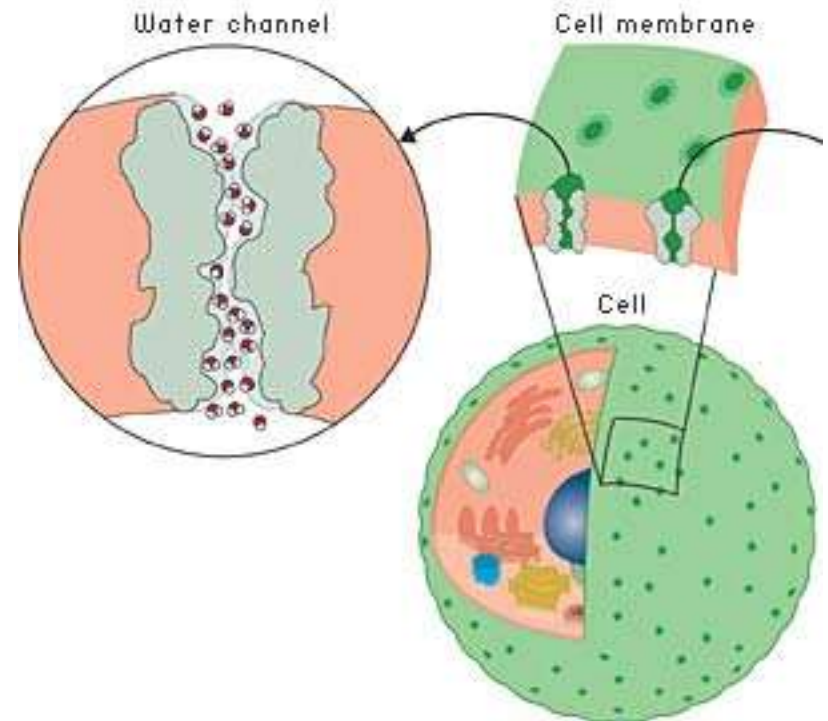
Functions of Membrane Proteins

1. Formation of Channel
 - passageway to allow specific substance to pass through
2. Transporter Proteins
 - bind a specific substance, change their shape & move it across membrane
3. Receptor Proteins
 - cellular recognition site -- bind to substance
4. Cell Identity Marker
 - allow cell to recognize other similar cells
5. Linker
 - anchor proteins in cell membrane or to other cells
 - allow cell movement
 - cell shape & structure
6. Act as Enzyme
 - speed up reactions



Membrane Permeability

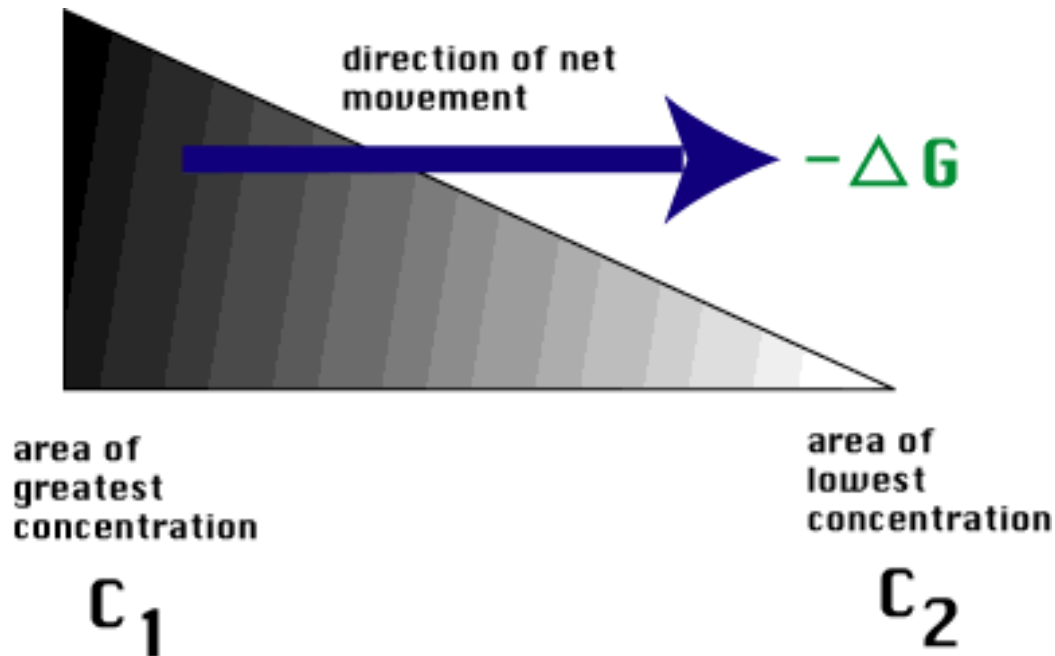
- Plasma membranes are selectively permeable.
 - Some things can pass through and others cannot.
- The lipid bilayer portion of the membrane is permeable to small, nonpolar, uncharged molecules but impermeable to ions and charged or polar molecules.
- The membrane is also permeable to water because of aquaporins.





Gradients Across the Plasma Membrane

A concentration gradient is the difference in the concentration of a chemical between one side of the plasma membrane and the other.



Transport Across the Plasma Membrane

Substances cross membranes by a variety of processes:

- **Passive Transport** – no ATP is required
 - **Simple Diffusion**
 - Osmosis
 - **Facilitated Diffusion**
 - Channel-mediated facilitated diffusion
 - Carrier-mediated facilitated diffusion
- **Active Transport** – ATP (energy) is required
 - **Primary Active Transport**
 - **Secondary Active Transport**

Transport Across the Plasma Membrane

Passive Transport – no ATP is required

- Simple Diffusion
- Facilitated Diffusion

Simple Diffusion

- **Definition:** Movement of **small molecules** (like oxygen or carbon dioxide) **directly through the cell membrane**.
- No energy required.
- Molecules move **from high → low concentration**.

Osmosis (water diffusion)

Definition: A special type of diffusion for **water molecules**.

- Water moves across a **semi-permeable membrane** from an area of **more water (less solute) → less water (more solute)**.
- No energy required.

