Neuroscience for Kids

http://faculty.washington.edu/chudler/neurok.html

STUDENT GUIDE

Our Sense of Touch

How do our bodies get information through the *sense of touch*?

Nick was desperate. His paper for History class was due in an hour, but the thermostat in the computer lab wasn't working and it was freezing in there! Pulling on his ski glove liners, he tried to finish typing the paper. "Hey man, whadda ya doin'?" Dave mumbled as he walked in. "Me?" said Nick. "Trying to type my paper. Hey, what happened to you?? Your face looks lopsided." "Yeah," said Dave, "I hadda go to the dentist—now my face is numb. Man, I can't feel a thing when I touch it. Why are you wearing gloves??" "I'm freezing in here," said Nick, "but I've got to type this paper. Boy, this isn't working. I can't feel where one key ends and the next one begins. I'm making too many mistakes!" "Yeah, we're a matched pair," said Dave. I can't feel anything on my face, and you can't feel anything with your fingers."

What's going on here? Are Nick's and Dave's problems really alike? What has happened to their senses of touch?

We hardly think about our **sense of touch** until something goes wrong—trying to find a small object with gloves on, waiting for dental anesthetic to wear off so our faces don't feel "dead." What a relief when things are back to normal! Just how does the skin let the brain know what it is touching?

You've noticed that when you want to find out whether something is smooth or rough, you run your fingertips over it, rather than the palm of your hand or your elbow. And you may have noticed that you can feel a tiny fragment of a bone in your mouth, but you wouldn't have noticed it at all if you had stepped on it with your bare foot. What does it mean when part of your body is "better" at getting touch information?

Your teacher will discuss in class the parts of the touch sensory system and how they work. This system includes special **receptors** in the skin, **nerve cells or neurons and their extensions called axons** that form **pathways** where the messages travel, and areas of the **brain** that receive messages and interpret them. After your class discussion and experiment, try to figure out what had happened to Nick and Dave.

Name:_____ Date:_____

CLASS EXPERIMENT

HOW SENSITIVE IS MY SKIN?

LAB QUESTION

PREDICTIONS

SUPPLIES

toothpicks	blindfolds, optional
corks	data recording sheets
metric rulers	graph paper

PROCEDURE

1. Write the Lab Question and then write your predictions in the boxes above.

2. Follow your teacher's instructions for choosing a data recorder, a subject, and a tester for your group. Let your teacher know if you do not want to be a subject.
3. Find the Data Recording Sheet at the end of this Student Guide and begin the experiment with the first skin area on the list, the forehead.

4. The subject must either close his/her eyes or wear a blindfold.
   (The subject may not watch the procedure—this would give away the answer!)

5. The tester should use a cork with two toothpicks stuck into it. You can use one cork and move the toothpicks different distances apart, or use several corks, each one with two toothpicks a measured distance apart. Your teacher will give further

instructions on how to do this. The tester should start with toothpicks about 50 millimeters (mm) apart. Make sure that the two points touch the skin **at the same time.**

6. The data recorder asks how many points the subjects feels. If the person feels two, move the points closer together—about 40 mm apart, and check again. Continue the procedure until you find the smallest distance the points can be separated for the person to feel two points instead of one. When the person reports "one point" for the first time, move the two points apart only one or two millimeters at a time and try to make a very accurate measurement.

7. When the smallest distance is found, the data recorder can measure the distance in millimeters between the two points while the experimenter holds them on the subject.

8. Continue this process for the rest of the skin areas on the Data Sheet.

9. Use fresh toothpicks if another person becomes a subject.

DATA AND OBSERVATIONS

After you have measured and recorded all distances on the Data Sheet, make a histogram of your results on the graph provided at the end of the Student Guide.

Your teacher will ask the recorder to write your results in a class chart on the board.

Write down any other interesting things you noticed while doing this experiment.

ANALYSIS: THINK ABOUT IT!

1. How do your results compare with those of other groups?

2. Are the two-point distances on different areas of the skin the same—for example, is the measurement on fingertips the same as the measurement on the back of the leg?

3. Which parts of the body are best at telling that two points are touching them even when the points are very close together?

4. Which skin areas do you think have more receptors, areas that have small two-point distances, or large two-point distances? Why do you think so?

5. Which brain area do you think is larger, one receiving information from skin with lots of receptors, or from skin with a few receptors?

6. How does information from sensory receptors in the skin get to the brain?

7. What is the sensory homunculus, and how does it help you understand sensory information in the brain

CONCLUSIONS

How was the Lab Question answered in your experiment?

List three findings you think are important from today's experiment. Were you surprised by anything you found?

How could you improve this experiment?

OUR SENSE OF TOUCH

WHAT ELSE CAN WE FIND OUT ABOUT THE SENSE OF TOUCH?

You can use what you have learned about the touch sensory system to develop your own experiment. **Explore** the materials your teacher makes available and think of some things you can investigate. Here are some ideas to begin with.

