

Skin Sensitivity

Pre-Lab Discussion

The senses receive information about the environment and relay it to the central nervous system, where the information is interpreted. The sense organs contain specialized neurons called *receptors*, each of which is adapted to receive a particular kind of stimulus. Like all neurons, receptors follow the *all-or-none principle*. That is, any stimulus that is weaker than the *threshold* will produce no impulse; any stimulus that is as strong as or stronger than the threshold will produce an impulse. The threshold is the minimum level of a stimulus that is required to activate a neuron.

The receptors for the sense of touch are scattered over the surface of the entire body. The receptors, however, are more closely grouped together in some areas of the body than in others. In addition, the receptors in one area may respond to a weaker threshold than receptors in another area.

In this investigation, you will study the distribution and sensitivity of the touch receptors of the human body.

Problem

How sensitive is the skin?

Materials (per pair of students)

- 3 bristles of various thickness
- Blindfold
- 9 toothpicks
- Masking tape
- Metric ruler
- Pencil
- Blunt probe

Safety

Be careful when handling sharp instruments. Note all safety alert symbols next to the steps in the Procedure and review the meanings of each symbol by referring to the symbol guide on page 10.

Procedure

Part A. Determining Threshold

1. Blindfold your partner.
2. Gently touch your partner on the fingertip with one of the three bristles just until the bristle bends. Your partner should tell you whether he or she feels the touch of the bristle.
Note: *Avoid parts of the fingertip that have calluses.*
3. Touch each of the three bristles to the fingertip five times. Try to alternate the bristles so that your partner will not know which bristle is being used. In Data Table 1, record the bristles that are felt by placing a check mark in the appropriate place. If the bristles are not felt, leave the space blank.
4. Repeat steps 2 and 3 for the palm, back of the hand, inside of the forearm, and back of the neck. Record the information in the appropriate places in Data Table 1.
5. Switch roles with your partner and repeat steps 2 through 4.

Part B. Distinguishing Between Two Stimuli

1. Obtain nine toothpicks. Tape two toothpicks together so that their tips are 5 millimeters apart. Use the metric ruler to ensure that the spacing between the toothpicks is accurate. Make sure that the tips of the toothpicks are even with each other. See Figure 1. Using the same procedure, tape three pairs of toothpicks together so that the tips of the first pair are 10 millimeters apart, the tips of the second pair are 15 millimeters apart, and the tips of the last pair are 20 millimeters apart. Allow the last toothpick to remain unpaired and untaped.

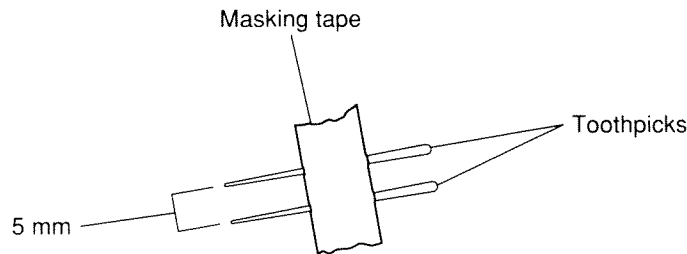


Figure 1

2. Blindfold your partner. Gently touch your partner's fingertip with any of the sets of toothpicks.
CAUTION: *Be very careful when touching your partner's skin. Apply only a small amount of pressure.* Have your partner identify whether you are using one or two toothpicks. Record this information in the appropriate place in Data Table 2.
3. Repeat step 2 with the remaining sets of toothpicks. Use the sets of toothpicks in random order so that your partner will not know the pattern in the testing. **Note:** *Use the same pressure on the toothpicks in all trials.*
4. Repeat steps 2 and 3 using the palm, back of the hand, inside of the forearm, and back of the neck. Record the information in the appropriate places in Data Table 2.
5. Switch roles and repeat steps 2 through 4.

Part C. Locating a Stimulus

1. Blindfold your partner and give him or her a blunt probe to use as a pointer.
2. With a pencil, touch your partner's fingertip so as to make a visible mark on the skin.
CAUTION: *Do not press so hard as to break the skin. Make sure that the pencil has a rounded, blunt tip.*

3. Have your partner try to touch the same point on his or her skin with the blunt probe that you touched with the pencil.
4. With the metric ruler, measure the distance between your mark and the point of the probe. Record this measurement in the appropriate place in Data Table 3.
5. Repeat steps 2 through 4 two more times using points near, but not the same as, the first point. Record the information in the appropriate place in Data Table 3.
6. Repeat steps 2 through 5 on the palm, back of the hand, inside of the forearm, and back of the neck. Record the information in the appropriate places in Data Table 3.
7. Switch roles and repeat steps 1 through 6.
8. Calculate the average distance between the pencil mark and the probe for each of the five sets of data. Record the averages.

Observations

Data Table 1

Skin Surface	Small Bristle	Medium Bristle	Large Bristle	Trial
Fingertip				1
				2
				3
				4
				5
Palm of hand				1
				2
				3
				4
				5
Back of hand				1
				2
				3
				4
				5
Inside of forearm				1
				2
				3
				4
				5
Back of neck				1
				2
				3
				4
				5

Data Table 2

Body Part	Number of Stimuli Felt				
	One Toothpick	Toothpicks 5 mm Apart	Toothpicks 10 mm Apart	Toothpicks 15 mm Apart	Toothpicks 20 mm Apart
Fingertip					
Palm of hand					
Back of hand					
Inside of forearm					
Back of neck					

Data Table 3

Distance Between Pencil Mark and Probe (mm)					
Trial	Fingertip	Palm of Hand	Back of Hand	Inside of Forearm	Back of Neck
1					
2					
3					
Average					

Analysis and Conclusions

1. Of the parts of the body you tested, which part had the lowest threshold? Which part had the highest threshold? _____

2. Of the parts of the body you tested, which part was best able to distinguish between the closest stimuli? Which part was least able to distinguish between the closest stimuli?

3. What does your answer to question 2 indicate about the distribution of touch receptors in the skin? _____

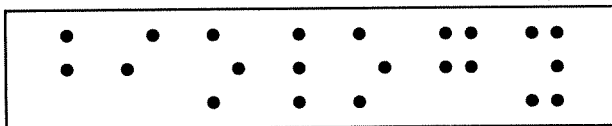
4. On which part of the body you tested were you best able to locate a stimulus? On which part were you least able to locate a stimulus? _____

5. How are the results of Part C related to the results of Parts A and B?

6. Were there any differences between your results and those of your partner? If so, what might account for these differences? _____

Critical Thinking and Application

1. Braille is a special system of writing with raised dots. Blind people read Braille by touching these dots and recognizing patterns for each letter. The Braille pattern below is for the word *biology*.



How does the body's arrangement of nerve receptors for touch make the Braille system possible? _____

2. In addition to touch receptors, the skin contains receptors for pain. How are pain receptors helpful to us? _____

3. In what way is the concentration of touch receptors in the human hand related to its functions? _____

4. When you put on a wristwatch, you become aware of the pressure it applies to the touch receptors in your wrist. Why do you think that you will not be aware of the presence of the watch after a period of time? _____

Going Further

1. To determine the sensitivity of other areas of the body, such as the upper arm, the knee, the foot, or various parts of the face, repeat the procedures in Parts A, B, and C of this investigation. Record your observations and compare them with those in this investigation.
2. Use blunt probes warmed in warm water to determine the distribution of heat receptors in the skin. **CAUTION:** *Do not heat the probes to a temperature above 40°C.* Record your observations.
3. Use blunt probes cooled in ice water or in a refrigerator to determine the distribution of cold receptors in the skin. Record your observations.