CAN YOU TASTE WITHOUT YOUR NOSE?
Background

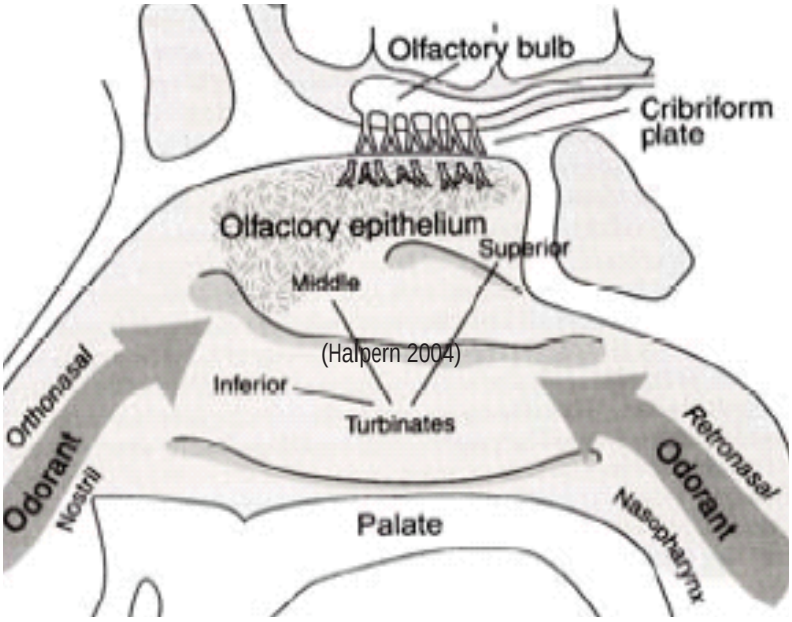
Smell

Think about the last time you had a cold and your nose was blocked. Do you remember eating and thinking that your food had less flavor? That's because most of what we "taste" is actually being sensed by our olfactory system. The word *olfaction* is actually based on the Latin word *olfacere*, which means to smell. In contrast to taste, where humans can only perceive five qualities (sour, bitter, sweet, salty, and umami), humans can smell thousands of odorants.

Odorants can reach the olfactory epithelium by two routes. The first route, **orthonasal olfaction**, is the detection of an odor through the nostrils by sniffing or inhalation. The second route, **retronasal olfaction**, is the detection of an odorant when it is released from food in your mouth during chewing, exhalation, or swallowing. During this process, the odorant passes through the posterior nares of the nasopharynx (or the back of the nose; retro-means backward).

Once in the olfactory epithelium, odor molecules bind to olfactory receptors which are expressed in olfactory sensory neurons in the nose. Once an odorant binds to the receptor, the olfactory receptors trigger a series of signals to the cells' interiors that ultimately results in the opening and closing of ion channels. The opening of the ion channels increases the concentration of positive ions inside olfactory cells. This depolarization causes the olfactory cells to release tiny packets of chemical signals called neurotransmitters, which initiate a nerve impulse. Odor information is then relayed to many regions throughout the brain. Each odorant binds to a unique combination of olfactory receptors which means that a unique signal is sent to the brain for each odorant. In fact, there are at least 400 functioning olfactory receptors, which is why we can smell hundreds of smells!

Some interesting things happen during olfaction. Think about the last time you went into a restaurant and smelled a really strong smell. After a while, did you realize you didn't smell it anymore? This process is called adaptation, and it is a decrease in response under conditions of constant stimulation. Adaptation also occurs with taste. Adaptation is an important process because otherwise you would smell all odorants all of the time, and your sensory system would go into overload!



(Halpern 2004)

Another interesting thing about smell is that some people just can't smell certain odorants. This is called a **specific anosmia**. Differences also exist in how sensitive people are to different odorants. Some people are more sensitive to some odorants than others. Individual genetic differences in the expression of the hundreds of olfactory receptors may explain the variation.

Flavor

The sensory experience of eating is really a combination of taste and smell. If you still don't believe it, try eating a food while holding your nose shut. You will see how important smell is to the sensory experience. Don't forget there are also other sensations from trigeminal irritants such as the "heat" from spicy foods and the "tingling" from soda. Flavor is the word used to describe the perception of taste and smell together, along with any other perceptions experienced while eating.

