

CHAPTER 5—HOMESTASIS AND CELL TRANSPORT

MULTIPLE CHOICE

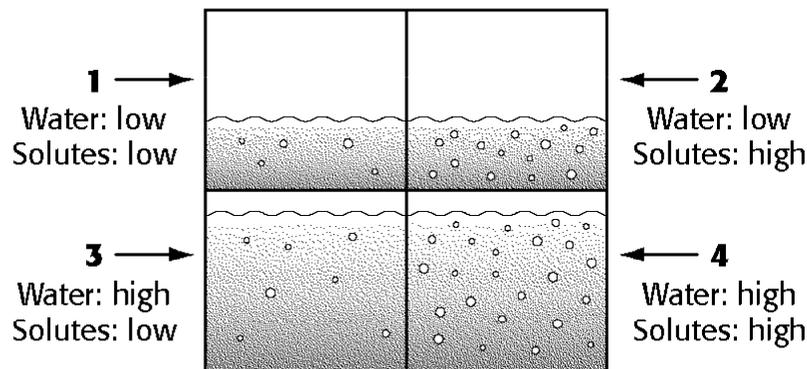
- As a result of diffusion, the concentration of many types of substances
 - always remains greater inside a membrane.
 - eventually becomes balanced on both sides of a membrane.
 - always remains greater on the outside of a membrane.
 - becomes imbalanced on both sides of a membrane.

ANS: B DIF: 1 OBJ: 5-1.1

- Diffusion takes place
 - only through a lipid bilayer membrane.
 - from an area of low concentration to an area of high concentration.
 - only in liquids.
 - from an area of high concentration to an area of low concentration.

ANS: D DIF: 1 OBJ: 5-1.1

Concentration of Water and Solutes in Four Adjacent Cells



- Refer to the illustration above. Which cell is most likely to lose both water molecules and solute molecules as the system approaches equilibrium?
 - cell 1
 - cell 2
 - cell 3
 - cell 4

ANS: D DIF: 2 OBJ: 5-1.2

- Refer to the illustration above. In this system, solute molecules in cell 2 are most likely to
 - remain in cell 2.
 - adhere to cell 2's membrane.
 - diffuse into cell 1.
 - diffuse into cell 4.

ANS: C DIF: 2 OBJ: 5-1.2

5. Refer to the illustration above. In which direction are water molecules in this system most likely to diffuse?
- a. from 1 to 2
 - b. from 2 to 4
 - c. from 4 to 3
 - d. from 3 to 1

ANS: D DIF: 2 OBJ: 5-1.2

6. The dispersal of ink in a beaker of water is an example of
- a. diffusion.
 - b. osmosis.
 - c. active transport.
 - d. endocytosis.

ANS: A DIF: 1 OBJ: 5-1.2

7. heavy rains : flooding ::
- a. osmosis : plasmolysis
 - b. high solute concentration : isotonic solution
 - c. active transport : ATP
 - d. concentration difference : osmosis

ANS: D DIF: 2 OBJ: 5-1.2

8. Sugar molecules can enter cells through the process of
- a. exocytosis.
 - b. facilitated diffusion.
 - c. osmosis.
 - d. ion pumps.

ANS: B DIF: 1 OBJ: 5-1.3

9. Channels utilizing facilitated diffusion
- a. work in two directions.
 - b. require an electrical signal to function.
 - c. Both a and b
 - d. None of the above

ANS: A DIF: 1 OBJ: 5-1.3

10. Which of the following is *not* characteristic of facilitated diffusion?
- a. It requires a carrier protein.
 - b. It moves substances against a concentration gradient.
 - c. It requires no energy input.
 - d. It involves a change in the shape of its carrier.

ANS: B DIF: 1 OBJ: 5-1.3

11. Which of the following is true of ions and their transport across cell membranes?
- a. The “gates” for ion channels are always open.
 - b. Ion channels always allow any type of ion to pass through them.
 - c. Electrical or chemical signals may control the movement of ions across cell membranes.
 - d. Because they are charged particles, the movement of ions across cell membranes requires energy input.

