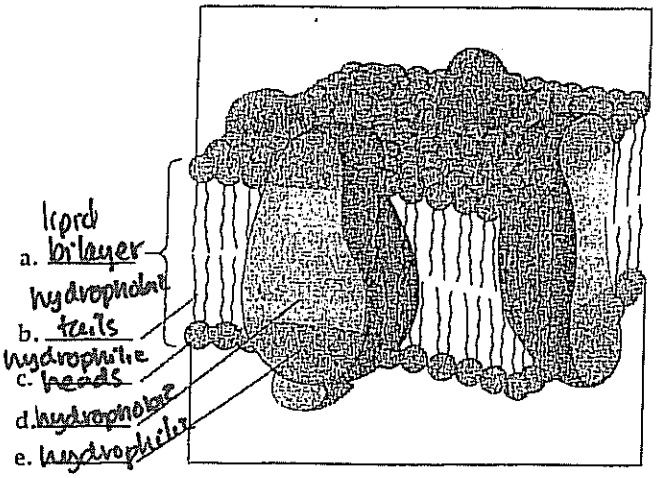
Answer Key (Ch 7-8)

INTERACTIVE QUESTION 8.1

Label the components in this diagram of the fluid mosaic model of membrane structures. Indicate the regions that are hydrophobic and those that are hydrophilic.



INTERACTIVE QUESTION 8.4

What types of molecules have difficulty crossing the plasma membrane? Why?

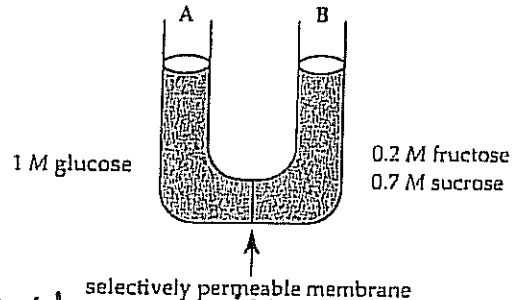
polar, ionic molecules – can't cross hydrophobic region

INTERACTIVE QUESTION 8.2

a. Cite some experimental evidence that shows that membrane proteins drift.

See exp. on mouse/human cell

b. How might the plasma membrane of a plant cell change in response to the cold temperature of winter? can shift to making more unsat. fatty acids in phospholipids.



Which way will water move if membrane is not permeable to sugars? ←

INTERACTIVE QUESTION 8.6

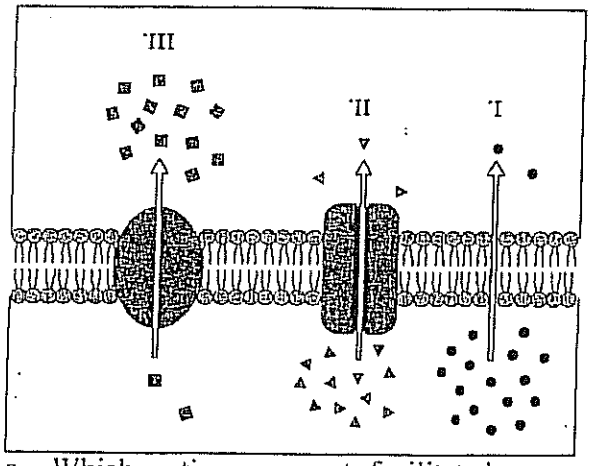
a. What osmotic problems do freshwater protists face? Freshwater is hypotonic to them, so they take in too much water

b. What adaptations may help them osmoregulate?

use contractile vacuoles to pump out excess H_2O

STRUCTURE YOUR KNOWLEDGE

1. Create a concept map to illustrate your understanding of osmosis. This exercise will help you practice using the words *hypotonic*, *isotonic*, and *hypertonic*, and it will help you focus on the effect of these osmotic environments on plant and animals cells. Explain your map to a friend.
2. The following diagram illustrates passive and active transport across a plasma membrane. Use it to answer questions a-d.



