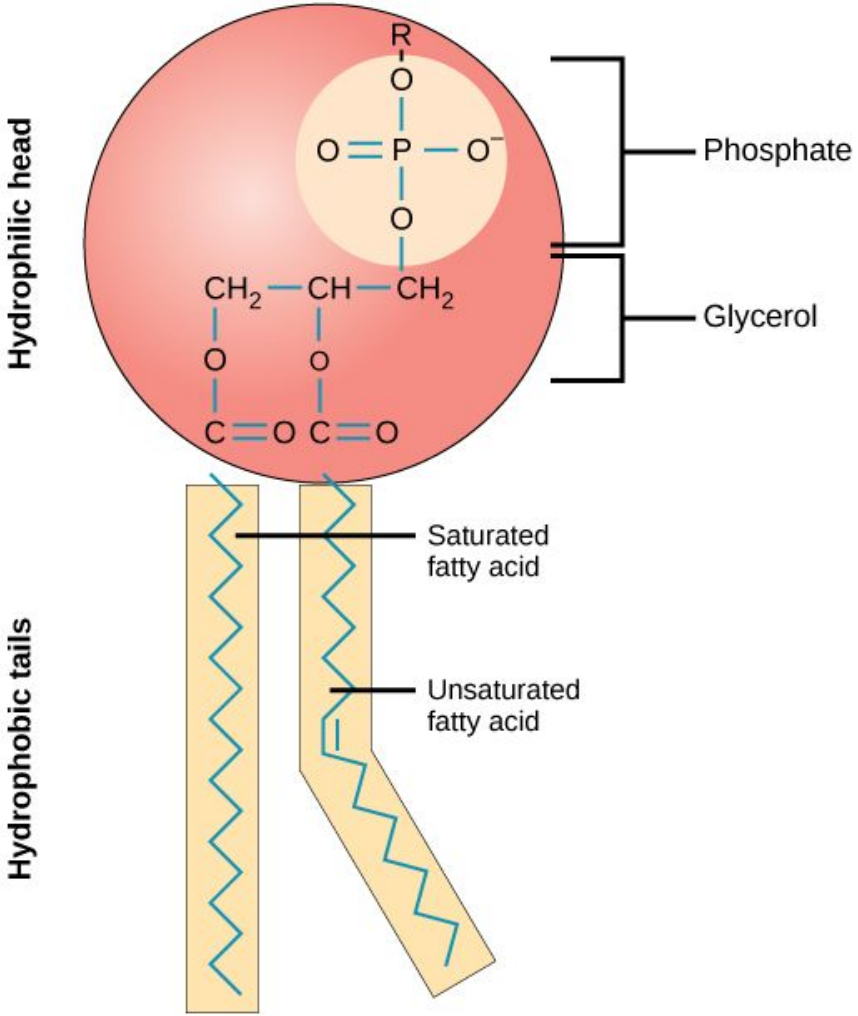
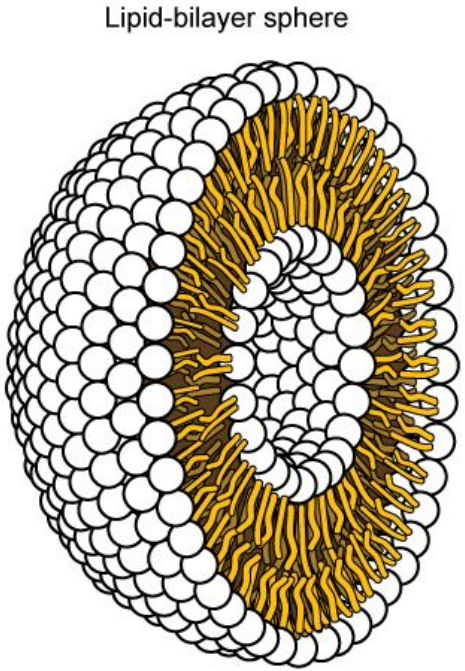