ANS: C DIF: 2 OBJ: 5-1.4

12. Which of the following does *not* expend energy?
- a. diffusion
 - b. endocytosis
 - c. active transport
 - d. a sodium-potassium pump

ANS: A DIF: 1 OBJ: 5-2.1

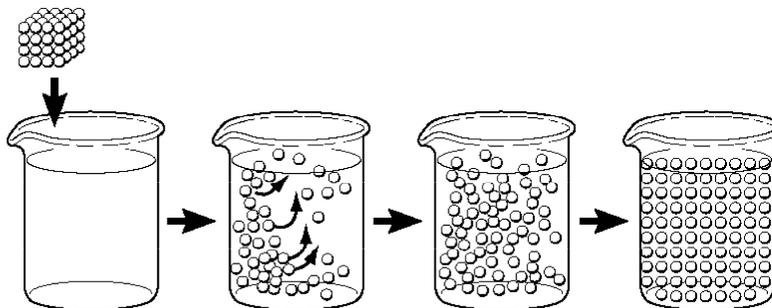
13. Which of the following enters a cell by active transport?
- a. glucose
 - b. water
 - c. lactose
 - d. potassium ion

ANS: D DIF: 1 OBJ: 5-2.1

14. The process by which water passes into or out of a cell is called
- a. solubility.
 - b. osmosis.
 - c. selective transport.
 - d. endocytosis.

ANS: B DIF: 1 OBJ: 5-1.2

15.



- Refer to the illustration above. The process shown is called
- a. osmosis.
 - b. facilitated diffusion.
 - c. active transport.
 - d. diffusion.

ANS: D DIF: 2 OBJ: 5-1.1

16. The sodium-potassium pump usually pumps
- a. potassium out of the cell.
 - b. sodium into the cell.
 - c. potassium into the cell.
 - d. only a potassium and sugar molecule together.

ANS: C DIF: 1 OBJ: 5-2.2

17. ion channels : ions ::
- a. facilitated diffusion : carrier protein
 - b. plasmolysis : turgor pressure
 - c. sodium-potassium pump : ATP
 - d. sodium-potassium pump : sodium

ANS: D DIF: 2 OBJ: 5-2.2

18. Ridding the cell of material by discharging it from sacs at the cell surface is called
- pinocytosis.
 - phagocytosis.
 - exocytosis.
 - endocytosis.
- ANS: C DIF: 1 OBJ: 5-2.3
19. Molecules that are too large to be moved across a cell membrane can be removed from the cell by
- diffusion.
 - exocytosis.
 - lipid carriers.
 - osmosis.
- ANS: B DIF: 1 OBJ: 5-2.3
20. Molecules that are too large to be moved through the membrane can be transported into the cell by
- osmosis.
 - endocytosis.
 - lipid carriers.
 - diffusion.
- ANS: B DIF: 1 OBJ: 5-2.3
21. endocytosis : exocytosis ::
- phagocytosis : bacteria
 - secrete : exocytosis
 - cold : hot
 - white blood cell : bacteria
- ANS: C DIF: 2 OBJ: 5-2.3
22. Placing a plant into a hypertonic environment will
- cause turgor pressure to increase.
 - cause the plant to take in water.
 - have no effect.
 - cause turgor pressure to decrease.
- ANS: D DIF: 1 OBJ: 5-2.2
23. A calcium ion channel will allow
- any kind of ion to pass through it.
 - only calcium ions to pass through it.
 - positive ions to pass through it.
 - None of the above
- ANS: B DIF: 1 OBJ: 5-1.4

COMPLETION

1. Active transport systems are a form of cell transport that requires energy from molecules of _____.

ANS: ATP

DIF: 1 OBJ: 5-2.1

2. _____ allows a cell to stockpile substances in far greater concentrations than they occur outside the cell.