a. Which section represents facilitated diffusion? II

How can you tell? move from ↑ to ↓ thru integral protein

Does the cell expend energy in this transport? NO

Why or why not? B/C the gradient is a form of potential energy and as long as the gradient exists, mole can move

What types of solute molecules may be moved by this type of transport?

ions, glucose, amino acids etc. (small)

b. Which section shows active transport?
How can you tell? III
Does the cell expend energy in this transport? Yes bc material is moved against gradient
Why or why not?

c. Which section shows diffusion? I
What types of solute molecules may be moved by this type of transport?
gases, small nonpolar molecules

d. Which of these sections are considered passive transport? I + II

TEST YOUR KNOWLEDGE
Multiple Choice: Choose the best answer.

1. Glycoproteins and glycolipids are important for
   a. facilitated diffusion.
   b. active transport.
   c. cell-cell recognition
   d. cotransport
   e. Ssgnal-transduction pathways.

2. A single layer of phospholipid molecules coats the water in a beaker. Which part of the molecules will face the air?
   a. the phosphate groups
   b. the hydrocarbon tails
   c. both head and tail because the molecules are amphipathic and will lie sideways.
   d. the phospholipids would dissolve in the water and not form a membrane coat
   e. the glycolipid regions

3. Which of the following is *not* true about osmosis?
   a. It increases free energy in a system.
   b. Water moves from a hypotonic in a hypertonic solution.
   c. Solute molecules bind to water and decrease the water available to move.
   d. It increases the entropy in a system.
   e. There is no net osmosis between isotonic solutions.

4. Support for the fluid mosaic model of membrane structure comes from
   a. The freeze-fracture technique of electron microscopy.
   b. The movement of proteins in hybrid cells.
   c. The amphipathic nature of membrane proteins.
   d. Both a and c.
   e. All of the above.

5. A freshwater *Paramecium* is placed into salt water. Which of the following events would occur?
   a. an increase in the action of its contractile vacuol
   b. swelling of the cell until it becomes turgid
   c. swelling of the cell until it lyses
   d. shriveling of the cell
   e. diffusion of salt ions out of the cell

6. Ions diffuse across membranes down their
   a. electrochemical gradient. (both charge + concentration determ direction of movement)
   b. electrogenic gradient.
   c. electrical gradient.
   d. concentration gradient.
   e. osmotic gradient.

7. The fluidity of membranes in a plant in cold weather may be maintained by
   a. increasing the number of phospholipids with saturated hydrocarbon tails.
   b. activating an H^+ pump.
   c. increasing the concentration of cholesterol in the membrane.
   d. increasing the proportion of peripheral proteins.
   e. increasing the number of phospholipids with unsaturated hydrocarbon tails.

8. A plant cell placed in a hypotonic environment will
   a. plasmolyze.
   b. shrivel.
   c. become turgid.
   d. become flaccid.
   e. lyse. (animal cell may lyse)

9. Which of the following is *not* true of the carrier molecules involved in facilitated diffusion?
   a. They increase the speed of transport across a membrane.
   b. They can concentrate solute molecules on one side of the membrane. this requires energy
   c. They may have specific binding sites for the molecules they transport.
   d. They may undergo a conformational change upon binding of solute.
   e. They may be inhibited by molecules that resemble the solute to which they normally bind.

10. The membrane potential of a cell favors the
    a. movement of cations into the cell.
    b. movement of anions into the cell.
    c. action of an electrogenic pump.
    d. movement of sodium out of the cell.
    e. action of a protein pump.

11. Cotransport may involve
    a. active transport of two solutes through a transport protein.
    b. passive transport of two solutes through a transport protein.
    c. ion diffusion against the electrochemical gradient created by an electrogenic pump.
    d. a pump such as the Na^+-K^+ pump that moves ions in two different directions.
    e. transport of one solute against its concentration gradient in tandem with another that is diffusing down its concentration gradient.

12. Exocytosis involves all of the following *except*
    a. ligands and coated pits. this is true of receptor-mediated endocytosis
    b. the fusion of a vesicle with the plasma membrane.
    c. a mechanism to transport carbohydrates to the outside of plant cells during the formation of cell walls.
    d. a mechanism to rejuvenate the plasma membrane.
    e. a means of exporting large molecules.

