TRANSPORT

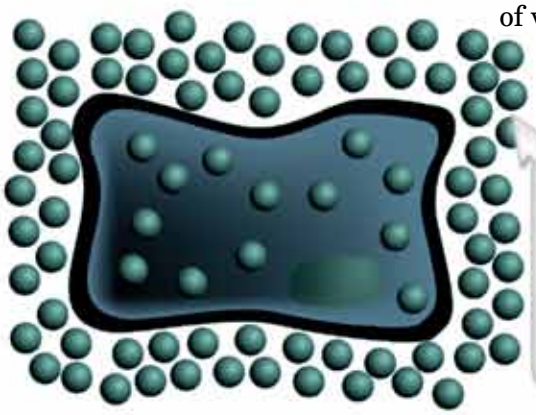
VOCABULARY

diffusion (di·ˈfo͞o·zhən) the movement of molecules from an area of higher concentration to an area of lower concentration

osmosis (äz·ˈmō·səs) the diffusion of water through a membrane that allows specific substances to pass through

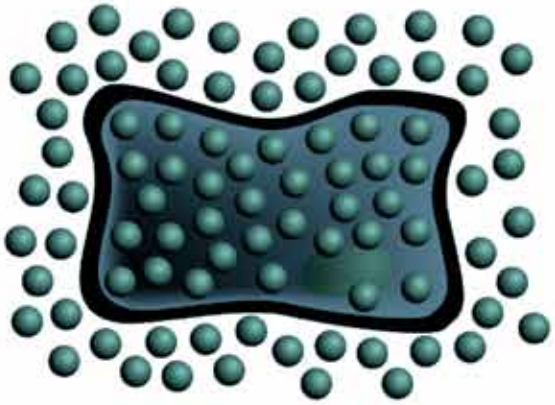
The flexible cell membrane separates the cell's contents from the environment around it. It surrounds the cell and provides shape, support, and protection. It also determines what can enter and exit the cell. The cell membrane is selectively permeable. This means it has openings that allow only specific particles to pass through. These particles move through the cell membrane in one of two ways—either passive or active transport. Passive transport does not require the cell to use energy to help move the particles. Active transport does require extra energy.

Diffusion is a type of passive transport. It is the process by which particles move from an area of higher concentration of substances to an area of lower concentration. Oxygen enters and carbon dioxide exits the cell by diffusion. Osmosis is another form of passive transport that involves the movement of water molecules across a membrane. If a cell is placed in pure water, the water will move into the cell until equilibrium is reached or the membrane bursts. In contrast, if the concentration of water is higher inside the cell than outside, water leaves the cell. This can lead to dehydration. Equilibrium occurs when the concentration of water inside the cell matches that outside the cell.



Before

The concentration of particles before diffusion is greater outside the cell than inside. Diffusion moves particles from the area of higher concentration to the area of lower concentration until equilibrium is reached.



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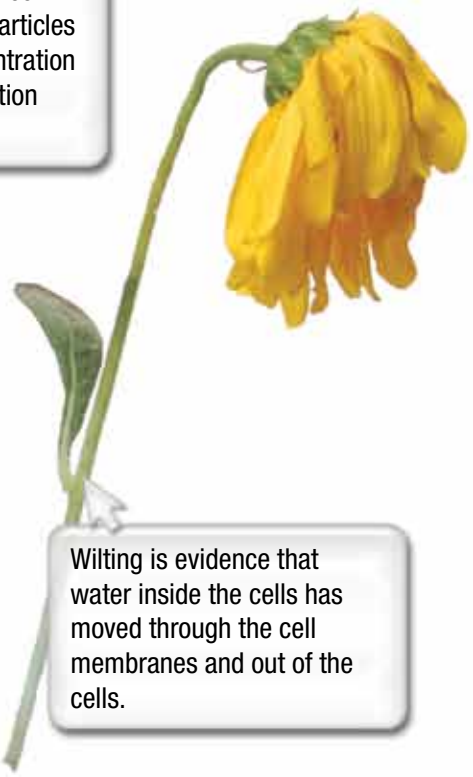


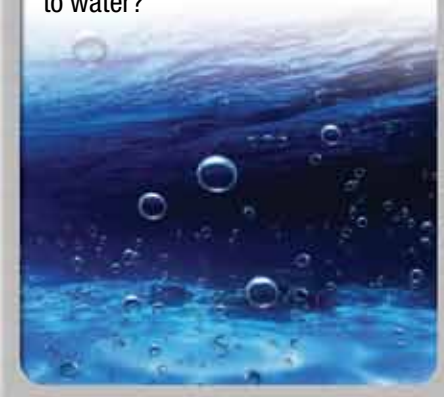
Wilting is evidence that water inside the cells has moved through the cell membranes and out of the cells.

