

# Smell & Taste

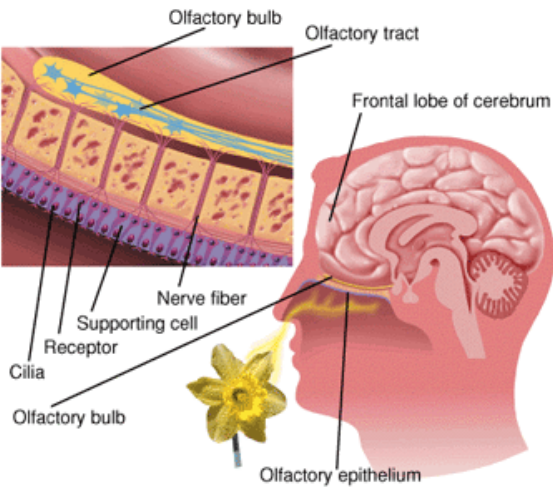
HASPI Medical Anatomy & Physiology 11d  
Lab Activity

## Background

### Odor and Food Receptors

Smell and taste are important senses capable of alerting us to danger within the environment, while at the same time allowing us to find pleasure in food and scents. These special senses are closely linked, and in fact our sense of taste would be quite boring without our sense of smell. The processes of smell and taste are actually quite complicated, but in both cases they begin when a molecule of a substance contacts special receptors in our nose or in our mouth.

These molecules must first diffuse into the mucous within our nasal cavity or saliva within our mouth and then reach ciliated neurons capable of binding to these molecules. The neurons transmit a message to the brain, which interprets what it is we smell or taste.

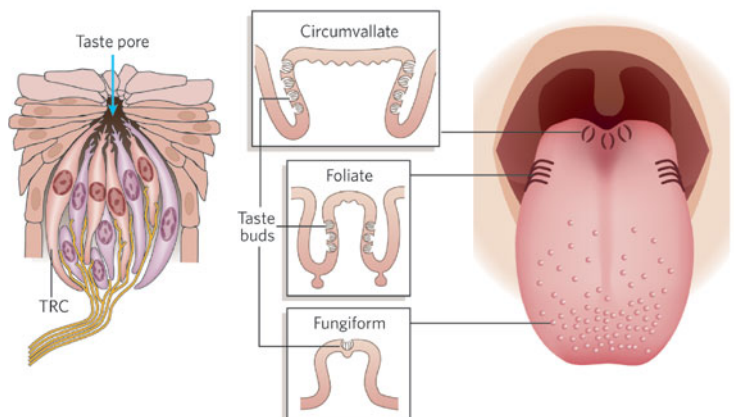


[http://www.medicalook.com/systems\\_images/Olfactory\\_sense.gif](http://www.medicalook.com/systems_images/Olfactory_sense.gif)

### Taste or Gustation

Every human is born with a specific number of taste buds, and this number varies widely from person to person. The sense of taste is hereditary. Do you have friends that find coffee bitter or that cannot tolerate spicy foods, while others love both? This is because they have a different concentration of papilla, and therefore taste buds. Taste buds are located in the papilla found on the surface of the tongue. Different types of papilla are located on different portions of the tongue and have different arrangements of taste buds.

A study by Linda Bartoshuk determined that there are three groups of tasting ability: supertasters, normal tasters, and non-tasters. Approximately 25% of the U.S. population is a supertaster, 50% are normal, and the other 25% are non-tasters. Supertasters have a much higher concentration of taste buds and therefore experience the texture, temperature, and taste of food at a higher level than a non-taster. Every taste bud is surrounded by pain nerves, which means that supertasters are usually much more sensitive (and tend to stay away from) spicy foods.



<http://embryology.med.unsw.edu.au/notes/images/senses/nature05401-f1.2.jpg>

Name(s): \_\_\_\_\_

Period: \_\_\_\_\_ Date: \_\_\_\_\_



<http://www.thenayshun.com/wp-content/uploads/2011/02/CakeSniffing-420x420.jpg>

### Smell or Olfaction

Humans are capable of detecting more than 10,000 different odors. More than 50 million specialized receptor cells are located at the upper portion of the nasal cavity in a sheet of cells called the olfactory epithelium. In comparison, canines have more than 200 million olfactory cells, which explains their heightened sense of smell. These receptors are concentrated in a structure called the olfactory bulb that is embedded in the olfactory epithelium and is actually the end of the olfactory nerve. The ends of olfactory neurons are covered with cilia (tiny hair-like structures) that have smell receptors covering the surface.

