

Sensing the Environment



California Science Standards

7.5.a, 7.5.b, 7.5.g, 7.6.b

BEFORE YOU READ

After you read this section, you should be able to answer these questions:

- How do the integumentary system and nervous system work together?
- What is a feedback mechanism?
- How do your five senses work?

STUDY TIP

List As you read, make a list of the five senses. In your list, include the type of receptors used by those senses.

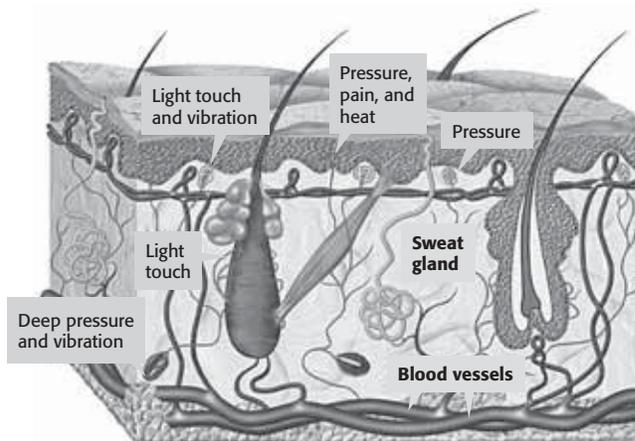
How Does Your Sense of Touch Work?

When a friend taps you on the shoulder, or you feel a breeze, how does your brain know what has happened? Receptors throughout your body gather information about the environment and send this information to your brain.

A tap on the shoulder and a cool breeze are both felt by your skin. Your skin is part of the integumentary system. The **integumentary system** is an organ system that protects the body. This system also includes hair, skin, and nails.

Your skin does not just protect your body from harm, however. It is also the main organ that helps you to feel touch. Your skin has many different *sensory receptors* that are part of the nervous system. Each kind of receptor responds mainly to one kind of stimulation. For example, *thermoreceptors* respond to temperature changes.

Sensory receptors detect a stimulus and create impulses. These impulses travel to your brain. In your brain, the impulses produce a sensation. A *sensation* is the awareness that you have sensed something.



Different kinds of receptors in your skin can sense different things.

TAKE A LOOK

1. List What are three types of sensations that your skin can detect?

SECTION 2 Sensing the Environment *continued*

REFLEXES

When you step on something sharp, do you stand still? Of course not! You move your foot right away without thinking about it. This reaction is called a reflex. A **reflex** is an action that happens very fast and that you cannot control.

Reflexes help protect your body from getting hurt. For example, if you step on something sharp, pain receptors in your foot send messages to your spinal cord. The spinal cord sends a message back to move your foot. Messages that cause reflexes don't even travel all the way to your brain. If you had to wait for your brain to act, you could be badly hurt.



Discuss With a partner, name some other examples of reflexes. What part of the body is involved? When does the reflex happen? How does the reflex protect your body?