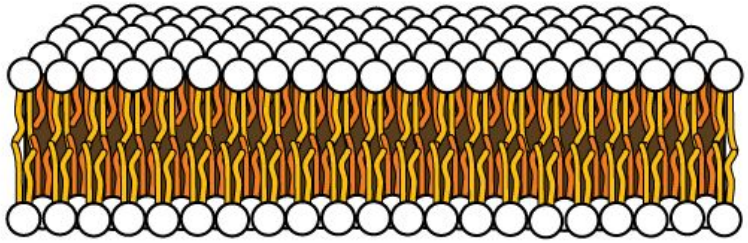
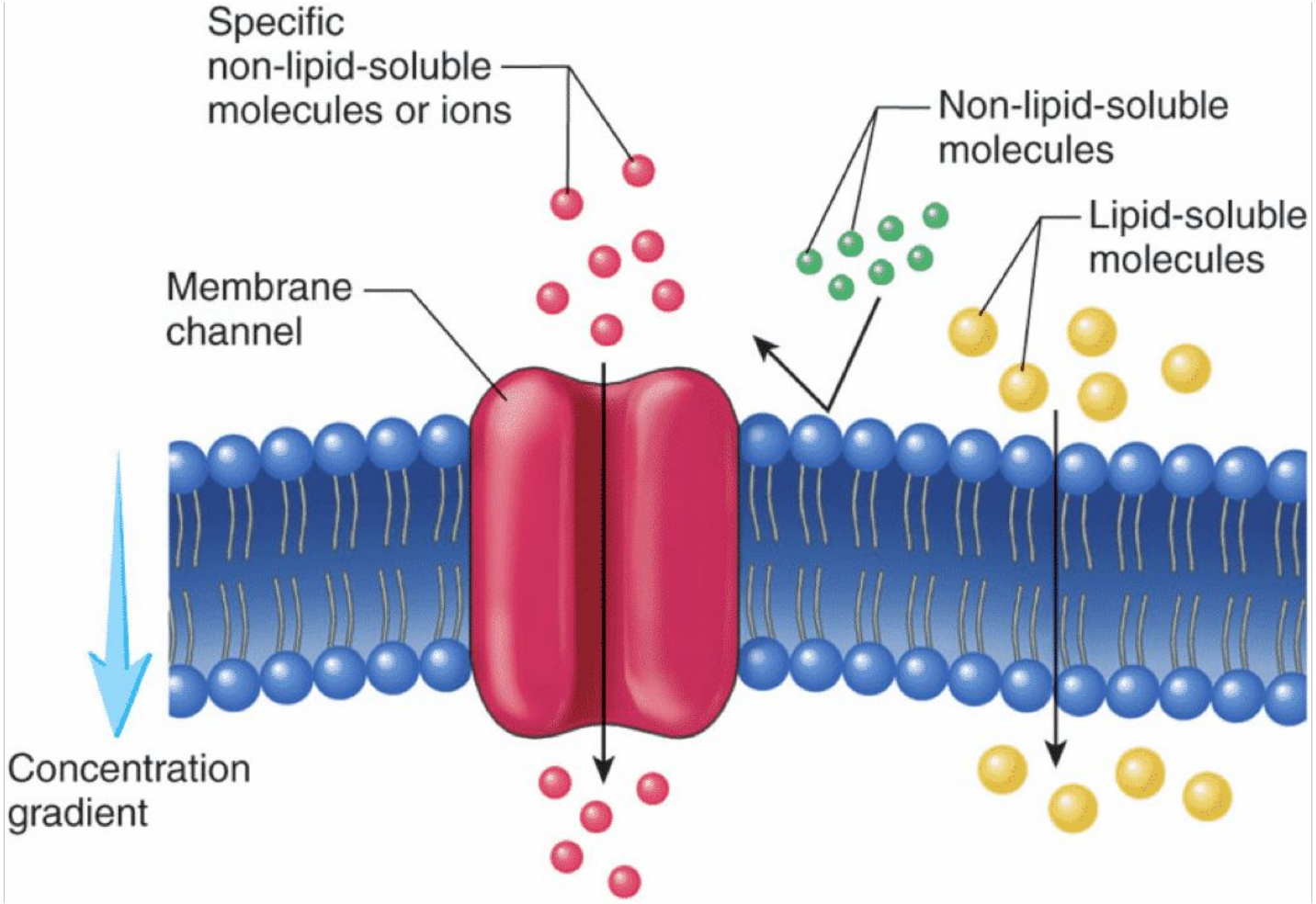
Diffusion & Osmosis Labs