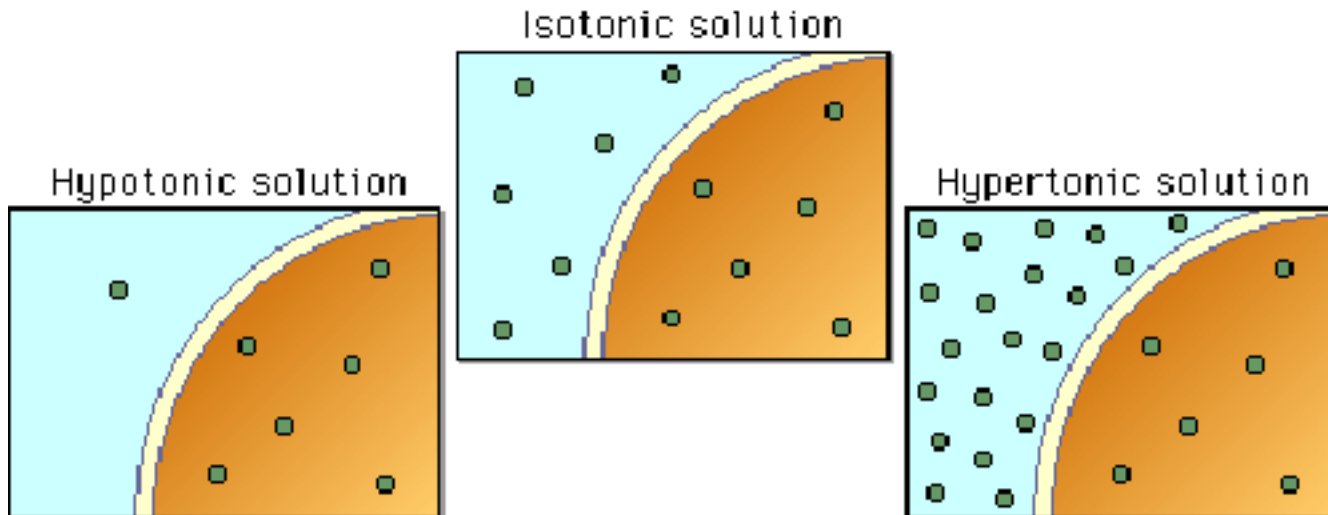
Tonicity

Definition:

Tonicity describes the **ability of a solution to change the shape of a cell** by affecting **water movement** across the cell membrane.

Types of Tonicity:

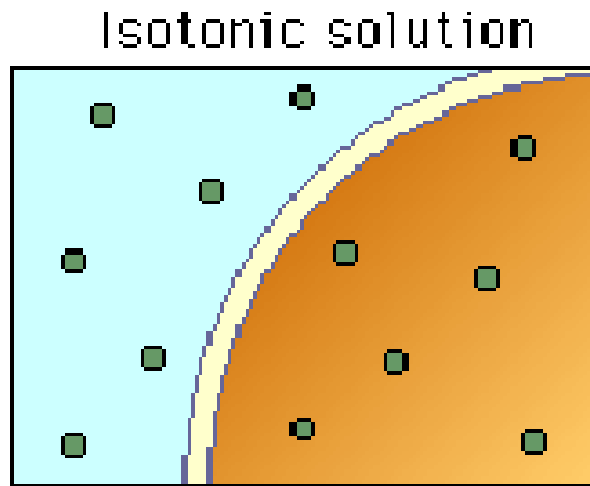
- Isotonic Solution
- Hypotonic Solution
- Hypertonic Solution



Tonicity

Isotonic Solution

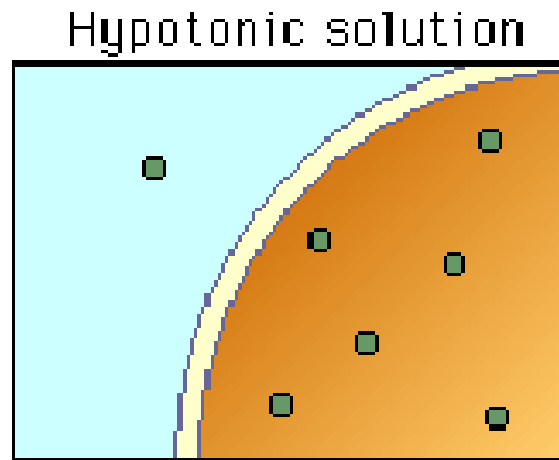
- The concentration of solutes **outside the cell** = **inside the cell**.
- Water moves **in and out equally**.
- **Result:** Cell stays the **same size**.



Tonicity

Hypotonic Solution

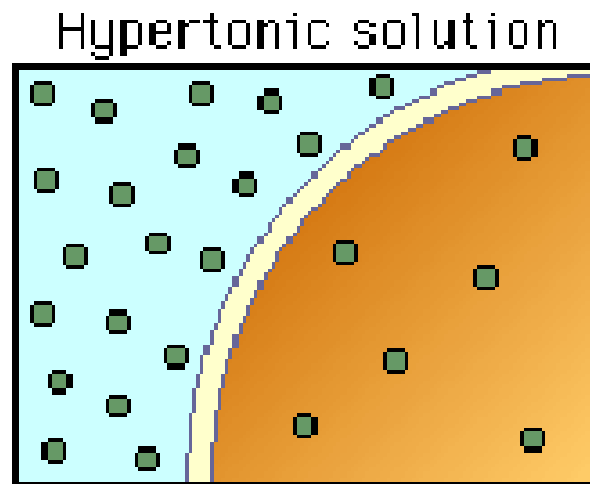
- The solution outside the cell has **less solute than inside the cell**.
- Water moves **into the cell**.
- **Result:** Cell may **swell or burst (lysis)**.