13. The proton pump in plant cells is the functional equivalent of an animal cell's
    a. cotransport mechanism.
    b. sodium-potassium pump. both create electrochem. gradients
    c. contractile vacuole for osmoregulation.
    d. receptor-medicated endocytosis of cholesterol.
    e. ATP pump.

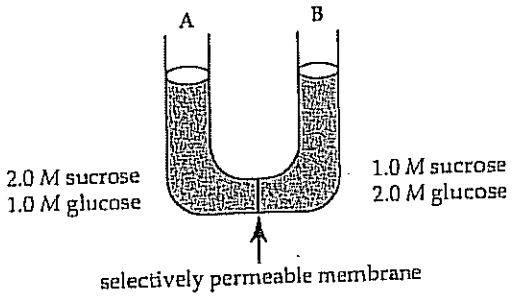
14. Pinocytosis involves
    a. the fusion of a newly formed food vacuole with a lysosome.
    b. receptor-mediated endocytosis and the formation of vesicles.
    c. the pinching in of the plasma membrane around small droplets of external fluid.
    d. pseudopod extension as vesicles move along the cytoskeleton and fuse with the plasma membrane.
    e. the accumulation of specific large molecules in a cell.

15. Watering a houseplant with too concentrated a solution of fertilizer can result in wilting because
    a. the uptake of ions into plant cells makes the cells hypertonic.
    b. the soil solution becomes hypertonic, causing the cells to lose water.
    c. the plant will grow faster than it can transport water and maintain proper water balance.
    d. diffusion down the electrochemical gradient will cause a disruption of membrane potential and accompanying loss of water.
    e. the plant will suffer fertilizer burn due to a caustic soil solution.

16. A cell is manufacturing receptor proteins for cholesterol. How would those proteins be oriented in the following membranes before they reach the plasma membrane?
    a. facing inside the ER lumen but outside the transport vesicle membrane
    b. facing inside the ER lumen and inside the transport vesicle
    c. attached outside the ER and outside the transport vesicle
    d. attached outside the ER but facing inside the transport vesicle
    e. completely embedded in the hydrophobic center of both the ER and transport vesicle membranes.

17. Which of the following is the most probable description of an integral, transmembrane protein?
    a. amphipathic with a hydrophilic head and a hydrophobic tail region
    b. a globular protein with hydrophobic amino acids in the interior and hydrophilic amino acids arranged around the outside
    c. a fibrous protein coated with hydrophobic sugar residues
    d. a glycoprotein with oligosaccharides attached to the portion of the protein facing the exterior of the cell and cytoskeletal elements facing the inside the cell
    e. a middle region composed of a-helical stretches of hydrophobic amino acids, with hydrophilic regions at both ends of the protein

Use the U-tube set up to answer questions 18-20.



The solutions in the two arms of this U-tube are separated by a membrane that is permeable to water and glucose but not to sucrose. Side A is filled with a solution of 2.0 M sucrose and 1.0 M glucose. Side B is filled with 1.0 M sucrose and 2.0 M glucose.

18. *Initially*, the solution in side A, with respect to that in side B, is
    a. hypotonic.
    b. hypertonic.
    c. isotonic.
    d. lower.
    e. higher.

A ← HO B

2 M Suc. 1.5 M glu

1 M Sucrose 1.5 M glucose

19. *After* the system reaches equilibrium, what changes are observed?
   a. the water level is higher in side A than in side B.
   b. the water level is higher in side B than in side A.
   c. the molarity of glucose is higher in Side A than in side B.
   d. the molarity of sucrose has increased in side A.
   e. both a and c have occurred.