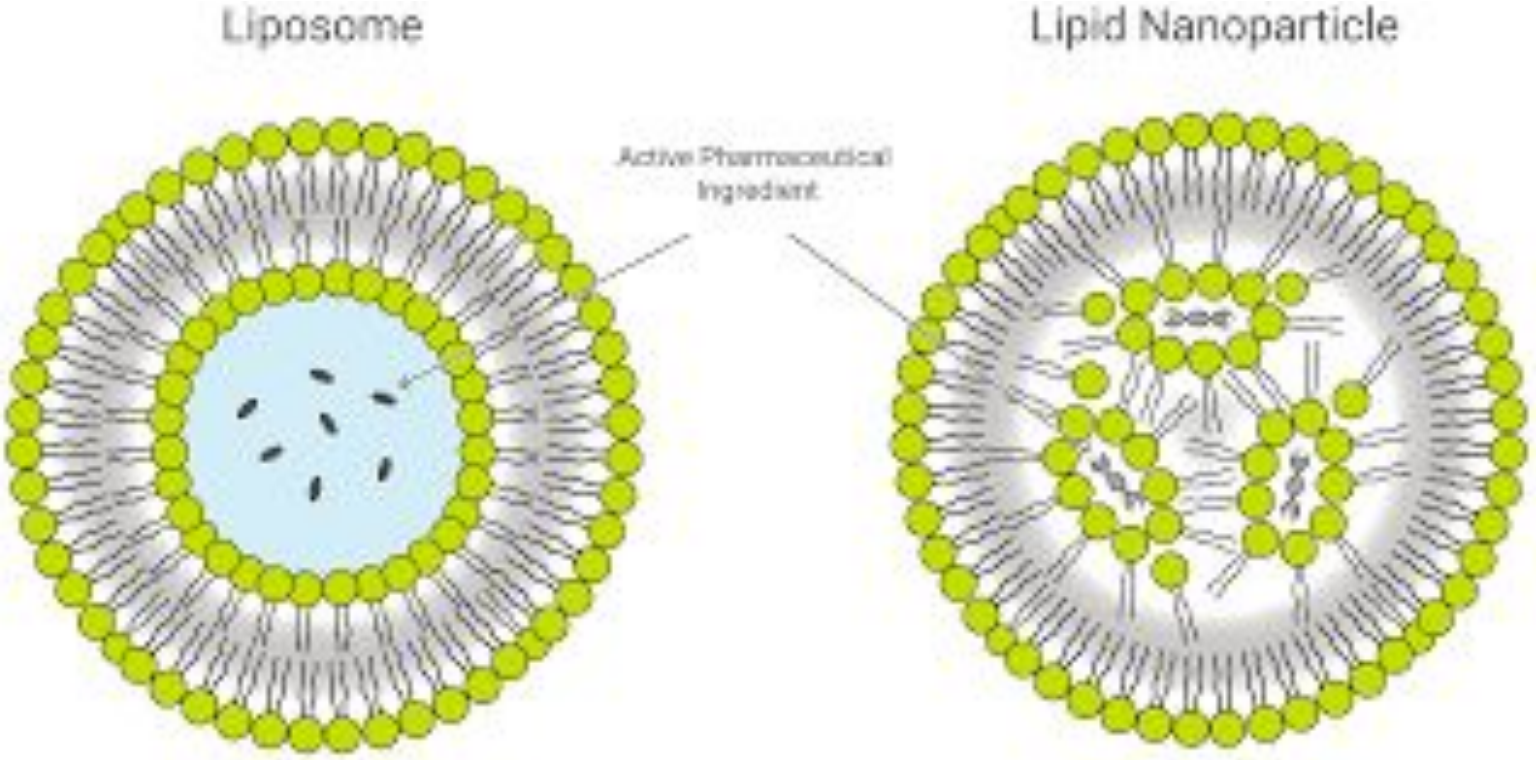
Cell membranes are selectively permeable due to their structure.


