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AP Biology Insta-Review

Unit 2: Cell Structure and Function

Tiffany Jones

@apbiopenguins

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AP Biology

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Today's Plan:

Cellular Organelles

Surface Area : Volume

Membrane Transport

Practice Questions

Unit 2 Q&A

Cellular Organelles

Nucleus

Structure:

- Double membrane (nuclear envelope) with pores

Functions:

- Stores genetic information (DNA)
- Synthesis of RNA
- Ribosome subunit assembly

Rough ER

Structure:

- Membrane studded with ribosomes attached to nuclear envelope

Functions:

- Site of membrane-bound protein and secreted protein synthesis
- Cell compartmentalization
- Mechanical support
- Role in intracellular transport

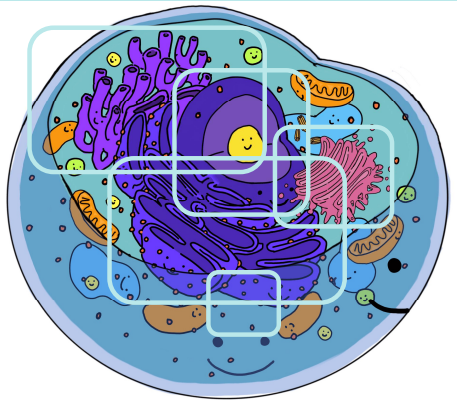
Smooth ER

Structure:

- Folded, tubelike structure (cisternae)

Functions:

- Detoxification
- Calcium Storage
- Lipid synthesis



Structure:

- Membrane-bound structure composed on flattened sacs (cisternae)

Functions:

- Folding and chemical modification of synthesized proteins
- Packaging protein traffic

Golgi Complex

Structure:

- Composed of rRNA and protein
- Large & small subunits
- Types: bound or free (cytoplasmic)

Functions:

- Protein synthesis

Ribosomes

Cellular Organelles

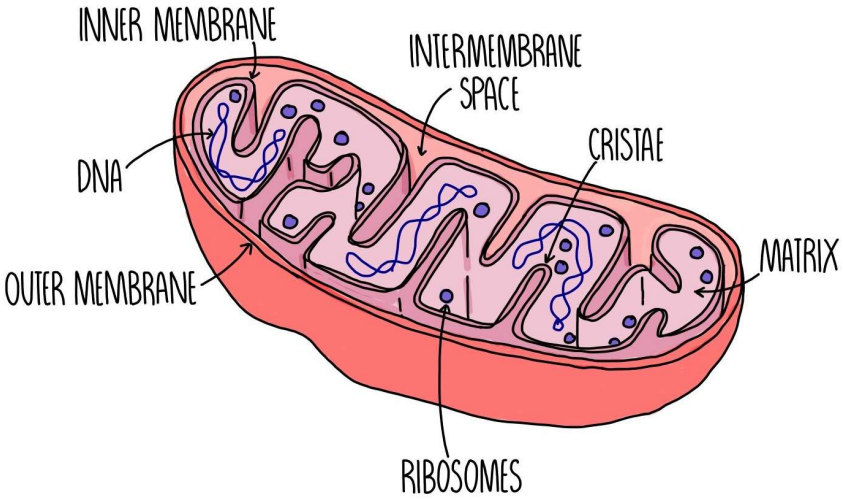
Mitochondria

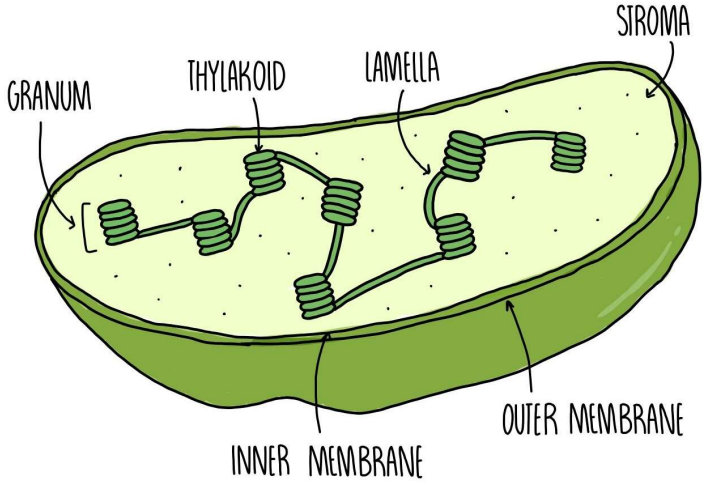
Structure:

- Double membrane (outer: smooth; inner: highly folded)

Functions:

- Site of oxidative phosphorylation (cristae/inner membrane)
- Site of Krebs Cycle (matrix)





Structure:

- Double outer membrane (thylakoid sac stacked: grana and fluid: stroma)

Functions:

- Site of photosynthesis
- Thylakoid: Light Reactions
- Stroma: Calvin-Benson Cycle

Chloroplast

Cellular Organelles

Mitochondria

Structure:

- Double membrane (outer: smooth; inner: highly folded)

Functions:

- Site of oxidative phosphorylation (cristae/inner membrane)
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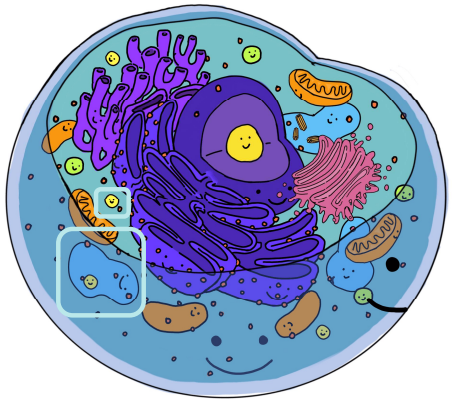
Lysosome

Structure:

- membrane-enclosed sacs that contain hydrolytic enzymes

Functions:

- Intracellular digestion (recycle cell organic materials & programmed cell death: apoptosis)



Structure:

- membrane-bound sac

Functions:

- storage and release of macromolecules and cellular waste products
- Central: water retention – turgor pressure
- Contractile: osmoregulation (protist)
- Food: phagocytosis, fuse with lysosome

Vacuole

Structure:

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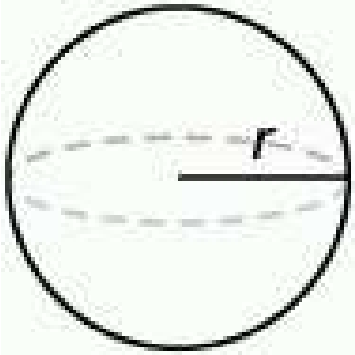
Chloroplast

Surface Area: Volume



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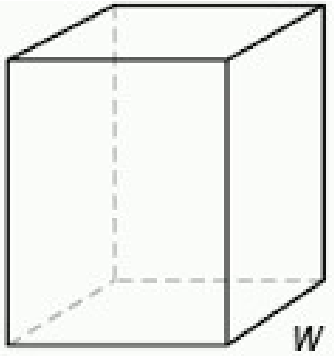
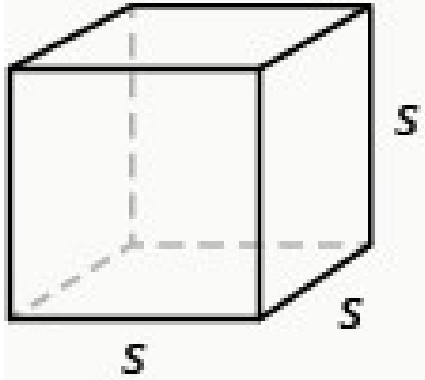
Surface Area: $S = 4\pi r^2$