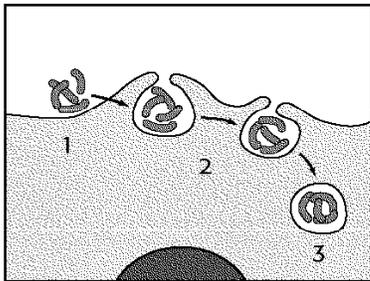
ANS: Active transport

DIF: 2 OBJ: 5-2.1

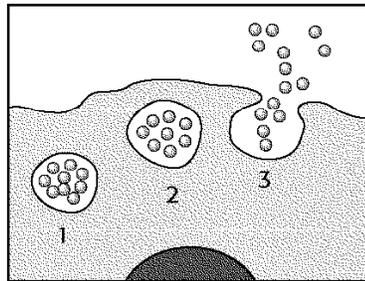
3. Conduction of nerve impulses is possible because of the _____.

ANS: sodium-potassium pump

DIF: 1 OBJ: 5-2.2



X



Y

4. Refer to the illustration above. The process shown in figure Y is called _____.

ANS: exocytosis

DIF: 2 OBJ: 5-2.3

5. Refer to the illustration above. Cells often trap extracellular particles and fluid. This is shown in figure _____.

ANS: X

DIF: 2 OBJ: 5-2.3

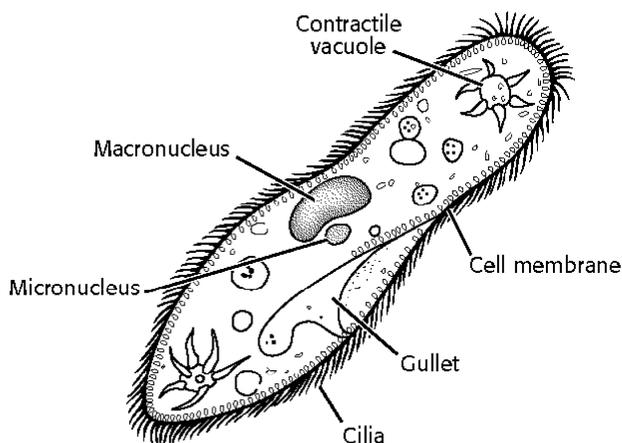
6. The process in which an amoeba engulfs its prey and takes it in is known as _____.

ANS: phagocytosis

DIF: 1 OBJ: 5-2.3

PROBLEM

1. Organisms in the genus *Paramecium* are unicellular protists. They have a number of characteristics also found in animals, such as the need to ingest food in order to obtain energy (they are heterotrophs) and the fact that they have a cell membrane but not a rigid cell wall. They have organelles found in animal cells, including nuclei, mitochondria, ribosomes, and cilia. In addition, they have star-shaped organelles called contractile vacuoles, which collect excess water from inside the paramecium and expel it periodically to the outside of the organism. The picture below depicts a paramecium.



The data presented in the table below were obtained in an experiment in which paramecia were placed in different salt concentrations and the rate at which the contractile vacuole contracted to pump out excess water was recorded.

Salt concentration	Rate of contractile vacuole contractions / minute
Very high	2
High	8
Medium	15
Low	22
Very low	30

Refer to the illustration above.

- a. How can you explain the observed relationship between salt concentration and rate of contractile vacuole contraction? Write your answer in the space below.
- b. If something happened to a paramecium that caused its contractile vacuole to stop contracting, what would you expect to happen? Would this result occur more quickly if the paramecium was in water with a high salt concentration or in water with a low salt concentration? Why? Write your answer in the space below.

ANS:

- a. The contractile vacuole maintains water balance by pumping water outside of the cell. When the salt concentration outside the cell is very high, water will move from inside to outside the cell—little or no pumping action is required. When the salt concentration outside the cell is lower than inside, the tendency is for water to move from outside to inside, necessitating increased pumping action by the vacuole to move excess water out of the cell.

- b. If the contractile vacuole were to stop contracting, the organism would burst open because water would collect in excess inside of it and the cell membrane would not be strong enough to resist rupturing. This result would be expected to occur more quickly if the organism were placed in water with a low salt concentration than it would if the organism were placed in water with a high salt concentration. This is because water accumulates inside the paramecium more rapidly when it is placed in a low salt environment.