Hydrophilic head
R
O
O
P
O⁻
O
CH2
CH
CH2
O
O
C
O
C
O
Phosphate
Glycerol
Saturated fatty acid
Unsaturated fatty acid
Hydrophobic tails

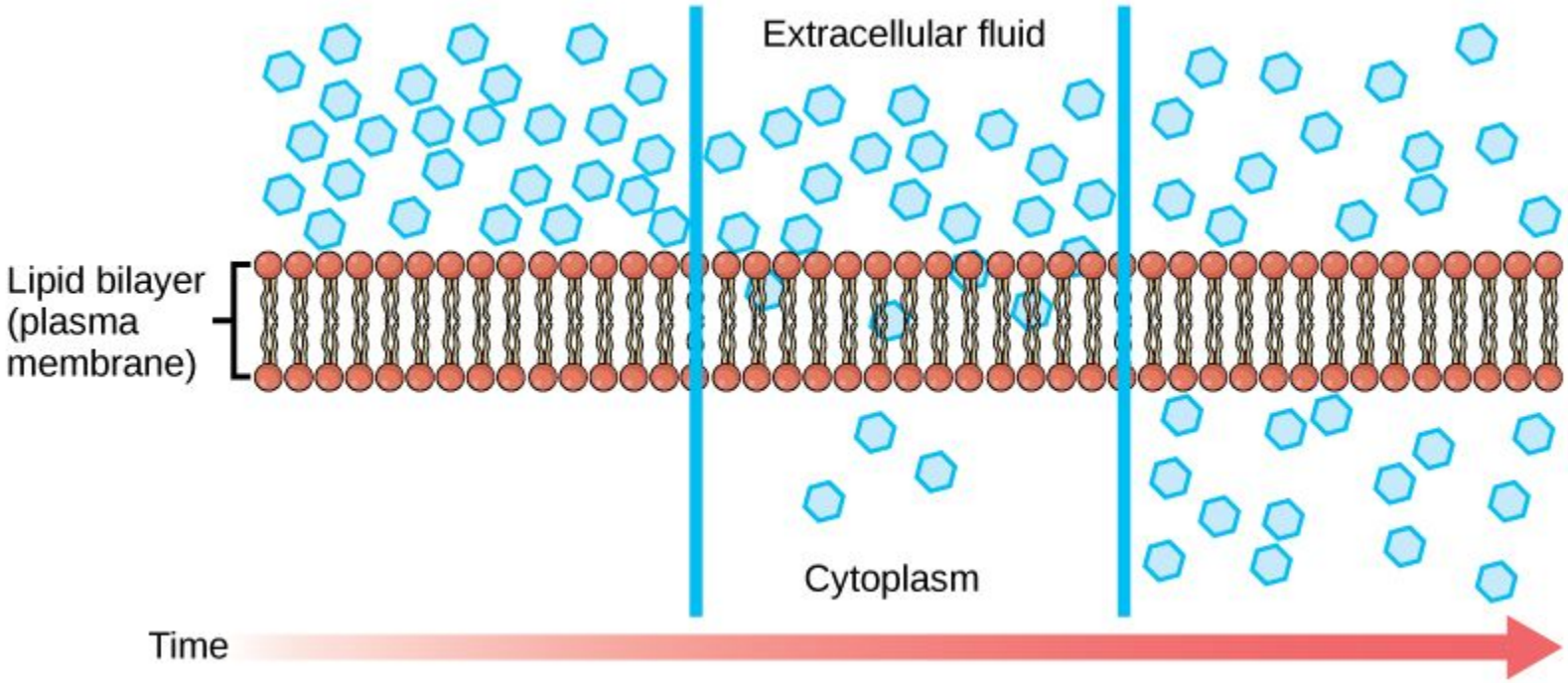

Lipid-bilayer sphere
Single-layer lipid sphere

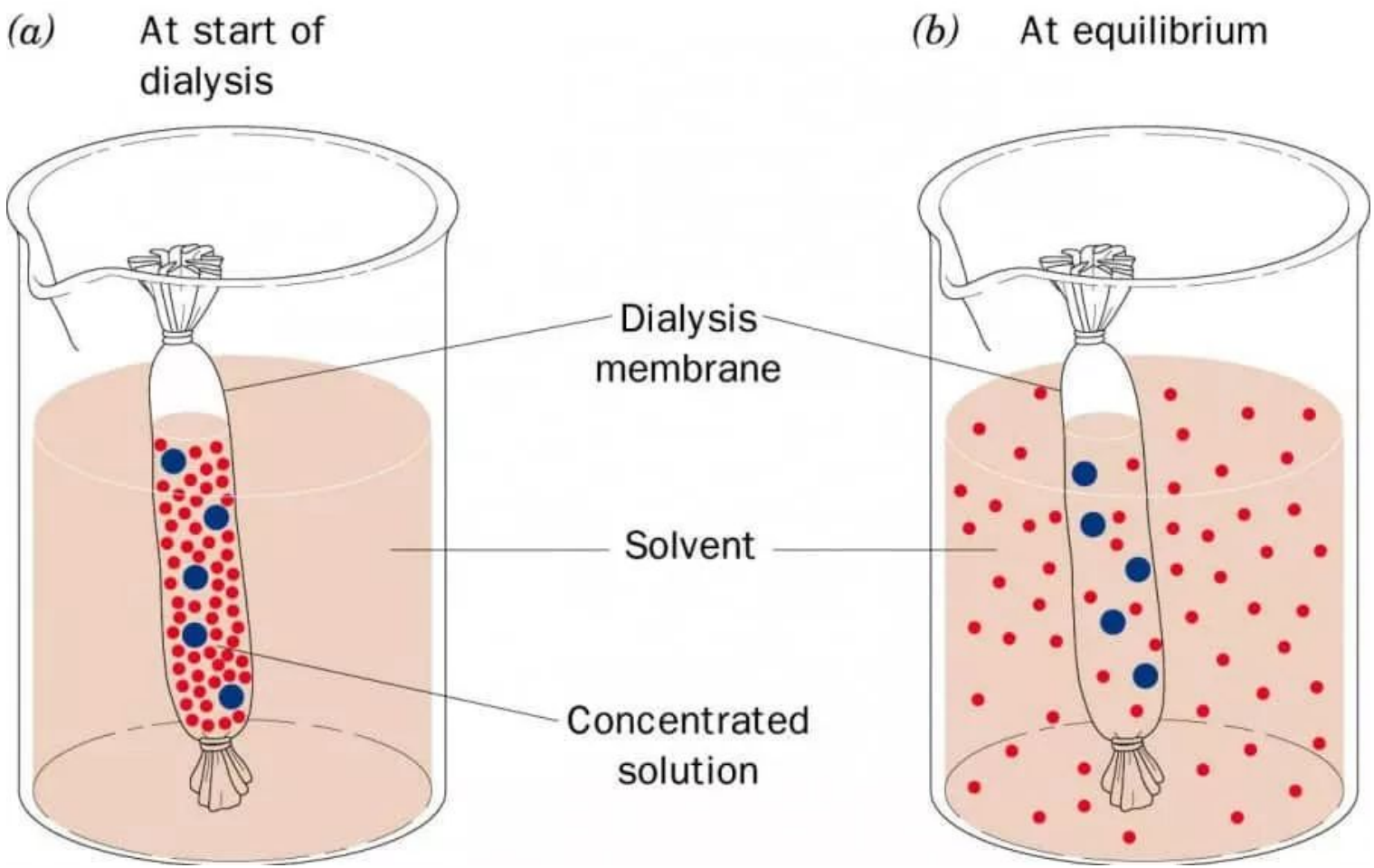

Lipid-bilayer sheet


Specific
non-lipid-soluble
molecules or ions
Non-lipid-soluble
molecules
Lipid-soluble
molecules
Membrane
channel
Concentration
gradient


