INSTRUCTOR GUIDE

ACTIVITY TITLE: Test Your Touch

Theme:	Somatosensation (Two-Point Discrimination)
Objectives: *(What key learning do you want students to come away with?)*	Understand how sensory information from the outside environment reaches the brain, what sensory receptors are, and how receptor size and density affects touch sensitivity.

LESSON OUTLINE:

1. Introduction: *Plan a script of what you will say to start.* *- What will this be about? Why's it interesting? (Hook)*	**Think about one of your favorite hobbies -- what senses are you using when you do it?** ● Basically everything you do, from eating to dancing, requires your senses to take in information from your surroundings! (e.g. in basketball, you need vision, hearing, and touch). ● You use your senses to gather information from the outside world so that you know what's going on around you.
2. Building Background: *List questions you can use to immediately engage your audience and prepare their thinking for your activity.* *-What prior knowledge might they have about/related to your topic?* *-What prior knowledge (background) do they need for your activity?*	**What are the 5 main human senses? What do we need these senses for?** ● Sight, smell, hearing, taste, touch ● Everything! **In this demonstration, we will be focusing on touch** ● Our sense of touch is controlled by our body's biggest organ: the skin! ● Touch stimuli are sensed by **sensory receptor neurons** in our skin, which have special parts called **receptors** that can sense when something is touching our skin [show hand diagram and Merkel cell image]. ● These neurons in the skin receive information about the environment, and then send that information up the spinal cord to the brain. The brain then processes this information and decides on a behavior (e.g. *Water is dripping on my hand. Should I move my hand?*). ● The part of the brain that receives touch information is a strip at the top of the brain, called the **somatosensory cortex** [show labeled picture of brain, point to somatosensory cortex]. **Our sense of touch varies based on where on our body we are touched.** ● The skin on some parts of the body has more receptors than in other parts. For example, some areas of our skin have fewer/bigger sensory receptor neurons that make this area less sensitive, while other areas have smaller/more sensory receptor neurons that make it

	more sensitive. **Which parts of your body do you think are more sensitive to touch?** ● More sensitive: lips, fingertips ● [Show corresponding diagram of arm vs. lips] ● The circles represent something called **receptive fields** of sensory receptor neurons. ● We can think about a receptive field as the area a soccer player is in charge of getting the ball, where the soccer player would be the neuron and the area they're in charge of is the receptive field [show field diagram]. If you have lots of players close together like in Team B, with small areas to guard, that team will be more sensitive to small changes in where the ball is -- a slightly different location will lead to a different player responding. In Team A, the ball can move a lot and there isn't any difference for which player gets the ball (or, less sensitivity).
3. Lesson & Activity: *Outline the key components of your lesson.* **Plan/Note**: - key ideas/ vocabulary - scaffolds - images/media - extension questions *Consider how to best deliver your content! *Plan interactive components that encourage active thinking in your students.	**Let's test the touch sensitivity of different parts of our body.** ● How can we test touch sensitivity? By measuring whether we can feel two points of touch that are very close on our skin! If we can tell that there are two different points touching us even when they are close together, we are highly sensitive. ● So, we will place calipers on different body parts and see if we can feel one or two points. We can do this in a few areas, such as the upper arm, lower arm, leg, palm of hand, and back. ● Starting with the calipers as far apart as possible, place it on your partner's selected skin area while their eyes are closed. Ask whether your partner felt one or two points. Move calipers one cm closer each time *(check that the calipers units are cm)*, and continue until your partner only feels one point. Write down the smallest distance at which your partner could tell there were two points. Repeat for all body parts, and then switch roles so that both of you can perform this test!
4. Wrap Up: *- Review key ideas* *- Share takeaways and final thoughts* *- Discuss connections to other questions and ideas. Extensions.* *- Ask: Who could you teach what you learned here today?* *- Ask/Suggest: What can I do to learn more?*	**Today we learned about touch sensitivity on different parts of our body.** ● Touch sensitivity depends on: receptor density (how many receptor neurons there are in an area of skin) and receptive field size (how big of an area of skin that one sensory receptor neuron responds to) ● This sensitivity affects how our brain perceives touch stimuli. **Why do we have different sensitivities in different skin areas? How could this be useful for survival?** ● Different areas of skin have different functions. For example, on our lips, we may want to feel the food we are putting in our mouths,

