

## C5 What functions does the skin have? – The skin as a sense organ

### 1 How does skin react to touch?

#### 1.1 Apparatus and materials


- Cloth or scarf to be used as a blindfold
- Scissors, if necessary
- 4 sheets of sandpaper, 60, 80, 100, and 120 grit  
(The first time this experiment is conducted, use scissors to cut the sheets of sandpaper into pieces approx. 5 x 5 cm.)

**Attention:** After you have completed the experiment, return the materials or dispose of them properly as instructed by your teacher.

#### 1.2 Safety information

The materials may be used only as instructed by your teacher or as described in the experimentation instructions. Be careful if you use scissors.

#### 1.3 Conducting the experiment

- Blindfold the test person with the cloth or scarf.
  - Hand the test person the four pieces of sandpaper.  
The test person will touch the pieces and try to arrange them on the table in the order of coarseness (e.g., from left to right/from finest to coarsest).
  - Note whether the test person was able to arrange the four sheets by coarseness.
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- Fig. 1: Sorting the sandpaper according to the coarseness felt while blindfolded.
- In the second round of the experiment, carefully rub two pieces of sandpaper (60 and 120 grit) on specific areas of the test person's skin. The test person should indicate the order in which the pieces of sandpaper are applied to each area (first coarse, then fine, or vice versa).
  - Tear off small pieces of sandpaper from each sheet and rub them on the test person's lips. (For reasons of hygiene, do not reuse these pieces; discard them immediately.)
  - Then rub the larger pieces of sandpaper on the following areas: forehead, neck, fingertips, palm of the hand, back of the hand, inside of the upper arm, back.
  - Make a note of the body areas where the test person was able to correctly feel the different grits, and those where he or she could not.
  - Repeat the experiment using the 80 and 100 grit sandpaper.

#### 1.4 Observation

Write down a summary of your observations.

## **1.5 Analysis**

- a) Compare your test person's results with those of other test persons.
- b) Determine the similarities and differences between test persons.
- c) Compare the areas of skin that were especially sensitive to differences in coarseness with those that tended to be more "insensitive."

## **1.6 Questions**

- a) What are the three layers of skin?
- b) What structures in the skin are responsible for the perception of tactile stimuli?

## 2 How does the skin perceive cold and heat?

### 2.1 Apparatus and materials

- 1 bowl, plastic
- Cold water, ice cubes if possible
- 1 felt-tipped pen, blue
- 1 felt-tipped pen, red
- 1 lighter or matches
- 1 nail
- 1 tea light

**Attention:** After you have completed the experiment, return the materials or dispose of them properly as instructed by your teacher.

### 2.2 Safety information

The materials may be used only as instructed by your teacher or as described in the experimentation instructions.

For this experiment, be aware of the following risks:

- Take care when working with a flame that you don't burn yourself or start a fire.
- Be careful that the nail doesn't get too hot.

### 2.3 Conducting the experiment

- Light the tea light.
- Hold the nail over the tip of the flame for approx. 3 seconds. Be careful that the nail doesn't get too hot!
- Now run the tip of the nail lightly over the back of the test person's hand. The test person should indicate the points at which he or she feels an especially strong sensation of heat. Mark these points with a red dot.
- Keep reheating the nail for the same length of time (approx. 3 seconds) above the tip of the tea light flame and running it across the entire back of the hand systematically with as narrow gaps as possible.
- Fill a bowl with (ice-)cold water (adding ice cubes, if desired). Hold the nail repeatedly in the cold water for approx. 15 seconds.
- Follow the same procedure with the cold nail that you used for the heated nail. Mark the points of the test person's hand that are especially sensitive to cold with a blue dot.



Fig. 2: Experiment setup for determining the points that are sensitive to heat and cold.

#### Notes:

- The second round of the experiment can also be conducted on the test person's other hand.
- During the experiment, test persons should not look at their hands, but should close their eyes so that they can concentrate more fully on the sensations of heat and cold.
- It is useful to hold the nail in one hand and the marker in the other. Then you can immediately mark the point at which the test person feels heat or cold. Then you won't have to put down the nail, but can continue it moving slowly across the skin.

## 2.4 Observation

- Test person: Describe your sensations during the experiment.
- Experimenter: Look at the test person's hand. Note the number of red (heat) dots and blue (cold) dots.

## 2.5 Analysis

- a) Compare the results on the test person's hand to those of other test persons.
- b) Explain the differences in the number of red and blue dots.

## 2.6 Questions

- a) What different types of receptors are in human skin?
- b) What layers of skin are they located in?
- c) Which receptors are responsible for sensing thermal stimuli?

### 3 How does the skin distinguish between different temperatures?

#### 3.1 Apparatus and materials

- Cold water, ice cubes if possible
- 1 digital thermometer
- Hot water, max. 45°C
- 3 large bowls for filling with water and submerging hands
- 1 towel for drying hands
- 1 watch

**Attention:** After you have completed the experiment, return the materials or dispose of them properly as instructed by your teacher.

#### 3.2 Safety information

The materials may be used only as instructed by your teacher or as described in the experimentation instructions. Make sure the water is not too hot (from 40°C to max. 45°C). Check the temperature with the thermometer.

#### 3.3 Conducting the experiment

Normally this experiment should be conducted with a partner who watches the time and writes down your observations from the experiment.

- Fill the three bowls with water of different temperatures (approx. 45°C, approx. 25°C, and below 10°C) and arrange them in a row on the table.
- Fill the medium-temperature bowl with an equal amount of hot and cold water (1:1).
- All the bowls should contain the same amount of water and be large enough so that they don't overflow when you submerge your hands.
- Submerge your entire left hand in the left-hand bowl containing the hot water. At the same time, submerge your right hand in the right-hand bowl containing cold water.
- After approx. 1 minute, place both hands in the middle bowl containing the mixed water.
- Leave your hands in the mixed water for at least 2 minutes.
- Determine how long your left and right hands continue to sense a difference in the temperature of the mixed water (in seconds).



Fig. 3: Experiment setup with bowls containing water of different temperatures.

#### 3.4 Observation

Describe your sensations when you submerged your hands in the mixed water.

#### 3.5 Analysis

- a) Describe the processes that were taking place in your skin's thermoreceptors that resulted in the contradictory sensations in your two hands.
- b) How long do your two hands continue to feel temperature differences in the mixed water? Explain the results.

### 3.6 Questions

- a) What type of information do the heat and cold receptors deliver?
- b) Why does your hand that was in the warm water feel the difference in temperature longer than your other hand?