

Sensory Receptors

Reflect

How many senses do you think you have? Ever since the ancient Greek philosopher Aristotle wrote that human senses were the “window to the soul,” most people have thought that we only have five senses: taste, touch, smell, sight, and hearing. Scientists now believe our **sensory receptors** may number closer to 18 to 20.

sensory receptor – a nerve ending that sends signals to the central nervous system when it is stimulated

Your brain is constantly receiving information from multiple systems and body parts via your sensory receptors, which can be stimulated internally and externally. Actually, the number of sensory receptors varies depending on whether you are classifying the receptors by their stimulus type or by their location.



Sensory Receptors

Chemoreceptors respond to chemicals in taste and smell and in internal changes.

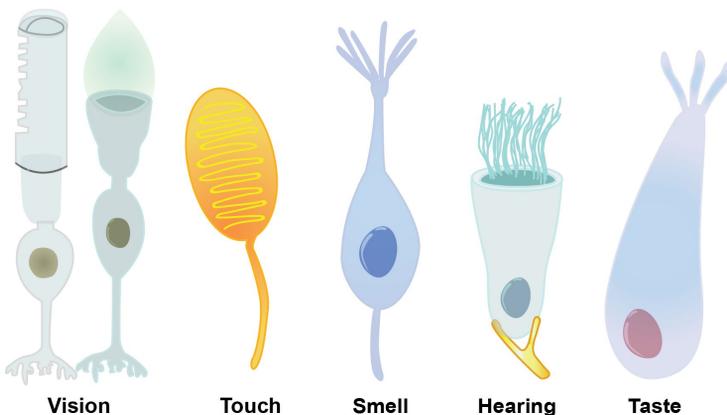
Thermoreceptors respond to temperature changes.

Mechanoreceptors respond to physical forces in touch, hearing, and pressure.

Photoreceptors respond to light.

Nociceptors respond to tissue damage (pain).

Proprioceptors respond to the body positions of skeletal muscles, tendons, ligaments, and joints.



Examples of various receptor nerve cells include rods and cones (vision), Meissner's corpuscles (touch), olfactory cells (smell), hair cells (hearing), and gustatory cells (taste).

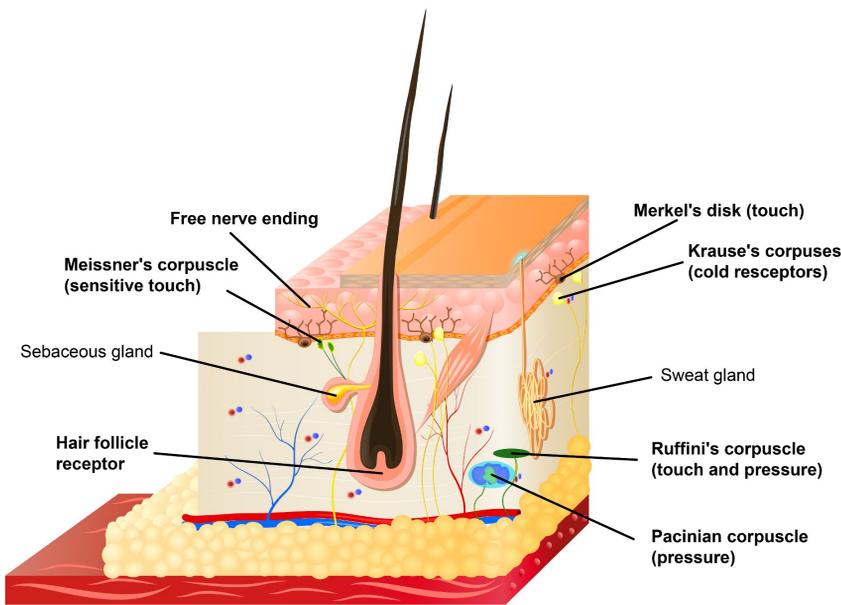
Sensory Receptors

Mechanoreceptors

Has a doctor ever checked your reflexes by tapping your knee? Your leg involuntarily kicks out. The mechanoreceptors in your knee respond to pressure. When the rubber hammer is tapped below your knee, it strikes a tendon that stretches an extensor muscle in the front of your thigh. This activates the stretch receptors in the muscle spindles, where neurons send impulses to the spinal cord, which returns the impulses to the same muscle, telling it to contract, or flex, and your leg straightens.