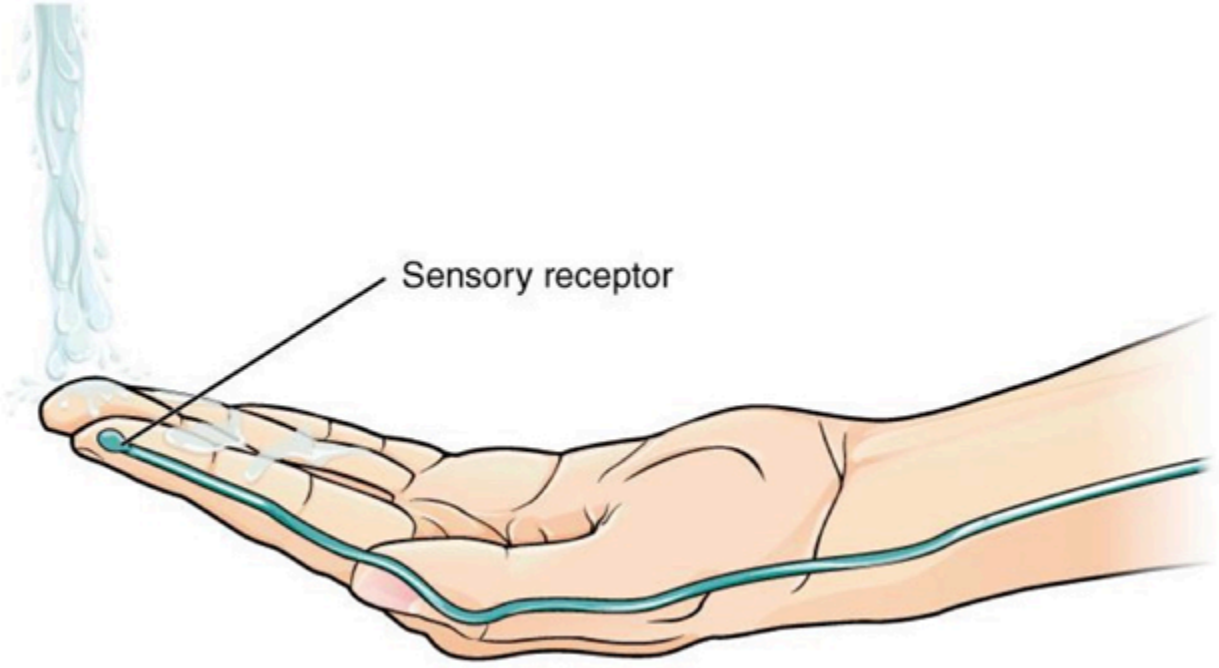
	which is crucial to our survival and requires detailed information. However, on our arms, we may just want to feel if we bumped into something. ● We don't need to be super sensitive everywhere – that sounds painful! We also don't want to be insensitive everywhere – that could lead us to miss important information. Our skin sensitivity varies across our body to be efficient and helpful for our survival.

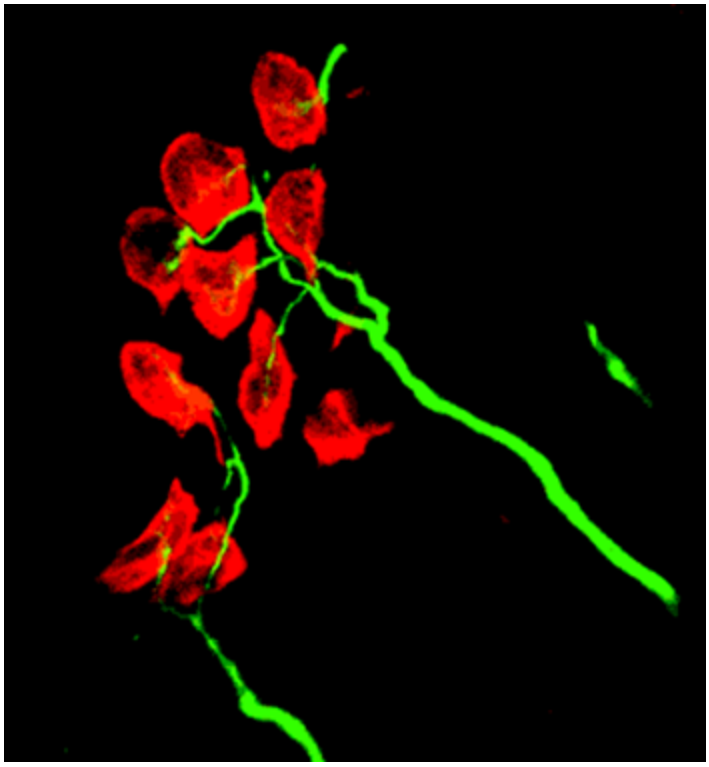
MATERIALS NEEDED: *(please list all items and quantities necessary for preparation)*
Two-point discrimination calipers (check that they work properly), pen, paper (printed out chart).

