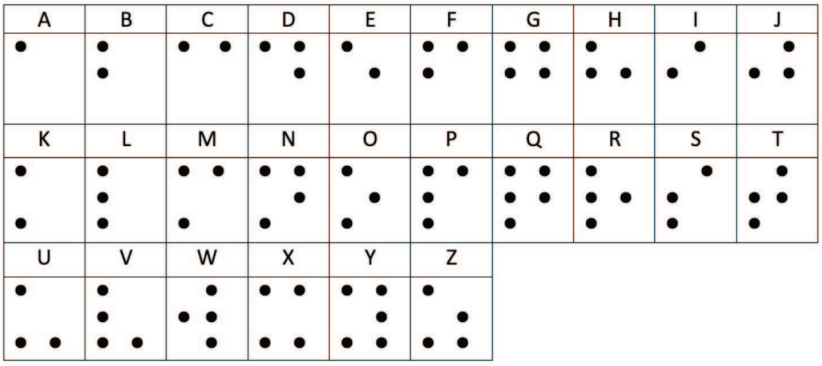
Name: _____ Date: _____

Reading: How does touch work?

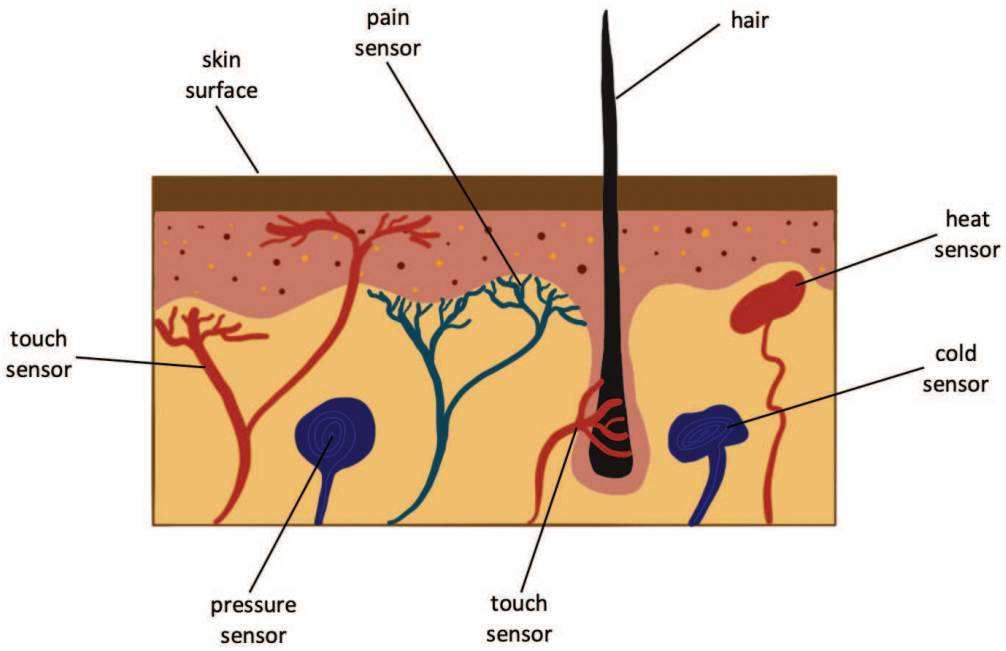
How does our sense of touch work?

Do you know anyone who is blind? How do they navigate the world? You may be thinking that they use other senses like hearing and touch. People without sight can still do many of the things people with sight can do. For example, blind people often use their fingers to read by feeling patterns of raised dots in books, on restaurant menus, or on signs. Braille is a coding system that allows people who are visually impaired to read by pressing their fingers onto raised dots that represent sequences of letters forming words and sentences. The Braille alphabet is shown in the figure below. Do you think you could feel your name in raised dots using this system?



If you are a sighted person, you also have the ability to recognize objects using only your sense of touch. If you close your eyes, you could probably identify a cell phone, a pencil, or a feather using only your fingers. You could press on the smooth glass surface of the cell phone and feel the pointed end of the pencil and the lightness of the feather. How are you able to do this?

Your skin is an amazing organ covering the surface of your body. It has millions of sensors that sense feelings in many different forms like, pain, temperature, and pressure. Different kinds of sensors respond to different sensations. One square inch of your skin contains about 200 sensors for pain, fewer than 10 for temperature, and about 15 for light touch and pressure from forces applied to your skin.