Tonicity

Hypertonic Solution

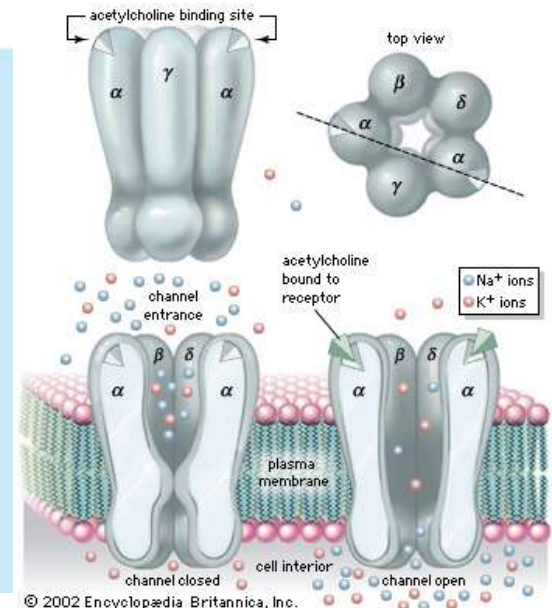
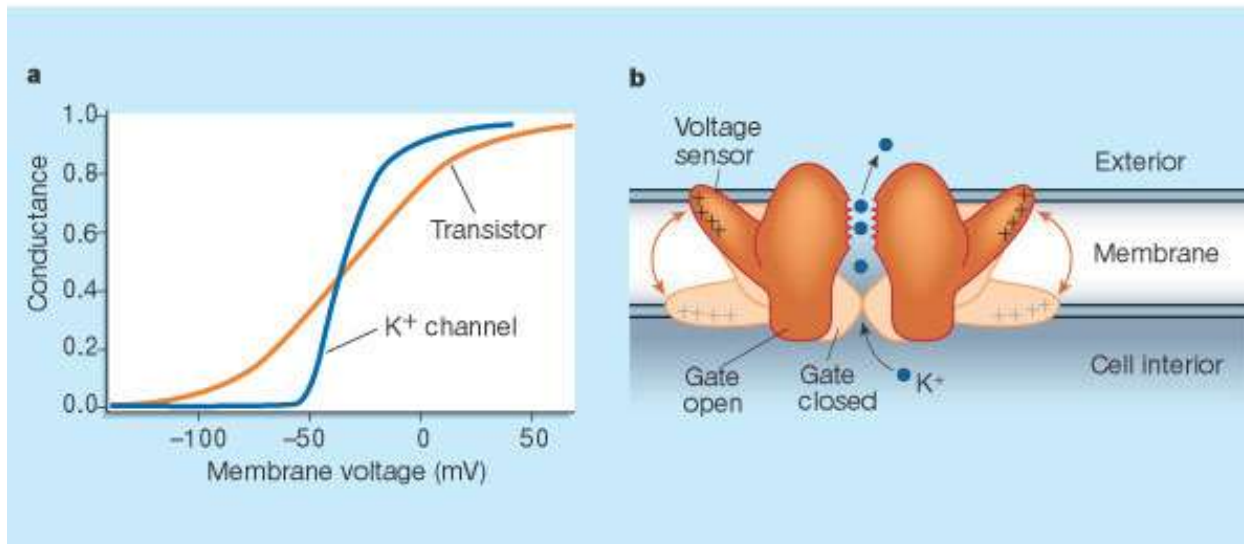
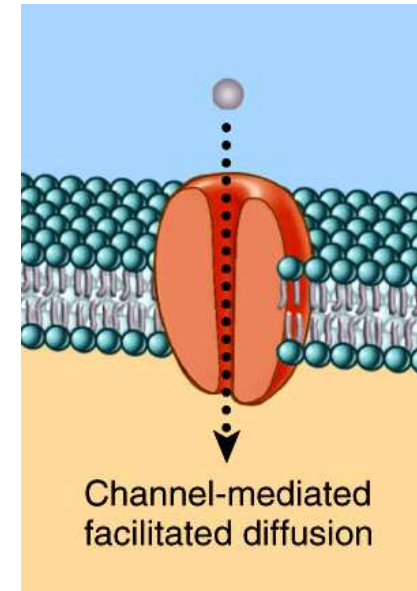
- The solution outside the cell has **more solute than inside the cell**.
- Water moves **out of the cell**.
- **Result:** Cell shrinks.



Facilitated Diffusion

Channel Mediated Facilitated Diffusion

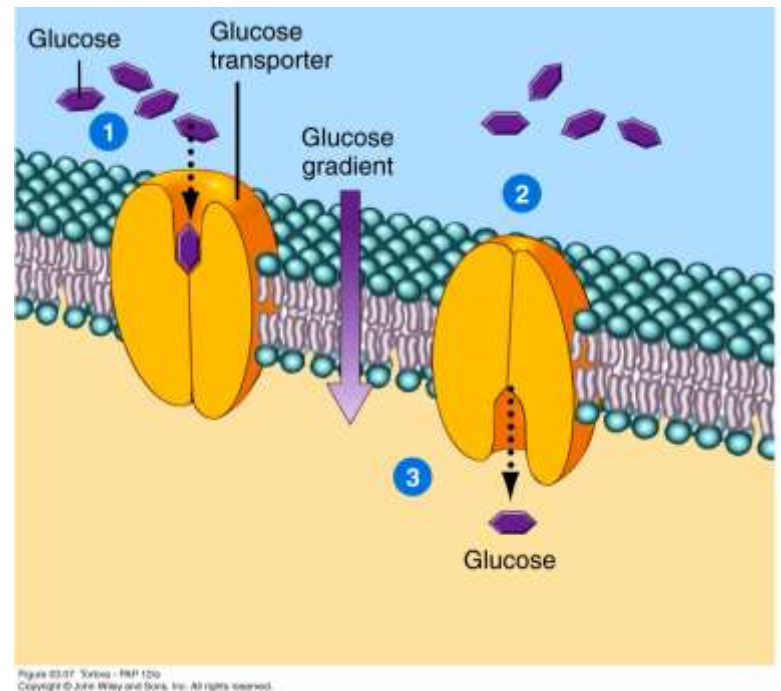
1. Simple channel
2. Voltage-gated channel
3. Ligand-gated channel



