KEY QUESTION: How do substances enter and leave a cell?

Looking Ahead

- The cell membrane is a selectively permeable membrane. It regulates the movement of substances into and out of the cell.
- Diffusion is one of the basic ways that substances move into and out of cells.
- Osmosis moves water into and out of cells.
- The skills of scientific inquiry can be used to conduct controlled experiments on diffusion and osmosis.
- Cells use special processes to move non-dissolved particles, or large amounts of material, into and out of the cytoplasm.

VOCABULARY

- selectively permeable membrane
- diffusion
- concentration gradient
- osmosis
- turgor pressure
- endocytosis
- phagocytosis
- exocytosis
Gatekeepers in Our Environment

You learned in Chapter 4 that the cell membrane controls the movement of materials into and out of a cell. Take a look at the photos below. What is the purpose of each of these structures? What do they have in common with the cell membrane?

**LINKING TO LITERACY**

**Reading Graphic Text—Photographs**

Photographs are often added to text to clarify your understanding of the ideas presented. Photographs add interest and illustrate key points in the text. Sometimes captions tell you exactly what the photograph shows. Other times, you will need to review the photo carefully and draw your own conclusions about (infer) what the photo may indicate based on ideas presented in the text and your own knowledge.

1. With a partner, discuss the information you learned from the photos. As you examined the structures shown in these photographs, what did you notice about the size of the objects that could fit through them?

2. How do the photos in this photo essay help you visualize substances moving into and out of a cell?

3. Why might cells need substances to move in and out of them?
The Cell Membrane

A cell is the smallest form of life. Like all living things, a cell requires energy and produces wastes. How do cells take up nutrients and get rid of unwanted wastes?

The Cell Membrane

The cell membrane is a natural gatekeeper around a cell. The cell membrane controls the movement of materials into and out of the cell. The cell membrane is permeable to some materials and impermeable to others. Permeable means “allowing passage,” and impermeable means “not allowing passage.” The cell membrane plays an important role in keeping harmful substances out of the cell and in removing wastes. Because it allows only certain substances to pass through it, we call the cell membrane a **selectively permeable membrane**.

The cell membrane is made up of two layers of fat particles in which many proteins are embedded. Some of these proteins act as channels, opening and closing pathways through which materials can pass into and out of the cell (Figure 1). In general, small particles such as water, oxygen, and carbon dioxide are able to pass through the cell membrane easily. Larger particles such as sugars and fats cannot pass through easily.

**selectively permeable membrane:**
a membrane that allows only certain substances to pass through it

**Figure 1** Protein channels in the cell membrane vary in size. Each protein channel selectively allows some particles to pass into the cell while blocking others.

**CHECK YOUR LEARNING**

1. What is the function of the cell membrane?
2. Why are cell membranes said to be selectively permeable?
3. In your own words, describe the structure of a cell membrane.
4. Explain how the cell membrane is important to the health of a cell.
Fluid Movement in Cells: Diffusion

Have you ever wondered how the smell of a home-cooked meal or of a freshly baked pie can travel through the house? What about air fresheners that work to keep rooms smelling clean?

In Grade 7, you learned about the particle theory, which states that all particles of matter are in constant motion. This can explain how the scent of an air freshener is able to fill a room. When you release air freshener into a room, the scent particles from inside the air freshener are released into the air. Since particles are in constant motion, the scent particles begin to collide with air particles in the room. Though you may not be able to see the particles of air or of freshener, both are in constant motion. These movements cause the scent particles to move through the room until they are evenly dispersed among the air particles. This fills the room with a pleasant scent (Figure 1).

**Figure 1** Particles from the air freshener move through the air in the room, filling it with a pleasant scent.

In Figure 1, the scent particles of the air freshener are highly concentrated only around the bottle (and likely have quite a strong scent). When the bottle is opened, they slowly spread to parts of the room where they are less concentrated. This continues until there is an equal concentration of scent particles and air particles in the room. Recall from Grade 7 that concentration is a measure of the amount of a substance that is mixed in with another substance. This movement of particles from an area of higher concentration to an area of lower concentration is known as **diffusion**.