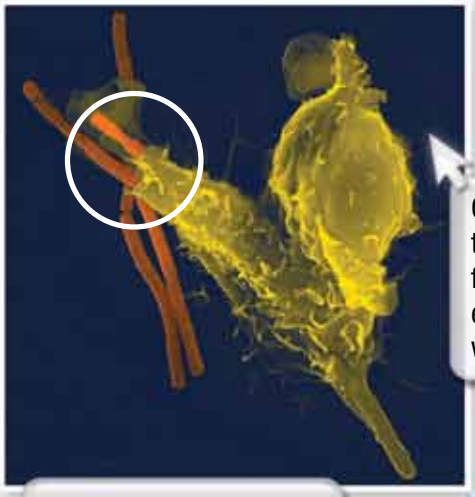
Glucose and some types of sodium, potassium, and chlorine molecules cannot diffuse through membranes. However, in a type of passive transport called *facilitated diffusion,* molecules are able to cross the cell membrane because they are helped, or facilitated, by transport proteins. These special proteins are located throughout the cell membrane. The molecules bind to the proteins, which then transport them into or out of the cell. Once the substance is bound, the transport protein changes shape and carries the substance across the cell membrane.

Sometimes a cell needs more of a substance that has a higher concentration inside the cell than outside. To move that material into the cell requires extra energy. Active transport is the process by which materials are actively pumped through the cell membrane. Often other cells, fragments, or proteins may be too large to pass through the membrane. Instead, the membrane will engulf these large particles. This form of active transport occasionally involves the cell creating a vacuole around the engulfed materials. Lysosomes then break down the materials so that they are digestible. A cell can also actively move wastes or other unwanted materials outside the cell. The cell membrane wraps around the vacuole and pinches off, releasing the vacuole and its contents outside the cell.

OUTLOOK

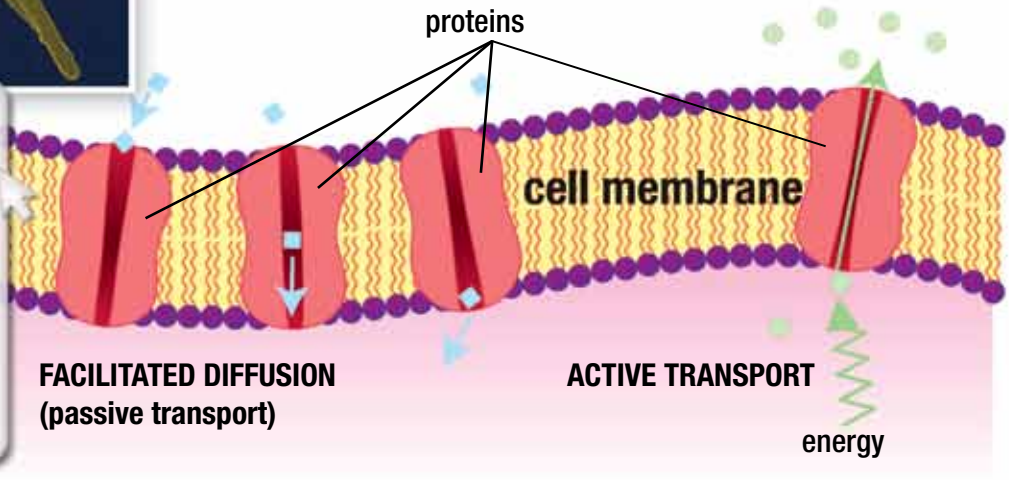
Without water, life ceases. Water accounts for approximately 66% of the human body and 75% of the human brain. Throughout the Scriptures, God compares Himself with water. In Jeremiah 2, God is referred to as *the spring of living water.* Jesus said that whoever drinks of the water He gives will never thirst again. Based on what you have learned, why do you think God would compare Himself to water?