Volume: $V = LWH$

Surface Area: $S = 2LH + 2LW + 2WH$



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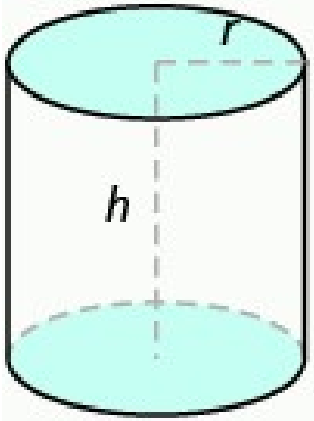


Volume: $V = \pi r^2 h$ or $V = Bh$

Surface Area: $S = 2\pi r^2 + 2\pi rh$

Smaller cells typically have a higher surface area-to-volume ratio and more efficient exchange of materials with the environment.

Simple Diffusion

- Passive Transport, No NRG
- Down concentration gradient
- Small, Nonpolar
- No transport protein needed
- Examples: CO_2, O_2, N_2, steroids
- Small amount of H_2O leak through membrane

Facilitated Diffusion

- Passive Transport, No NRG
- Down concentration gradient
- Small Molecules
- Requires transport protein
  Channel vs. Carrier protein
- Example: water, Na^+, K^+, Ca^+

Active Transport

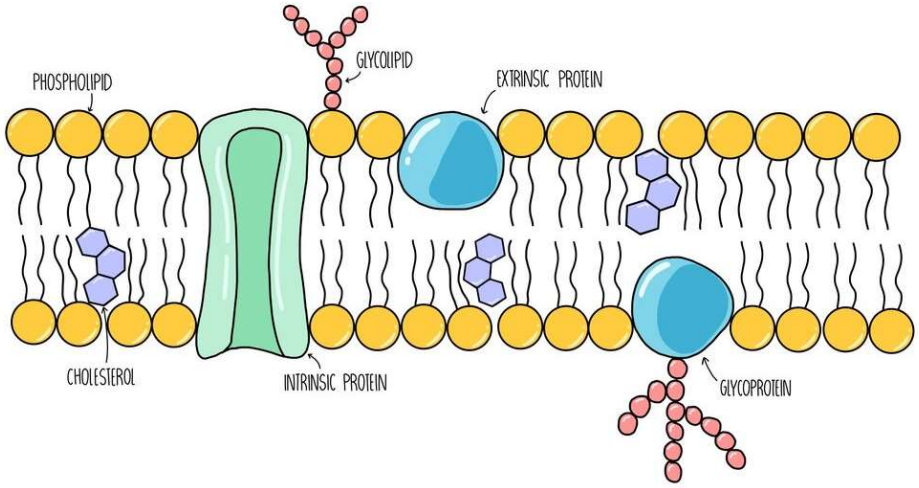
- Requires input of NRG
- Against concentration gradient
- Requires transport protein (carrier protein)
- Example: Na^+, K^+, Ca^+, H^+

Membrane Transport

Plasma Membrane

Composed of:

- Phospholipids
- Membrane Proteins
- Glycolipids/Glycoproteins
- Cholesterol



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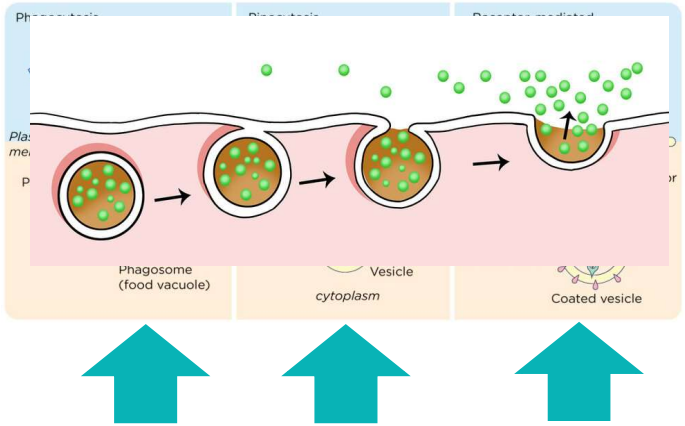
Membrane Transport