**diffusion**: the movement of particles from an area of higher concentration to an area of lower concentration

To watch an animation of how perfume particles diffuse through the air,

**Go to Nelson Science**
We refer to a difference in concentration between two areas as a **concentration gradient**. This difference in concentration determines the direction of particle movement between the two areas. Diffusion is a natural process that always occurs down a concentration gradient. This means that the particles move from an area where they are more concentrated to an area where they are less concentrated. As this continues, the concentration gradient decreases until the concentrations are equal (Figure 2).

**Figure 2** In a cell, diffusion of particles occurs across the selectively permeable membrane.

**TRY THIS:** Modelling Diffusion at Home

**SKILLS MENU:** predicting, performing, observing, analyzing, evaluating, communicating

A simple model of diffusion can be observed by making a cup of tea. Brewing tea involves the diffusion of tea particles into the surrounding water (Figure 3).

**Figure 3**

**Equipment and Materials:** 2 beakers (250 mL); pencil; paper; room-temperature water; hot water; 2 tea bags

1. Fill one beaker with 200 mL of room-temperature water. Fill the other beaker with 200 mL of hot water.

2. Gently place a tea bag into each of the beakers and observe what happens. Draw what you see in your notebook.

3. Wait 2 min and observe the water again. Draw what you see and write a statement that summarizes your observations.

A. How does the tea bag act as a selectively permeable membrane? Use a diagram to show the movement of the tea solutes and the water over the 2 min period.

B. What do you think would happen if the water was cold? Use your knowledge of the particle theory to make a prediction about the movement of particles.

C. Repeat the procedure using cold water and compare your observations to the prediction you made in B. Was your prediction supported by your observations? Evaluate your prediction and make a conclusion about the effect of temperature on diffusion.

D. Describe two other situations from your everyday experience where diffusion occurs.
Diffusion plays an important role in how living things obtain energy and get rid of wastes. In living things, the intake of nutrients from food and the removal of wastes occur at the cellular level. This requires that particles cross the cell membrane. In your body, for example, tiny blood vessels in your muscles (capillaries) carry oxygen-rich blood cells to individual muscle cells. Oxygen diffuses from the blood cells in the capillaries, where it is highly concentrated, into the muscle cells, where the oxygen is less concentrated (Figure 4). Once inside the muscle cell, oxygen is used up to make energy. This keeps the concentration of oxygen in the muscle cell lower than the concentration of oxygen outside the cell. This allows diffusion to continue.

At the same time, wastes, such as carbon dioxide, are produced inside the muscle cells. The wastes accumulate inside the cell to higher concentrations than outside of the cell. These particles diffuse from the muscle cells, where they are highly concentrated, into the blood. The exchange of oxygen and carbon dioxide happens continuously. This makes it necessary for you to have a constant supply of oxygen-rich blood.

**CHECK YOUR LEARNING**

1. How have the concepts in this reading added to your understanding of cells?
2. Describe the process of diffusion in your own words. Use the particle theory in your explanation.
3. What does the term “concentration gradient” mean?
4. How is the movement of particles in diffusion determined?
5. Give two examples in your everyday experience where diffusion occurs. Can you think of a situation where this might be harmful?
5.3 Osmosis: An Important Type of Diffusion

Water is vital to life. Plants and animals (including humans) use water to carry out essential life processes (Figure 1). Water particles are small enough to cross the cell membrane by diffusion. Normally, there is a constant diffusion of water across the cell membrane in both directions (into and out of a cell). This means that the concentration of water is equal on both sides of the cell membrane. The cell maintains its size.

Sometimes water is more concentrated either inside or outside of the cell. The direction in which water moves across the cell membrane adjusts to this imbalance. This means that more water will move in one direction than in the other. Water moves across the cell membrane from an area of higher water concentration to an area of lower water concentration (down its gradient) by osmosis (Figure 2).