20. During the period *before* equilibrium is reached, which molecule(s) will show net movement through the membrane?
   a. water
   b. glucose
   c. sucrose
   d. water and sucrose
   e. water and glucose

21. Facilitated diffusion across a cellular membrane requires _____ and moves a solute _____ its concentration gradients.
   a. energy and transport proteins.....down
   b. energy and transport proteins ...up (against)
   c. energy....up
   d. transport proteins...down
   e. transport proteins...up

22. The extracellular fluids that surround the cells of a multicellular animal must be ____ to the cells.
   a. buffers
   b. isotonic
   c. hypotonic
   d. hypertonic
   e. homeotonic

SKIP

23. LDLs (low-density lipoproteins) enter animal cells by
   a. diffusion through the lipid bilayer.
   b. pinocytosis.
   c. exocytosis.
   d. receptor-mediated endocytosis.
   e. diffusion through transport proteins.

24. The fluid mosaic model describes biological membranes as consisting of
   a. a phospholipid bilayer with proteins sandwiched between the layers.
   b. a lipid bilayer with proteins coating the outside of this hydrophobic structure.
   c. a phospholipid bylayer with proteins embedded in and attached to it.
   d. a protein bilayer with phospholipic embedded in it.
   e. a cholesterol bilayer with proteins embedded in the hydrophobic center.

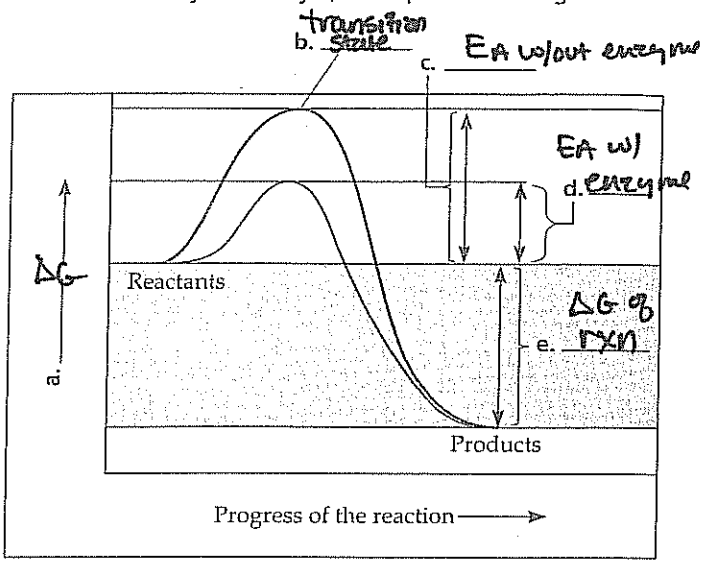
25. You observe plant cells under a microscope that have just been placed in an unknown solution. First the cells plasmolyze; after a few minutes, the plasmolysis reverses and the cells appear normal. What would you conclude about the unknown solute.
   a. It is hypertonic to the plant cells, and its solute cannot cross the plant cell membranes.
   b. It is hypotonic to the plant cells, and its solute cannot cross the plant cell membranes.
   c. It is isotonic to the plant cells, but its solute can cross the plant cell membranes.
   d. It is hypertonic to the plant to the plant cells, but its solute can cross the plant cell membranes.
   e. It is hypertonic to the plant cells, but its solute can cross the plant cell membranes.

typo

but would be correct.

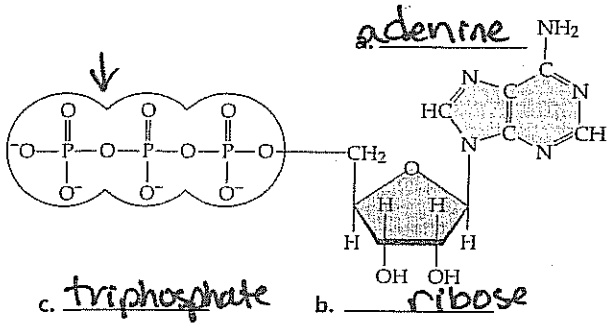
INTERACTIVE QUESTION 8.5

In the following graph of an exergonic reaction with and without an enzyme catalyst, label parts a through e.