Endocytosis

- Import of materials
- Phagocytosis: Cellular Eating
- Pinocytosis: Cellular Drinking
- Receptor-Mediated: Endocytosis



Exocytosis

Export of materials
Rough ER (synthesize) → Golgi complex (package/modification) → Plasma Membrane

Hypertonic Solution

- HIGH solute concentration
- LOW free water concentration

- GAINS water from hypotonic solution

Isotonic Solution

- EQUAL solute concentration (as other solution)
- EQUAL free water concentration (as other solution)

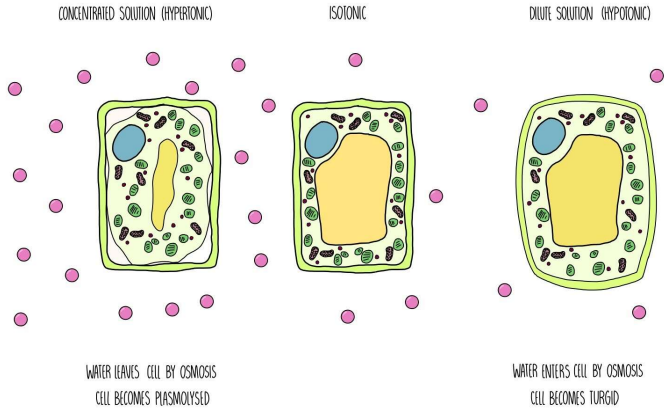
- Equal water movement into and out of solution