Cells perform a special form of active transport to bring other live cells or fragments into the cytoplasm. This engulfing action is called *phagocytosis*, which means *cell-eating*.

The cell membrane is a two-layered structure with proteins embedded throughout the membrane. These proteins act as gatekeepers, carrying substances of specific sizes and shapes in and out of the membrane.



Egg-speriment Procedures

BLM 3.1B

Read and follow the directions below for each day. Remember to always handle your egg carefully. Use **Science Notebook 3.1B Egg-speriment Data Collection** to record your data for all six days.

Day 1

1. Carefully hold the egg, so that it does not crack. Wrap the tape measure around the widest girth of the egg and measure the egg's circumference to the nearest tenth of a centimeter. Record the measurement along with any other observations.
2. With a spoon gently lower the egg into a container. Pour in enough vinegar to cover the entire egg. If the egg floats, leaving a portion of it uncovered, set an apple or pear on top of the egg to hold it down. Record the time. Allow the egg to sit undisturbed for at least 24 hours.

Day 2

1. Record the number of hours the egg soaked in vinegar. Lay out a paper towel to set the egg on. Use a spoon to gently lift the egg and remove the egg from its container. Carefully rinse the egg in the bowl with clear water. Set the egg on the paper towel. Observe and record what happened to the egg. Measure the circumference of the egg to the nearest tenth of a centimeter. Record the measurement. Gently rub the eggshell until it comes off.
2. Rinse the container. Use the spoon to place the egg into the container. Completely cover the egg with water. Do not be concerned if the egg floats. Record the time. Allow the egg to sit undisturbed for at least 24 hours. Write your prediction about what the egg will look like in 24 hours.

Day 3

1. Record the number of hours the egg soaked in water. Lay out a paper towel to set the egg on. Using the spoon, carefully remove the egg from the water. Set the egg on the paper towel. Measure the circumference of the egg. Record the data and observations.
2. Empty the container. Use the spoon to place the egg into its container. Cover the egg with pre-mixed saltwater. Do not be concerned if the egg floats. Record the time. Allow the egg to sit undisturbed for at least 24 hours. Write your prediction.

Day 4

1. Record the number of hours the egg soaked in saltwater. Lay out a paper towel to set the egg on. Use the spoon to carefully remove the egg. Rinse the egg with clear water. Set the egg on the paper towel. Measure the circumference of the egg. Record the data and observations.
2. Rinse the container. Fill the container halfway with fresh water. Add several drops of food coloring and stir. Place the egg in the container. Add water to cover the egg if necessary. Record the time. Allow the egg to sit undisturbed for at least 24 hours. Write your prediction.

Egg-speriment Procedures, continued

Day 5

1. Record the number of hours the egg soaked in colored water. Lay out a paper towel to set the egg on. Carefully remove the egg from its container. Rinse the egg with clear water. Set the egg on the paper towel. Measure the egg's circumference. Record the data and observations.
2. Rinse the container. Place the egg in the container and cover the egg with fresh water. Record the time. Allow the egg to sit undisturbed for 24 hours. Write your prediction.

Day 6

1. Record the number of hours the egg soaked in fresh water. Lay out a paper towel to set the egg on. Use the spoon to carefully remove the egg. Rinse the egg with clear water. Set the egg on the paper towel. Measure the circumference of the egg. Record the data and observations.
2. Clean up and discard the materials according to your teacher's instructions.

MUSCULAR SYSTEM

VOCABULARY

peristalsis (per·ə·'stôl·səs) the muscular contractions that move food through the digestive tract