References

Chandrashekar, J, Hoon, MA, Ryba, NJ, Zuker, CS. 2006. The receptors and cells for mammalian taste. Nature 444: 288-294.

Halpern, BP. 2004. Retronasal and orthonasal smelling. ChemoSense 6(3). 1-7.

Lawless, HT and Heymann, H. 1998. Sensory Evaluation of Food: Principles and Practices. New York: Chapman & Hall.

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Administrator's Guide

The following experiment was prepared by Sarah Smith-Simpson.

Grade levels: 5-12
Estimated Preparation Time: 10 minutes
Estimated Activity Time: 30 minutes
Standard Addressed: Content Standard C (Behavior of Organisms)

Multicellular animals have nervous systems that generate behavior. Nervous systems are formed from specialized cells that conduct signals rapidly through the long cell extensions that make up nerves. The nerve cells communicate with each other by secreting specific excitatory and inhibitory molecules. In sense organs, specialized cells detect light, sound, and specific chemicals, and enable animals to monitor what is going on in the world around them.

Objectives:

- To introduce sensory science to students

Materials:

- Set of individually wrapped candies with four or five different flavors
- Blind folds (handkerchiefs can be used)
- Scorecards
- Saltine crackers
- Water

Sensory Test Procedures:

1. Students can voluntarily participate, but should not be forced to participate because all sensory tests that include human subjects must be conducted on a voluntary basis.
2. Pair students with a classmate.
3. Pass out a handful of candies to each pair of students. Be sure each pair receives at least 2 pieces of every flavor, and that they receive at least 8 pieces in total.
4. Instruct one student to put the blindfold on.
5. Instruct the other student to hand their partner a different flavor of food one at a time and record the actual flavor of the food AND what flavor the student tastes. Between samples, the blindfolded student should clear their palate with cracker and water.
6. Students should trade places and repeat Steps 4 and 5.
7. Next, the students should each repeat Step 5 while blindfolded AND holding their nose. Be sure the students record the actual flavor and the flavor tasted by the student who is taste testing.
8. When students are finished tasting with the blindfold and plugged nose, have them compile the data on the data sheet provided.
9. Calculate the percentage of correct answers received during Steps 5 and 8 for conclusions.

Flavor of Food While Blindfolded		*Correct or Wrong?*
Actual Flavor	*Flavor Tasted*	
Flavor of Food While Blindfolded and Plugging Nose		*Correct or Wrong?*
Actual Flavor	*Flavor Tasted*	

Record your partner's response on this chart:

Flavor of Food While Blindfolded		*Correct or Wrong?*
Actual Flavor	*Flavor Tasted*	
Flavor of Food While Blindfolded and Plugging Nose		*Correct or Wrong?*
Actual Flavor	*Flavor Tasted*	

Record your partner's response on this chart:

Flavor of Food While Blindfolded		*Correct or Wrong?*
Actual Flavor	*Flavor Tasted*	
Flavor of Food While Blindfolded and Plugging Nose		*Correct or Wrong?*
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Flavor of Food While Blindfolded		*Correct or Wrong?*
Actual Flavor	*Flavor Tasted*	
Flavor of Food While Blindfolded and Plugging Nose		*Correct or Wrong?*
Actual Flavor	*Flavor Tasted*	

CAN YOU TASTE WITHOUT YOUR NOSE?
Student Handout

Background: Believe it or not, most of what we "taste" is actually being sensed by our olfactory system. The word olfaction refers to the sense of smell and is based on the Latin word *olfacere*, which means "to smell." In contrast to taste, where humans can only perceive five qualities (sour, bitter, sweet, salty, and umami), humans can smell thousands of odors.

Objective: To investigate the importance of olfaction (smell) when eating

Record your partner's response on this chart:

Flavor of Food While Blindfolded		*Correct or Wrong?*
Actual Flavor	*Flavor Tasted*	
Flavor of Food While Blindfolded and Plugging Nose		*Correct or Wrong?*
Actual Flavor	*Flavor Tasted*	

Conclusion Questions:

1. Did you correctly identify all flavors while blindfolded?

2. Did you correctly identify all flavors while blindfolded and plugging your nose?

3. Why do you think the percentage of correct answers decreased when your nose was plugged?

4. Were your answers affected by orthonasal olfaction, retronasal olfaction, or both?