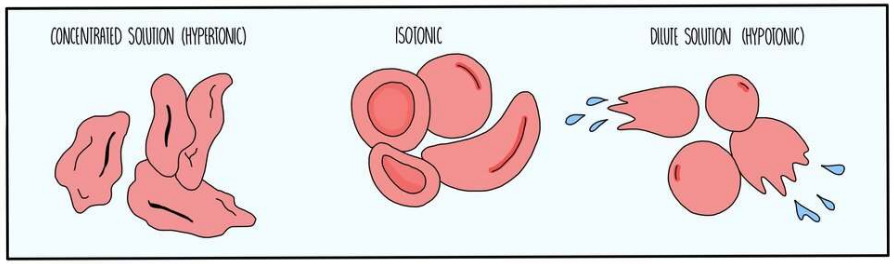
Hypotonic Solution

- LOW solute concentration
- HIGH free water concentration

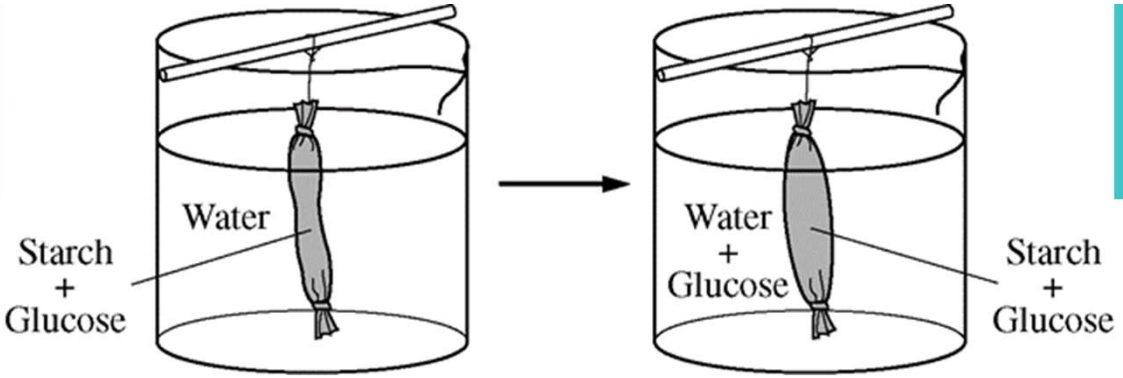
- LOSES water to hypertonic solution

Osmosis

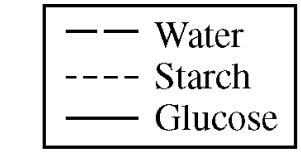


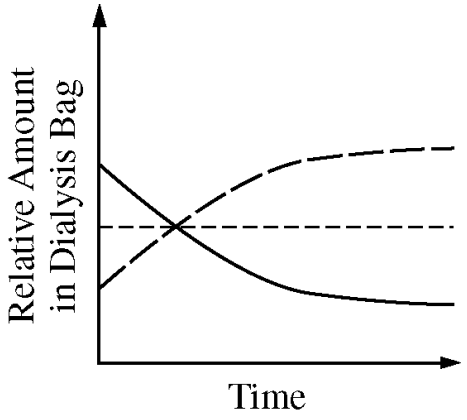


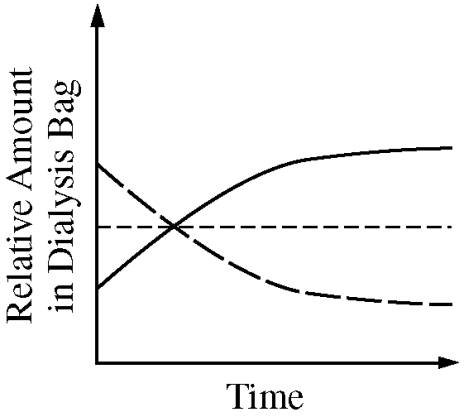
Multiple Choice Practice

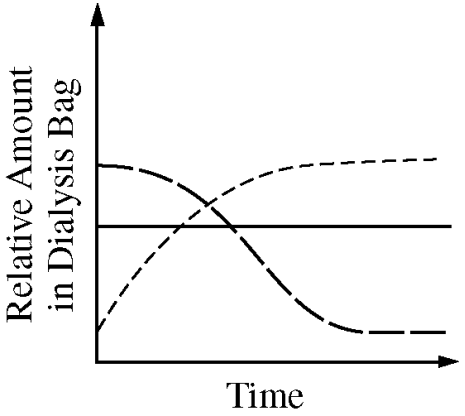


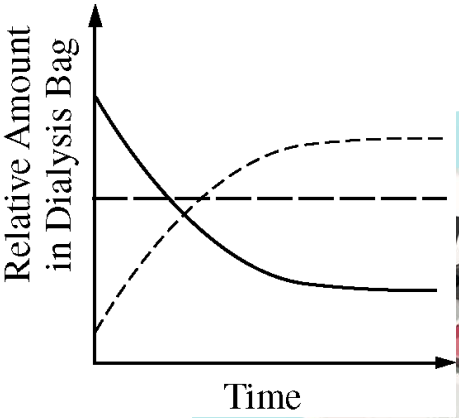
A common laboratory investigation involves putting a solution of starch and glucose into a dialysis bag and suspending the bag in a beaker of water, as shown in the figure below. The investigation is aimed at understanding how molecular size affects movement through a membrane. Which of the following best represents the amount of starch, water, and glucose in the dialysis bag over the course of the investigation?











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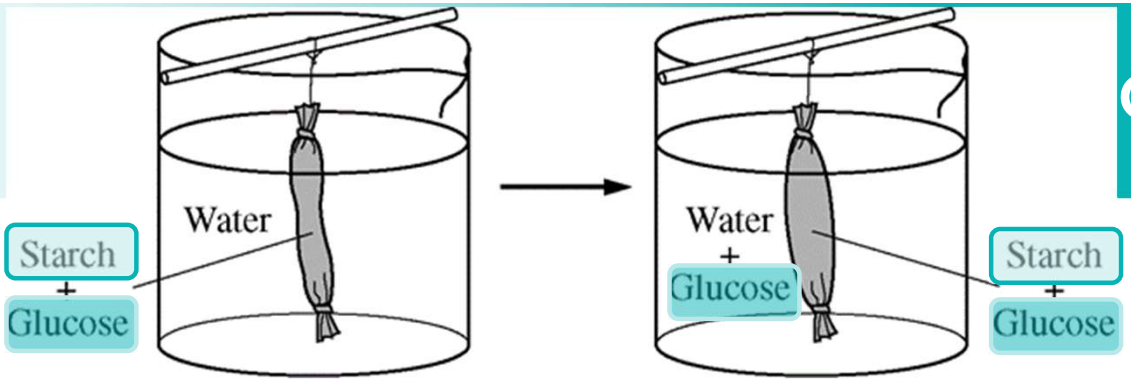
Choice Practice