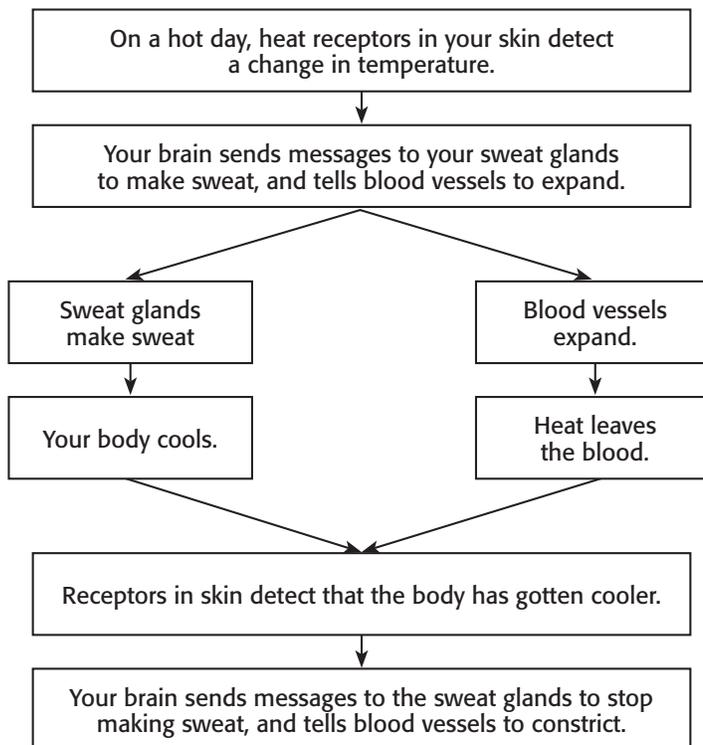
FEEDBACK MECHANISMS

Reflexes are helpful to your body. However, most of the time, the brain decides what to do with the messages from the skin receptors. Your brain helps to control many of your body's functions by using feedback mechanisms. A **feedback mechanism** is a cycle of events in which one step controls or affects another step. ✓

Feedback mechanisms help to keep your body functioning. Below is an example of how a feedback mechanism helps to keep your body temperature stable.



2. Complete Feedback mechanisms in your nervous system are controlled by the _____.



SECTION 2 Sensing the Environment *continued*

How Does Your Sense of Sight Work?

Sight is the sense that lets you know the size, shape, motion, and color of objects around you. You see an object when light bounces off the object and enters your eyes. The light produces impulses in your eyes. These impulses travel to the brain and produce the sensation of sight.

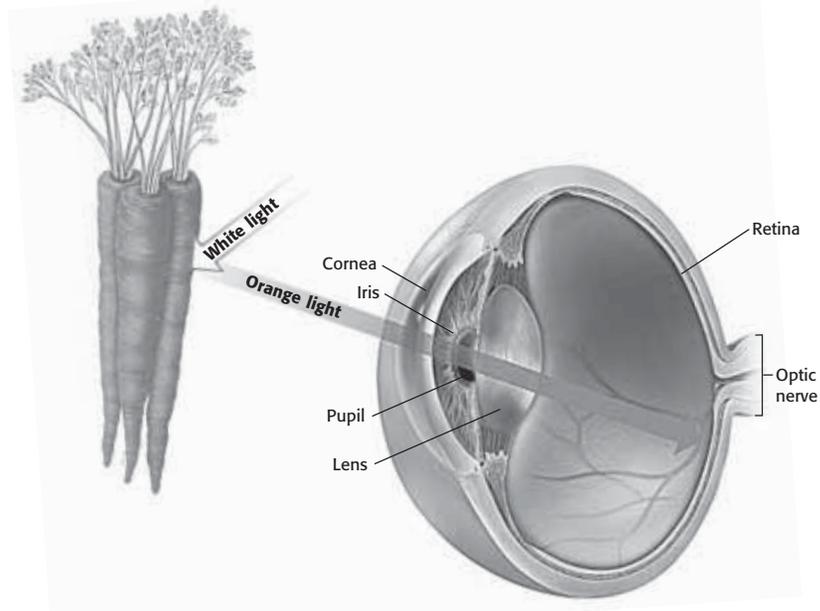
The eyes are complex sensory organs. A clear membrane called the *cornea* covers the front of the eye. The cornea protects the eye but lets light enter. Light from an object enters the front of your eye through an opening called the **pupil**. Then, the light travels through the lens to the back of the eye. There, the light hits the **retina**, a layer of light-sensitive cells.

CALIFORNIA STANDARDS CHECK

7.5.g Students know organ systems function because of the contributions of individual organs, tissues, and cells. The failure of any part can affect the entire system.

Word Help: affect
to change; to have an effect on; to influence

3. List Name three parts of the eye and list their functions.



Carrots look orange because they reflect orange light.

