

CELLS EXCHANGE MATERIALS

CHAPTER 04

Cell Requirements

- All body systems work together to ensure a constant cellular environment is maintained → homeostasis.
 - Constant temperature.
 - Constant conc. of fluids in ECF & ICF.



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Cell Requirements

- Continual exchange of materials between the ECF & ICF.
- Each cell's requirements specific to their function → produce different products as a result.
- All cells undergo respiration.
 - Requirements?

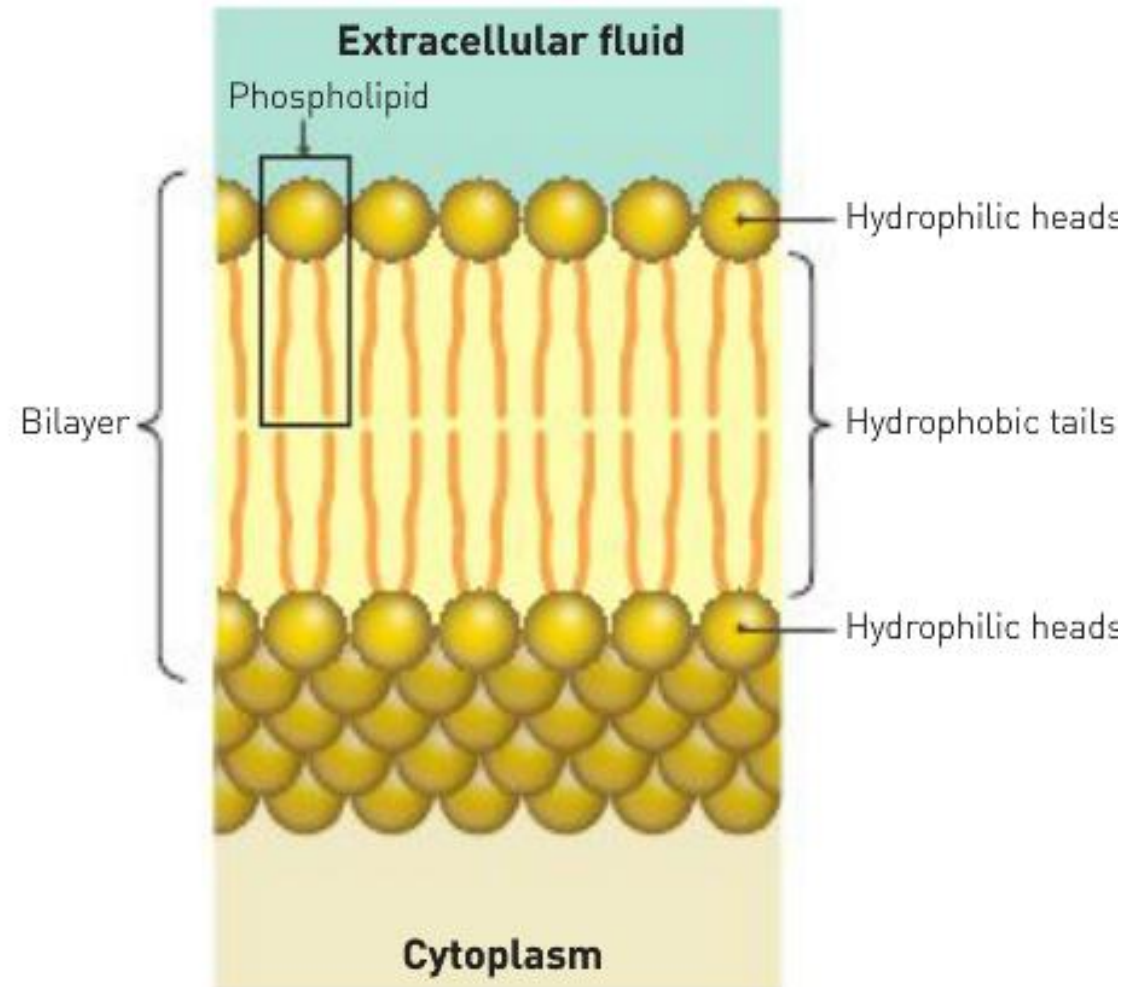


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Cell Membrane

Structure

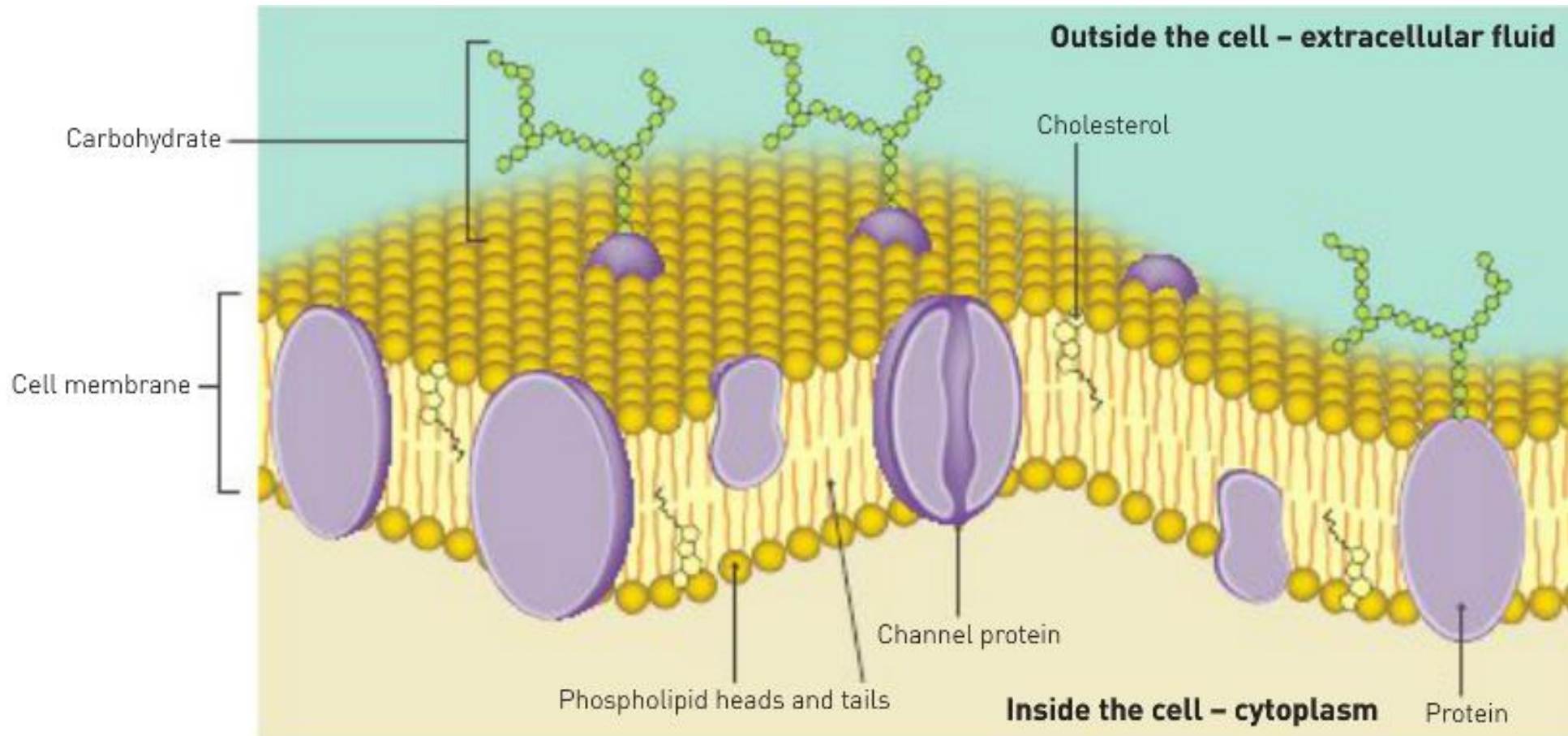
- Phospholipid bilayer.
- Phosphate heads on the outside are hydrophilic.
- Lipid tails on the inside are hydrophobic.
- Structure is able to move keeping membrane fluid.