Osmosis is a type of diffusion because it is driven by a concentration gradient. When the concentration of solutes is higher inside or outside of a cell, a concentration gradient exists. When this happens water will move from the area with higher water (or lower solute) concentration to the area with lower water (or higher solute) concentration. Osmosis continues until the concentration of water (and solute particles) is equal on both sides of the membrane. Once the concentrations are equal on both sides of the membrane, osmosis comes to an end. Water continues to pass through the cell membrane in both directions at an equal rate.

To watch an animation of osmosis, Go to Nelson Science.
Cells in Solution

Sugars, salts, and proteins are common solutes in cells. Water acts as the solvent. Cells need to maintain solute concentrations at certain levels to stay alive and healthy. The movement of water into and out of a cell determines the solute concentration inside the cell.

When water enters and exits a cell at the same rate, the cell maintains its size and shape (Figure 3(a)). When there is a lower concentration of water inside the cell than outside the cell (higher concentration of solutes inside), water moves into the cell by osmosis faster than it moves out of the cell. This causes the cell to increase in size. If too much water enters the cell, it may burst and die (Figure 3(b)). On the other hand, if there is a higher concentration of water inside the cell than outside the cell (lower concentration of solutes inside), water moves out of the cell by osmosis faster than it moves into the cell. The cell shrinks in size. If too much water leaves the cell, it may die (Figure 3(c)).

Turgor Pressure: Osmosis in Action

Plant cells have a large, central vacuole that is filled with water. This vacuole takes up most of the cell’s interior space. Plant roots absorb water from the soil surrounding the plant and transport it to cells in the plant. This water is stored in vacuoles. When a cell needs water for cellular processes, water moves from the vacuole to the parts of the cell where it is needed. This causes a decrease in the concentration of water in the cell’s cytoplasm, and, therefore, an increase in the concentration of solutes. If the solute concentration inside the plant cell becomes higher than the solute concentration outside the plant cell, water moves into the cell by osmosis.
When plant roots absorb water, the sudden influx of water fills the central vacuole and cytoplasm. This exerts pressure against the cell wall and causes the cell to swell. This outward pressure on the cell wall of a plant cell is called turgor pressure. A plant cell that is swollen with water is said to be “turgid.”

When the cells in a plant’s stem and leaves take in water by osmosis, they become turgid and press against each other. This causes the stems and leaves to stiffen and stay upright (Figure 4(a)). When the cells in a plant’s stem and leaves lose water by osmosis, the cells become less turgid. The plant wilts (Figure 4(b)).

Problems can arise when plants lose too much water. For example, fertilizers contain nutrients that can help plants grow. However, these nutrients become dissolved in water in the soil. This increases the concentration of solutes and lowers the concentration of water in the soil, compared to the concentration inside the plant roots. Water moves from cells in the plant’s roots (higher water concentration) into the soil by osmosis. To minimize crop damage, fertilizers must be applied in small amounts. Understanding osmosis in plants is important in industries such as farming and horticulture.

**CHECK YOUR LEARNING**

1. (a) Describe an idea in the reading that you found to be particularly important.
   (b) Why do you think this idea is important?
2. Explain the process of diffusion in your own words. Use a diagram with your explanation.
3. Explain the process of osmosis in your own words. Use a diagram with your explanation.
4. Explain how osmosis creates turgor pressure in plants.
5. What cell organelle makes turgor pressure in a plant cell possible? Describe the role of this organelle in this process.
Membrane Technologies

A cell membrane is an amazing structure. It allows nutrients and water to pass into and out of a cell, while keeping out harmful or unwanted substances. Our knowledge of the structure and function of the cell membrane has led to practical applications that use the same processes. Kidney dialysis, for example, is a well-established technology that makes use of our knowledge of the properties of cell membranes (Figure 1).

Cell membrane technologies are being applied to other areas of medicine as well. Doctors around the world are worried about the problem of deadly bacteria that are resistant to antibiotics—"superbugs." Cell membrane technologies are being applied to help counter this problem. A Montreal biotech company, Biophage Pharma Inc., is developing a new treatment for superbugs using "phages."