Resources:
● See Eric Chudler's section on this activity and its background concepts here (very useful): http://faculty.washington.edu/chudler/twopt.html

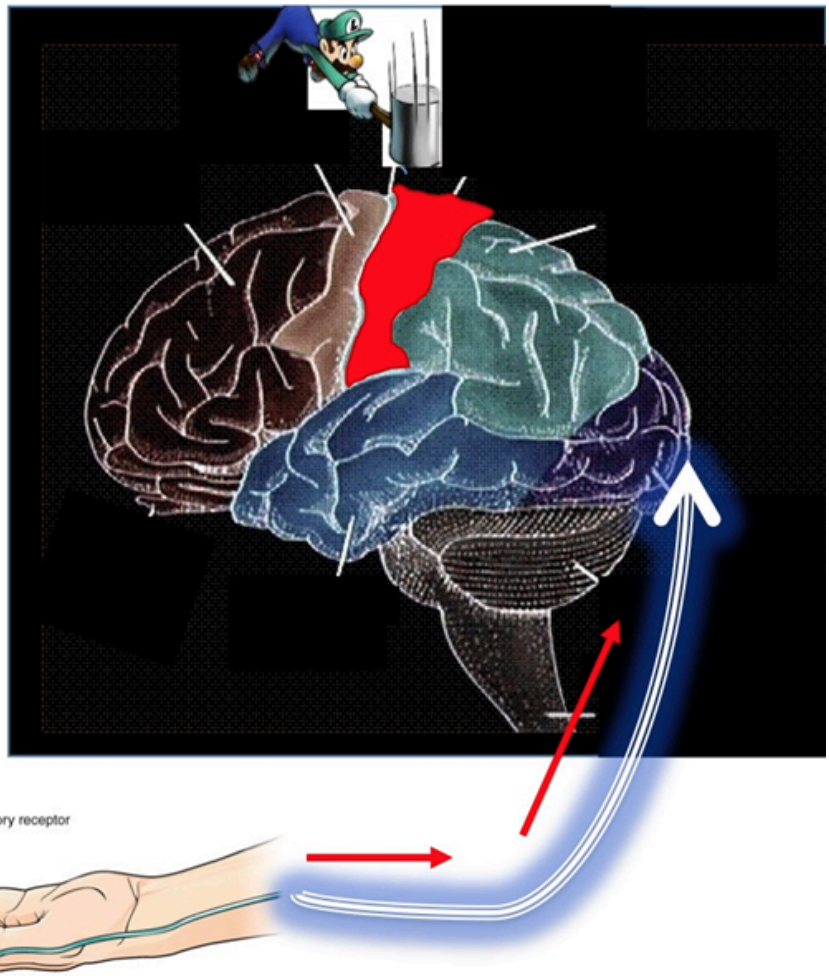
NOTES:

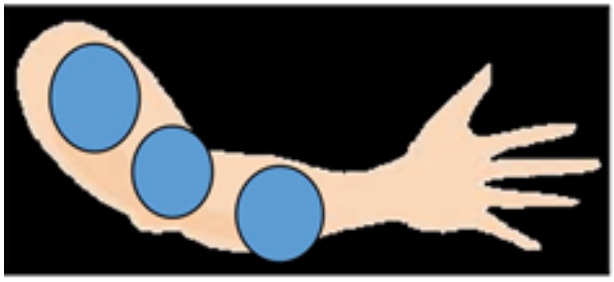
- The two-point touch discriminators can also be used to have students design their own experiments. Encourage them to develop clear hypotheses and experimental approaches.
- Discourage students from testing their tongues/lips, and ask them to be gentle with each other!