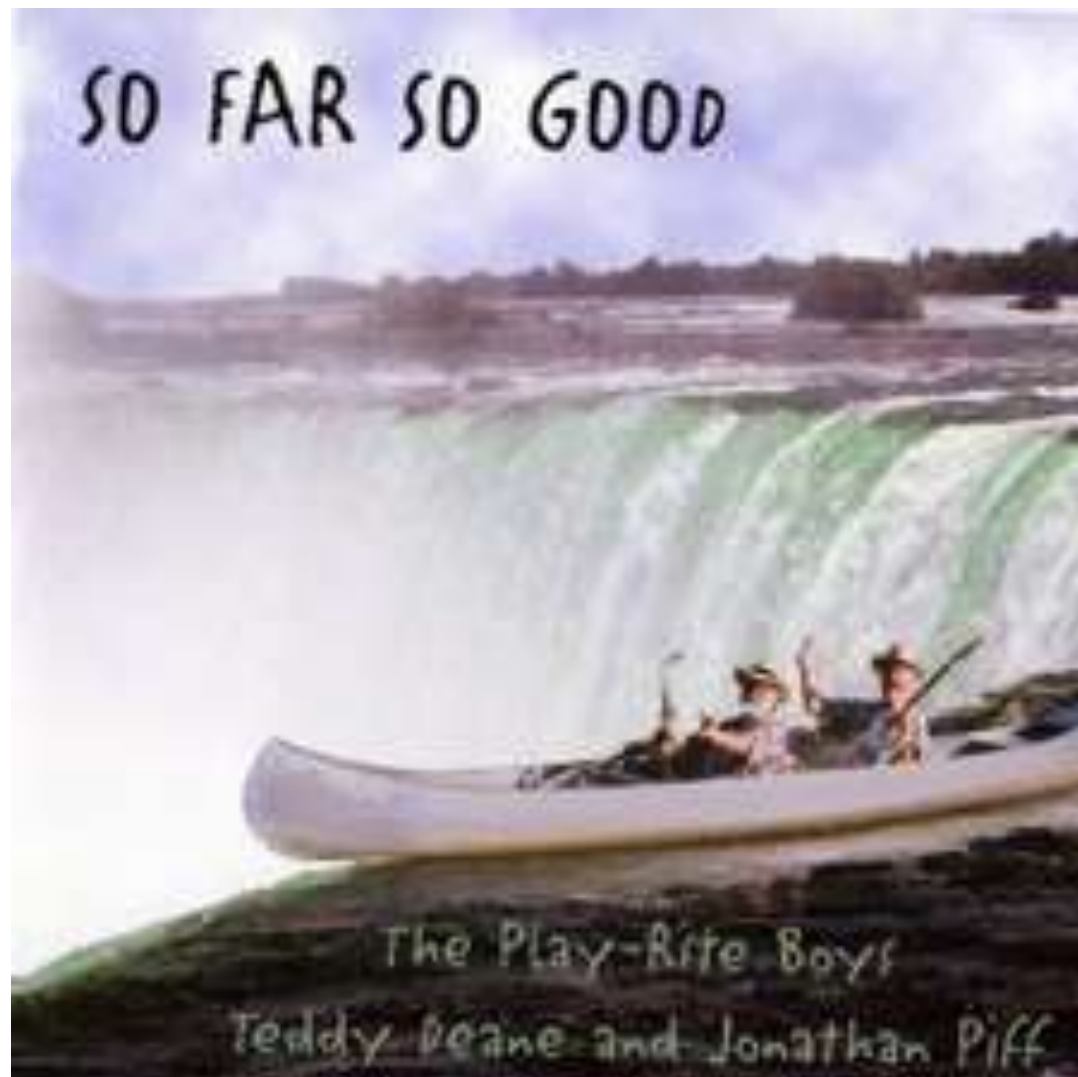
Facilitated Diffusion – Carrier Mediated

Transport maximum – upper limit on the rate at which facilitated diffusion can occur

Before transport maximum is reached (think a saturated sponge) the rate of carrier-mediated facilitated diffusion is determined by the steepness of the concentration gradient across the membrane.



Good so far?



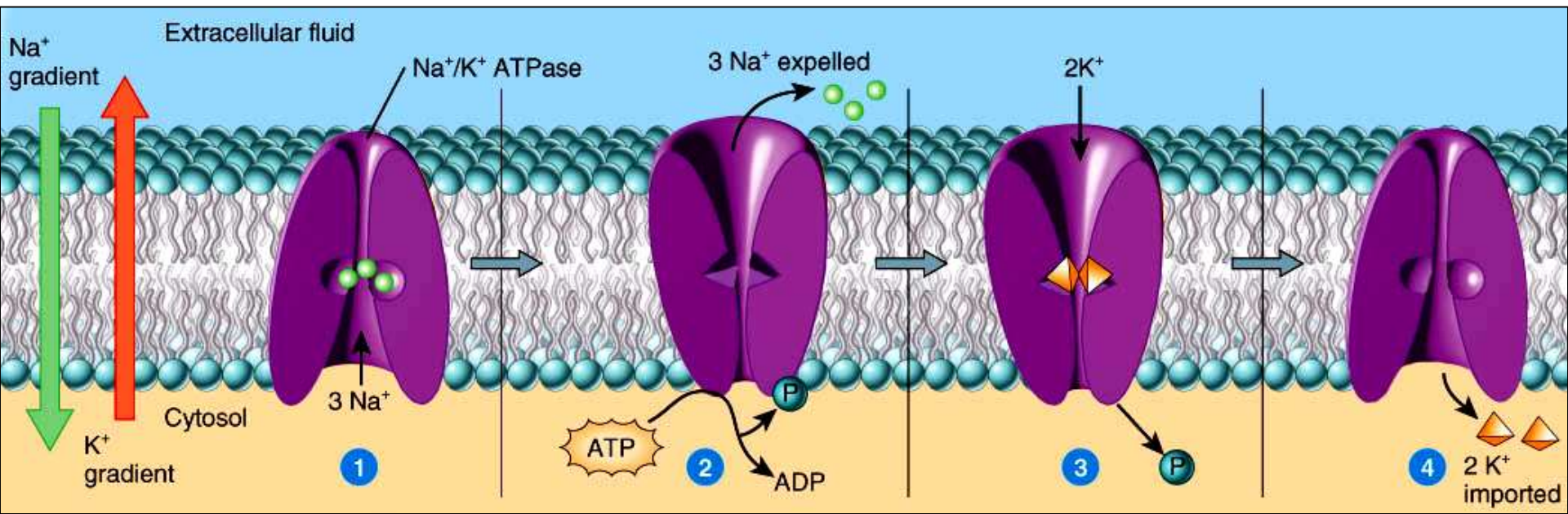
Active Transport

- Distinguishing characteristics:
 - A substance moves against its concentration gradient.
 - It requires a carrier molecule.
 - Uses ATP
- There are 3 types of active transport:
 1. **Primary active transport** requires the direct use of ATP to drive a sodium-potassium pump.
 2. **Secondary active transport** is driven by a concentration gradient of ions established by primary active transport.
 3. **Vesicular Transport**