Liposome
Active Pharmaceutical Ingredient
Lipid Nanoparticle

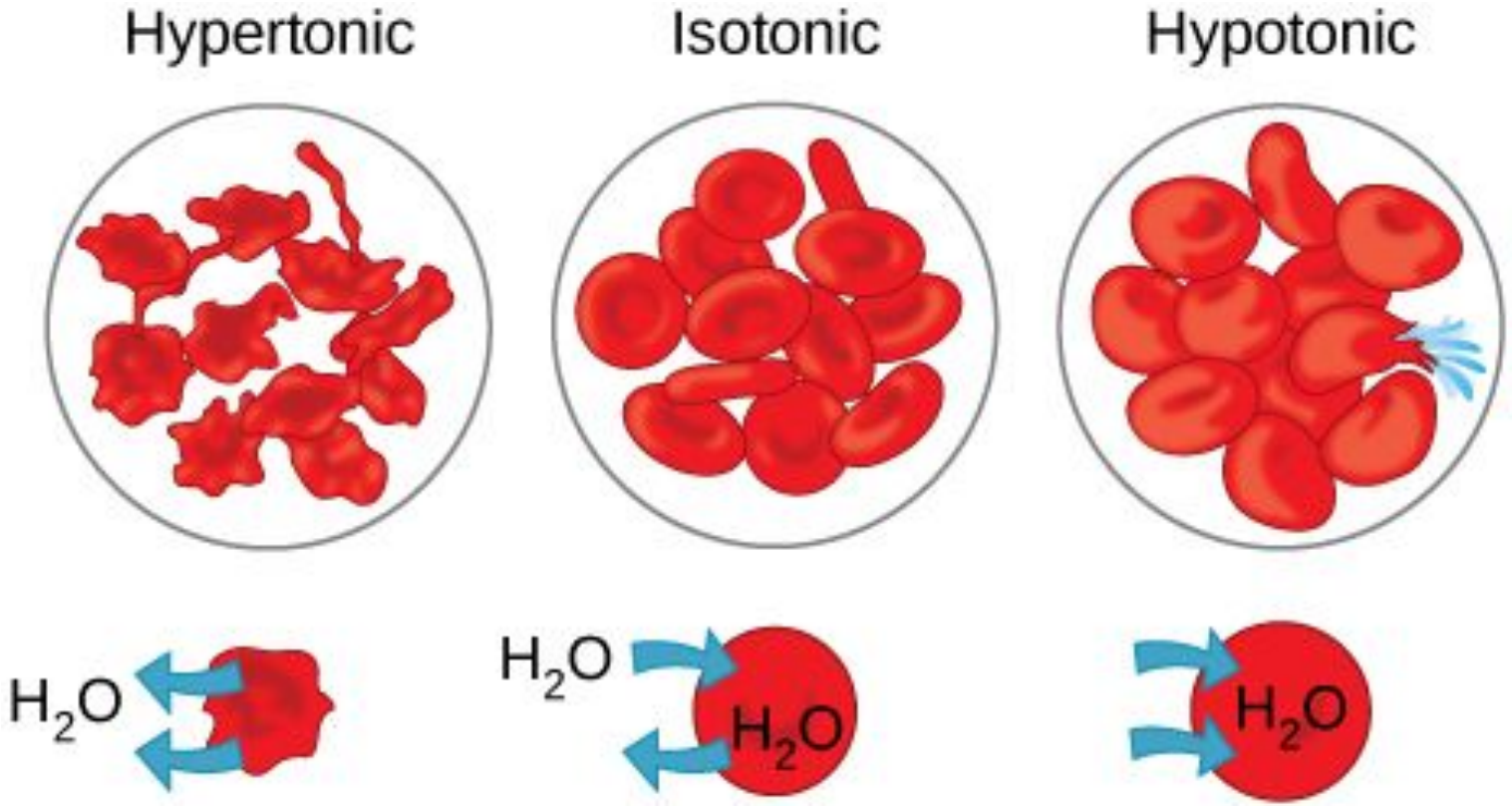
Growth and dynamic homeostasis are maintained by the constant movement of molecules across membranes.