Cell Membrane

Fluid Mosaic Model

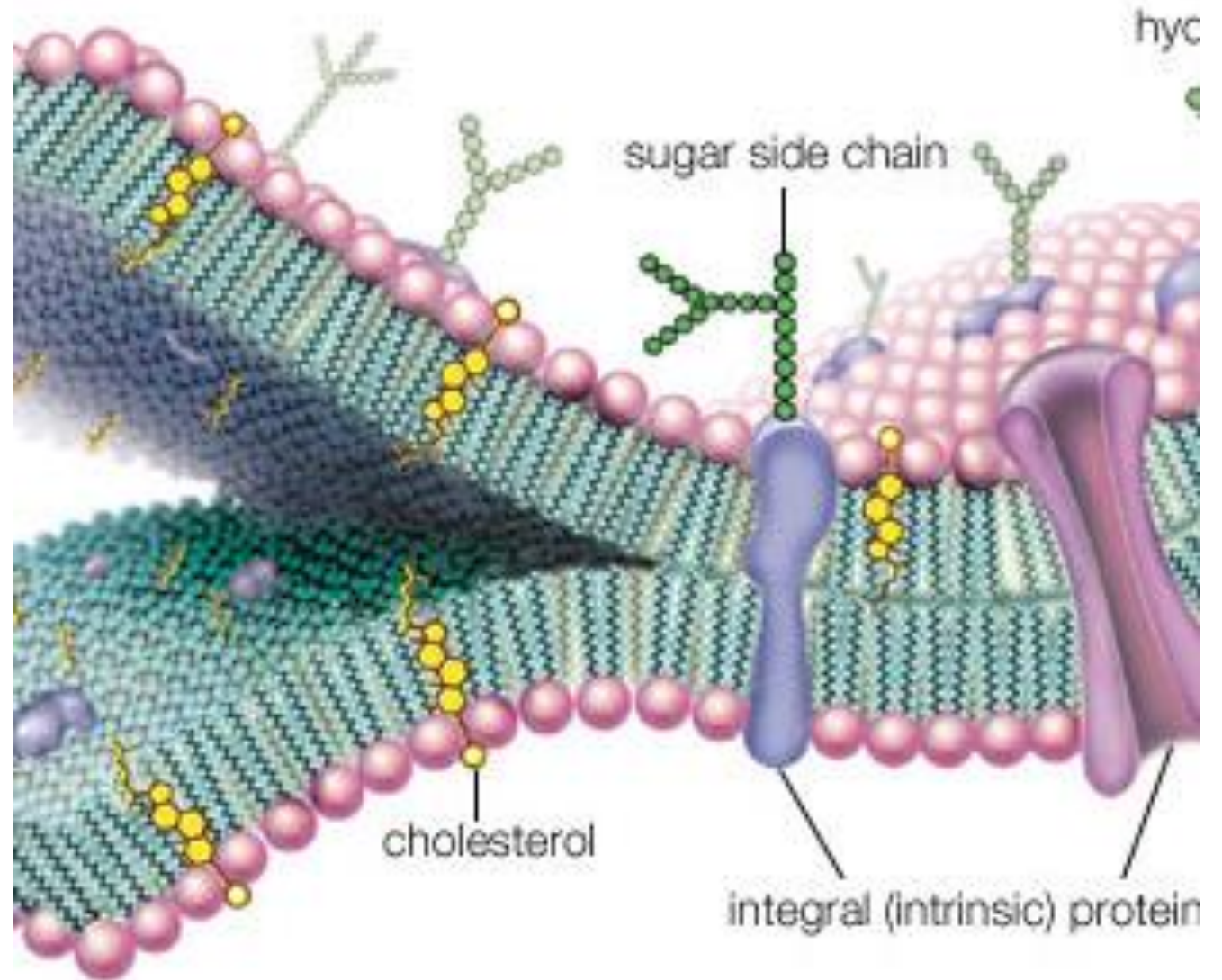
- Embedded in the bilayer are proteins and cholesterol molecules.



Cell Membrane

Functions

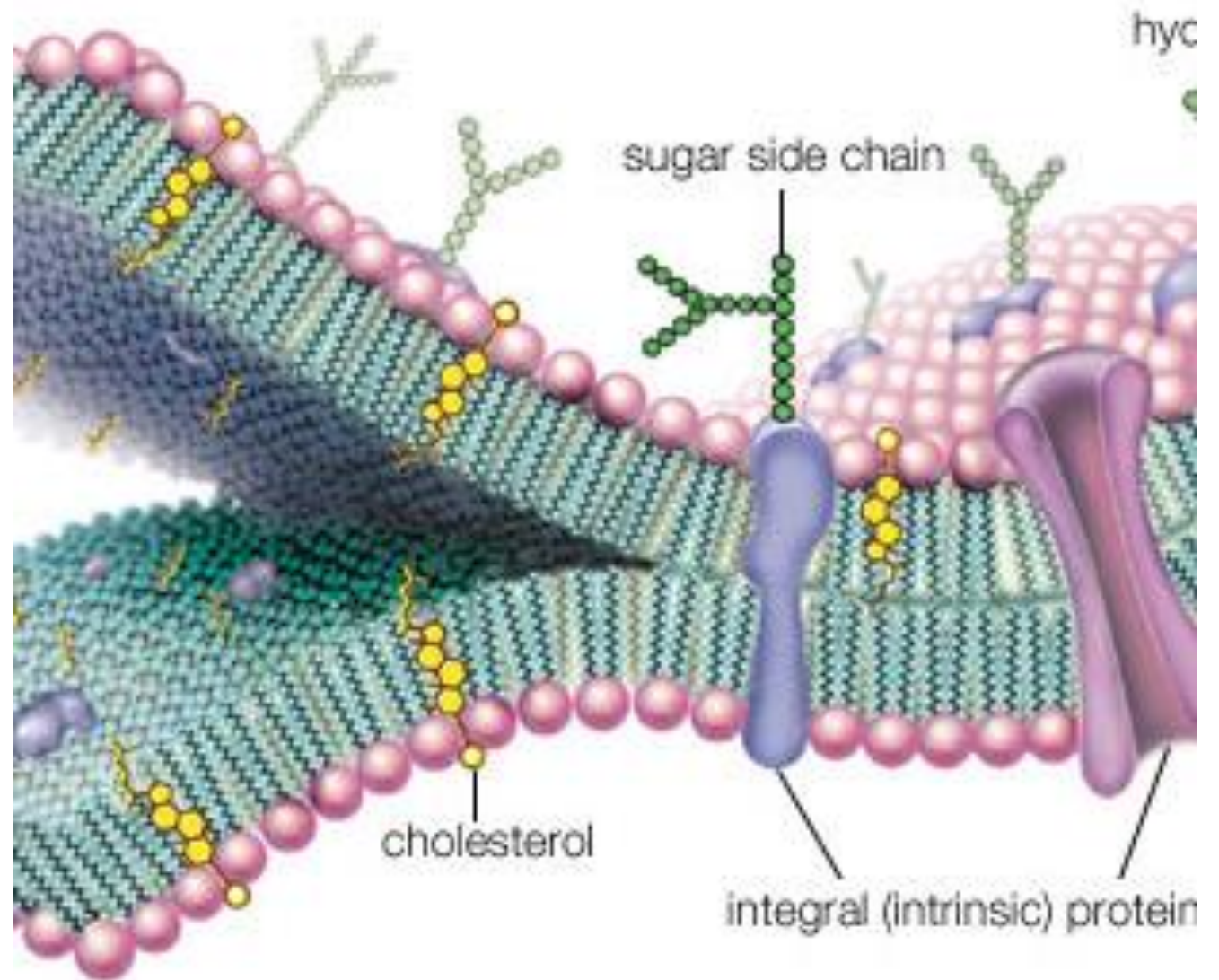
- A physical barrier
 - Separates the cytoplasm and ECF, as they have very different composition.
- Regulation of the passage of materials
 - Controls the movement of substances like nutrients and waste into and out of the cell.