1. Primary Active Transport

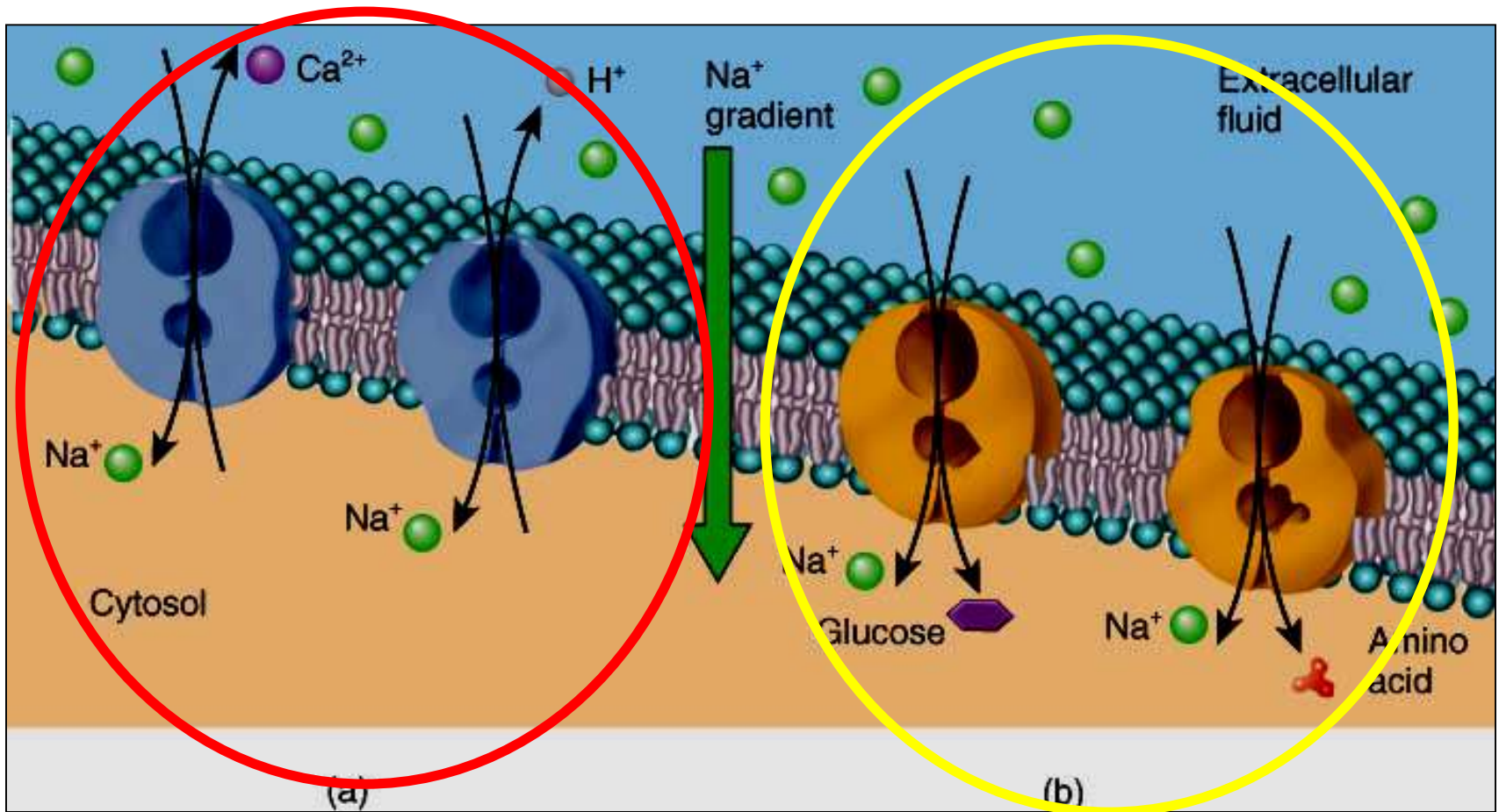
Primary active transport requires the direct use of ATP to drive a sodium-potassium pump.

The most prevalent primary active transport mechanism is the sodium ion/potassium ion pump.



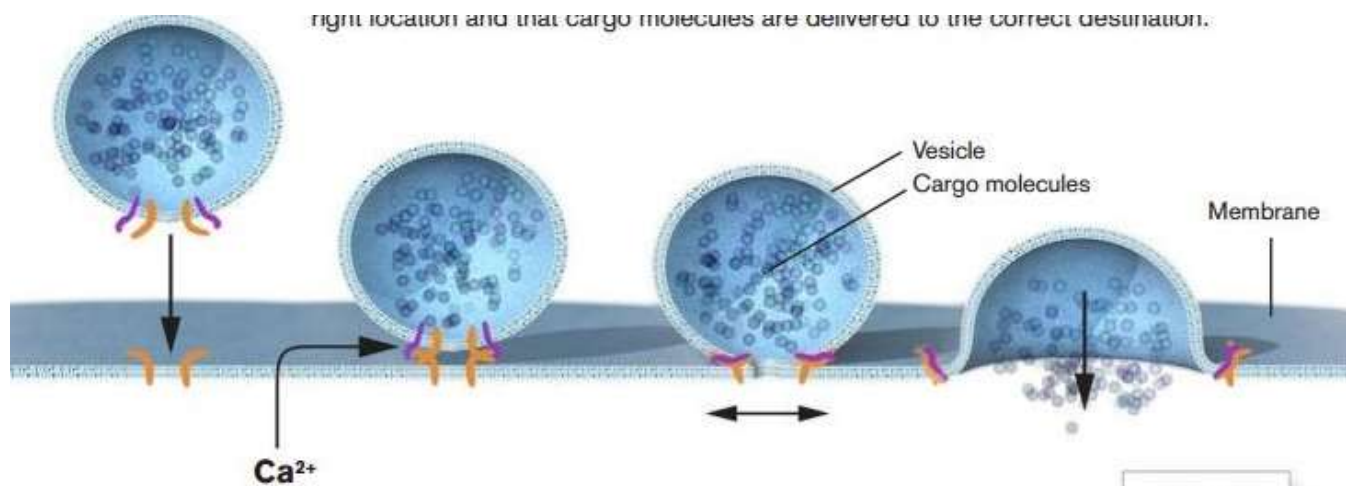
2. Secondary Active Transport

- Plasma membranes contain several **antiporters** and **symporters** powered by the sodium ion gradient.



3. Vesicular Transport

- vesicular transport - Materials move in or out of the cell wrapped in a membrane.
- Two types:
 - endocytosis substances move into the cell.
 - Phagocytosis – “cell eat”
 - Pinocytosis – “cell drink”
 - exocytosis is the reverse process.



