NEUROSCIENCE FOR KIDS
http://faculty.washington.edu/chudler/neurok.html

OUR CHEMICAL SENSES: TASTE

TEST YOUR TASTE

Featuring a "Class Experiment" and "Try Your Own Experiment"

TEACHER GUIDE

WHAT STUDENTS WILL DO

- predict and then determine their ability to identify food samples by taste alone (holding the nose) and then by taste plus smell
- collect all class data on identifying food samples and calculate the percentage of correct and incorrect answers for each method (with and without smell)
- list factors that affect our ability to identify substances by taste
- discuss the functions of the sense of taste
- draw a simple diagram of the neural "circuitry" from the taste receptors to the brain
- learn how to design experiments that include asking specific questions, defining control conditions, and changing one variable at a time
- devise their own experiments to extend the study of the sense of taste

SUGGESTED TIMES for these activities: 45 minutes for discussing background concepts and introducing the activities; 45 minutes for the "Class Experiment;" and 45 minutes for "Try Your Own Experiment."

SETTING UP THE LAB

Supplies

For the Introduction to the Lab Activities

Taste papers: control papers
sodium benzoate papers
phenylthiourea papers

Source: Carolina Biological Supply Company, 1-800-334-5551
(or other biological or chemical supply companies)

For the Class Experiment

Food items, cut into identical chunks, about one to two-centimeter cubes. Food cubes should be prepared ahead of time by a person wearing latex gloves and using safe preparation techniques. Store the cubes in small lidded containers, in the refrigerator. Prepare enough for each student group to have containers of four or five of the following items, or seasonal items easily available. Try to use foods that have similar textures and firmness.

apple
potato
sweet potato
pear, firm
onion
jicama
melon, firm
strawberry (fresh)

Be sure to check for food allergies before letting subjects taste the food.

plastic forks for tasting food cubes
paper for recording results
blindfolds or glasses with opaque tape on the lenses

For "Try Your Own Experiment"

Food items from above

The following items in clean containers:

squares of semi-sweet or milk chocolate
ice cubes
garlic powder
limburger or other smelly cheese
powdered ginger
cinnamon graham crackers
garlic crackers

Solutions in clean cups or small glasses: (increase proportionately as needed)

Sweet: table sugar: ½ teaspoon dissolved in 2 tablespoons water
Salt: table salt: 1/8 teaspoon dissolved in 2 tablespoons water
Sour: vinegar: ½ teaspoon dissolved in 2 tablespoons water
Bitter: coffee, brewed or made from instant:
(Savory: because of sensitivities to monosodium glutamate (MSG), it is probably best to avoid testing for these receptors.)

Solution mixtures in clean cups or small glasses: (increase proportionately for number of student groups)

½ teaspoon sugar and ½ teaspoon vinegar in 2 tablespoons water
½ teaspoon sugar and a pinch of instant or ½ tsp brewed coffee in 2 tablespoons water
½ teaspoon sugar and ½ teaspoon salt in 2 tablespoons water

plastic spoons for tasting the solutions

Make sure that students do not dip spoons back into a common container after putting them in their mouths.

Check again for food allergies.

Other Preparations

- For the Class Experiment, students can **write results** on a plain sheet of paper. For "Try Your Own Experiment," help students **create data sheets or tables as needed.**
- **Construct a chart** on the board where all data can be entered for class discussion.

- **Decide the size of the student groups**; for example, in groups of four, there can be two subjects and two data recorders, or for more data, three subjects and one data recorder. For "Try Your Own Experiment," students can switch roles so other people can be subjects, if they want.

- **Decide** the number of food items to test.

- **Make sure** that people are comfortable in their roles. Some students may have an aversion to blindfolds, so they may not want to be subjects.

- **Modify activities for exceptional students**: check for allergies and for students who have had a bad experience with a particular food, so that no one becomes ill.

INTRODUCTORY ACTIVITIES

Give students initial information

Introduce the Taste System to the class according to your teaching practices; e.g., with reading, lecture, and discussion before lab work (see the **Teacher Resource** accompanying this unit, for background information). In addition to covering the anatomy and physiology of the system, discuss concepts such as tastes and memories, things that affect our sense of taste, and other topics you think might come up in the "Try Your Own Experiment" section.

Introduce lab activities with a demonstration or scenario

When students enter the classroom on lab day, introduce the activities either by passing out taste papers (see below) or by discussing the Scenario from the first page of the Student Guide.

Because the characteristics of taste receptor cells are genetically determined, people vary in their ability to taste some molecules. **Taste papers** (see **Supply List**) are small strips of paper impregnated with chemicals that test for perception of discrete tastes. Phenylthiourea papers, for example, taste bitter to seven out of ten people, and sodium benzoate papers taste sweet, salty, bitter, or tasteless to different people. Control papers are also available, and the cost of all these is minimal.