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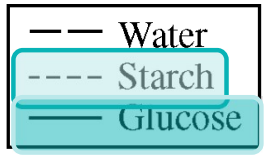

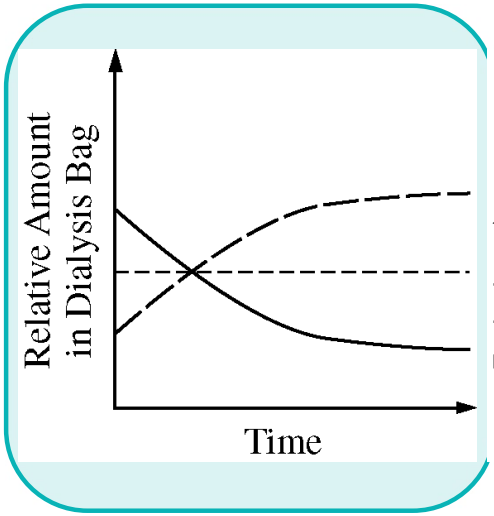

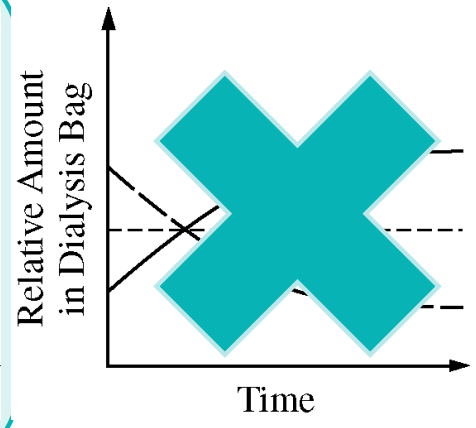

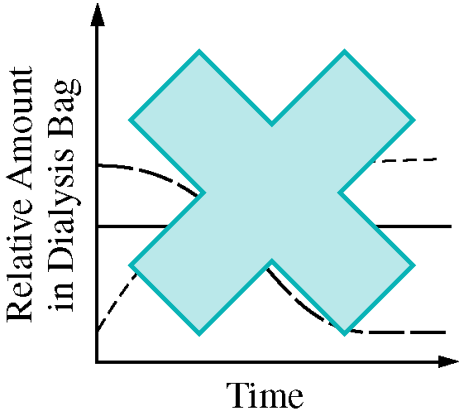

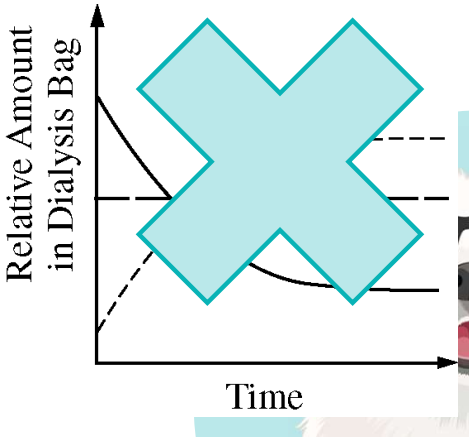

Free Response Practice:

Cystic fibrosis is a genetic condition that is associated with defects in the CFTR protein. The CFTR protein is a gated ion channel that requires ATP binding in order to allow chloride ions (Cl-) to diffuse across the membrane.

(b) **Identify** the most likely cellular location of the ribosomes that synthesize CFTR protein.