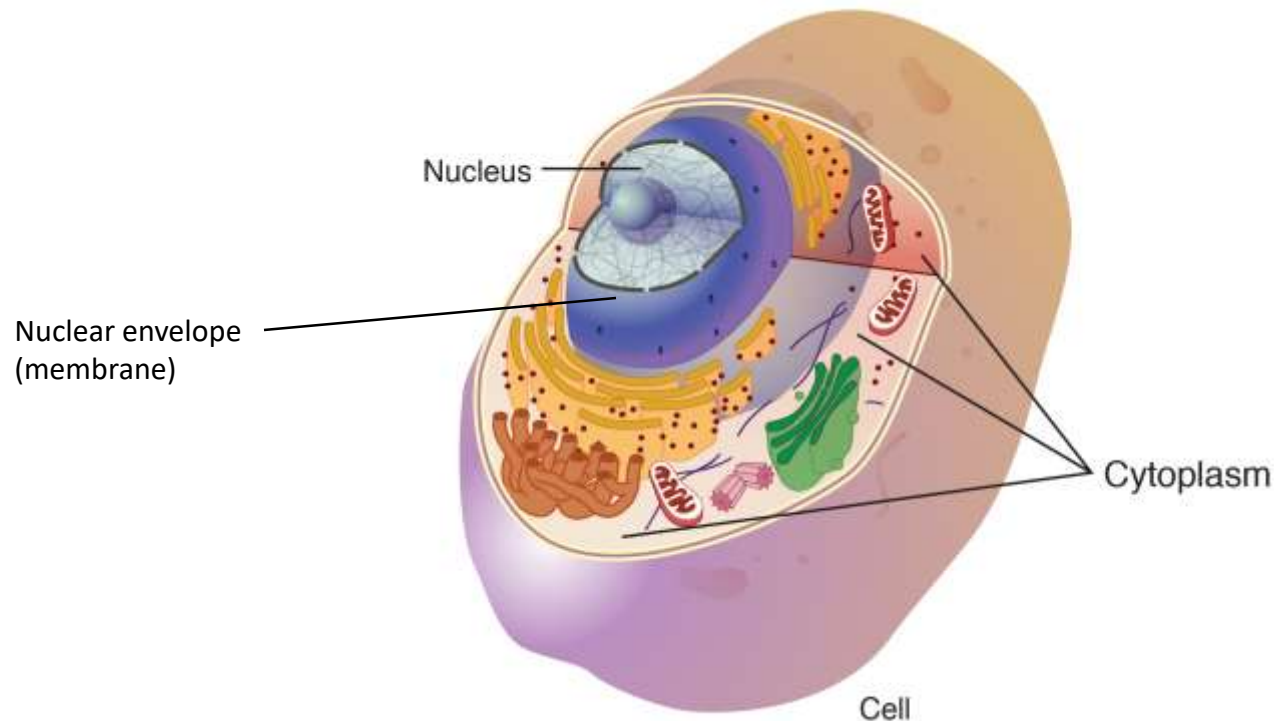
Phew! That was all just the cell membrane!



2. CYTOPLASM

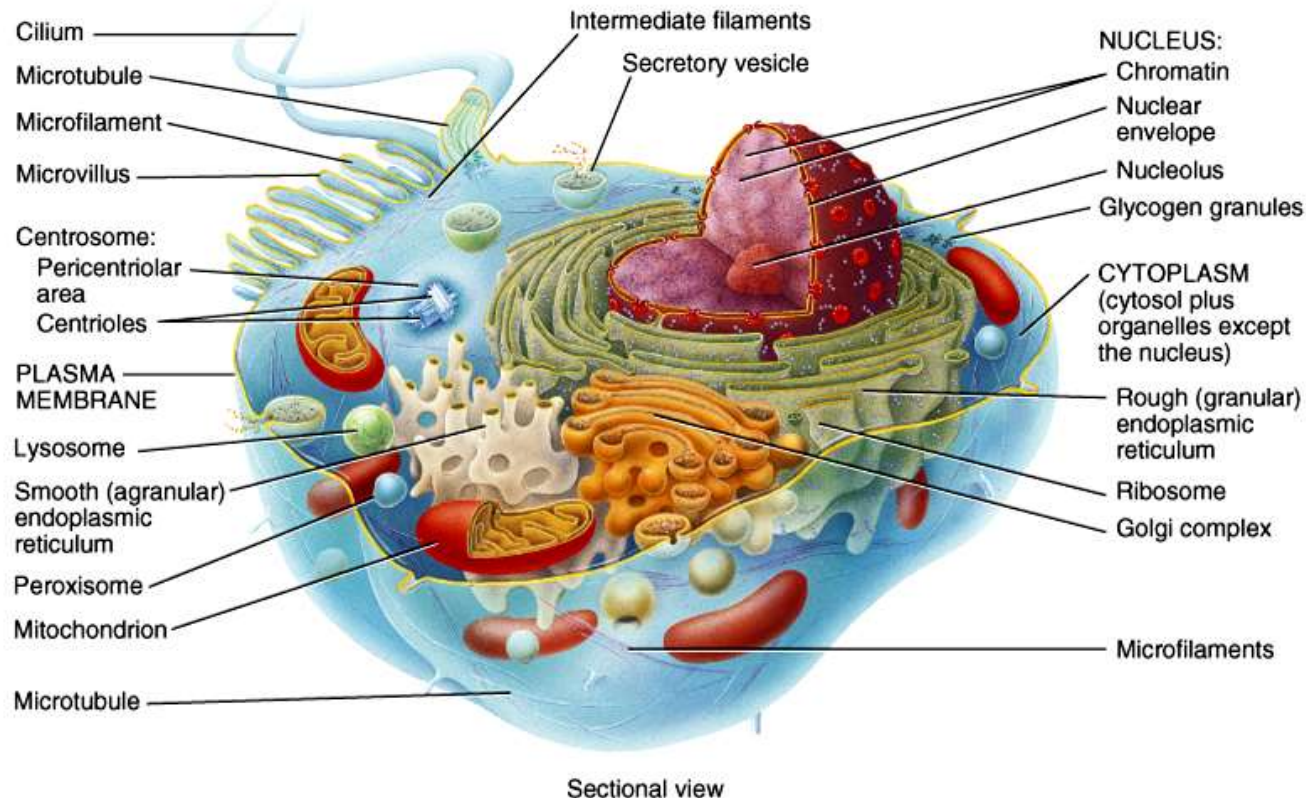
The cytoplasm is everything between the plasma membrane and the nuclear membrane.

Cytosol, the intracellular fluid, is the semifluid portion of cytoplasm that contains inclusions and dissolved solutes.