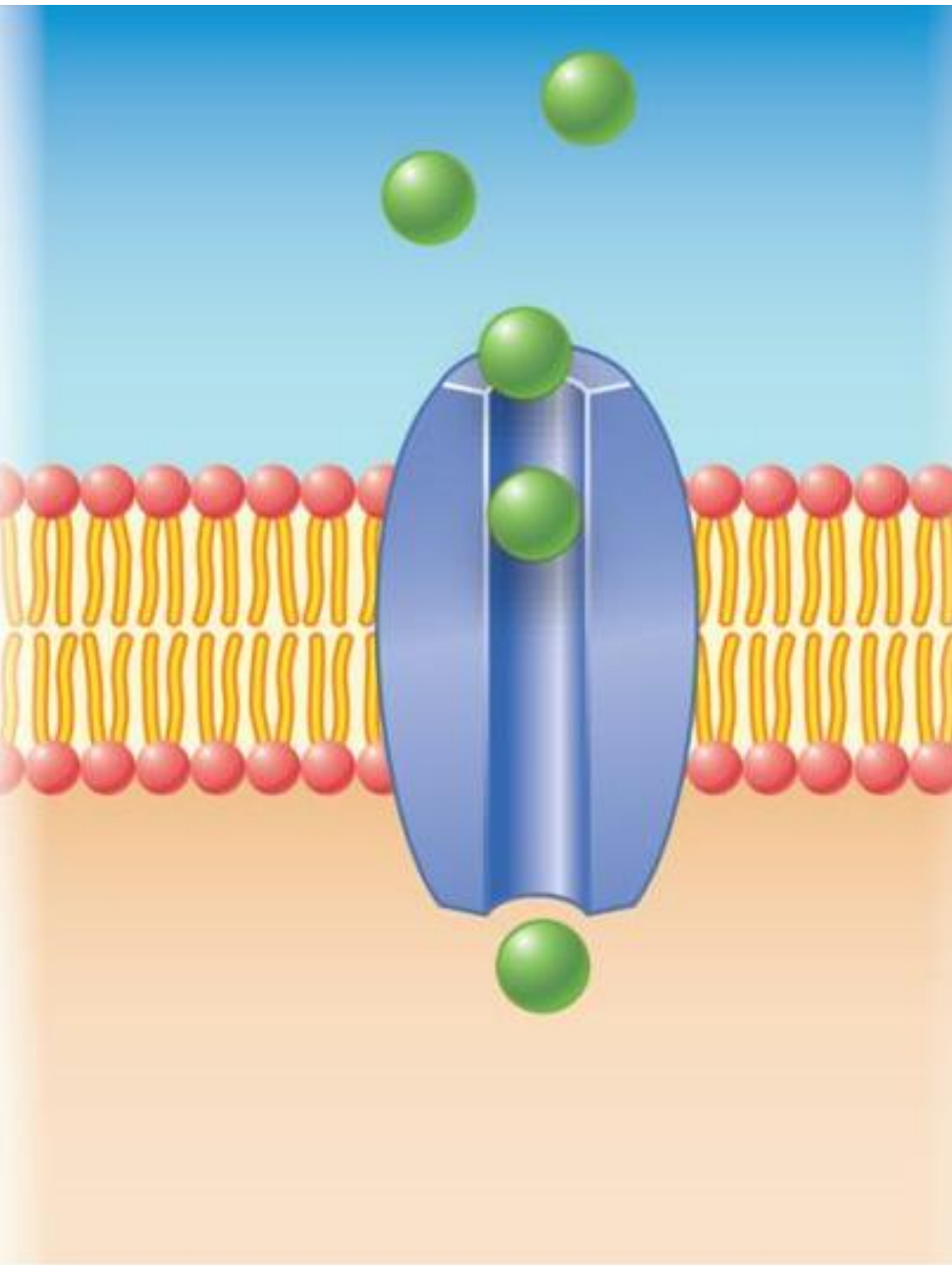


Cell Membrane

Functions

- Sensitivity
 - First part of the cell to be affected by changes in ECF.
 - Receptors sensitive to particular molecules in the immediate environment.
- Support
 - Attached to microfilaments → supports the whole cell.
 - Also attached to other cells to support the whole tissue.





Cell Membrane

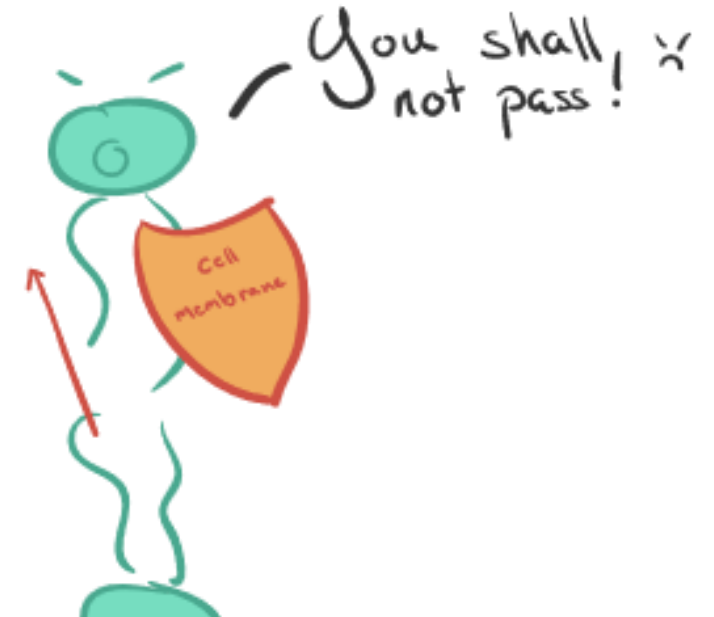
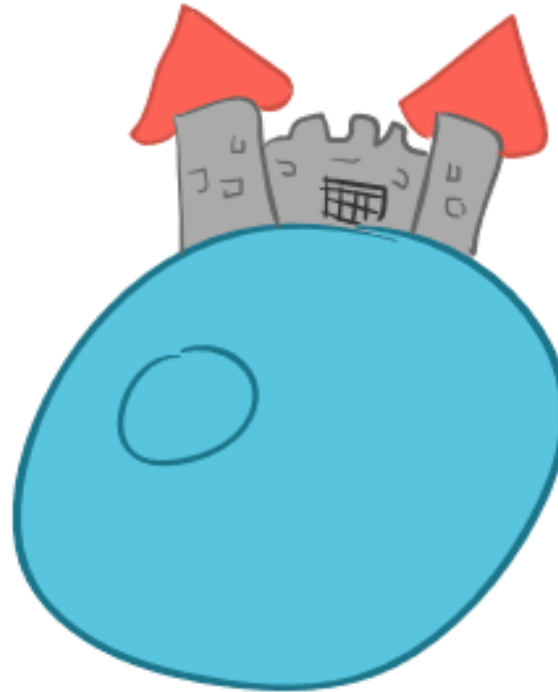
Proteins

- Large proteins embedded throughout plasma membrane.
- Consists of:
 - Receptor proteins.
 - Channel proteins.
 - Recognition/marker proteins.
 - Carrier proteins - through process of carrier mediated transport.