The retina contains many specialized cells called photoreceptors. A *photoreceptor* is a special neuron that responds to light. It causes the other cells in the retina to produce impulses. The brain interprets these impulses as light.

The retina has two kinds of photoreceptors: rods and cones. *Rods* are very sensitive to dim light. They are important for night vision. The brain interprets the impulses from rods as black-and-white images. *Cones* are very sensitive to bright light. They let you see colors and fine details. ✓

The impulses from rods and cones travel along axons. These impulses leave the back of the eye through the optic nerve. The *optic nerve* carries the impulses to your brain.

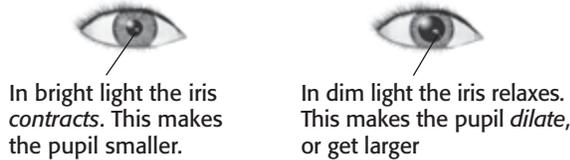
READING CHECK

4. Identify What are the two kinds of photoreceptors in the retina?

SECTION 2 Sensing the Environment *continued*

REACTING TO LIGHT

Your pupil looks like a black dot in the center of your eye. Actually, it is an opening that lets light enter the eye. Around the pupil is a ring of muscle called the **iris**. The iris controls how much light enters your eye. It also gives your eye its color. ✓



READING CHECK

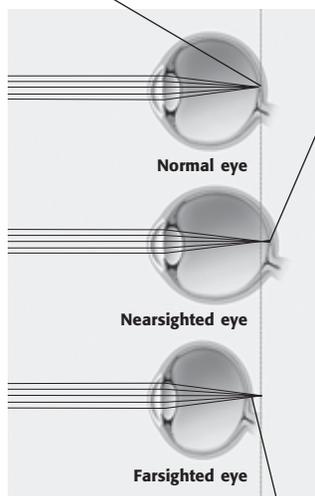
5. Identify What is the function of the iris?

FOCUSING LIGHT

The lens focuses light onto the retina. The *lens* is an oval-shaped piece of clear, curved material behind the iris. The lens *refracts*, or bends, light. Muscles in the eye change the shape of the lens in order to focus the light on the retina. When you look at something that is close to your eye, the lens becomes more curved. When you look at objects that are far away, the lens gets flatter.

Some people have vision problems because their eyes cannot focus light correctly. The figure below shows the causes of some common vision problems.

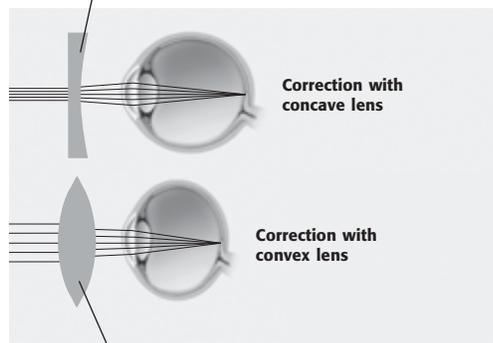
In a normal eye, light focuses onto a point on the retina. The image is in focus.



In a farsighted eye, the light focuses on a point behind the retina. The image looks blurry.

In a nearsighted eye, the light focuses on a point in front of the retina. The image looks blurry.

A lens that is thinner in the middle than at the edges is a *concave* lens. Concave lenses bend light outward and help to correct nearsightedness.



A lens that is thicker in the middle than at the edges is a *convex* lens. Convex lenses bend light inward to help correct farsightedness.

TAKE A LOOK

6. Explain Why do some images look blurry to people who are nearsighted and farsighted?

SECTION 2 Sensing the Environment *continued*

How Does Your Sense of Hearing Work?