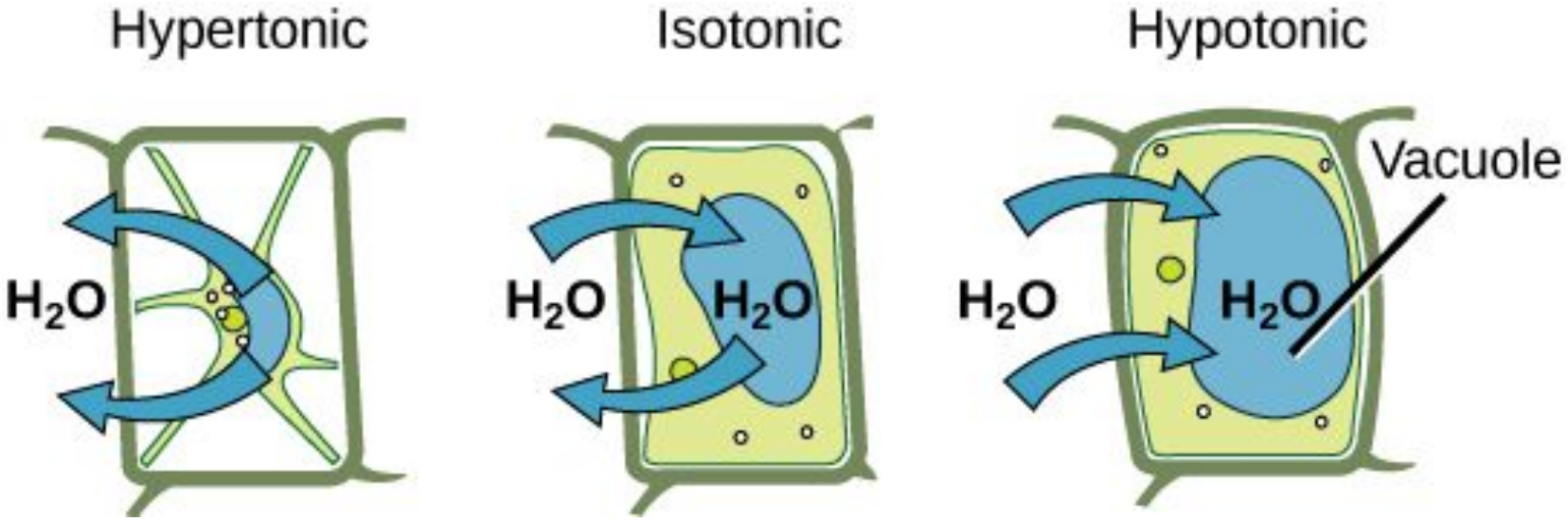

Extracellular fluid
Lipid bilayer
(plasma
membrane)
Cytoplasm
Time

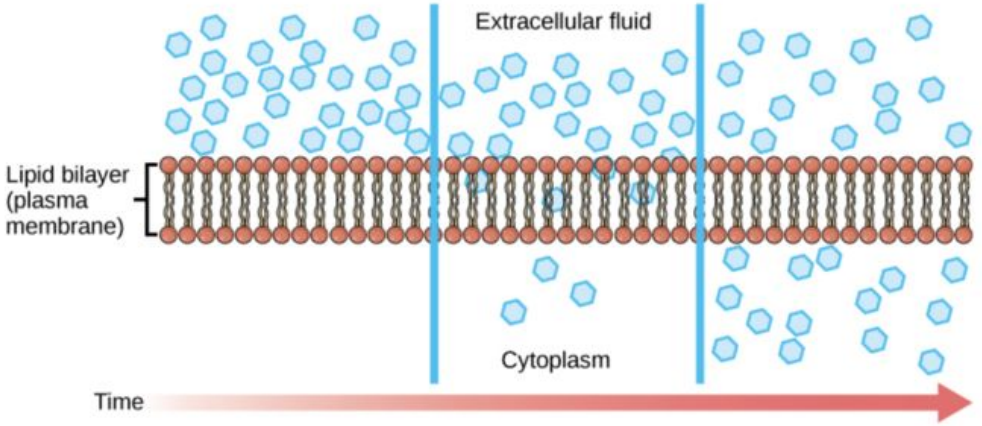

(a) At start of dialysis
(b) At equilibrium
Dialysis membrane
Solvent
Concentrated solution

Factors that Affect Diffusion (OpenStax 5.2)

Extent of the concentration gradient:	
Mass of the molecules diffusing:	
Temperature:	
Solvent density:	
Solubility:	
Surface area and thickness of the plasma membrane:	
Distance travelled:	


Hypertonic
Isotonic
Hypotonic
H_2O
H_2O
H_2O
H_2O


Hypertonic
Isotonic
Hypotonic
Vacuole
H2O
H2O
H2O
H2O



Identify the principal driving movement in diffusion, such as depicted here.

A. concentration gradient
B. membrane surface area
C. particle size
D. temperature

10. A student used a microscope to observe a wet-mount slide of red onion epidermal cells that were suspended in a 1% NaCl solution. The student then added a 15% NaCL solution to the slide and observed the changes that occurred. The student's observations are represented in Figure 1.

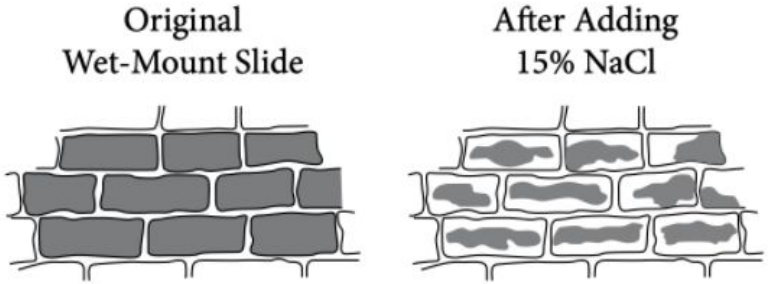


Figure 1. Student's observations of onion cells

Which of the following most directly explains the changes in the cells?

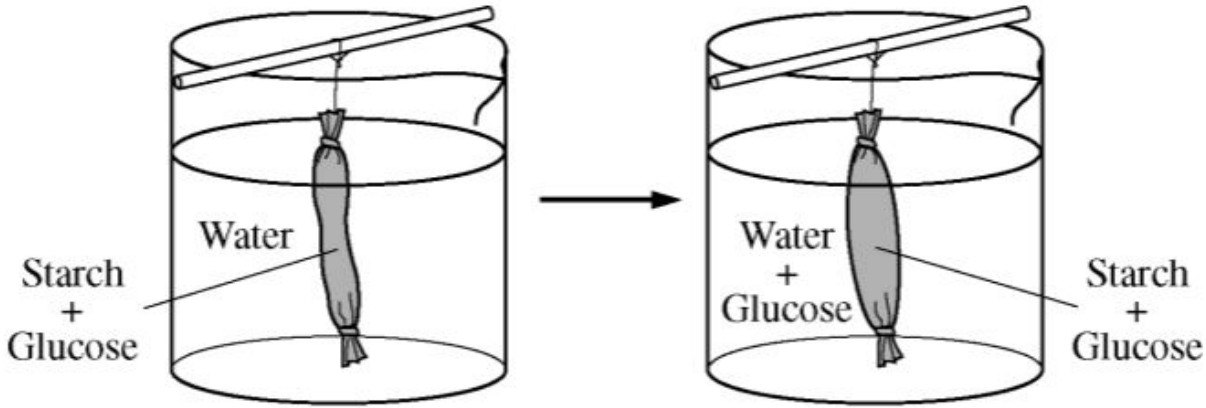
(A) The degradation of DNA in the nuclei of the cells

(B) The lysis of chloroplasts in the cells

(C) The movement of water from the central vacuoles of the cells into the solution