Cytoplasm holds **organelles** in place

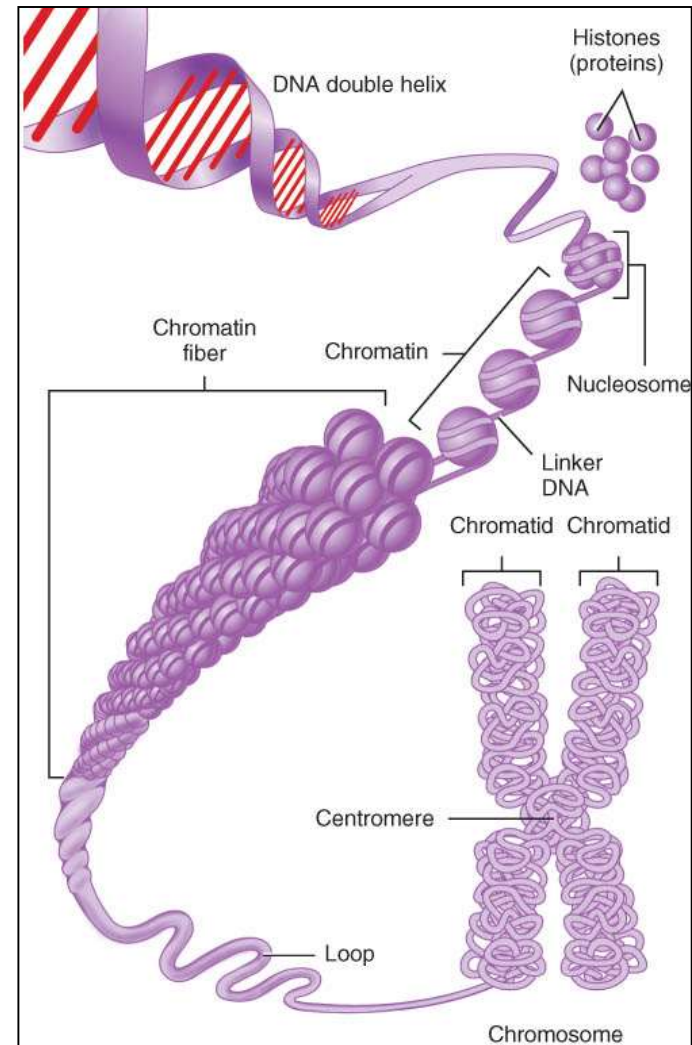
Organelles are specialized structures that have characteristic shapes and perform specific functions in cellular growth, maintenance, and reproduction.



Organelle	Job / Function	Easy Tip
Mitochondria	Produces energy (ATP)	“Powerhouse”
Ribosomes	Make proteins	“Protein factories”
Endoplasmic Reticulum (ER)	Moves proteins & fats	“Cell highway”
Golgi Apparatus	Packages & ships materials	“Post office”
Lysosomes	Breaks down waste	“Recycle bin”
Cytoskeleton <ul style="list-style-type: none"> • Microfilaments • Intermediate Filaments • Microtubules 	Supports cell structure	“Skeleton”

3. Nucleus

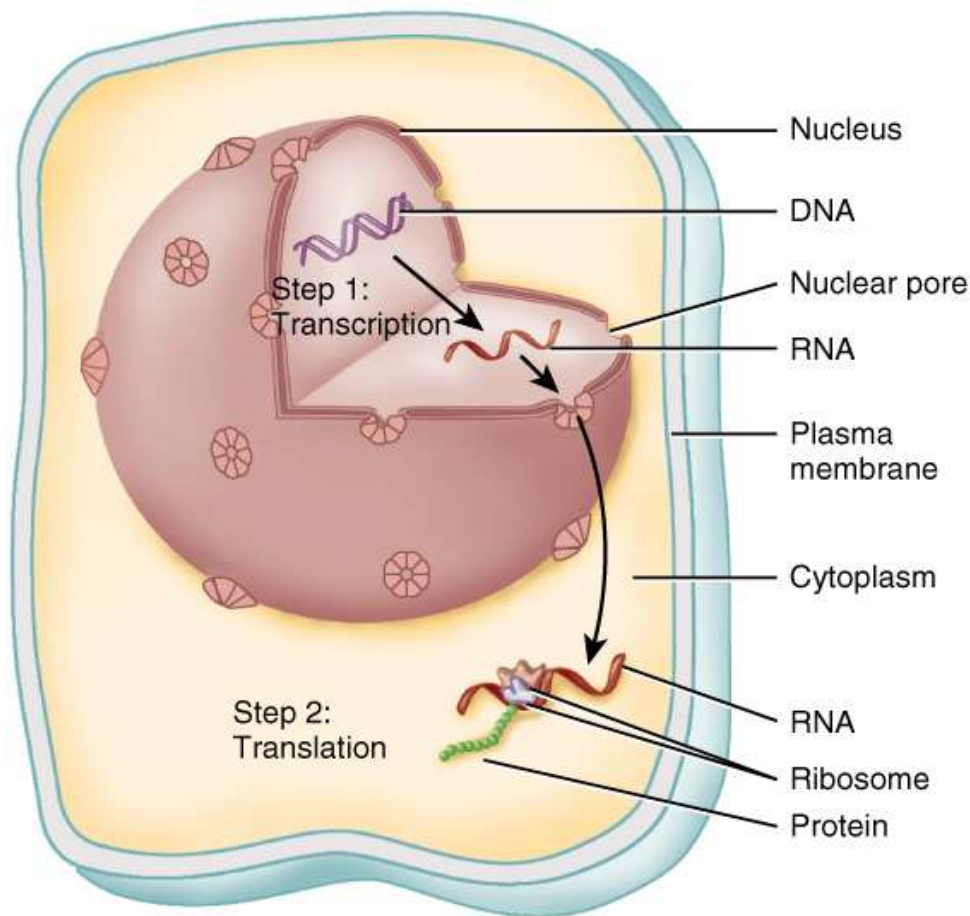
- 46 human DNA molecules or chromosomes
 - genes found on chromosomes
 - gene is directions for a specific protein
- Non-dividing cells contain nuclear chromatin
 - loosely packed DNA
- Dividing cells contain chromosomes
 - tightly packed DNA
 - it doubled (copied itself) before condensing



PROTEIN SYNTHESIS

- The instructions for protein synthesis is found in the DNA in the nucleus.
- Much of the cellular machinery is devoted to synthesizing large numbers of diverse proteins.
- Protein synthesis involves transcription and translation.