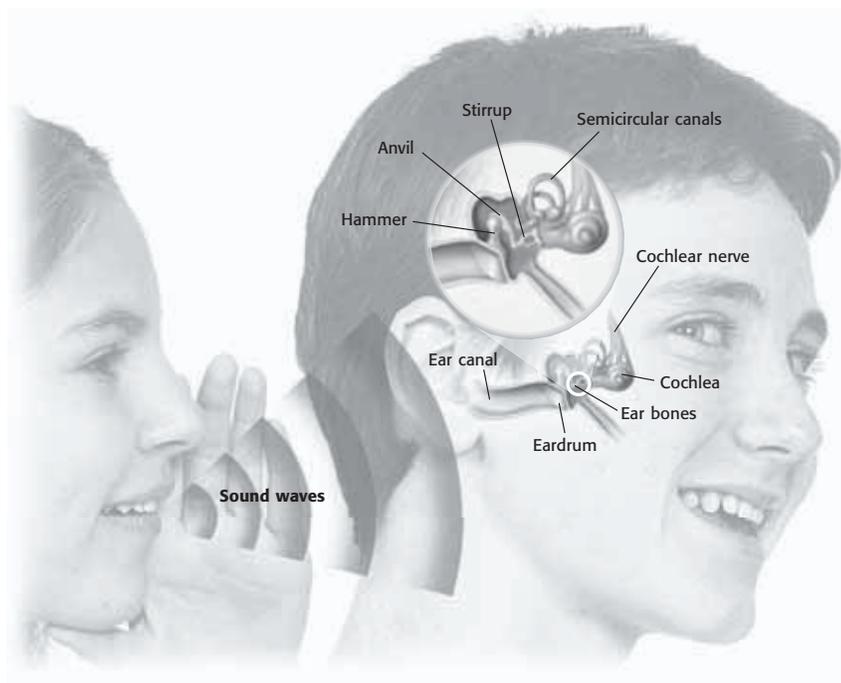
Sound is produced when something *vibrates*. A drum, for example, vibrates when you hit it. Vibrations produce waves of sound energy. Hearing is the sense that lets you experience sound energy. ✓

READING CHECK

7. Complete Sound energy is produced by _____.

Ears are the organs used for hearing. The ear has three main parts: the outer ear, middle ear, and inner ear. The chart below shows the structures that make up each part.

Part of ear	Main structures
Outer ear	ear canal
Middle ear	<i>tympanic membrane</i> , or eardrum; three ear bones: hammer, anvil, and stirrup
Inner ear	cochlea and auditory nerve



A sound wave travels through the air into the outer ear. The wave produces vibrations in the middle ear and inner ear. These vibrations produce impulses in the cochlear nerve that travel to the brain.

TAKE A LOOK

8. Color Use colored pencils to color the outer ear blue, the middle ear green, and the inner ear red.

Sound waves must create vibrations throughout your ear to be interpreted by your brain as sound. The outer ear funnels sound waves to the middle ear. Sound waves hit the eardrum and make it vibrate. These vibrations make the hammer, anvil, and stirrup vibrate. The stirrup vibrates against the **cochlea**, an organ filled with fluid. The vibrations make waves in the fluid. This causes neurons in the cochlea to send impulses to the brain.

SECTION 2 Sensing the Environment *continued*

THE EXTERNAL EAR

The part of the ear that you can see is called the *external ear*. It collects sound waves and sends them into your ear canal. In humans, the external ear is fixed in place. However, many animals can move their external ears around. This helps them hear sounds that are very quiet. Moving the external ear helps some animals, such as rabbits, know which direction a sound is coming from.

KEEPING YOUR BALANCE

Your ears let you hear, but they also help you keep your balance. The *semicircular canals*, special fluid-filled canals in your inner ear, are filled with tiny hair cells. Fluid bends the hair cells when you move your head. This sends impulses to your brain. The brain then uses these impulses to figure out the position of your head. ✓

How Does Your Sense of Taste Work?

Taste is the sense that lets you detect chemicals and tell one flavor from another flavor. Your tongue is covered with tiny bumps called *papillae* (singular, *papilla*). Most papillae contain taste buds. Taste buds have groups of *taste cells*, which are the receptors for taste. Taste cells respond to dissolved food molecules in your mouth. Taste cells react to five basic tastes.