(D) The movement of NaCl from the solution into the cytoplasm of the cells

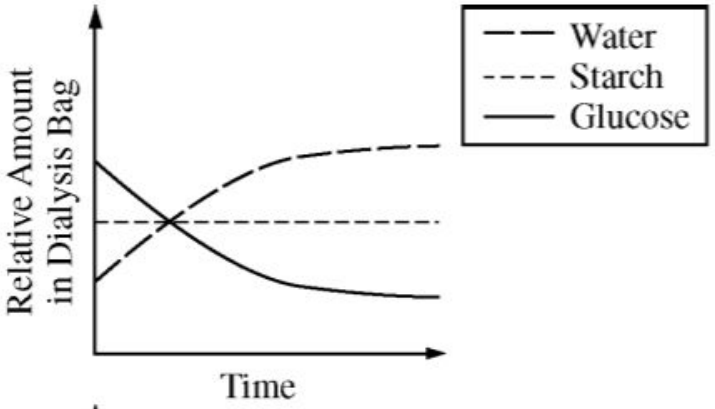
19. A common laboratory investigation involves putting a solution of starch and glucose into a dialysis bag and suspending the bag in a beaker of water, as shown in the figure below.



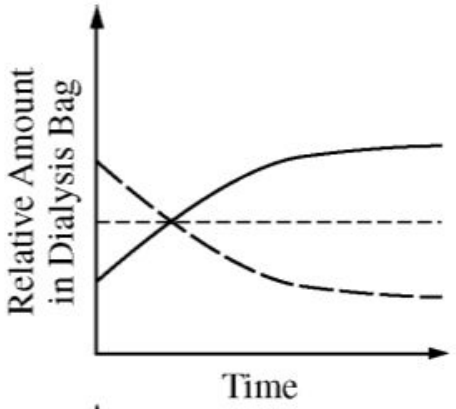
The investigation is aimed at understanding how molecular size affects movement through a membrane.

Which of the following best represents the amount of starch, water, and glucose in the dialysis bag over the course of the investigation?

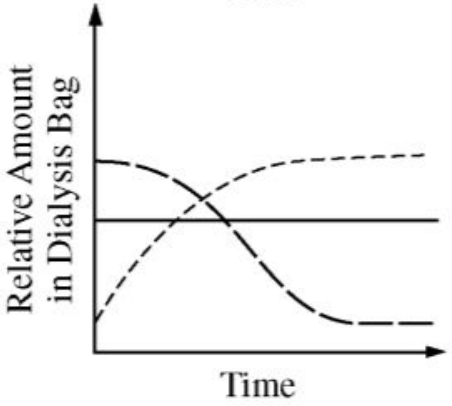
(A)



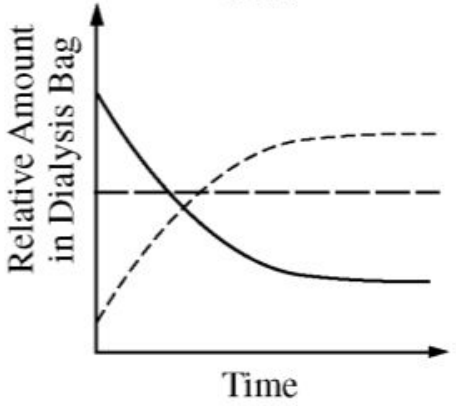
(B)



(C)



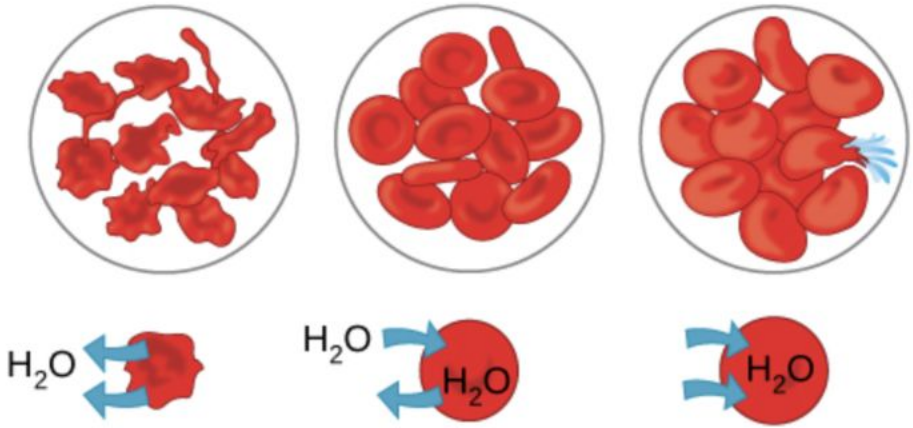
(D)



21. Discuss why the following affect the rate of diffusion: molecular size, temperature, solution density, and the distance that must be traveled.

1. Larger molecules move faster than lighter molecules. Temperature affects the molecular movement. Density is directly proportional to the molecular movement. Greater distance slows the diffusion.
2. Larger molecules move slower than lighter molecules. Increasing or decreasing temperature increases or decreases the energy in the medium, affecting molecular movement. Density is inversely proportional to molecular movement. Greater distance slows the diffusion.
3. Larger molecules move slower than lighter molecules. Temperature does not affect the rate of diffusion. Density is inversely proportional to molecular movement. Greater distance speeds up the diffusion.
4. Larger molecules move slower than lighter molecules. Increasing or decreasing temperature increases or decreases the energy in the medium, affecting molecular movement. Density is inversely proportional to the molecular movement. Greater distance speeds up the diffusion.