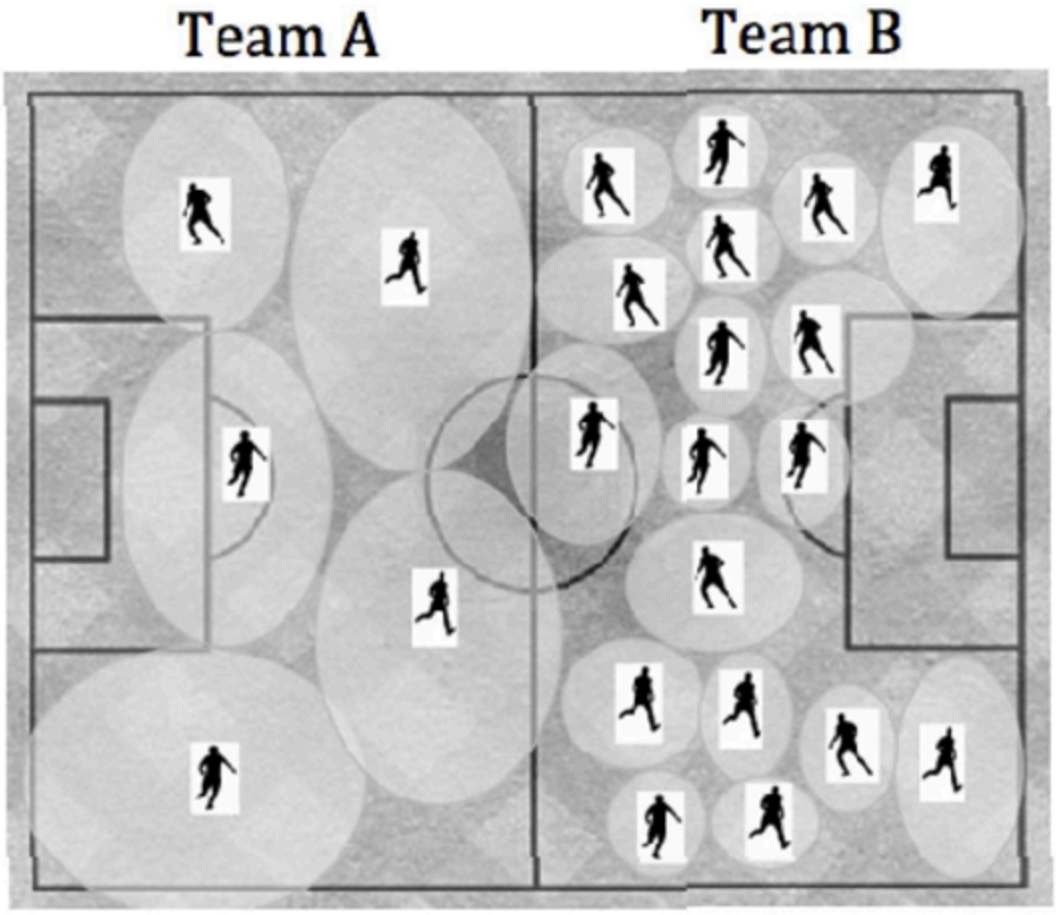
Merkel cell -- a special type of touch receptor found in the top layer of our skin
Merkel cells (red) within the skin, innervated by mechanosensory axons (green). The Merkel cells convey the mechanical stimulus from the surface of the skin to the axon terminals. (from http://www.nature.com/neuro/journal/v1/n1/full/nn0598_5.html)





Sensory receptor neurons

Sensory receptor neurons


Team A
Team B

Skin area	**Minimum Distance for 2 point discrimination (cm)**	
	Trial 1	Trial 2
Upper arm		
Palm of hand		
Back		
Lower arm		
Leg		