INTERACTIVE QUESTION 8.4

Label the three components (a through c) of the following ATP molecule.



d. Indicate which bond is likely to break. By what chemical mechanism is the bond broken? hydrolysis

e. Explain why this reaction releases so much energy.

many neighboring neg. charges make last phosphate unstable

Test Your Knowledge

MULTIPLE CHOICE: *Choose the one best answer.*

1. Catabolic and anabolic pathways are often coupled in a cell because
   a. the intermediates of a catabolic pathway are used in the anabolic pathway.
   b. both pathways use the same enzymes.
   c. the free energy released from one pathway is used to drive the other pathway.
   d. the activation energy of the catabolic pathway can be used in the anabolic pathway.
   e. their enzymes are controlled by the same activators and inhibitors.

2. According to the first law of thermodynamics,
   a. for every action there is an equal and opposite reaction.
   b. every energy transfer results in an increase in disorder or entropy.
   c. the total amount of energy in the universe is conserved or constant.
   d. energy can be transferred or transformed, but disorder always increases.
   e. potential energy is converted to kinetic energy, and kinetic energy is converted to heat.

3. When a cell breaks down glucose, only about 34% of the energy is captured in ATP molecules. The remaining 66% of the energy is
   a. used to increase the order necessary for life to exist.
   b. lost as heat, in accordance with the second law of thermodynamics.
   c. used to increase the entropy of the system by converting kinetic energy into potential energy.
   d. stored in starch or glycogen for later use by the cell.
   e. released when the ATP molecules are hydrolyzed.

4. When glucose and O_2 are converted to CO_2 and H_2O, changes in total energy, entropy, and free energy are correctly represented as
   a. $-\Delta H, -\Delta S, -\Delta G$.
   b. $-\Delta H, +\Delta S, -\Delta G$.
   c. $-\Delta H, +\Delta S, +\Delta G$.

d. $+\Delta H, +\Delta S, +\Delta G$.
e. $+\Delta H, -\Delta S, +\Delta G$.

5. When amino acids join to form a protein, which of the following energy and entropy changes apply?
a. $-\Delta H, +\Delta S, +\Delta G$
b. $-\Delta H, -\Delta S, +\Delta G$
c. $+\Delta H, +\Delta S, +\Delta G$
d. $+\Delta H, -\Delta S, +\Delta G$
e. $+\Delta H, +\Delta S, -\Delta G$

6. A negative ΔG means that
a. the quantity G of energy is available to do work.
b. the reaction is spontaneous.
c. the reactants have more free energy than the products.
d. the reaction is exergonic.
e. all of the above are true.

7. One way in which a cell maintains metabolic disequilibrium is to
a. siphon products of a reaction off to the next step in a metabolic pathway.
b. provide a constant supply of enzymes for critical reactions.
c. use feedback inhibition to turn off pathways.
d. use allosteric enzymes that can bind to activators or inhibitors.
e. use the energy from anabolic pathways to drive catabolic pathways.

8. At equilibrium,
a. no enzymes are functioning.
b. free energy is decreasing.
c. the forward and backward reactions have stopped.
d. the products and reactants have equal values of H.
e. ΔG is 0.

9. An endergonic reaction could be described as one that
a. proceeds spontaneously with the addition of activation energy.
b. produces products with more free energy than the reactants.
c. is not able to be catalyzed by enzymes.
d. releases energy.
e. produces ATP for energy coupling.

10. The formation of ATP from ADP and inorganic phosphate
a. is an exergonic process.
b. transfers the phosphate to an intermediate that becomes more reactive.
c. produces an unstable energy compound that can drive cellular work.
d. has a ΔG of -7.3 kcal/mol under standard conditions.
e. involves the hydrolysis of a phosphate bond.

11. What is meant by an induced fit?
a. The binding of the substrate is an energy-requiring process.
b. A competitive inhibitor can outcompete the substrate for the active site.
c. The binding of the substrate changes the shape of the active site, which can stress or bend substrate bonds.
d. The active site creates a microenvironment ideal for the reaction.
e. The binding of an activator to an allosteric site induces a more active form of the subunits of an enzyme.