Phages are tiny viruses that infect certain bacteria, which they recognize by their cell membranes. Each type of phage recognizes specific structures on the cell membrane. The phages attach to a bacterium’s cell membrane and inject their genetic material into the cell (Figure 2).

Inside the bacterial cell, the genetic material copies itself, making another generation of phages. Eventually, the new phages break out of the bacterial cell, killing it. The phages remain in the bloodstream, where they search for bacteria to infect. In this way, more phages are produced that are able to target the bacterial cells. This method of fighting bacterial infections is useful because there are no side effects and the phages target only specific cells (based on their cell membranes).

To learn more about phages, Go to Nelson Science.
Modelling and Observing Diffusion

In this investigation, you will construct a model of a membrane using a material called dialysis tubing. You will investigate the ability of dialysis tubing to act as a selectively permeable membrane.

Testable Question
How can dialysis tubing be used to model a selectively permeable membrane?

Hypothesis/Prediction
Read the Experimental Design and Procedure, and then formulate a hypothesis based on the Testable Question. Your hypothesis should include a prediction and reasons for your prediction.

Experimental Design
In Part A, you will learn how to test for the presence of starch and glucose in water. In Part B, you will place dialysis tubing containing glucose and starch in a beaker containing an iodine–water solution and determine if diffusion occurs.

Equipment and Materials
- apron
- gloves
- 2 eyedroppers
- microscope slide
- scissors
- graduated cylinder
- funnel
- 2 beakers (250 mL)
- water
- 20 mL of 1 % starch solution
- 200 mL of dilute iodine solution
- dialysis tubing (20 cm) or sandwich bags
- string
- distilled water

Iodine solution is an irritant and can cause temporary scarring or staining of the skin. Wear protective gloves when handling iodine solution and rinse spills with water.
**Procedure**

**Part A: Testing for Starch and Glucose**
1. Put on your apron and gloves.
2. Using an eyedropper, place a drop of water onto one end of a microscope slide, and a drop of starch solution onto the other end. Add a small drop of the iodine solution to each of the drops. Record your observations. Rinse the slide and eyedropper.
3. In your notebook, make and record a conclusion regarding the ability of iodine solution to act as a test for starch.

**Part B: Investigating the Permeability of Dialysis Tubing**
4. Copy Table 1 into your notebook.

**Table 1  Record of Observations**

<table>
<thead>
<tr>
<th>Component</th>
<th>Contents</th>
<th>Initial colour</th>
<th>Final colour after 15 min</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dialysis tube 1</td>
<td>starch solution</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Beaker 1</td>
<td>iodine solution</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Dialysis tube 2</td>
<td>starch solution</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Beaker 2</td>
<td>distilled water</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

5. Cut a 10 cm piece of dialysis tubing and soak it in water for 2 min. Remove the tubing from the water and tie a tight knot at one end of the tubing with a piece of string. Use caution, as wet dialysis tubing tears easily. Open the other end of the tubing by gently rubbing it between your fingers.
6. Measure 15 mL of the starch solution. Pour the solution into the dialysis tube using a funnel. Tie the open end of the dialysis tube with string. Make sure that there are no leaks from either end of the tube. This is Dialysis Tube 1. Record the colour of the solution inside the tubing.
7. Rinse the outside of the tubing with lots of running tap water.
8. Pour 175 mL of dilute iodine solution into a 250 mL beaker. Label this Beaker 1. Record the colour of the solution.
9. Place Dialysis Tube 1 into the beaker containing the iodine solution, and then set it aside.
10. Repeat steps 5 to 7. This is Dialysis Tube 2.
11. Pour 175 mL of distilled water into another 250 mL beaker. Label this Beaker 2. Place Dialysis Tube 2 into the beaker containing the distilled water and observe any changes.
12. Place the two beakers side by side. Observe the contents of the dialysis tubes in each beaker for 15 min. Record your observations in your notebook.
13. For each setup, record the final colour of the solution inside the dialysis tube and the solution in the beaker. Clean up your work area according to your teacher’s instructions.