If you choose not to use taste papers, discuss the Scenario from the Student Guide to get the class involved in the topic.

TEST YOUR TASTE

CLASS EXPERIMENT

The sections below match those in the Student Guide. The comments guide teachers in preparing and teaching the labs.

LAB QUESTION

After the Introductory activity, help students to write the following Lab Question or one that matches it closely:

How well can we identify food items if we eat while holding our noses (not using our sense of smell)? How does this change if we use our noses while tasting?

PLANS AND PREDICTIONS

Encourage students to add their own knowledge and experiences in order to make predictions after you have provided background information.

Have students predict their accuracy in identifying food samples by taste alone, that is, when holding their noses. Get them to write a quantitative prediction such as " three out of five," or "95%" of the time. Ask them to predict if this will change if they eat the same items while not holding their noses.

Ask other questions to encourage thinking about how the sense of taste works; for example, "What things determine whether a person likes or dislikes a food?"; "Do you think the temperature of food affects its taste?"; "Is it hard to eat a meal if you are in a place with a bad smell?"

PROCEDURE

1. **Introduce safety precautions:**

   General:

   Follow all standard lab safety guidelines for preparing and teaching the activity; e.g., take precautions to avoid germ spread; wash hands; dispose of chemicals properly; use equipment properly.

   Specific:

   - Check for allergies or sensitivities to food items.
   - Make sure food preparation is sanitary.
   - Conduct the tasting experiments in a safe room; if no eating is allowed in the science lab, conduct the activities in a classroom.
   - Provide separate blindfolds or opaque glasses for subjects, to avoid germ spread.

2. **Establish** the number of data recorders and subjects in each student group
3. **Decide** how many food items each group should test.
4. **Explain** the steps in the class experiment. These are listed in the Student Guide, under **Procedure**.
5. Remind students to **clean up** the lab when they finish.

DATA AND OBSERVATIONS

- Make sure students cannot see the materials they are tasting.
- Check to see that students do not share utensils.
- Have the data recorders from each group list their results in the prepared table on the board. The data should be organized so students can calculate percentages of correct and incorrect identifications in the two experiments (with and without smelling).

  Below is a **sample table**. The values are set up to reflect four group reports, where each group has two data recorders and two subjects. Adjust this to fit the

group sizes in your classroom. **Have each group tally the numbers and calculate percentages individually.**

CLASS RESULTS

	Without smelling		***With smelling***	
	Correct	Incorrect	Correct	Incorrect
Apple				
Group 1:	1	1	2	0
Group 2:	0	2	1	1
Group 3:	0	2	2	0
Group 4:	1	1	2	0
Totals:	2	6	7	1
Percent correct	33%		88%	
Potato				
Group 1:	0	2	0	2
Group 2	1	1	2	0
Group 3:	0	2	2	0
Group 4:	0	2	1	1
Totals:	1	7	5	3
Percent correct:	12%		62%	

ANALYSIS: THINK ABOUT IT!

The following questions can encourage thinking about the activity; add your own questions. (*See also the specific questions in the Analysis section of the Student Guide.)*

- Why is it easier to identify a flavor while using your nose as well as your mouth?

- How do your results compare with those of other groups?

- Can you explain the differences you see among the observations? (Differences in individual physiology; interfering smells, noises, etc., may have distracted the subject)

- Do you have any direct evidence from your experiment to show that taste receptors exist? (There is no direct evidence; this would require microscopic investigation to identify possible receptors, and recording from nerves with tiny electrodes to show nerve impulses resulting from food presence and changes.)

- Discuss what the results mean in terms of the concepts learned in the Background lecture and discussion on the taste system.

CONCLUSIONS

Students should:

- State how the Lab Question was answered in their experiments.

- List three things (or a number you choose) they think are important about today's experiment. Focus students by asking such questions as: How is our sense of taste important to us? What do our brains do with sensory (particularly taste) information? Can you investigate some questions on your own? Do scientists know everything there is to know about the sense of taste?

- List ways to improve this experiment.

TEST YOUR TASTE

TRY YOUR OWN EXPERIMENT

Lab Question

After Students have completed the Class Experiment, indicate the lab bench where additional materials are available for "Try Your Own Experiment" and let them explore the items. Then **brainstorm** with them for ideas such as masking or altering the sense of taste or testing it in different ways. Help them see that the ice and chocolate, for example, can be used to test the effect of temperature on taste, and that smelling garlic powder or Limburger cheese while eating another food can mask its taste or change the usual experience.

