

**Activity Guide for Students: How Sensitive?**

**Purpose:** To design and execute an experiment to determine the relative sensitivity of touch receptors in different areas of human skin using the two-point threshold test.

**Background information:** Skin is the human body's largest organ. It acts as a container to keep vital chemicals and nutrients in the body and as a barrier for keeping dangerous substances, including ultraviolet radiation from the sun, out of the body. Skin's common functions include maintaining a water and electrolyte balance, participating in vitamin D synthesis and sensing painful and pleasant stimuli.

Four different types of mechanoreceptors are encapsulated in the skin and provide information to the central nervous system about touch, pressure, vibration and skin tension. Meissner corpuscles, Pacinian corpuscles, Merkel disks and Ruffini corpuscles are considered high-sensitivity mechanoreceptors — even a weak mechanical stimulus can elicit nerve impulses in sensory neurons and deliver information to the brain or spinal cord.

The number and type of mechanoreceptors vary over the body. A mechanoreceptor's receptive field is the patch of skin that a neuron responds to and is dependent on the type of mechanoreceptor. The level of skin sensitivity depends on how many mechanoreceptors there are in a particular area of skin. The most sensitive areas of skin will have a large number of mechanoreceptors. A small area of skin on the palm of your hand, the top of your hand and your fingertips all have different numbers and types of mechanoreceptors, therefore, they have different tactile sensitivities.

**Procedural overview:** The two-point threshold test can be used to demonstrate the sensitivity of touch based on the number of touch receptors for different areas of human skin. You can work in groups to report what you feel is happening when your skin is being touched at one or two points. Only one point may be perceived when the two touch points are in an area of skin with a low number of mechanoreceptors. The minimum distance where two points can be correctly distinguished should be measured for different parts of the body, revealing the sensitivity of touch receptors in these different regions.

**Get started:**

1. Using the general instructions below, try the two-point threshold test and determine a more detailed, repeatable technique to administer the test on different areas of skin:

- Use two toothpicks to touch the palm of the hand of a blindfolded student at two different locations with the toothpicks.
- Measure the distance between those two locations.
- Record whether the blindfolded student reports that each poke feels like two different sticks or one.

- To make sure the blindfolded student isn't anticipating any number of points touching his or her skin, the experimenter should use a technique that tests one, two or three toothpicks at each distance between the toothpicks.
- Generally start two sticks at a certain distance apart from each other, and then try them at closer and closer distances.
- Measure and record the minimum distance between sticks for which the blindfolded student can distinguish two different sticks on the palm of the hand.

2. Record the data from the first test subject's palm. Based on this data, each student should create a data table for four additional skin-testing locations. Other testing locations could be: on the back of the hand, on a fingertip, on the arm (try to avoid hairs — movement of hairs can also be sensed), on the back (through the shirt) or on the ankle, cheek or neck.

3. Write a numbered procedure for the two-point threshold test your group will use.

4. Perform the two-point threshold test on four additional areas for the first test subject. Measure and record the minimum distance between sticks for which the blindfolded student can distinguish two different sticks on the four additional areas. Each student should take a turn getting tested for all skin locations (if you are in a group of three, you should have data from 15 two-point threshold tests, five from each student).

5. Which areas were best able to distinguish between one or two toothpick pokes?

6. Which areas were least able to distinguish between one or two toothpick pokes?

7. How similar or different were the answers for different members of your group for the same region of the body?

8. Why would it make sense for some areas to be more sensitive than others?

9. Name any variable that may have confounded your results. If you were to redo the two-point threshold test again, what modifications would you make? How might the changes affect your results?

10. Research the four types of mechanoreceptors. How are they similar and how are they different? Which mechanoreceptors are common in the areas of skin you tested? Does the research information agree with your results? Why or why not?