**Analyze and Evaluate**

(a) Use your observations to answer the Testable Question. Draw a labelled diagram to show what you think was happening in step 12. Did the evidence you obtained support your hypothesis?
(b) What was the purpose of placing the dialysis tubing containing starch solution into the beaker of distilled water in step 11?
(c) What was the purpose of step 7?
(d) Suggest ways in which you could improve this experiment. Provide reasons for your suggestions.

**Apply and Extend**

(e) Research the function of the kidney. Explain why dialysis tubing may be used to treat individuals with damaged kidneys, including any possible limitations of its use.
Modelling and Observing Osmosis

Normally, healthy kidneys clean the blood and remove wastes and excess water from the body. When the kidneys are damaged and lose this function, kidney dialysis is one option for treatment. Dialysis tubing is used in the treatment of individuals with damaged kidneys. It is used in dialysis machines to filter the blood in place of the kidneys. In this investigation, you will investigate the ability of water to pass through dialysis tubing by osmosis.

Testable Question
Can water move through dialysis tubing by osmosis?

Hypothesis/Prediction
Read the Experimental Design and Procedure, and then formulate a hypothesis based on the Testable Question. Your hypothesis should include a prediction and reasons for your prediction.

Experimental Design
In this investigation, you will place a dialysis tube containing a sugar–water solution into a beaker filled with distilled water. You will then determine whether osmosis occurs through the dialysis tubing.

Equipment and Materials
- scissors
- graduated cylinder
- funnel
- triple beam balance
- 2 beakers (250 mL)
- dialysis tubing (20 cm)
- water
- string
- 20 mL of 40 % sucrose solution
- paper towel
- distilled water

Procedure
1. Copy Table 1 into your notebook.

Table 1

<table>
<thead>
<tr>
<th>Initial mass of dialysis tubing (g)</th>
<th>Mass of tube after 10 min (mL)</th>
<th>Mass of tube after 20 min (mL)</th>
<th>Overall change in mass of dialysis tubing (mL)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
</tbody>
</table>

SKILLS MENU
- Questioning
- Hypothesizing
- Predicting
- Planning
- Controlling
- Variables

Performing
- Observing
- Analyzing
- Evaluating
- Communicating
2. Cut a 10 cm piece of dialysis tubing and soak it in water for 2 min. Remove the tubing from the water and tie one end of the tubing closed tightly with string. Use caution as wet dialysis tubing tears easily. Open the other end of the tubing by gently rubbing it between your fingers.

3. Measure 15 mL of 40% sucrose solution into a graduated cylinder. Carefully pour the solution into the dialysis tube using a funnel. Tie the open end of the dialysis tubing closed with a piece of string. Make sure there are no leaks through the tied ends of the tube.

4. Gently rinse the outside of the tube with lots of running tap water and blot dry using paper towel.

5. Using a triple beam balance, measure and record the mass of the tube and its contents in column 1 of Table 1 (Figure 1).

6. Pour 175 mL of distilled water into a clean, dry 250 mL beaker. Gently place the tube into the beaker of water. Let it stand for 10 min.

7. Remove the tubing from the beaker of water, blot dry with paper towel, and measure the mass of the tube and its contents. Record the mass in column 2 of Table 1.

8. Place the tubing back into the distilled water and let it stand for another 10 min.

9. Repeat step 7, recording the mass of the tube and its contents in column 3 of Table 1.

10. Calculate the overall change in the mass of the dialysis tubing and its contents. Record this value in column 4 of Table 1.

**Analyze and Evaluate**

(a) Use the evidence you obtained in this experiment to answer the Testable Question. Draw a labelled diagram to show what you think was happening to the dialysis tube and its contents during the 20 min waiting period. Did the evidence you obtained support your hypothesis?

**Apply and Extend**

(b) Using the Internet and your knowledge of osmosis, conduct research into methods that are used to help increase the length of time cut flowers stay fresh (Figure 2). Create a poster explaining how they work.