DIF: 3 OBJ: 5-1.2

2. A biologist conducts an experiment designed to determine whether a particular type of molecule is transported into cells by simple diffusion, facilitated diffusion, or active transport. He collects the following information:
- 1) The molecule is very small.
 - 2) The molecule is polar.
 - 3) The molecule can accumulate inside cells even when its concentration inside the cell initially is higher than it is outside the cell.
 - 4) Cells use up more energy when the molecule is present in the environment around the cells than when it is not present.

The biologist concludes that the molecule moves across cell membranes by facilitated diffusion. Do you agree with his conclusion? Why or why not? Write your answer in the space below.

ANS:

Disagree. The information that cells can accumulate the molecule against a concentration gradient is compelling evidence that active transport is the mechanism of transport. This is the only mechanism among those named that allows movement against a concentration gradient. Active transport also requires energy consumption, which was also found to be a property of transport of this molecule.

DIF: 3 OBJ: 5-2.1

ESSAY

1. Why does the addition of a solute with polar molecules to one side of a membrane result in the diffusion of water? Write your answer in the space below.

ANS:

The addition of solutes to one side of a membrane reduces the number of water molecules that can move freely on that side. The water molecules become bound to the polar molecules in the solute. Water then moves by osmosis from the side where water molecule concentration is greatest to the side where concentration is least.

DIF: 2 OBJ: 5-1.2

2. Why is it dangerous for humans to drink ocean water? Write your answer in the space below.

ANS:

The concentration of salt in ocean water is higher than the concentration of salt in the fluids that surround the cells in the human body. Drinking ocean water increases the concentration of salt in the body's fluids. This causes water to leave the cells by osmosis, and without the proper amount of water the cells will be harmed or will die.

DIF: 2 OBJ: 5-1.2

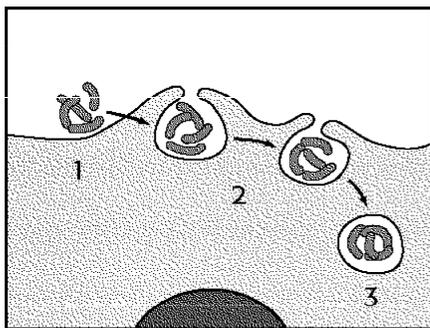
3. Distinguish facilitated diffusion from active transport. Write your answer in the space below.

ANS:

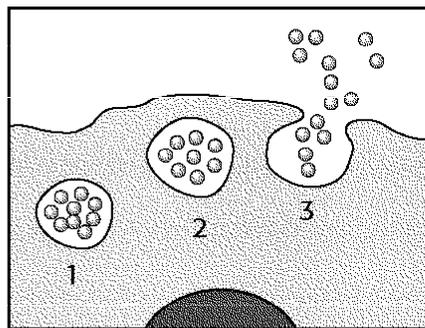
Protein channels that assist the diffusion of substances through the cell membrane do so by facilitated diffusion. Facilitated diffusion works in two directions. As long as a molecule or ion fits into the channel, it is free to pass through in either direction. Each kind of molecule or ion diffuses toward the side where it is least concentrated, eventually balancing the concentrations. Active transport, on the other hand, allows ions to move through the cell membrane in one direction only, like a turnstile at a subway station. Active transport enables a cell to stockpile certain substances in far greater concentrations than they occur outside the cell. Almost all active transport in cells is carried out by the sodium-potassium pump.

DIF: 2 OBJ: 5-2.1

- 4.



X



Y

Refer to the illustration above. Identify and explain the processes taking place in Figure X and Figure Y. Write your answer in the space below.

ANS:

Endocytosis is the process taking place in Figure X. Endocytosis is the process by which cells engulf substances that are too large to enter the cell by passing through the cell membrane. Exocytosis is the process taking place in Figure Y. Exocytosis is the process by which cellular wastes are discharged from sacs at the cell's surface.

DIF: 2 OBJ: 5-2.3