12. In an experiment, changing the pH from 7 to 6 resulted in an increase in product formation. From this we could conclude that
a. the enzyme became saturated at pH 6.
b. the enzyme's optimal pH is 6.
c. this enzyme works best at a neutral pH.
d. the temperature must have increased when the pH was changed to 6.
e. the enzyme was in a more active shape at pH 6.

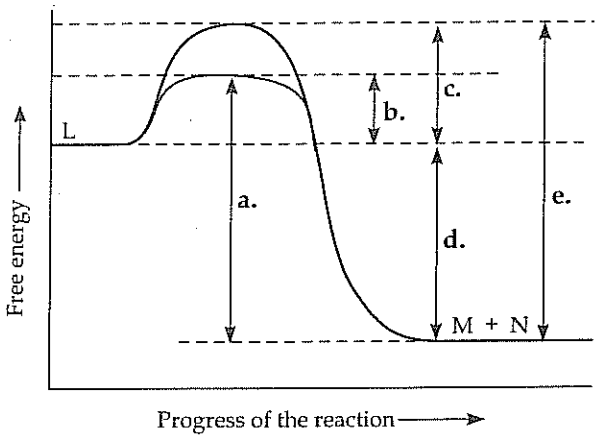
13. When substance A was added to an enzyme reaction, product formation decreased. The addition of more substrate did not increase product formation. From this we conclude that substance A could be
a. product molecules.
b. a cofactor.
c. an allosteric enzyme.
d. a competitive inhibitor.
e. a noncompetitive inhibitor.

14. Which of the following characteristics is most directly responsible for the specificity of a protein enzyme?
a. its primary structure
b. its secondary and tertiary structures
c. the shape and characteristics of its allosteric site
d. its cofactors
e. the R groups of the amino acids in its active site

15. An enzyme raises which of the following parameters?
a. ΔG
b. ΔH
c. the free energy of activation
d. the speed of a reaction
e. the equilibrium of a reaction

16. Zinc, an essential trace element, may be found bound to the active site of some enzymes. Such zinc ions most likely function as
a. a coenzyme derived from a vitamin.
b. a cofactor necessary for catalysis.
c. a substrate of the enzyme.
d. a competitive inhibitor of the enzyme.
e. an allosteric activator of the enzyme.

Use the following diagram to answer questions 17–19.



17. Which line in the diagram indicates the ΔG of the enzyme-catalyzed reaction L → M + N? D

18. Which line in the diagram indicates the activation energy of the noncatalyzed reaction? C

19. Which of the following terms best describes this reaction?
    a. nonspontaneous
    b. $-\Delta G$
    c. endergonic
    d. coupled reaction
    e. anabolic reaction

20. In cooperativity,
    a. a cellular organelle contains all the enzymes needed for a metabolic pathway.
    b. a product of a pathway serves as a competitive inhibitor of an enzyme early in the pathway.
    c. a molecule bound to the active site of one subunit of an enzyme affects the active site of other subunits.
    d. the allosteric site is filled with an activator molecule.
    e. the product of one reaction serves as the substrate for the next reaction in intricately ordered metabolic pathways.

21. In the metabolic pathway A → B → C → D → E, what effect would molecule E likely have on the enzyme that catalyzes A → B?
    a. allosteric inhibitor
    b. allosteric activator
    c. competitive inhibitor
    d. feedback activator
    e. coenzyme

FILL IN THE BLANKS

metabolism 1. the totality of an organism's chemical processes

anabolic 2. pathways that use energy to synthesize complex molecules

potential 3. the energy resulting from location or structure

heat 4. the most random form of energy

entropy 5. term for the measure of disorder or randomness

activation energy 6. the energy that must be absorbed by molecules to reach the transition state

Competitive 7. inhibitors that decrease an enzyme's activity by binding to the active site

Coenzymes 8. organic molecules that bind to enzymes and are necessary for their functioning

neg. feedback 9. regulatory device in which the product of a pathway binds to an enzyme early in the pathway

phosphorylated intermediate 10. more reactive molecules created by the transfer of a phosphate group from ATP