Transport across cell membrane

Transfer Mechanisms

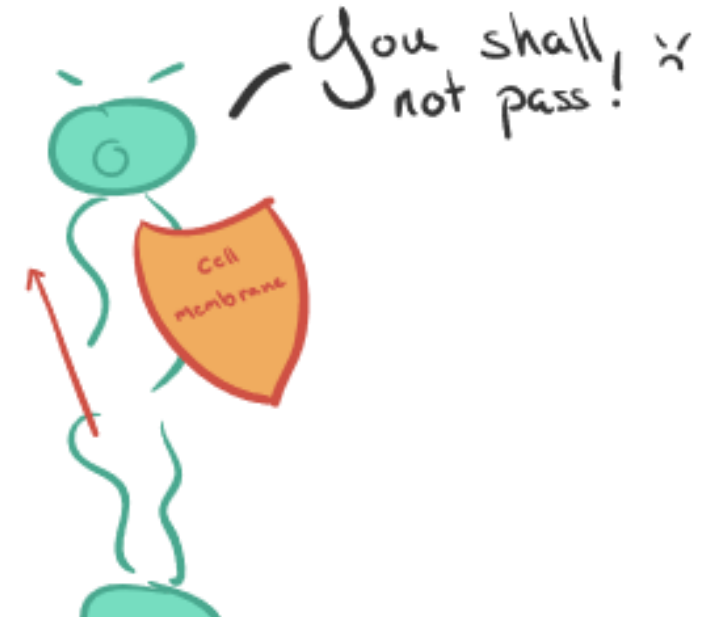
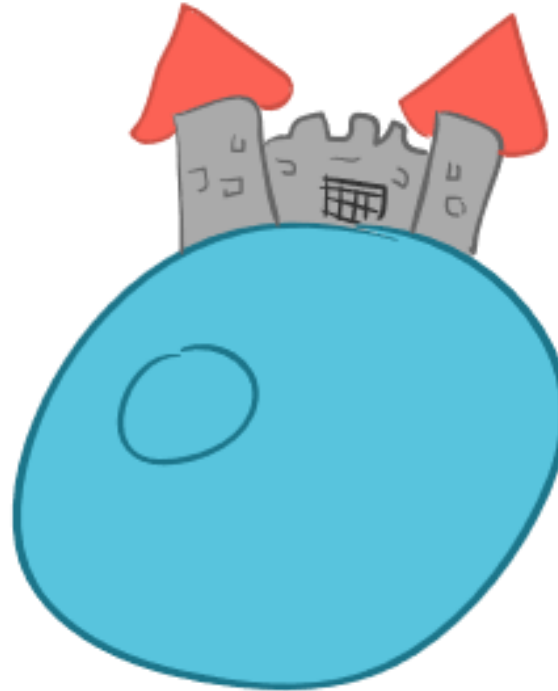
- Membrane is selectively permeable.
- Passive transport:
 - Along concentration gradient.
 - No energy required.
- Active transport:
 - Against concentration gradient.
 - Requires energy.



Transport Processes

Transfer Mechanisms

- Diffusion
 - Random movement of ions and molecules.
- Carrier-Mediated Transport
 - Relies on special proteins embedded in cell membrane.
- Vesicular Transport
 - Substances are moved in membranous sacs.





Diffusion

Transfer Mechanisms

- Occurs in liquids and gases → constant movement of molecules cause collisions.
- Molecules moving to less concentrated area experience less collisions.
- Movement of particles from an area of high to low concentration until evenly distributed over available space.
 - Difference in concentration → **concentration gradient.**



Diffusion

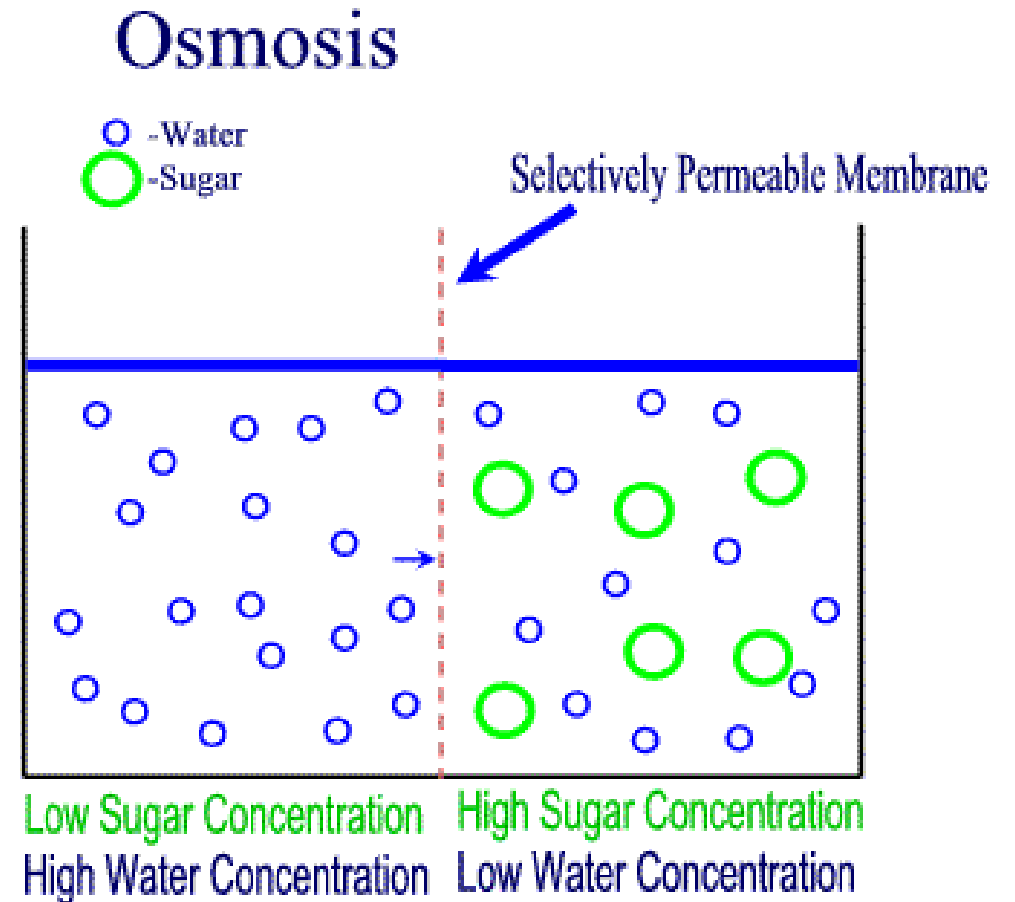
Transfer Mechanisms

- As particles move in random directions, most will travel along the concentration gradient.
- Some will move against gradient.
- **Net diffusion** is towards less concentrated area.
- Examples:
 - Oxygen, carbon dioxide, alcohol.
- Passive.