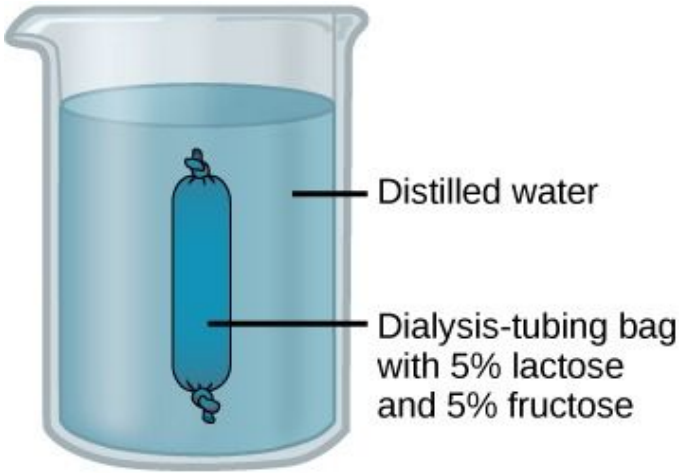
23. If a doctor injected a patient with what was labeled as an isotonic saline solution, but then the patient died, and an autopsy revealed that several of the patient's red blood cells had burst, such as in the image on the right, would it be true that the injected solution was really isotonic? Why or why not?



A. False, the solution was hypertonic.
B. False, the solution was osmotic.
C. False, the solution was hypotonic.
D. True, the solution was isotonic.

An experiment was set up to determine the movement of molecules through a dialysis-tubing bag into water. A dialysis-tubing bag containing 5% lactose and 5% fructose was placed in a beaker of distilled water, as illustrated. After four hours, fructose is detected in the distilled water outside of the dialysis-tubing bag, but lactose is not. What conclusions can be made about the movement of molecules in this experiment?

1. Fructose, being a monosaccharide, diffused through the dialysis bag into the distilled water. However, lactose, being a disaccharide, could not diffuse through the dialysis bag.
2. Fructose was homogenized by lactose, allowing the fructose to diffuse through the dialysis bag and into the distilled water. Lactose is not homogenized, so it could not pass through the dialysis bag.
3. Fructose and lactose are oppositely charged and separated out due to the force of repulsion.
4. Fructose diffused because of the pore specificity of the semipermeable membrane, not because of its concentration gradient.



4. The following experiment was designed to test whether different concentration gradients affect the rate of diffusion. In this experiment, four solutions (0% NaCl, 1% NaCl, 5% NaCl , and 10% NaCl) were tested under identical conditions. Fifteen milliliters (mL) of 0% NaCl were put into a bag formed of dialysis tubing that is permeable to Na^+, Cl^-, and water. The same was done for each NaCl solution. Each bag was submerged in a separate beaker containing 300 mL of distilled water. The concentration of NaCl in mg/L in the water outside each bag was measured at 40-second intervals. The results from the 5% bag are shown in the table below.

CONCENTRATION IN mg/L OF NaCl OUTSIDE THE 5% NaCl BAG

Time (seconds)	NaCl (mg/L)
0	0
40	130
80	220
120	320
160	400

(a) On the axes provided, graph the data for the 5% NaCl solution.

(b) Using the same set of axes, draw and label three additional lines representing the results that you would predict for the 0% NaCl, 1% NaCl, and 10% NaCl solutions. Explain your predictions.

(c) Farmlands located near coastal regions are being threatened by encroaching seawater seeping into the soil. In terms of water movement into or out of plant cells, explain why seawater could decrease crop production. Include a discussion of water potential in your answer.

4. (a) **3 points maximum**

1 point correct orientation with dependent variable (concentration) on y (vertical) axis and independent variable (time) on x (horizontal) axis

1 point correct axes labels with units **and** scaling for 5% line on axes provided

1 point correct plotting of all data points including zero (0,0); line is not necessary but if drawn must not extend beyond last data point; dashing line beyond last data point is okay; arrow at end of line is okay

4. (b) **4 points maximum**

1 point correct prediction and legend (or label) for 0%, 1%, **and** 10% lines (0% line flat, 1% line below 5% line, 10% line above 5% line)

Explanation points

1 point correct explanation for 0% line (e.g., since there is no NaCl in the bag no $Na^{+}Cl^{-}$ can diffuse into the water in the beaker)

1 point correct explanation for 1% line — must include a discussion of rate; connects concentration of NaCl with diffusion rate

1 point correct explanation for 10% line — must include a discussion of rate; connects concentration of NaCl with diffusion rate

or

1 point general explanation that solute concentration affects the rate of diffusion; answers that attempt to explain the 0%, 1% or 10 % NaCl lines are not eligible to receive this point

4. (c) **4 points maximum**

1 point statement that water will leave the plant **and** description of effect this has on plant cell (e.g., loss of turgor, plasmolysis, decrease in cell volume, decrease in central vacuole volume)

1 point concept of osmosis (e.g., movement of water across a selectively permeable membrane (cell or cell membrane) from solution with lower solute concentration (hypotonic) to solution with higher solute concentration (hypertonic)

1 point explanation that water moves from solution with higher (more positive/less negative) water potential (ψ) to solution with lower (more negative) water potential (ψ)

1 point explanation of how water loss can cause decreased crop production (e.g., stomates close, transpiration stops, photosynthesis stops, decreased metabolism)