What Do You Think?



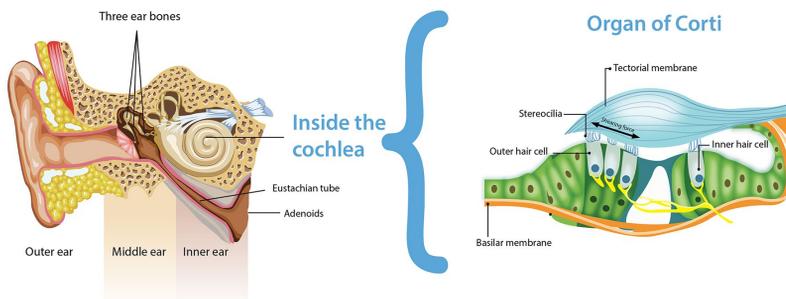
Have you ever felt the hair on the back of your neck stand up? What do you think causes your hair to stand up? Every hair follicle has receptors that sense when the hair changes position.

As the muscles tighten around the base of the hair, it “stands up,” which you are able to feel.

Other specialized receptors in the skin respond to sensitive touch, pressure, and temperature changes.

Look Out!

Some of the most sensitive mechanoreceptors are found in the inner ear (the cochlea), which is a spiral, fluid-filled tube divided lengthwise by the organ of Corti. As the waves of energy move over the little hair cells in the organ of Corti, impulses are transmitted to the brain as pitch and loudness of a sound. The organ of Corti is like the body's microphone.



Reflect



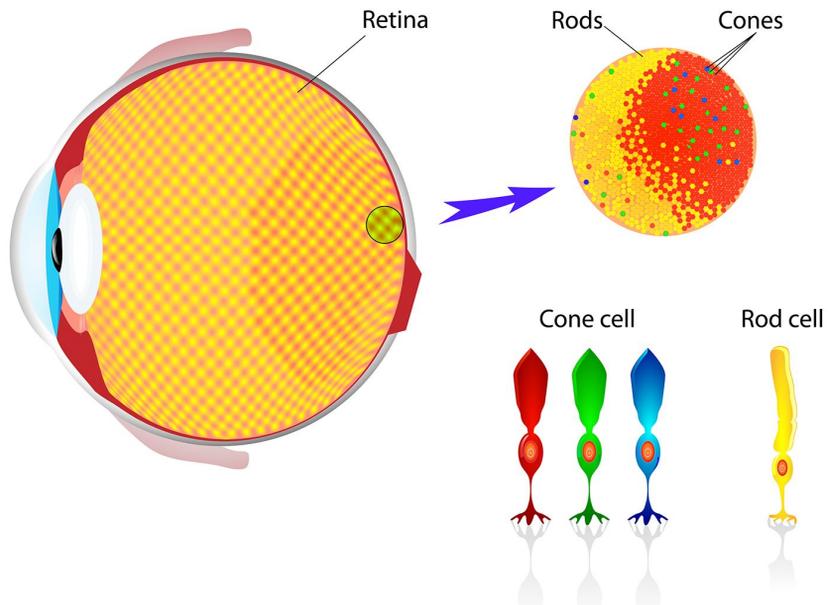
Photoreceptors

Photoreceptors are neurons in the retina of the eye that change visible light from the electromagnetic spectrum into signals that are perceived as images or sight. Rods and cones are two types of photoreceptors located at the back of the eye.

Cones allow us to see color. There are red, blue, and green cones. The photoreceptors contain a special chemical called *photo pigment*, which responds to a specific wavelength of light. When the appropriate wavelength strikes a cone, a message is sent through other cell layers, which send the information to the brain via the optic nerve.

Rods are activated by light but do not register any colors. This is why in very low light, it is difficult to distinguish color and objects appear in shades of gray.

Photoreceptor cell



The human eye has about 120 million rod cells and six million cone cells.

Look Out!