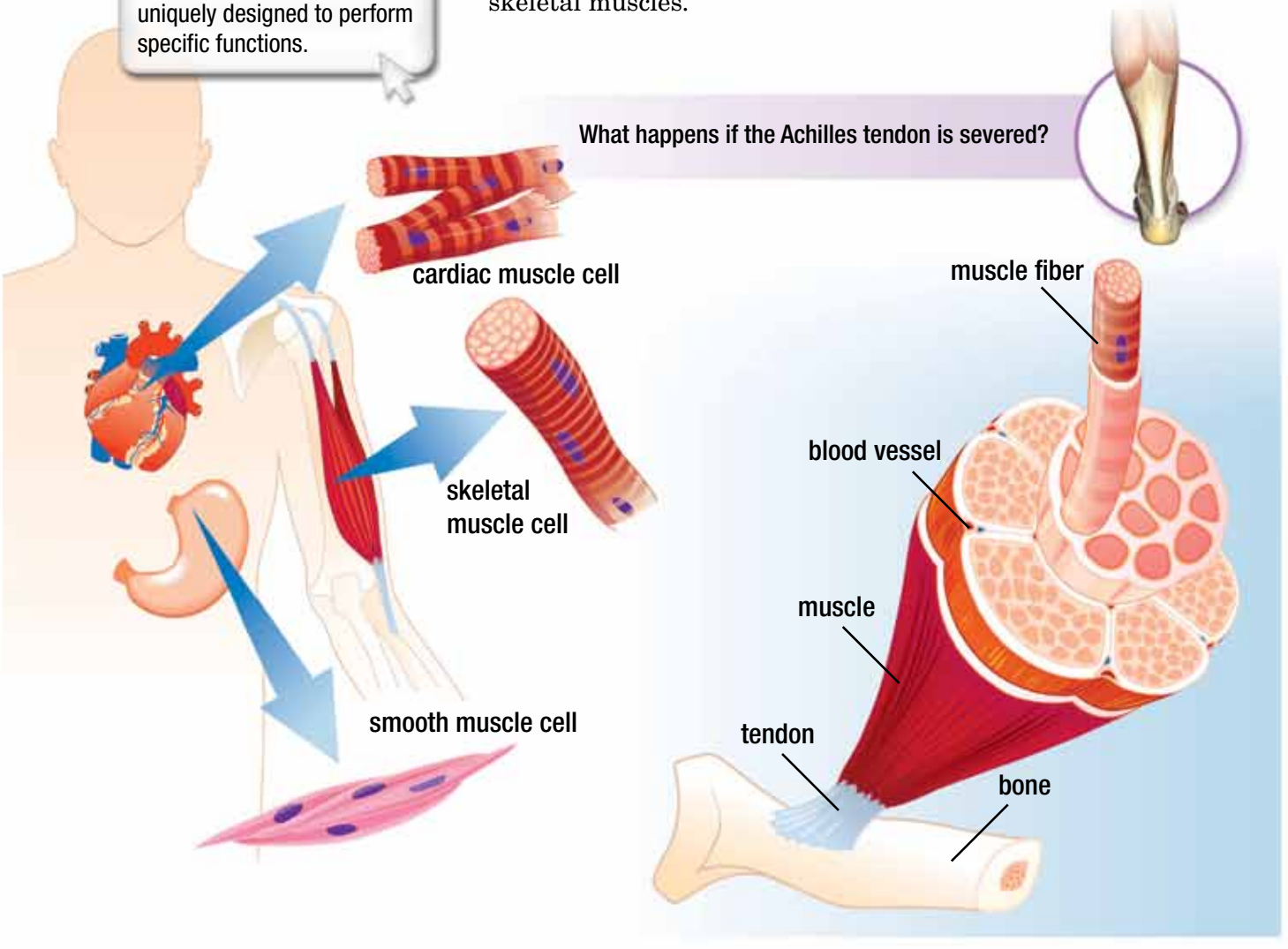
tendon ('ten·dən) the connective tissue that attaches muscle to bone

The muscular system makes it possible to eat or drink something with the body upside down. Once swallowed, the food or drink moves through the digestive tract because muscles contract and relax. This involuntary, rhythmic movement is called peristalsis. Running, jumping, blinking the eyes, and breathing depend on muscle action also. In fact, whether awake or asleep, all body movement depends on many muscles working together.

There are three types of muscle tissue—skeletal, smooth, and cardiac. In the human body there are approximately 650 skeletal muscles that are attached to the bones of the skeleton. A skeletal muscle is composed of many muscle cells that appear striated, or banded. These individual cells are arranged in parallel bundles. The body of the muscle is called the *belly*. The entire muscle is wrapped in connective tissue called *fascia*. At the end of the muscle, the fascia forms a tough fibrous tendon, which attaches the muscle to a bone. The nervous system constantly sends nerve impulses along nerve cells to the skeletal muscles.

Cardiac and skeletal muscles are striated, while smooth muscle is not. Each is uniquely designed to perform specific functions.