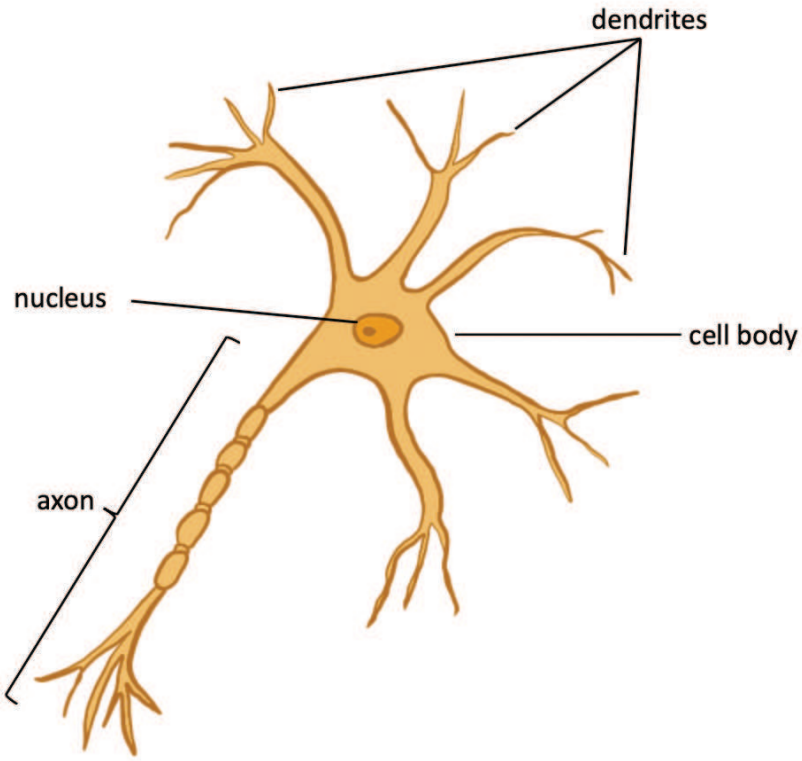


Why do you think there are so many pain receptors? You may be thinking that it would be a good thing to be unable to feel pain. But this would actually be very dangerous. Imagine tripping, falling down, and breaking your arm due to the forces between your arm and the ground. If you can't feel pain, you might not know you were seriously hurt. You might go about your day causing even more damage to your arm. People who can't feel pain have a very rare condition called *congenital analgesia*. These people must be very careful not to hurt themselves.

The heat and cold sensors in your skin help you regulate your body temperature. They signal when to put on a warm coat or seek out shade on a hot, sunny day.

Pressure and touch sensors detect and respond to contact forces between your skin and other things. These sensors are very sensitive to any deformation they experience in their structure. Touch sensors that are attached to hairs deform as the hair comes in contact with something else and moves. This can be something as gentle as the push from moving air in a light breeze. Other sensors, like pressure sensors, can help you detect when something presses firmly down on your skin.

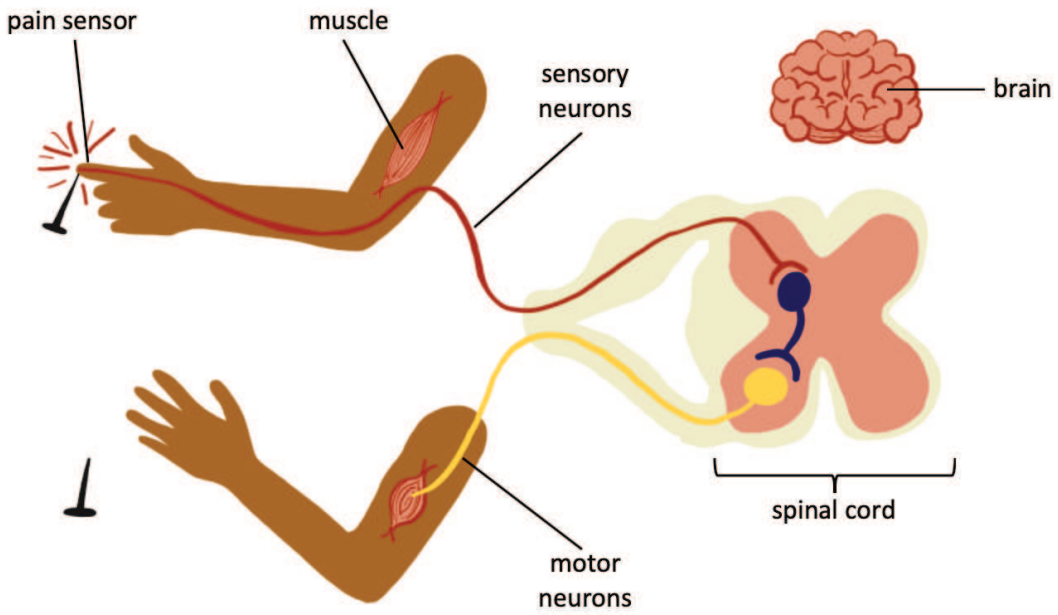
When these sensors are deformed they send a chemical signal to nerve cells that they are connected under your skin. These nerve cells are called *neurons*. An image of the structures that make up a neuron is shown below.



Neurons are very long cells with specialized ends that can send or receive chemical signals throughout your body to relay information. Sensory neurons in your skin send information to neighboring neurons which, in turn, send signals to your brain and spinal cord.

Your brain and spinal cord process these signals and send response signals to different parts of your body through a different type of neuron called a *motor neuron*. The motor neurons send signals that can trigger a response in the cells in that part of the body.

Signals that protect us from hurting ourselves usually move from sensory receptors in our skin to our spinal cord. Our spinal cord then sends a signal through motor neurons that results in some kind of fast action. For example, if your hand touches something sharp with too much force, a signal goes to your spinal cord and causes the cells in your arm muscles to contract quickly, resulting in you pulling your hand away before you even realize what happened.



When an immediate response isn't needed, a signal travels from sensory receptors in your skin to your brain. Then your brain interprets the signal, and you decide how you want your body to respond. Imagine you wake from sleep feeling uncomfortable pressure on your shoulder from being in the same position for too long. You decide to roll over to get more comfortable. To do this you will need to send a signal to those muscles in your body to move yourself around.

Try to represent this phenomenon as a chain of causes and effects in a labeled diagram in the space below:

1. Pressure sensors in your shoulder are deformed for an extended amount of time.
2. These send signals to neurons they are attached under the skin.
3. These neurons relay signals through axons to other neurons until the signal reaches your brain.
4. You decide you should roll over.
5. Your brain sends a signal to motor neurons that relay it to other motor neurons through axons until the signal reaches your leg muscles.
6. The cells that make up the muscle tissue in your leg muscles contract in response to the signal they receive.
7. This leads to your legs moving, which is what pushes your body around so that you roll over.

So remember, when you feel forces on your skin they are really deforming specialized structures (pressures sensors) under the skin, and these structures in turn relay signals through a connected series of nerve cells to your brain.