Color blindness is actually a decreased or limited ability to see colors. This can be caused by the lack of development of some cones. This form is a sex-related condition, because the genes that make photopigments are carried on the X chromosome.

If the genes on the X chromosomes are missing or damaged, color blindness may happen. Color blindness can also be caused by damage to the eye, the optic nerve, or the brain. Color blindness is considered a mild disability, but think about how a confusion in colors might affect your day-to-day life.

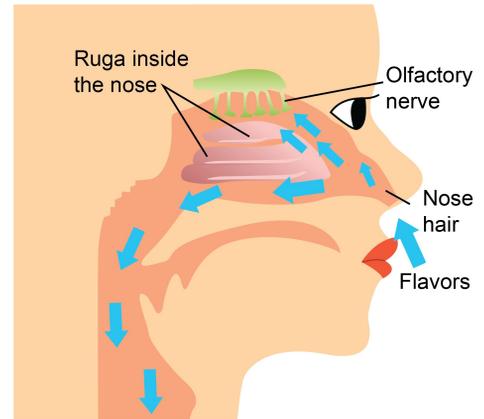


Reflect

Chemoreceptors play a major role in the senses of taste and smell. All chemoreceptors are stimulated by the presence of chemicals. Your sense of smell relies on **olfactory receptors**, which detect chemicals in a gaseous state.

olfactory receptors – respond to chemical odors
gustatory receptors – respond to chemical flavors

Olfactory receptors are distance chemoreceptors, food and odors can be identified from a distance.



The little bumps, or papillae, on your tongue contain taste buds (gustatory sense) and are direct chemoreceptors because they must make direct contact with the food item to taste it. Other taste buds are in the back and roof of the mouth. You have 5,000 to 10,000 taste buds, each containing 50 to 100 specialized **gustatory receptor** cells.

Involuntary Chemoreceptors

You also have involuntary chemoreceptors working to help you stay alive and safe. Some control your breathing and heart rate. Chemoreceptors called acid-sensing ion channels (ASICs) detect the level of carbon dioxide in the blood by monitoring hydrogen ions.

What Do You Think?

Proprioceptors

Do you love roller coasters? Do you play a sport? There is one more sense receptor system you should know about: proprioception. Proprioception senses the relative position of your various body parts and the amount of stress or effort being exerted with your movement. It may not seem like such a big deal that your right hand knows what your left hand is doing, but accomplishing any task safely and successfully relies on proprioception. You would not be able to touch-type because you would have to watch your hands to see that every finger is moving correctly with the right amount of pressure. You would not be able to drive a car because you would not be able to steer and use the pedals while keeping your eyes on the road. You would not be able to walk without watching your feet.



Reflect

Nociceptors

Have you ever stubbed your toe or fallen off a bike? You probably felt pain. Nociceptors are sensory nerves that respond to the pain when tissue is damaged in the skin, muscle, joints, bone, and internal organs. The root word *noci* comes from Latin and means “hurt.” The nociceptors respond to those stimuli that cause discomfort or pain: temperature extremes, cuts, blows, strong chemicals, infection, etc.



Try Now

Thermoreceptors

Take a minute to explore your thermoreceptors, or sensory nerves that respond to changes in temperature.

What you need:

- 3 bowls
- Ice water
- Warm to hot water (think bath or shower temperature)
- Tap water

Arrange the bowls in front of you as illustrated, left to right.



Hot water



Tap water



Ice water

Place your left hand in the hot water and your right hand in the ice water. Leave your hands submerged for 30 seconds.

After 30 seconds, place both hands in the tap water.

What do you feel? Can you explain why?

Sensory Receptors

In the left column is a list of activities you might do every day. Decide which sensory receptors are involved in the activities. List your choices in the right column by writing the first four letters of the sensory receptor's name.

Mechanoreceptors

Photoreceptors

Chemoreceptors

Thermoreceptors

Proprioceptors

Nociceptors

Activity	Sense Receptor
Starting to sweat from the hot sun at the beach	
Drinking sour milk from the carton	
Dancing to your favorite song	
Hitting your thumb with a hammer	
Watching a movie with all the snacks	
Wearing glasses to read a book	