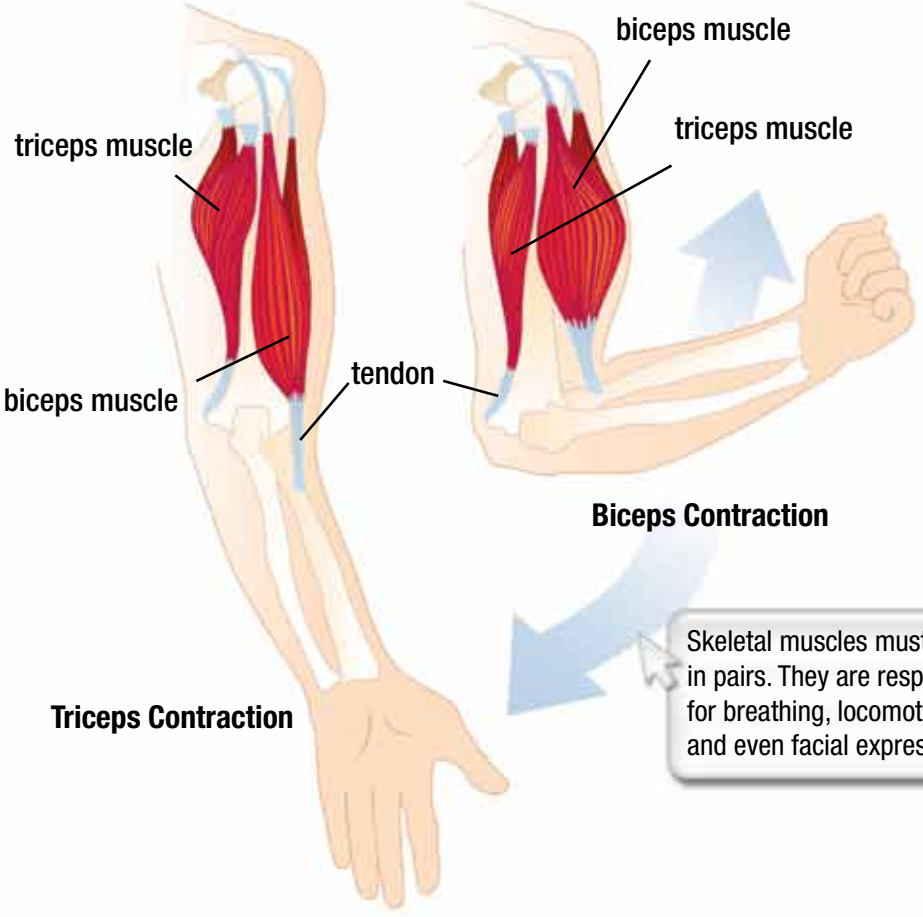
What happens if the Achilles tendon is severed?



Skeletal muscles hold the skeleton together, give the body shape, and provide the force to move bones. To give joints a full range of motion, skeletal muscles exist in pairs that oppose each other. For example, as the biceps on the arm contract, the triceps relax. This results in the lower arm moving upward. Reversing this process moves the arm downward. Skeletal muscles contract quickly and voluntarily, yet can tire easily.

Smooth muscles line the digestive tract, blood vessels, bladder, and other internal organs. They contract and relax slowly and have the ability to endure long periods of work without tiring. Smooth muscles move involuntarily because the nervous system automatically controls them. For example, as the smooth muscle of the stomach contracts, food is mixed with enzymes to make chyme.

Cardiac muscle is found only in the heart. Like skeletal muscle, it is striated, and like smooth muscle, it contracts involuntarily and does not tire quickly. The involuntary contractions are responsible for the constant heartbeat.



Skeletal muscles must work in pairs. They are responsible for breathing, locomotion, and even facial expressions.

IN THE FIELD

Ideas about robotics have been around throughout recorded history, although the term itself was not used until 1941. The first industrial robot became operational at the General Motors factory in 1961. Not until 1998 was the first bionic arm for humans fitted. Presently, research continues on the use of robotic assistance in the medical field. Robots have been utilized in the automotive industry, particularly in spot welding automobiles on an assembly line. In the space program, various unmanned spacecraft have gone to the moon and other planets. Robots are also used by law enforcement to dispose of bombs and carry video cameras and microphones into dangerous areas. In the military, robots help locate and destroy mines in water and on land.