(c) Design and describe an investigation that would help you determine the effect that different concentrations of sugar–water solutions would have on the rate of osmosis in dialysis tubing.
Endocytosis and Exocytosis

In diffusion, dissolved particles (solute) move down a concentration gradient. Sometimes cells need to move non-dissolved particles, or large amounts of material, across the cell membrane. They can do this by two processes: endocytosis and exocytosis.

**Endocytosis**

The process by which non-dissolved materials, or large amounts of material, are brought into a cell from the outside environment is called **endocytosis**. This process is used to transport solids or liquids that the cell can use as nutrients into the cytoplasm. **Phagocytosis** is one type of endocytosis that occurs when a cell uses its membrane to bring non-dissolved solid particles into its cytoplasm. In phagocytosis, the cell extends finger-like projections of its cell membrane, called pseudopods, around a piece of solid material outside of the cell. The pseudopods that surround the solid object eventually join to form a vacuole within the cell's cytoplasm (Figure 1). The cell then releases chemicals into the vacuole. The chemicals digest the solid particle into smaller particles that may be used for energy or building material. Phagocytosis is often called “cell eating.” This is because many cells use phagocytosis to obtain nutrients from their outside environment. Cells, such as white blood cells, also use phagocytosis to remove potentially harmful bacteria, dead tissue cells, and unwanted particles from the outside environment.

Figure 1 The cell membrane extends around large particles, or large amounts of material, that need to be ingested into the cell.
**Exocytosis**

A cell may also need to move non-dissolved particles, or large amounts of material, from its cytoplasm to the outside environment. It does this using a process called exocytosis. **Exocytosis** is essentially the reverse of endocytosis. Recall that in addition to storing nutrients and water, vacuoles store wastes. In exocytosis, a vacuole containing wastes (or other materials) fuses with the cell membrane and releases its contents into the outside environment (Figure 2).

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**Figure 2** When objects are too large to move through the cell membrane by diffusion, a cell can use exocytosis to move materials out of its cytoplasm.

Exocytosis also plays a role in other important biological processes. For example, cells in your body release helpful chemicals into your bloodstream using exocytosis. In many cases, the chemicals are proteins that travel through the bloodstream to other cells of the body. The proteins are packaged by the Golgi apparatus. Proteins are then released into the outside environment by exocytosis for transport to other cells within your body.

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**CHECK YOUR LEARNING**

1. Give two examples of situations where a cell might use
   (a) phagocytosis
   (b) exocytosis

2. A cell encounters a large piece of food. Use a simple diagram to show how it might move the food particles into the cell cytoplasm. Include labels in your diagram.

3. What is exocytosis? Explain using a diagram.
Looking Back

The cell membrane is a selectively permeable membrane. It regulates the movement of substances into and out of the cell.

- The cell membrane acts as a gateway for substances to move into and out of cells. It is selectively permeable.
- The cell membrane blocks harmful substances from entering the cell and removes wastes.
- The cell membrane is composed of two layers of fat particles with proteins embedded within it. Some of these proteins act as channels through which substances can enter or leave the cell.

Diffusion is one of the basic ways that substances move into and out of cells.

- The difference in concentration between two areas is called a concentration gradient.
- Diffusion occurs down a concentration gradient, moving particles from an area of higher concentration to an area of lower concentration.
- Living things depend on diffusion to move substances into and out of the cell.
Osmosis moves water into and out of cells.

- Osmosis is a special type of diffusion involving the diffusion of water across a selectively permeable membrane. Water molecules move into or out of a cell until the concentration of water molecules on both sides of the membrane is equal.
- Plant cells depend on osmosis to maintain turgor pressure.
- Cells can be damaged or killed if too much water diffuses into or out of them. Cell walls protect plant cells by preventing the turgor pressure from becoming high enough to burst cells.

The skills of scientific inquiry can be used to conduct controlled experiments on diffusion and osmosis.

- Diffusion across a selectively permeable membrane can be modelled using dialysis tubing.
- Dialysis tubing can be used to observe osmosis.

Cells use special processes to move non-dissolved particles, or large amounts of material, into and out of the cytoplasm.