Osmosis

Transfer Mechanisms

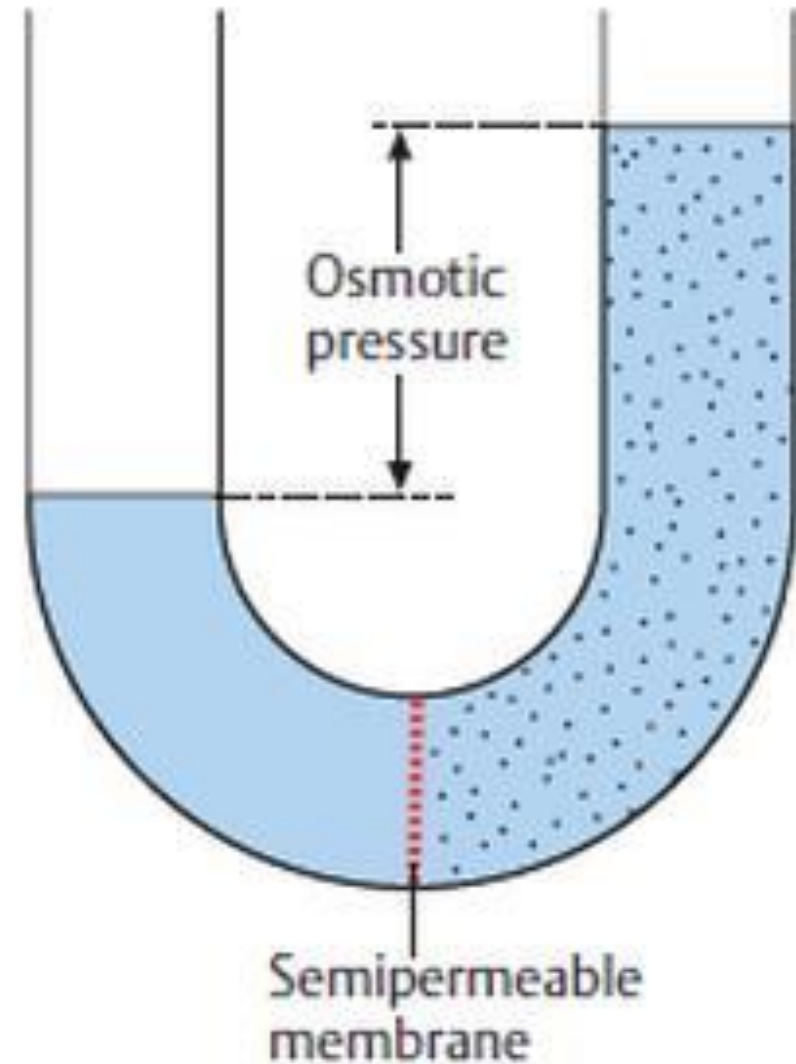
- Diffusion of solvent (water) through a semi-permeable membrane (plasma membrane) from high to low concentration.
- Small pores allow water to pass through but not large molecules (e.g. sugar or starch).
- Passive – why?



Osmotic Pressure

Osmosis

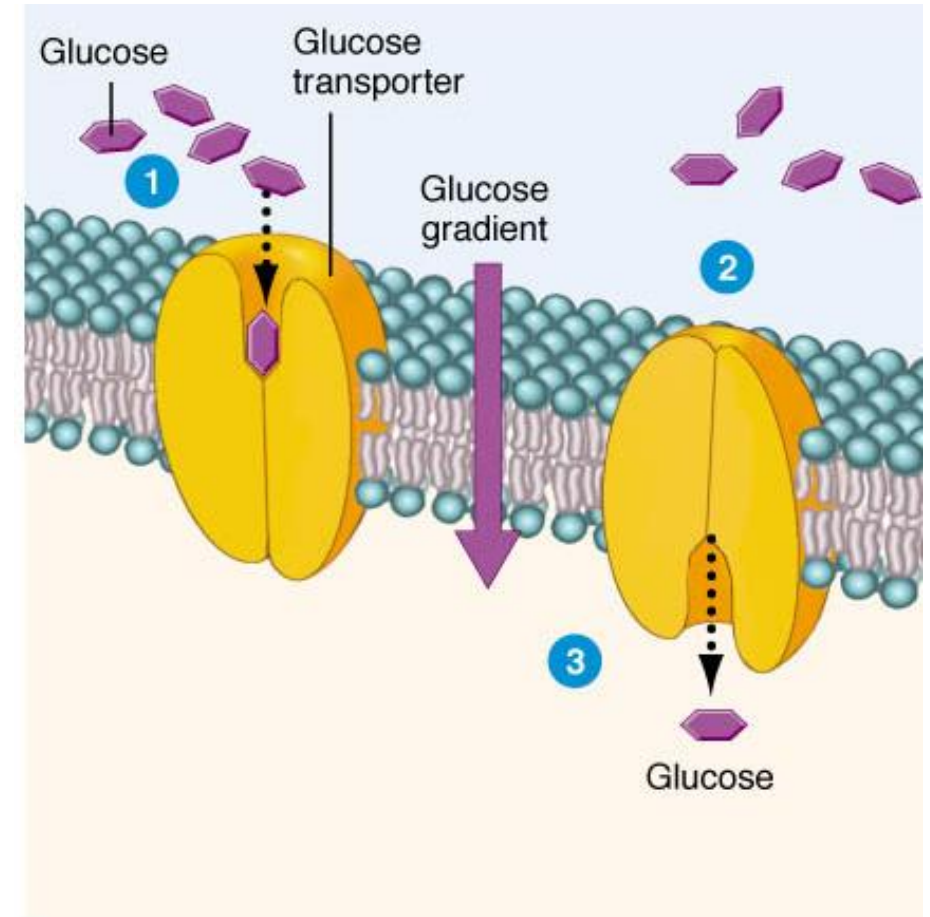
- Pressure due to the difference in concentration from either side of semipermeable membrane.
- Higher concentration of solute → fluid level rises on concentrated side → higher osmotic pressure.