## When Smell and Taste Go Bad

There are several conditions or disorders that can affect our sense of smell and taste. These most often result from infection, smoking, or drug use, and/or trauma to the nerves associated with each sense. In some cases these disorders may only last for a short period of time. More than 4 million Americans experience disorders of olfaction and gustation annually. These may include:

- Ageusia** – lack of taste
- Anosmia** – lack of smell
- Dysgeusia** – distorted tastes
- Dysomnia** – distorted smells
- Parosmia** – all substances smell bad
- Phantosmia** – smelling substances not there
- Hyperosmia** – overly acute sense of smell
- Hypogeusia** – decreased sense of taste
- Hyposmia** – decreased sense of smell



http://sxa.files.wordpress.com/2011/03/smell.jpg

Bartoshuk, L. 2010. The Psychophysics of Taste. *American Journal of Clinical Nutrition*, 31(6): 1068-1077.

Leopold, D., Meyers, A., Holbrook, E., and Noell, C. 2012. Disorders of Taste and Smell. *Medscape Reference*, Article 861242, [www.emedicine.medcape.com](http://www.emedicine.medcape.com).

## Materials

**Activity A:** Scents 1A-1E, Scents 2A-2E

**Activity B:** Wintergreen solution, cotton swab, timer

**Activity C:** Jellybeans (3 flavors)

**Activity D:** Sweet solution, sour solution, bitter solution, salt solution, cotton swabs, towels, water

## Procedure

In the following four activities you will have the opportunity to investigate some of the characteristics of your own sense of smell and taste. Find a partner and complete each activity. Some materials may need to be shared so continue on to a different activity until they become available.

### A. How Is Your Sense of Smell?

Individuals with more olfactory receptors are more sensitive to smells and are capable of identify scents with very few scent molecules present. The ability to identify a scent at very low concentrations and distinguish varying concentrations of a scent indicates a strong sense of smell. In this activity, there are two scents in concentrations from 0.1%, 1%, 3%, 5%, and 10%. Identify each scent and order them according to their concentration to the best of your ability.

## Directions

✓ when complete

<b>Step 1</b>	Scents 1A – 1E contain the same scent in different concentrations. The concentrations have been randomly placed in each container.	
<b>Step 2</b>	Remove the cap and smell each bottle 1A – 1E. Wait at least 30 seconds between smelling each bottle, and replace the cap on each bottle immediately after smelling.	
<b>Step 3</b>	Identify the scent and put the bottles in order from the lowest to highest concentration. In other words, from the bottle that smells the weakest to the bottle that smells the strongest. Record your hypothesis in Table 1.	
<b>Step 4</b>	Repeat Steps 1-3 for scents 2A – 2E.	
<b>Step 5</b>	Your instructor will have the correct answers for each scent. After you have recorded all of your hypotheses, ask your instructor for the answers and record the actual concentration orders in Table 1.	

Table 1. Concentration of Smells					
Scent	Your Hypothesis <i>(scale 1-5: 1 is the weakest odor and 5 is the strongest)</i>	Actual <i>(get the answer from your teacher)</i>	Scent	Your Hypothesis <i>(scale 1-5: 1 is the weakest odor and 5 is the strongest)</i>	Actual <i>(get the answer from your teacher)</i>
1A			2A		
1B			2B		
1C			2C		
1D			2D		
1E			2E		

## B. Smell Accommodation

Adaptation, or fatigue, of the senses occurs when a sensory neuron experiences constant stimulation. For example, when you jump in a cold pool, eventually the water becomes warmer. This is NOT because the water is actually warmer! It is because your skin has accommodated to the coldness. This occurs when the cold receptor cells stop sending an impulse, even though they are continuously stimulated with cold. If the stimulus is removed and then activated again, it will restart the impulse. In other words, if you get out of the pool long enough to reacclimate and then jump back in, it is going to feel cold all over again. This is why you may enter a room and experience a strong odor that eventually dulls as you remain in the room. In this activity, you will see how long it takes for you to experience olfactory adaptation.

