**Cell Structure and Function**

**Moving Cellular Material**

---

**Before You Read**

**What do you think?** Read the two statements below and decide whether you agree or disagree with them. Place an A in the Before column if you agree with the statement or a D if you disagree. After you’ve read this lesson, reread the statements to see if you have changed your mind.

<table>
<thead>
<tr>
<th>Before</th>
<th>Statement</th>
<th>After</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>5. Diffusion and osmosis are the same process.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>6. Cells with large surface areas can transport more than cells with smaller surface areas.</td>
<td></td>
</tr>
</tbody>
</table>

---

**Passive Transport**

The membranes of cells and organelles perform different functions. They form boundaries between cells. They also control the movement of substances into and out of cells.

Cell membranes are semipermeable. This means that only certain materials can enter or leave a cell. Substances can pass through a cell membrane by one of several different processes. The type of process depends on the physical and chemical properties of the substance that is passing through the membrane.

Small molecules, such as oxygen and carbon dioxide, pass through a cell’s membrane by a process called passive transport. **Passive transport is the movement of substances through a cell membrane without using the cell’s energy.** Passive transport depends on the amount of a substance on each side of the membrane. If there are more oxygen molecules outside a cell than there are inside a cell, oxygen molecules will move into the cell by passive transport. Oxygen molecules will move into a cell until the amount of oxygen outside the cell equals the amount of oxygen inside the cell. There are different types of passive transport.

---

**Key Concepts**

- How do materials enter and leave cells?
- How does cell size affect the transport of materials?
**Academic Vocabulary**

**concentration** *(noun)* the amount of a given substance in a certain area.

---

**Diffusion**

When the concentration, or amount per volume, of a substance is unequal on each side of a membrane, molecules will move from the side with a higher concentration of the substance to the side with the lower concentration. **Diffusion** is the movement of substances from an area of higher concentration to an area of lower concentration.

---

**Visual Check**

1. **Predict** What would the water in the beaker on the right look like if the membrane did not let anything through?

---

Diffusion will continue until the concentration on each side of the cell membrane is equal. The figure above shows how dye passed through the membrane into the clear water until there were equal concentrations of water and dye on both sides of the membrane.

**Osmosis—The Diffusion of Water**

Diffusion is the movement of any small molecules from areas of higher concentrations to areas of lower concentrations. **Osmosis** is the diffusion of water molecules only through a membrane. Water molecules pass through a semipermeable membrane from an area of high concentration to an area of low concentration. For example, plant cells lose water because of osmosis. The concentration of water in the air around a plant is less than the concentration of water in the cells of the plant. Water will leave plant cells and diffuse into the air. If the plant is not watered to replace the water lost by its cells, the plant will wilt and might die.

**Facilitated Diffusion**

Some molecules are too large or are chemically unable to move through a membrane by diffusion. **Facilitated diffusion** is the movement of molecules through a cell membrane using special proteins called transport proteins. Facilitated diffusion does not use the cell’s energy to move the molecules. The transport proteins do the work. There are two types of transport proteins.

**Carrier Proteins** Carrier proteins are transport proteins. They carry large molecules, such as the sugar molecule glucose, through the cell membrane.
**Channel Proteins** Channel proteins are also transport proteins. They form pores through the cell membrane. Ions, such as sodium and potassium, pass through the cell membrane by channel proteins. Transport proteins are shown below.

![Channel proteins diagram](image)

**Active Transport**

Sometimes a cell uses energy when a substance passes through its membrane. **Active transport** is the movement of substances through a cell membrane only by using the cell’s energy.

Substances moving by active transport move from areas of lower concentration to areas of higher concentration. Active transport is important for cells and organelles. Cells can take in nutrients from the environment through carrier proteins by using active transport. Some molecules and waste materials leave cells by active transport.

**Endocytosis and Exocytosis**

Some substances are too large to enter a cell membrane by diffusion or by using a transport protein. There are other ways that substances can enter a cell.

**Endocytosis** The process during which a cell takes in a substance by surrounding it with the cell membrane is called **endocytosis** (en duh si TOH sus). Some cells take in bacteria and viruses using endocytosis.

---

**Reading Check**

3. **Explain** how materials move through the cell membrane in facilitated diffusion.

---

**Visual Check**

4. **Identify** Circle the type of transport protein that carries large molecules through the cell membrane.

---

**Reading Check**

5. **Summarize** how a cell uses active transport.

---
Exocytosis Some substances are too large to leave a cell by diffusion or by using a transport protein. They can leave using exocytosis (ek soh si TOH sus). **Exocytosis** is the process during which a cell’s vesicles release their contents outside the cell. Proteins and other substances are removed from a cell through exocytosis. Both endocytosis and exocytosis are shown below.

**Cell Size and Transport**

For a cell to successfully transport materials, the size of the cell membrane must be large compared to the space inside of the cell. This means that the surface area of the cell must be larger than the volume of the cell. When a cell grows, both its surface area and its volume increase. However, the volume of a cell increases faster than its surface area. If a cell becomes too large, it might not survive. Its surface area will be too small to move enough nutrients into the cell and remove waste materials from the cell.

---

**Math Skills**

A ratio is a comparison of two numbers, such as surface area and volume. If a cell were cube shaped, you would calculate surface area by multiplying its length (ℓ) by its width (w) by the number of sides (6).

Surface area: \( \ell \times w \times 6 \)

You would calculate the volume of the cell by multiplying its length (ℓ) by its width (w) by its height (h).

Volume: \( \ell \times w \times h \)

To find the surface-area-to-volume ratio of the cell, divide its surface area by its volume.

\[
\frac{\text{Surface area}}{\text{Volume}}
\]

**7. Use Ratios** What is the surface-area-to-volume ratio of a cube-shaped cell whose sides are 6 mm long?

---

**Visual Check**

**8. Identify** the structure needed for exocytosis.
After You Read

Mini Glossary

**active transport**: the movement of substances through a cell membrane only by using the cell’s energy

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

**endocytosis (en duh si TOH sus)**: the process during which a cell takes in a substance by surrounding it with the cell membrane

**exocytosis (ek soh si TOH sus)**: the process during which a cell’s vesicles release their contents outside the cell

**facilitated diffusion**: when molecules pass through a cell membrane using special proteins called transport proteins

**osmosis**: the diffusion of water molecules only

**passive transport**: the movement of substances through a cell membrane without using the cell’s energy

1. Review the terms and their definitions in the Mini Glossary. Write a sentence that compares passive and active transport.

2. Fill in the table below to compare active and passive transport.

<table>
<thead>
<tr>
<th></th>
<th>Energy needed?</th>
<th>Structures Involved</th>
<th>Examples</th>
</tr>
</thead>
<tbody>
<tr>
<td>Active transport</td>
<td>yes/no</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Passive transport</td>
<td>yes/no</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

What do you think NOW?

Reread the statements at the beginning of the lesson. Fill in the After column with an A if you agree with the statement or a D if you disagree. Did you change your mind?

Log on to ConnectED.mcgraw-hill.com and access your textbook to find this lesson’s resources.