Carrier-Mediated Transport

Transfer Mechanisms

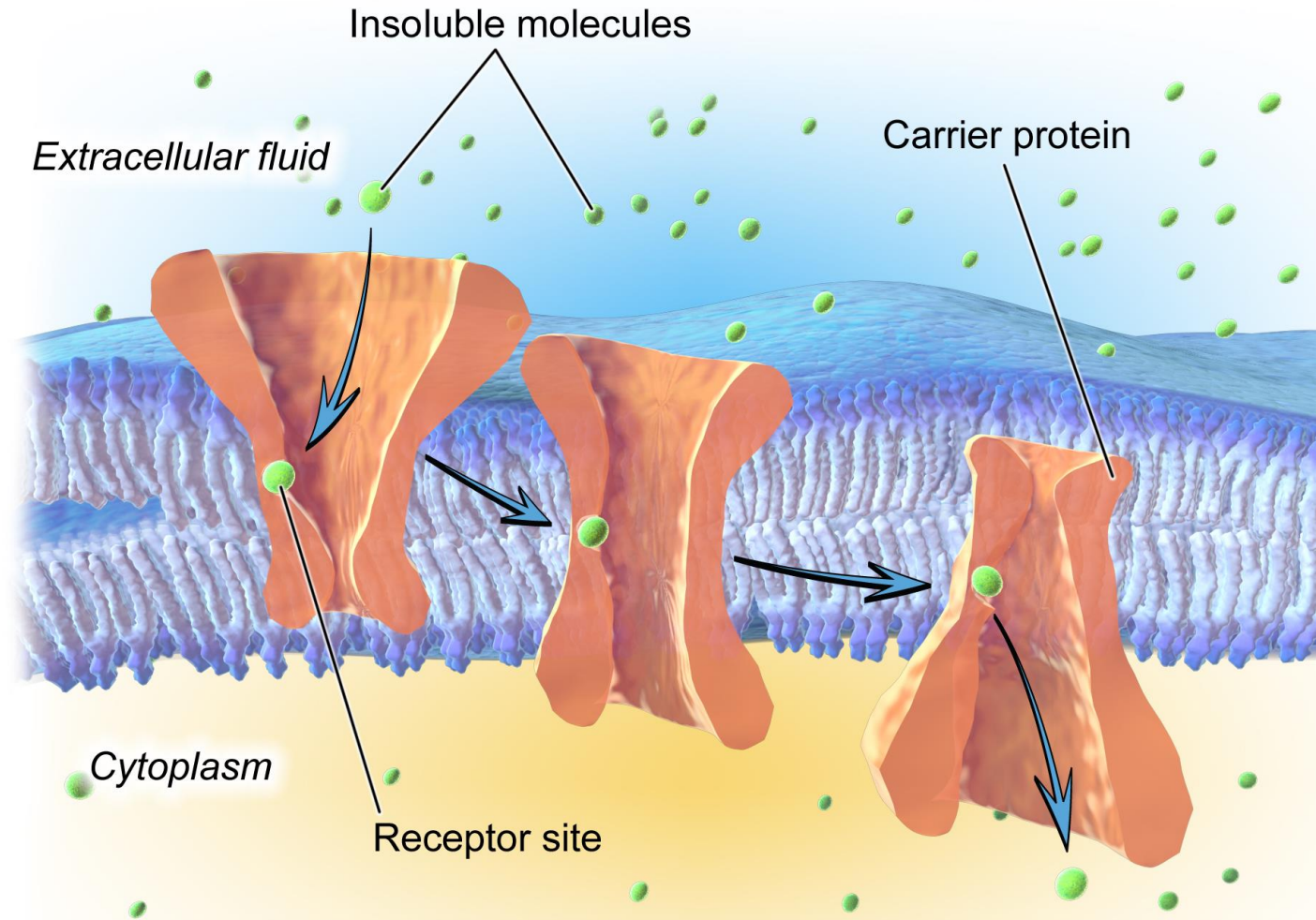
- Carrier proteins bind to specific molecules allowing passage across the membrane.
- Characteristics of CMT:
 - Specific in molecules they bind to.
 - Saturation → once all available carriers are occupied, increase in the rate of movement of molecules not possible.
 - Regulated by hormones → coordinate carrier protein activities.
- Examples:
 - Sodium-potassium pump & glucose transport.
- Passive or Active.



Facilitated Diffusion

Carrier-Mediated Transport

- Substances move **along** concentration gradient.
- Carrier changes shape when molecule attaches.
- Released on other side of the membrane.
- Passive.