### Directions

✓ when complete

<b>Step 1</b>	Obtain a cotton swab and place 2-3 drops of the wintergreen solution on the end of the cotton swab.	
<b>Step 2</b>	Have your partner start the timer at the same time that you plug your left nostril and place the end of the cotton swab with wintergreen solution under the right nostril.	
<b>Step 3</b>	Inhale through the right nostril and exhale through your mouth. Continue to breathe like this until the wintergreen scent disappears. The time that elapses is how long it took your olfactory neurons to adapt to constant stimulation.	
<b>Step 4</b>	Record the time it took for the scent to disappear in Table 2.	
<b>Step 5</b>	Wait 1 minute and then repeat steps 2-4 plugging the right nostril and placing the cotton swab under the left nostril.	

Table 2. Accommodation of Smells		
	Right Nostril	Left Nostril
Time for Accommodation		

### C. The Link Between Taste and Smell

Humans are only able to taste five tastes: sweet, salty, bitter, sour, and umami (savory). How is it then that we are able to interpret thousands of flavors in the variety of foods that we eat? It is the combination of the taste and the smell of food that provides the full flavor. An easy example of this phenomenon is eating food when you are extremely congested. Mucus and inflammation in the nasal cavity does not allow the food molecules to reach the olfactory bulb. This prevents a congested person from smelling the food being eaten and it will taste bland, with very little flavor. In this activity, you will investigate how your senses of taste and smell contribute to different flavors in food.

#### Directions

✓ when complete

<b>Step 1</b>	Obtain two each of three different flavors of jellybeans (6 total). For example, get 2 orange, 2 purple, and 2 yellow jellybeans.	
<b>Step 2</b>	Close your eyes and plug your nose. Make sure you cannot smell anything!	
<b>Step 3</b>	Have your partner randomly choose one of the flavors of jellybean. Hold your hand out and have your partner put the jellybean in your hand. Do not peek!	
<b>Step 4</b>	Eat the jellybean. Keep your eyes closed and nose plugged.	
<b>Step 5</b>	Tell your partner what flavor you think you ate and have him or her record your answer in Table 3. Your partner will also record the actual flavor handed to you in Table 3 without telling you the answer until the end of this activity.	
<b>Step 6</b>	Repeat steps 2-5 with the other two flavors of jellybean.	
<b>Step 7</b>	Keep your eyes closed, but unplug your nose.	
<b>Step 8</b>	Have your partner randomly choose a flavor, place it in your hand, and smell the jellybean. Again, no peeking! Tell your partner what flavor you smelled and have him or her record your answer in Table 3 along with the actual flavor. Don't eat the jellybean! Give the jellybean back to your partner when you are done.	
<b>Step 9</b>	Repeat steps 7 and 8 with the other two flavors of jellybean.	
<b>Step 10</b>	Your eyes should still be closed and you are not plugging your nose.	
<b>Step 11</b>	Have your partner randomly choose a flavor, place it in your hand, and now eat the jellybean. Tell your partner what flavor you tasted and have him or her record your answer in Table 3 along with the actual flavor.	
<b>Step 12</b>	Repeat steps 10 and 11 with the other two flavors of jellybean.	

**Table 3. Taste and Smell**

	Taste With No Smell		Smell Only		Taste and Smell	
	Actual Flavor	Guess	Actual Flavor	Guess	Actual Flavor	Guess
<b>Jellybean 1</b>						
<b>Jellybean 2</b>						
<b>Jellybean 3</b>						

## D. Taste Sensations

The tongue contains taste buds that are actually clusters of 40-60 sensory neurons from the facial, glossopharyngeal, and vagus nerves. These neurons are sensitive to chemicals associated with being salty, sweet, sour, bitter, and umami (savory). Taste buds are concentrated in the spaces between certain types of papilla, which are raised protrusions capable of trapping food chemicals and saliva.