Questions can help them formulate plans: Can the same food item taste different to different people? (Yes, some people may be missing specific types of receptors, e.g., a type of bitter receptor, so a food that is very bitter to some would not taste this way to others.) What kinds of things make it hard to identify tastes? (Changes in temperature—harder to identify when food or your mouth are cold; mixing of tastes; interfering smells or input from other senses) Do tastes sometimes remind you of places or people? (Taste information goes to the limbic system, which is involved in memory.)

See that each group defines a Lab Question, as they did for the Class Experiment.

PLANS AND PREDICTIONS

SUGGESTIONS FOR EXPERIMENTS

(Add your own ideas to this list.)

1. Repeat the Class Experiment using solutions of four of the basic tastes (sweet, salt, bitter, and sour). Subjects should be able to identify these equally well with or without holding the nose, because these flavors do not depend on smell.

2. Interfere with the ability to identify tastes by **mixing two materials together**. (More than two will make it quite difficult.) For a simple case, use the solutions of sweet plus sour, etc., in the Supplies list above. Students can also use a mixture of, for example, chopped apple and potato or chopped strawberry and melon, and ask a subject to identify the two ingredients (tell them there are just two).

3. Suggest that each student in a group taste a small piece of the same item, such as a strawberry, garlic cracker, or cinnamon graham cracker, and ask each student to write briefly on the memory this flavor brings up. **Take into account the ethnic backgrounds** of your students and try to include items that mean something to different cultures.

4. Interfere with taste by having a subject eat one thing (apple, melon, etc.) while smelling another (garlic, cheese).

PROCEDURE

- Follow all standard lab safety guidelines for preparing and teaching the activity; e.g., take precautions to avoid germ spread; wash hands; dispose of chemicals properly; use equipment properly.

- If time is limited, restrict the number of materials you put out for experimenting.

- Before students begin their experiments, have each group write a simple plan that includes a **question, a prediction, a list of steps** they will take to answer the question, and data sheets and graphs (if needed).

- The list of steps in the experiments should include comments on the control system and on the variable being tested.

- Approve each group's experiment before they begin.

- Remind students to keep good records.

- Students should clean up the lab when they finish.

DATA AND OBSERVATIONS

- Ensure that food handling techniques are sanitary.

- Make supplies available to students. Check to see if anyone is allergic to the food items.

- Suggest that students create any data sheets and graphs they need.

ANALYSIS: THINK ABOUT IT!

The following questions can encourage thinking about the activity; add your own ideas. (*See also the specific questions in the Analysis section of the Student Guide.)*

- Have each group present its findings in a quick oral presentation (two to three minutes).

- What was the control experiment or condition for your experiment? What did you change or add as your variable?

- Did you make sure to change only one variable? Were there variables you could not control?

- If you did a type of "interference" experiment, where do you think the inference was happening, in the nose or in the brain?

CONCLUSIONS

(See also the questions in the Student Guide.)

Ask students how certain they are of their conclusions. Would they need more evidence to make their conclusions more secure?

Each group should write a final conclusion, making sure it addresses their Lab Question.

MORE *TASTE SENSE* ACTIVITIES

MORE *TASTE SENSE* ACTIVITIES

Do other animals sense the same flavors we do? Are there animals that are much more sensitive to tastes than we are? How do aquatic animals, such as fish, taste things? Can insects taste anything? Perhaps you could imagine yourself as another animal—a dog, a fly—and describe your day of tasting and smelling the world. What role does taste play in advertising? Have you ever gone into a grocery where employees are giving away small samples of food to eat? Do you think this encourages people to buy things? Have you received food samples in your mailbox or along with your newspaper at home? Do you think this is a more effective way of advertising than showing pictures of food in magazines? Why? Find out about abnormalities or diseases of the human taste system, using your library or the Web. Try finding these words: hypogeusia, ageusia.Do some library or World Wide Web research and report to your class.

Here are some Web sites to get you started:

Mayo Clinic: http://www.mayohealth.org/mayo/9707/htm/taste.htm

Monell Chemical Senses Center: http://www.monell.org/sensation.htm
http://www.monell.org/neuroscience.htm

Society for Neurosciences: http://www.sfn.org/briefings/taste.html

Neuroscience for Kids: http://faculty.washington.edu/chudler/tasty.html
http://faculty.washington.edu/chudler/chtaste.html

National Institutes of Health: http://www.nidcd.nih.gov/health/pubs_st/smltaste.htm

Howard Hughes Medical Institute: http://www.hhmi.org/senses

The Chemoreception Web: http://www.csa.com/crw/websites.html

Taste and Smell and Disorders Clinic: http://blkbox.com/~rdevere/tsdc/index.html

International Food Information Council: http://ificinfo.health.org/insight/exper.htm

Anatomy and physiology of taste:
http://www.cf.ac.uk/biosi/staff/jacob/teaching/sensory/taste.html

Stick out your tongue and say Aah!, from KidsHealth:
http://kidshealth.org/kid/body/tongue_LP.html