- Cells use endocytosis to move undissolved substances into the cell.
- Cells use exocytosis to move undissolved substances out of the cell.
- Endocytosis and exocytosis are vital processes for cells when they need to move substances too big to diffuse through their cell membranes.
What Do You Remember?
1. Explain the term “selectively permeable.” What makes the cell membrane selectively permeable? K/U
2. What is the rule that governs the direction of the diffusion of particles? K/U
3. How is the concentration gradient of a substance important to diffusion? K/U
4. Name two substances that are exchanged across the cell membranes of red blood cells and muscle cells. K/U
5. Name three particles that are small enough to diffuse freely across a cell membrane. K/U
6. Explain osmosis in your own words. What is the significance of solute concentration to osmosis? K/U C
7. What does it mean if a plant cell is turgid? K/U
8. Give two examples of when a cell might use exocytosis. K/U
9. Why is phagocytosis often called “cell eating”? K/U
10. Why is an air freshener a good model for diffusion? Can you think of other good models of diffusion? K/U C

11. Use your knowledge of diffusion to explain Figure 1. You may use diagrams. K/U C

12. Explain the roles of osmosis, the cell wall, and vacuoles in creating turgor pressure. K/U
13. How are osmosis and diffusion different? How are they the same? K/U
14. Predict what might happen to an animal cell if it was placed in a beaker of distilled water. T/I
15. Why do plant cells not burst when water diffuses into them? K/U

What Do You Understand?
16. Golf courses make use of fertilizers to keep the grass green and healthy. Using your knowledge of osmosis, explain how applying too much fertilizer might not help the golf course stay green. K/U A
17. In hospitals patients sometimes receive fluids by intravenous injection. Doctors choose a salt solution and never plain water to inject into humans. You know that blood is composed mainly of red blood cells. Use your knowledge of osmosis to explain why doctors make this choice. T/I A
18. You take a summer vacation by the ocean in P.E.I. You love the ocean plants you see and you decide to bring some home for your fish tank. After a week or two, you notice that your plants are not thriving in your freshwater tank. Use your knowledge gained in this chapter to propose a reason for this. T/I A
19. Mary came home from school and looked in the fridge for a snack. She loves celery, but it was wilted. She placed the celery into a tall glass filled with water and left it for a while. Why did she do this? T/I

Solve a Problem!
20. Many schools have a “no scents policy” because some people have sensitivities to the odours of perfumes and colognes. Prepare a proposal for your principal explaining how perfumes and colognes can diffuse and cause people with sensitivities to experience negative reactions. C A
21. Salting roads in the winter often results in a buildup of salt, which causes the plant life that grows beside roads to die (Figure 2). Why are salty soil conditions not good for plants? Write a letter to your municipality informing them how salting roads damages plant life.

22. Examine Figure 3. Using your knowledge of turgor pressure, explain how the plant might be revived.

23. Imagine the impact on life if diffusion stopped working. Write a short story or draw a comic starring yourself as a biologist. All around the world, living things are dying because of Lack of Diffusion Syndrome (LDS)! How will you solve this mystery so that cells can keep depending on diffusion? What are some of the effects of LDS that are observed around the world?

24. Diffusion and osmosis are difficult concepts to visualize because we cannot see them happening. Below is an example of a writing strategy that helps you see diffusion (Figure 4). Come up with your own strategies to help understand diffusion and osmosis more deeply. In what way does this help you learn about diffusion or osmosis? What are some limitations of this strategy?

25. You are a biologist working for a fruit exporting company. You suggest dehydrating (drying) apricots to reduce the weight and therefore the cost of transportation. Your boss is not convinced. She thinks most people like juicy fruit. Use your knowledge about osmosis to create a solution that can make the dry fruits more juicy. Evaluate your idea. What are some advantages and disadvantages of your idea?

26. Describe a concept in this chapter that was new to you. In what ways has your understanding of this concept changed?

27. Think back to the Key Question on the first page of this chapter.
   (a) In a brief paragraph, answer the Key Question. You may use diagrams.
   (b) Write one or two more questions about the topic of this unit that you would like to explore.