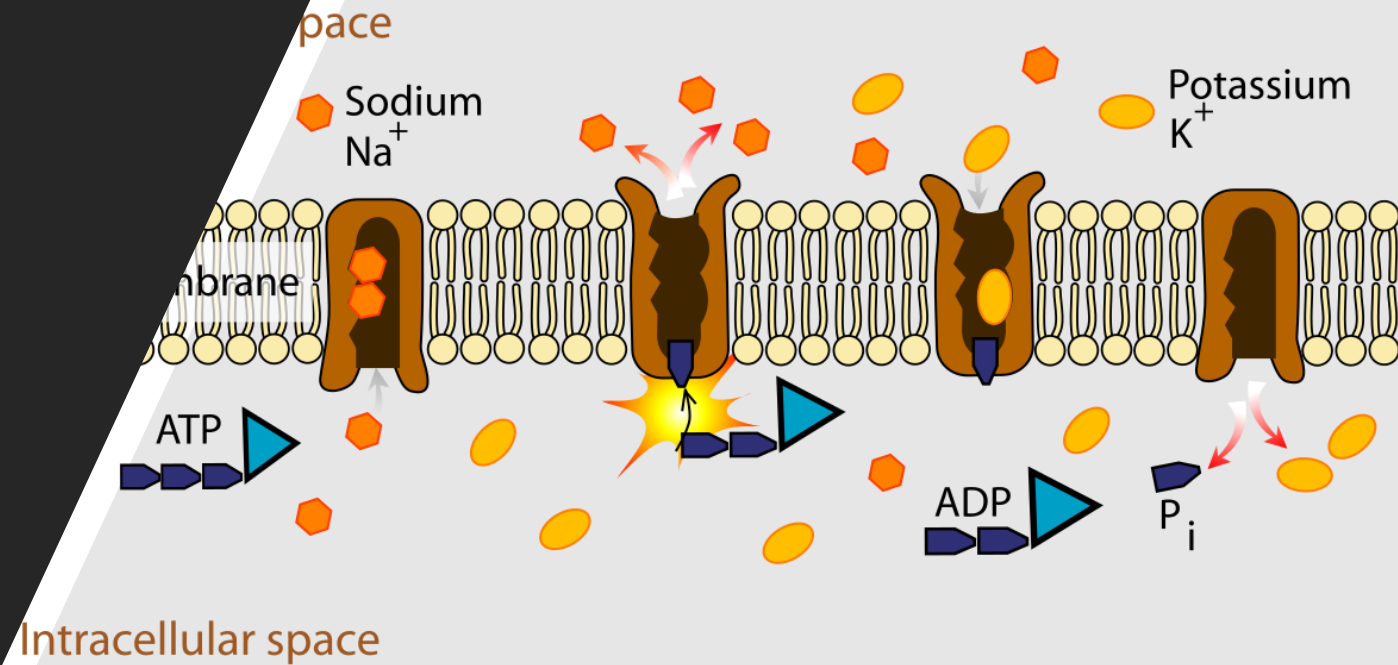


Facilitated Diffusion

Active Transport

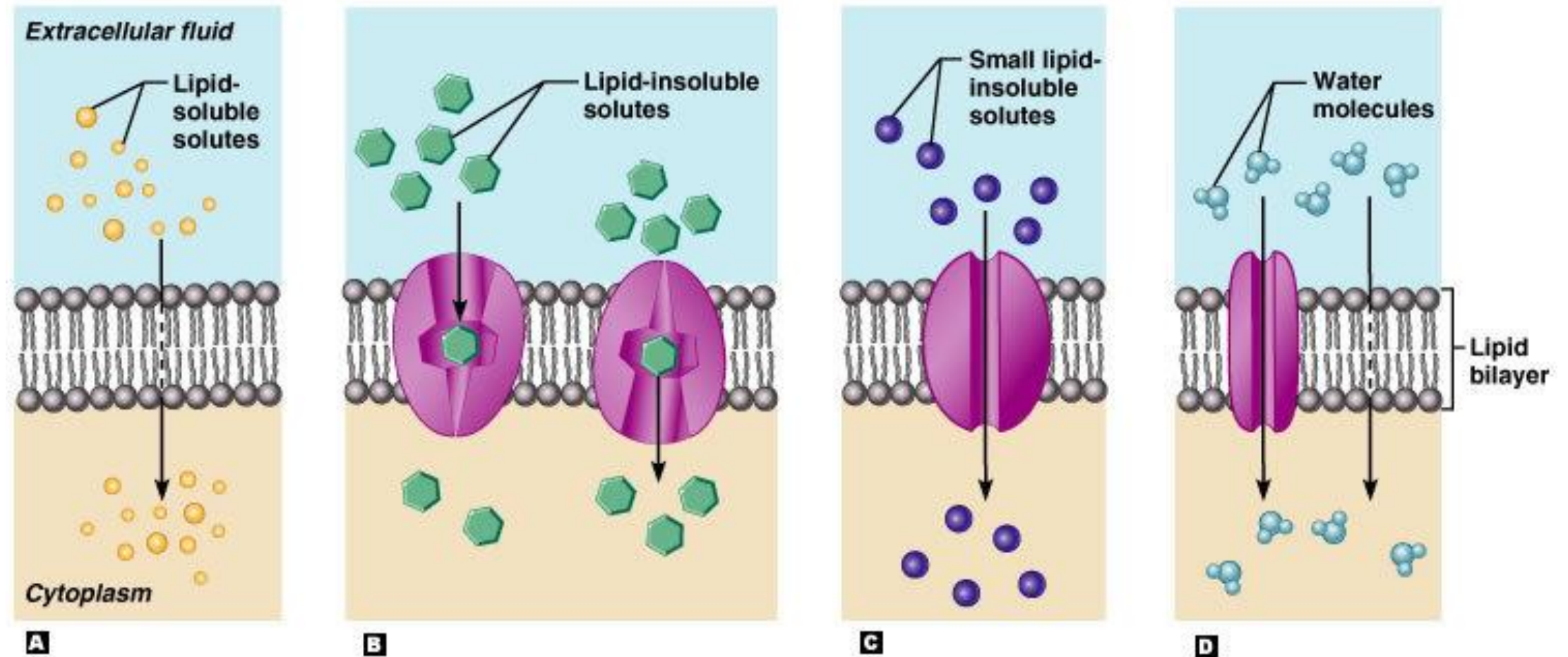
Carrier-Mediated Transport

- Substances move **against** concentration gradient.
- Similar process to facilitated diffusion.
- **ATP** broken down into **ADP + P** to provide energy.
- Active.