Transcription and Translation

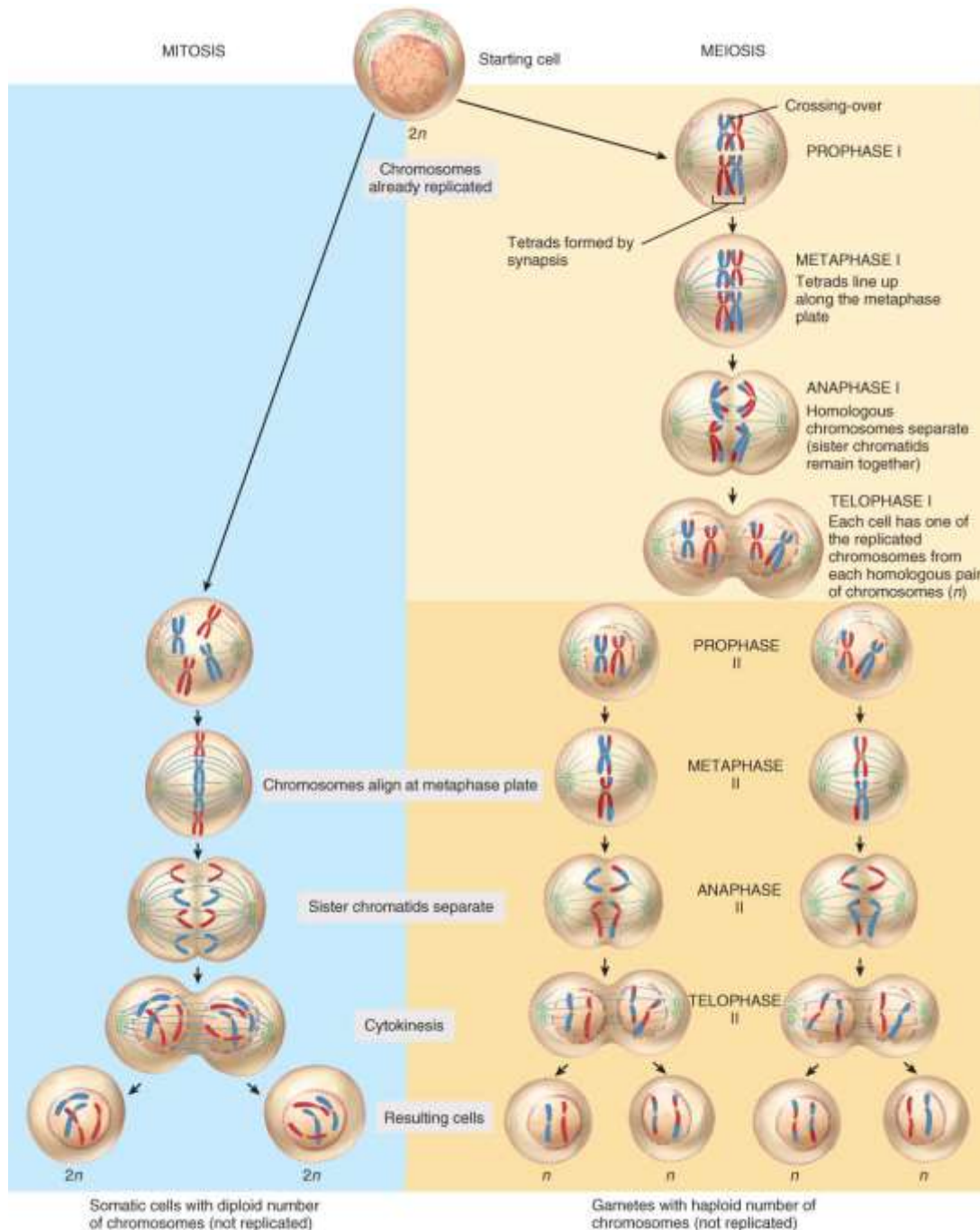


Transcription is the process by which genetic information encoded in DNA is copied onto a strand of RNA called messenger RNA (mRNA), which directs protein synthesis.

Translation is the process of reading the mRNA nucleotide sequence to determine the amino acid sequence of the protein.

CELL DIVISION

- Cell division is the process by which cells reproduce themselves. It consists of nuclear division (mitosis and meiosis) and cytoplasmic division (*cytokinesis*).
- Mitosis, plus cytokinesis, is where the body duplicates its cells.
- Meiosis plus cytokinesis, is used in producing sex cells or gametes and is where the cells are divided in half.

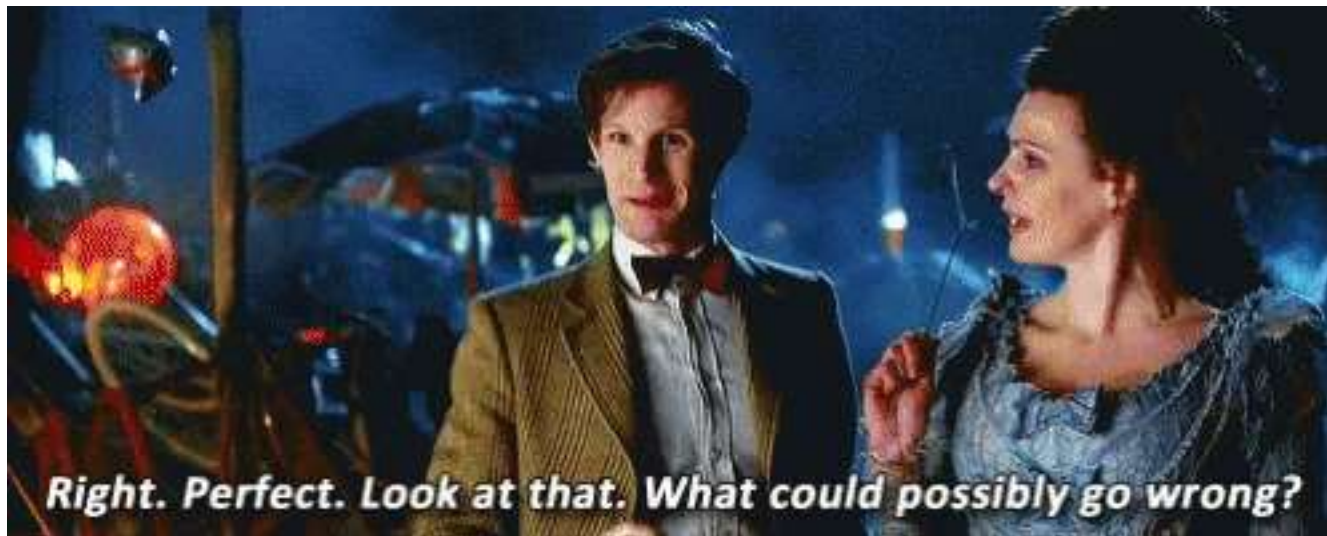


Review

<http://www.youtube.com/watch?v=VIN7K1-9QB0>

http://www.youtube.com/watch?v=D1_-mQS_FZ0

What Can Go Wrong?



Cancer = out of control cell division

- Growth and Spread of Cancer

- Cancer cells divide rapidly and continuously.
 - Hyperplasia = increased number of cell divisions
- They trigger angiogenesis - the growth of new networks of blood vessels.
- Cancer cells can leave their site of origin and travel to other tissues or organs, a process called metastasis.
 - benign tumor does not metastasize or spread
 - Malignant tumor ---spreads due to cells that detach from tumor and enter blood or lymph

- Causes -- carcinogens, x-rays, viruses

- every cell has genes that regulate growth & development
- mutation in those genes due to radiation or chemical agents causes excess production of growth factors

- Carcinogenesis

- multistep process by which normal cells transform into cancer cells. It usually takes years and many different mutations

General Types of Cancer

Carcinomas arise from epithelial cells.

Melanomas are cancerous growths of melanocytes.

Sarcomas arise from muscle cells or connective tissues.

Leukemia is a cancer of blood-forming organs.

Lymphoma is a cancer of lymphatic tissue.