Identification (1 point)

- (Rough) Endoplasmic Reticulum/ER

(c) **Identify** the most likely cellular location of a mutant CFTR protein that has an amino acid substitution in the ATP-binding site.

Identification (1 point)

- In the (cellular/plasma) membrane

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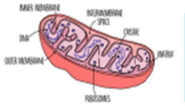

Lysosome

Structure:
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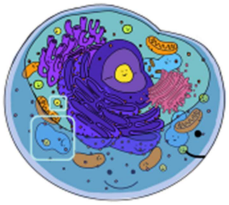
Functions:
- Intracellular digestion (recycle cell organic materials & programmed cell death: apoptosis)



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- Contractile: osmoregulation (protist)
- Food: phagocytosis, fuse with lysosome

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Functions:
- Site of photosynthesis
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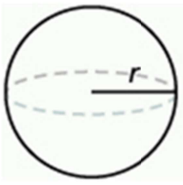
Chloroplast

Surface Area: Volume



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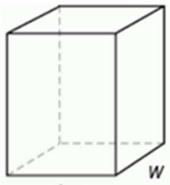

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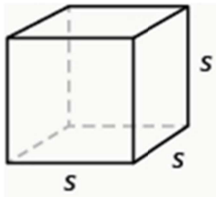

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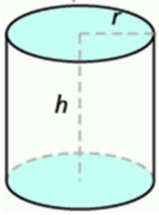

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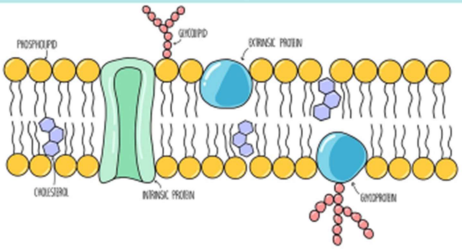
Smaller cells typically have a higher surface area-to-volume ratio and more efficient exchange of materials with the environment.

Plasma Membrane

Composed of:

- Phospholipids
- Membrane Proteins
- Glycolipids/Glycoproteins
- Cholesterol



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Active Transport

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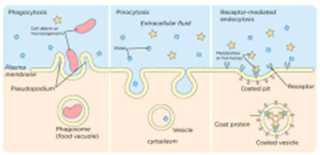
Membrane Transport

Endocytosis

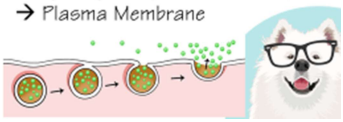
- Import of materials
- Phagocytosis: Cellular Eating
- Pinocytosis: Cellular Drinking
- Receptor-Mediated: Endocytosis

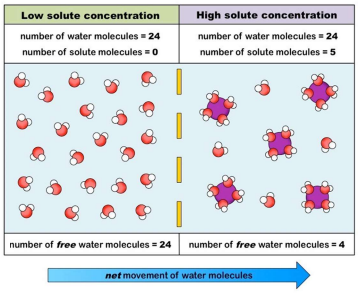
Bulk Transport

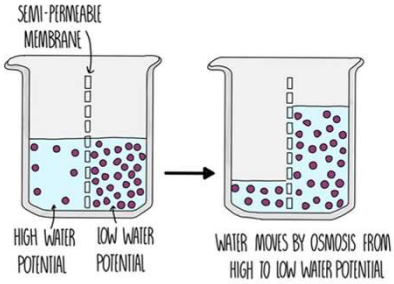


Exocytosis

- Export of materials
- Rough ER (synthesize) → Golgi complex (package/modification) → Plasma Membrane







Hypertonic Solution

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- LOW free water concentration

- GAINS water from hypotonic solution

Isotonic Solution

- EQUAL solute concentration (as other solution)
- EQUAL free water concentration (as other solution)

- Equal water movement into and out of solution

Hypotonic Solution

- LOW solute concentration
- HIGH free water concentration

- LOSES water to hypertonic solution

Osmosis