Taste	Example
Sweet	sugar
Sour	lemons, vinegar
Salty	potato chips
Savory	meats, cheeses
Bitter	coffee, unsweetened chocolate

How Does Your Sense of Smell Work?

Receptors for smell are located on olfactory cells in your nasal cavity. An *olfactory cell* is a nerve cell that senses the molecules in the air. You smell something when the receptors react to molecules you have inhaled.

Critical Thinking

9. Explain How is the external ear different from the outer ear?

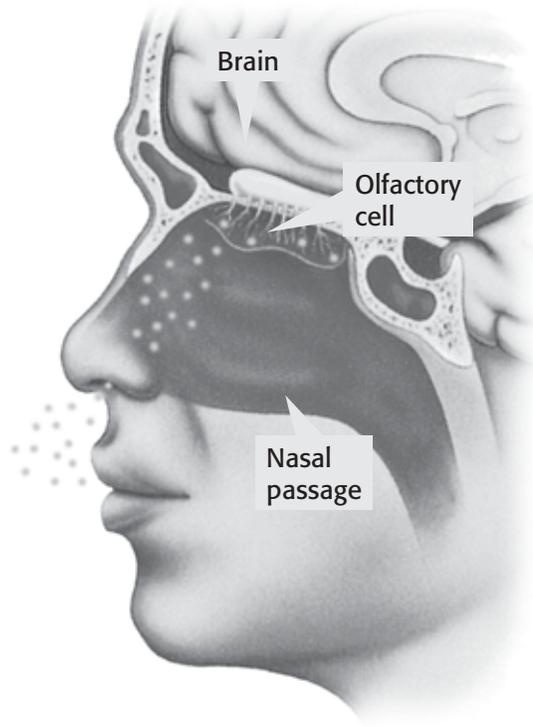
 **READING CHECK**

10. Identify What are two functions of the ear?

TAKE A LOOK

11. List Give two examples of foods that have a mainly salty taste. Do not use the example in the table.

SECTION 2 Sensing the Environment *continued*



Olfactory cells line the nasal cavity. These cells are sensory receptors that react to chemicals in the air and produce the sensation of smell.

Critical Thinking

12. Apply Concepts Why do you have a hard time tasting things when you have a cold?

Inhaled molecules dissolve in the moist lining of the nasal cavity and trigger an impulse. Olfactory cells send the impulses to the brain. The brain interprets the impulses as the sensation of smell.

Taste buds and olfactory cells both sense dissolved molecules. Your brain combines the information from your taste buds and your nose to let you sense flavor.

TAKE A LOOK

13. Summarize Complete the chart to summarize the major senses and sense receptors.

Sense	Receptors	What the receptors respond to
Touch	many different kinds	
Sight		
	neurons in the cochlea	
Taste		dissolved molecules
	olfactory cells	

Section 2 Review

7.5.a, 7.5.b, 7.5.g, 7.6.b



SECTION VOCABULARY

<p>cochlea a coiled tube that is found in the inner ear and that is essential to hearing</p> <p>feedback mechanism a cycle of events in which information from one step controls or affects a previous step</p> <p>integumentary system the organ system that forms a protective covering on the outside of the body</p> <p>iris the colored, circular part of the eye</p>	<p>pupil the opening that is located in the center of the iris of the eye and that controls the amount of light that enters the eye</p> <p>reflex an involuntary and almost immediate movement in response to a stimulus</p> <p>retina the light-sensitive inner layer of the eye that receives images formed by the lens and transmits them through the optic nerve to the brain</p>
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1. List What are the five senses?

2. Explain How do the integumentary system and nervous system work together?

3. Explain Why are reflexes important for the body?

4. Describe What are the functions of rods and cones in the retina?

5. Describe How do the lenses in your eyes change when you look at things that are close and things that are far away?

6. Explain How do your ears help you keep your balance?
