Mechanoreceptors

Introduction

Does every area of the skin's surface detect stimuli at the same level or are some areas more sensitive than others? Are the bottoms of your feet more or less sensitive than your back? In this lab, students will test different areas of the body to determine the concentration of mechanoreceptors. Let's be careful—students might suggest testing some very sensitive areas. The concentration of mechanoreceptors in particular areas will be estimated based on the smallest detectable distance between two points of a paper clip.

Concepts

- Mechanoreceptors
- Sensory mechanisms

Background

Mechanoreceptors are sensory receptors that are stimulated by touch, stretch, pressure, motion or sound. The density of mechanoreceptors differs from one part of the body to another. Some areas contain hardly any mechanoreceptors and others have so many that even very faint stimuli can be detected. In an area such as the back there are very few mechanoreceptors—simultaneously touching two points that are a large distance apart may feel like just one point. The fingertips and feet are two areas of the body that have the greatest concentration of mechanoreceptors. Since there are more mechanoreceptors, stimuli at two different points can be detected as separate at a much smaller distance.

In this activity students will gain perspective of the difference in density of mechanoreceptors in three locations of the body based on the threshold at which they are able to tell the difference between one stimulus from two stimuli.

Materials

Metric ruler
Paper clips

Safety Precautions

The materials used in this activity are considered nonhazardous. Please follow all normal laboratory safety precautions.

Procedure

1. Obtain four paper clips. Open (spread) the paper clips apart and bend them into a "V" shape.
2. Using a metric ruler, adjust the distance between the ends of the "V-shaped" paper clips so that the two end points are separated by the following distances: 2.0 cm, 1 cm, 0.5 cm, and 0.1 cm.
3. Working in pairs, one student will be the subject and the other student will administer the test.
4. The subject should sit with his or her eyes closed.
5. While the subject's eyes are closed, obtain the 2.0 cm paper clip and touch your partner's hand five times using both points of the paper clip and five times using just one point. Mix up the order so that your partner does not notice a pattern.
6. After each touch ask your partner if he or she felt one paper clip point or two. Record the number of points actually used and the number of points felt in Data Table 1.
7. After ten trials are finished with the 2.0 cm paper clip, switch to the 1.0 cm paper clip and repeat steps 3–6 for a total of 10 trials.
8. Repeat steps 3–6 two more times using the 0.5 cm paper clip and then the 0.1 cm paper clip.
9. Test the skin on the tip of lab partner's index finger using the same procedure described in steps 3–8. Record the results in Data Table 2.
10. Test the skin on the top of your partner's forearm, using the same procedure. Record the results in Data Table 3.

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Disposal

No disposal is required for this activity.

Connecting to the National Standards

This laboratory activity relates to the following National Science Education Standards (1996):

Unifying Concepts and Processes: Grades K–12
Evidence, models, and explanation
Constancy, change, and measurement
Content Standards: Grades 5–8
Content Standard C: Life Science, structure and function in living systems
Content Standard F: Science in Personal and Social Perspectives
Content Standards: Grades 9–12
Content Standard C: Life Science
Content Standard F: Science in Personal Perspectives; personal health

Tips

- This activity is designed for students working in pairs.
- Depending on class time, the activity can be done with one student always acting as the subject, or the students can switch roles and repeat the activity. Allowing the students to do the activity twice may support the data obtained with one subject or show that sensitivity varies per individual.
- Ask students, based on their results, which areas of the body have the most mechanoreceptors based on their results.
- "Human Senses Experiment Kit" available from Flinn Scientific (Catalog No. FB0439) allows students to explore a wide range of receptors, including taste receptors, olfactory receptors, and nerve impulses.

Reference

Biology: *Explaining Life. Laboratory Manual, Teacher's Edition.* Pearson; Prentice Hall: Needham, MA, Vol 1, p: 335–340.

Mechanoreceptors Worksheet

Data Table 1. Back of Hand

	2 cm		1.0 cm		0.5 cm		0.1 cm	
Trial	**Points Used**	**Points Felt**	**Points Used**	**Points Felt**	**Points Used**	**Points Felt**	**Points Used**	**Points Felt**
1								
2								
3								
4								
5								
6								
7								
8								
9								
10								

Data Table 2. Fingertip

	2 cm		1.0 cm		0.5 cm		0.1 cm	
Trial	**Points Used**	**Points Felt**	**Points Used**	**Points Felt**	**Points Used**	**Points Felt**	**Points Used**	**Points Felt**
1								
2								
3								
4								
5								
6								
7								
8								
9								
10								

Data Table 3. Top of Forearm

	2 cm		1.0 cm		0.5 cm		0.1 cm	
Trial	**Points Used**	**Points Felt**	**Points Used**	**Points Felt**	**Points Used**	**Points Felt**	**Points Used**	**Points Felt**
1								
2								
3								
4								
5								
6								
7								
8								
9								
10								