1. Now that you know some ways that touch receptors can be masked, can you think of other ways to **interfere** with the skin receptors or the nerves that receive or send information? You may not block all messages, but perhaps you can slow them down, or interfere with their interpretation in the brain. For example, you can ask whether the distances you measured for two-point discrimination stay the same under all conditions.

2. Maybe you want to test the touch system in another way. Are the areas that have the best two-point discrimination also best at other sensory jobs? What about judging whether a surface is smooth or rough?

3. Could you use a manual task, such as putting together small nuts and bolts, to see if you can interfere with the sensory information needed for delicate work?

4. We usually use more than one of our senses to accomplish a job. For instance, when putting a puzzle together, we use vision and touch. What happens if you must rely on touch alone?

HOW TO DESIGN A GOOD EXPERIMENT

In designing experiments to ask and answer questions like these, keep in mind what a successful investigator must do:

- Ask a **very specific question**: not, for example, "Does the sense of touch sometimes change?" but rather, "Does the two-point discrimination distance of the forearm change when I rub the arm with an ice cube for a few seconds right before testing?" It's good to have the general question in mind, but ask a narrow question for each experiment.

- Be sure you understand the **control condition** for your experiment, and then **change only one thing, or variable,** in the experiment. Some examples follow:

    - If you decide to interfere with two-point discrimination ability, the control experiment is the one the entire class did, measuring two-point discrimination under normal conditions. If you decide, for example, to change the temperature of your subject's skin, temperature is your variable and you should not change anything else. If you also change the person who is the subject, you will not know if the different measurements you gather are a result of the new person's touch receptors or the change in temperature.

    - If you measure the time it takes to count the number of "bumps" on a set of Lego bricks with and without gloves on, you would **define the control condition** as the one without gloves.

- Write down your new lab question, your predictions, and the steps in your procedure. Follow the general plan of the Class Experiment. Keep good records of everything you do.

NAME:_____DATE:_____

TRY YOUR OWN EXPERIMENT

LAB QUESTION

PREDICTIONS

PROCEDURE

1. After exploring the materials and brainstorming for ideas, each group should agree upon and write a Lab Question in the box above.
2. Write predictions for the answer to your question in the second box above.
3. List the steps you will take to perform your experiment. Include a list of supplies.
4. Figure out what the control conditions for your experiment will be, and whether your experiment is just setting control conditions, or if you will also test a variable.
5. Try to change only one variable.
6. Design a data sheet or table to record your results.
7. Get your teacher's OK before beginning your experiment.

DATA AND OBSERVATIONS

Your teacher will give you **supplies** for your new experiment.

Make any recording sheets and graphs that you need.

ANALYSIS: THINK ABOUT IT!

1. What is the control condition for your experiment?

2. What did you change or add for your new experiment? Did you make sure to change only one variable?

3. Did you find a difference between the results from the control experiment and your new experiment? How can you explain the difference?

4. What new information did you get from your experiment, information that you had not heard before?

5. If your new experiment interfered with or masked two-point discrimination, do you think the change in the ability to report two points was a result of interference in the **skin** (touch receptors and sensory neurons) or in the **brain** (interpretation of what was felt)?

CONCLUSIONS

How did your results answer your Lab Question?

How certain are you of your conclusions? Would you need more evidence to convince yourself or others that your conclusions are right?

What are some other ideas for experiments on the sense of touch?

MORE *SENSE OF TOUCH* ACTIVITIES

- Draw a one centimeter per side square and make 100 dots with a pencil inside it. There are **2500 receptors** in a square centimeter of fingertip skin! Of course, they are much smaller than pencil dots.

- Do other animals sense things with their skin the way we do? What about animals that are very different from us, such as insects? Do some library research and report back to your class. How do researchers know what animals are feeling with their skin if the animals can't talk?

- Make a "distorted" map of your neighborhood, like the brain homunculus, to reflect the relative importance of home, video store, school, climbing gym, etc. Or, make distorted maps of the country, emphasizing places you like or know.

- Find out more about abnormalities or diseases of the touch sensory system, using your library or the Internet.

Here are some good Web sites to visit for touch or somatosensory information.

http://vm.uconn.edu/~advance/00050111.htm changes in the sense of touch with aging

http://thalamus.wustl.edu/course/bassens.html pathways for touch information in the brain

http://www.sfn.org/briefings/pain.html receptors that detect pain

http://faculty.washington.edu/chudler/chtouch.html
http://faculty.washington.edu/chudler/receptor.html lots of information and activities related to the sense of touch, right here at Neurosciences for Kids

http://www.apa.org/monitor/jun98/touch.html a young man loses his sense of touch

Name_____

DATA RECORDING SHEET

SKIN AREA FOR TESTING	**MINIMUM DISTANCE FOR TWO POINT DISCRIMINATION** in millimeters (mm)
FOREHEAD	
CHEEK	
FOREARM	
PALM OF HAND	
TIP OF THUMB	
TIP OF INDEX FINGER	
BACK OF LOWER LEG	

Name_____

DATA GRAPHING SHEET