Cell Membrane

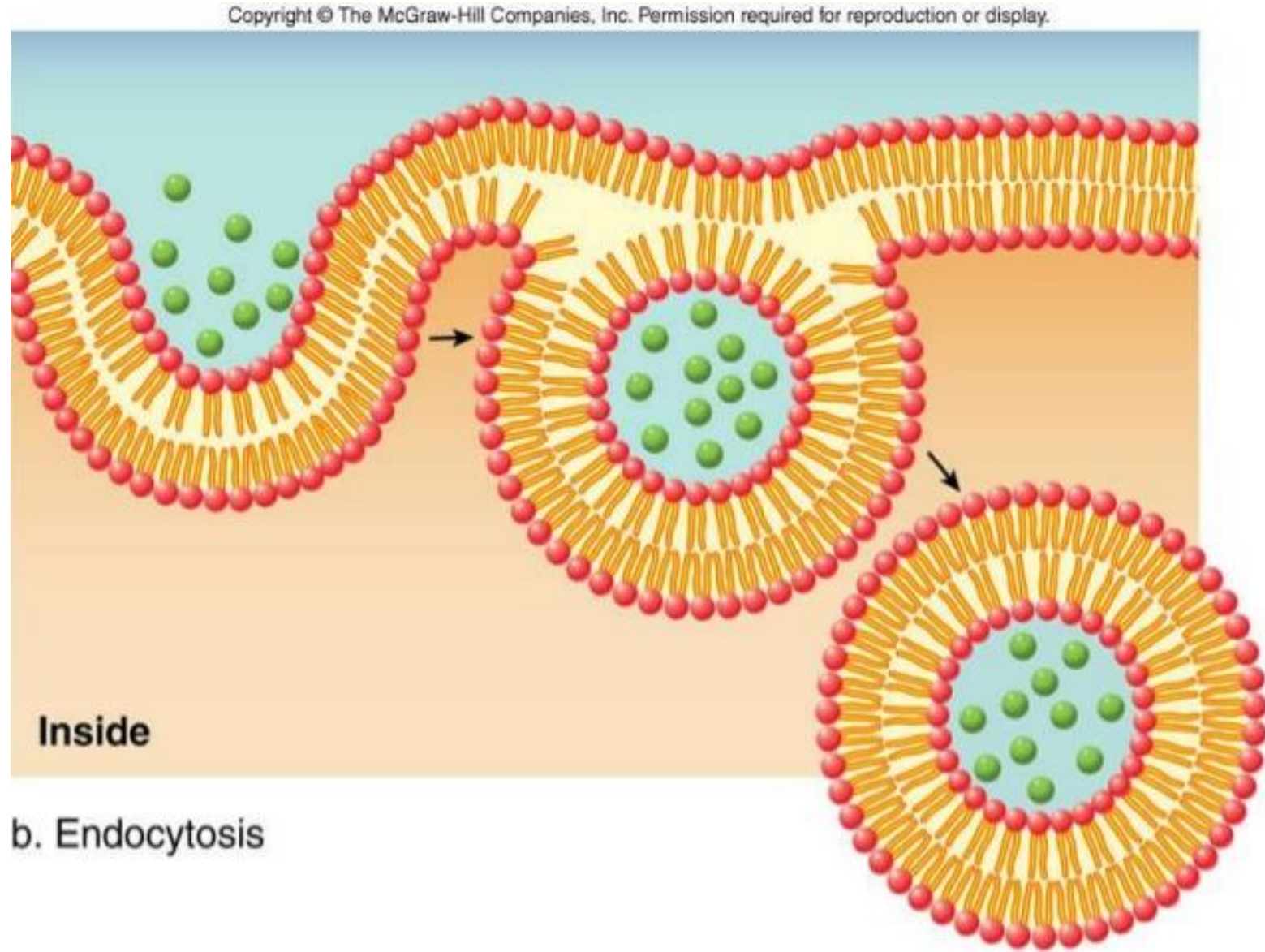
Proteins



Vesicular Transport

Transfer Mechanisms

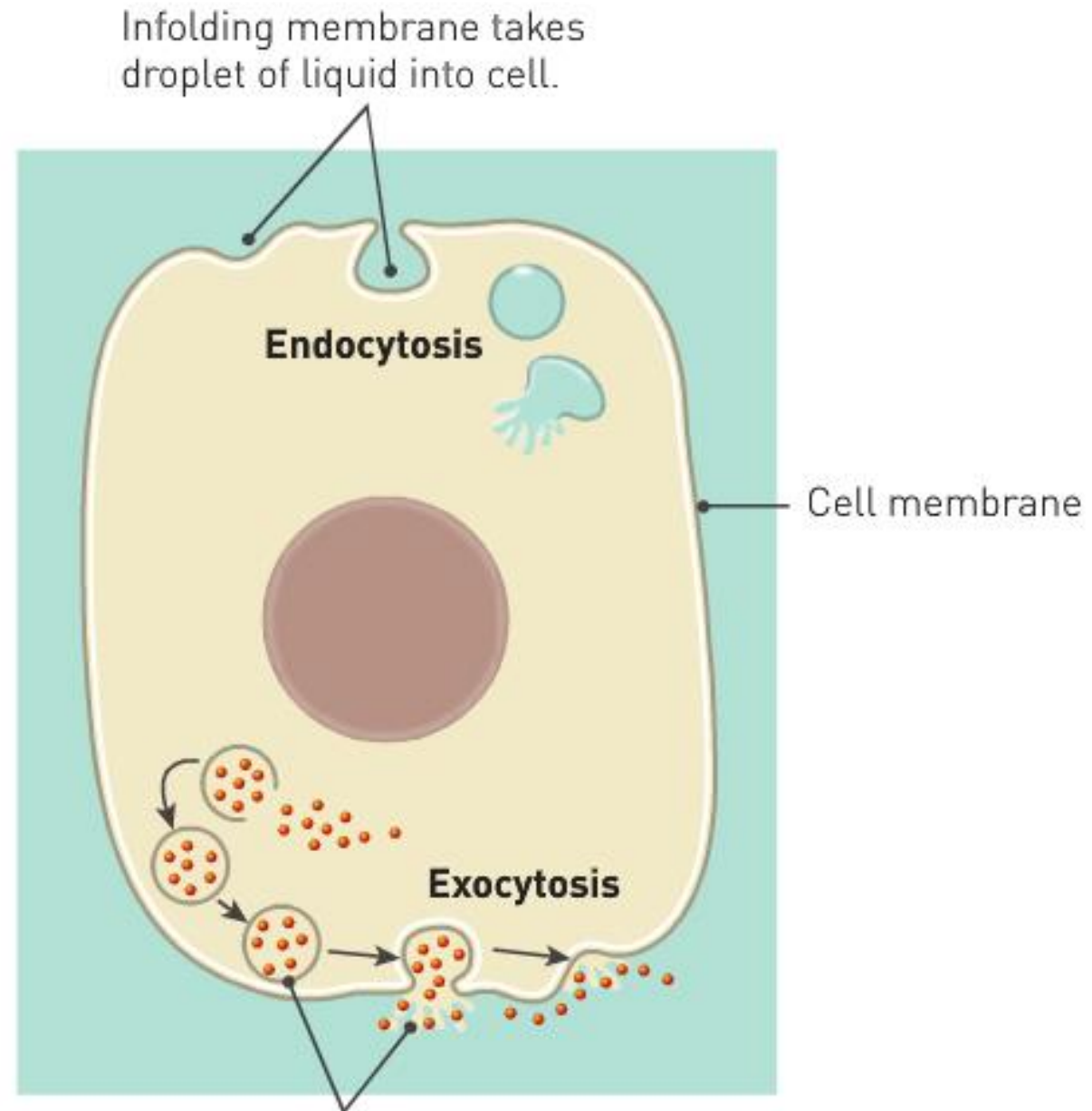
- Movement of substances across the membrane in vesicles (membranous bags).
- Energy is required to form vesicles.
- Active.



Endocytosis

Vesicular Transport

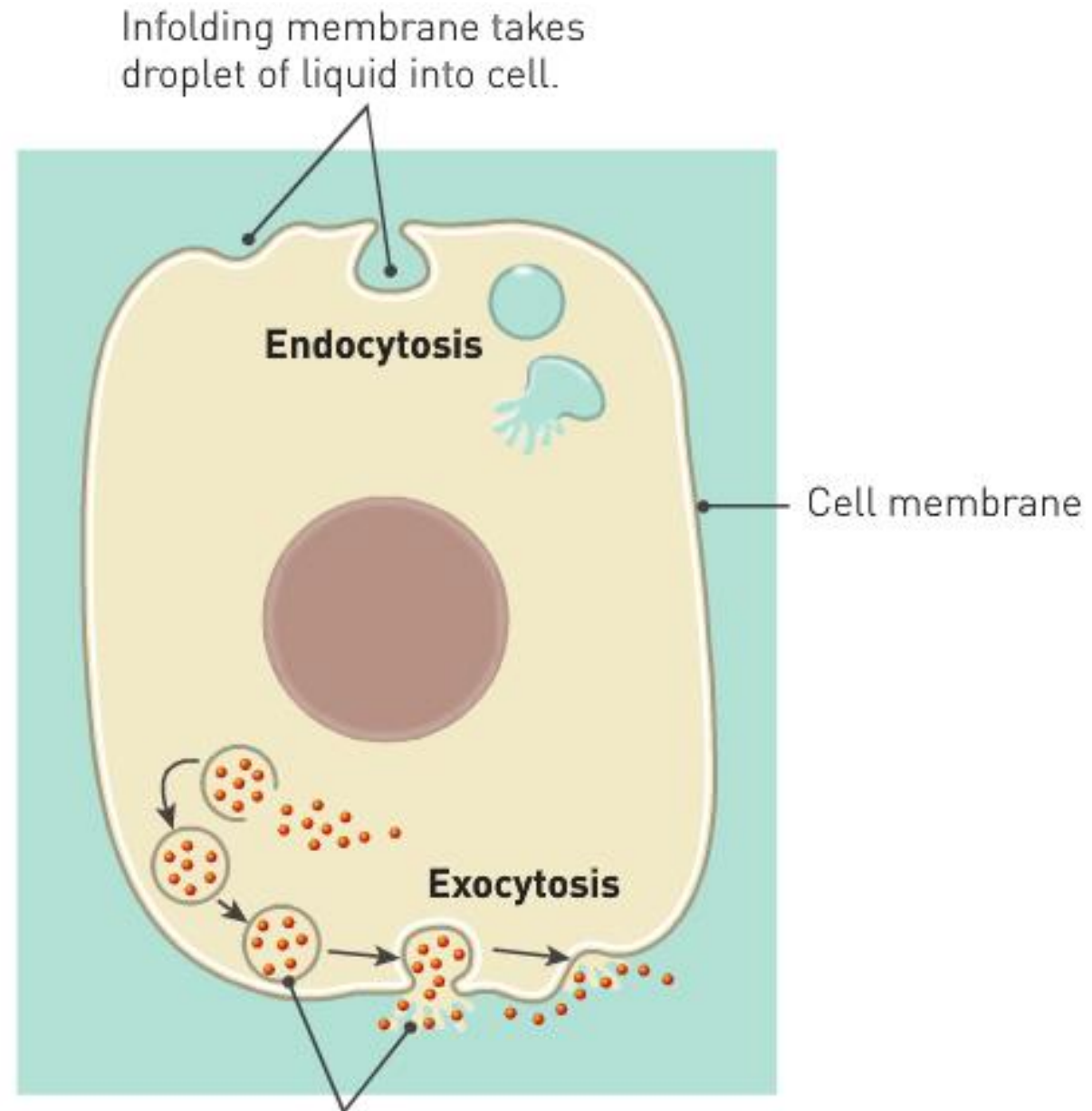
- Solids or liquids are taken into a cell by a vesicle.
- Phagocytosis → solid particles taken in.
- Pinocytosis → liquid particles taken in.
- Examples:
 - Cholesterol, Fe ions, microorganisms, cell debris (only specific specialised cells).



Exocytosis

Vesicular Transport

- Contents of a vesicle are passed to the outside of the cell.
- Vesicle migrates to cell membrane and fuses with it → contents pushed to ECF.
- Examples:
 - Secretions such as mucus, digestive juices, breast milk.



Vesicle migrates to cell membrane, fuses with it, and expels contents from cell.