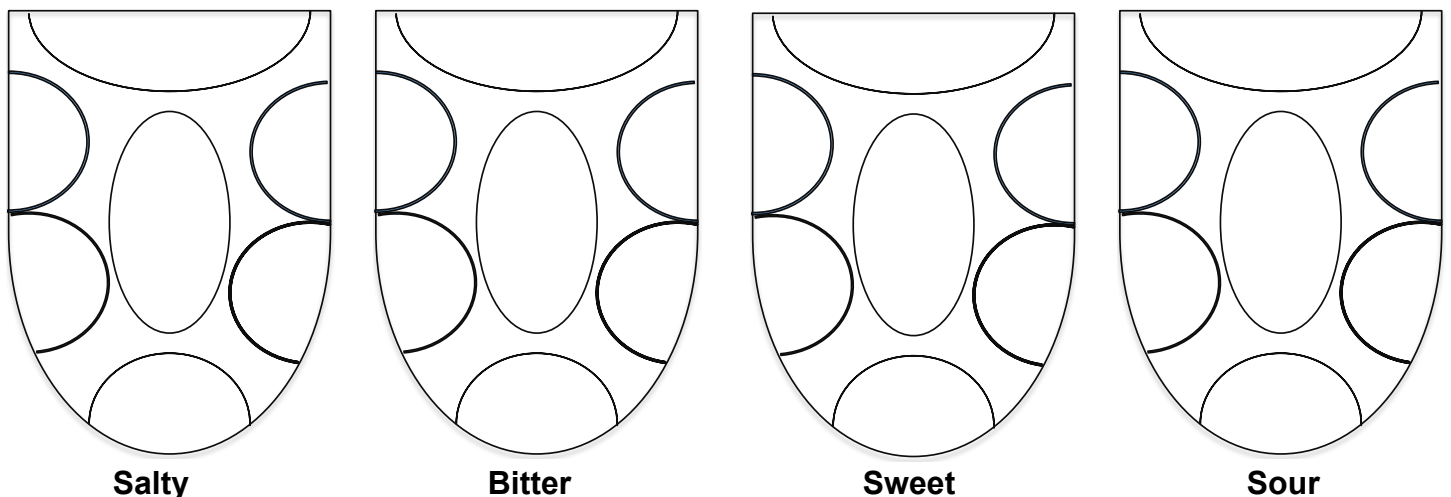
Vallate papillae are located at the back of the tongue and are the largest. Fungiform papillae are mushroom-shaped and also located throughout the surface of the tongue, but are concentrated at the front. Foliate papillae are located throughout the tongue, especially on the sides, and are long and thin. Filiform papillae do not actually contain any taste buds, are V-shaped, and are spread throughout the tongue. While taste buds sensitive to different types of taste are distributed throughout the surface of the tongue, humans differ on where these tastes may be concentrated. In this activity, you will create a map of your tongue to see where your different types of taste buds may be concentrated.

### Directions

✓ when complete

<b>Step 1</b>	Obtain a paper towel, cotton swab, and cup of water. Place 3-5 drops of salt solution on the end of the cotton swab.	
<b>Step 2</b>	Stick out your tongue and use the paper towel to dry off your tongue. Keep your tongue out after drying.	
<b>Step 3</b>	Have your partner lightly touch the end of cotton swab containing the salt solution to the back, back left and right, front left and right, middle, and tip of your tongue (see Figure 1 below). Discard the cotton swab in the trash.	
<b>Step 4</b>	Keep your tongue out for at least 10 seconds and determine in which areas of the tongue you taste salt. Once you know where you taste, salt you can rinse your mouth out with water.	
<b>Step 5</b>	Shade in the "Salt" tongue diagram in Figure 1 with the areas where you tasted salt. The tongue in the diagram is an anatomical diagram so the right side of the tongue diagram is actually representing the left side of your tongue.	
<b>Step 6</b>	Repeat steps 1-5 using the bitter, sweet, and sour solutions. You will not be testing umami.	

**Figure 1.** Shade the part of the tongue where you tasted each different type of taste.



## **Analysis Questions** - on a separate sheet of paper complete the following

### **Activity A: Sense of Smell**

1. Explain how an individual might be more sensitive to smells?
2. Were you able to smell the scents at the lowest concentration? What does this say about your smelling ability?
3. How close were you in identifying the correct order of concentrations for scents 1A-1E? Hypothesize why.
4. How close were you in identifying the correct order of concentrations for scents 2A-2E? Hypothesize why.

### **Activity B: Accommodation**

5. In terms of the senses, what is adaptation?
6. Explain why you don't constantly feel your socks touching you all day.
7. Were the times it took for your right and left nostrils to accommodate to the wintergreen odor close? Hypothesize why this occurred.

### **Activity C: Taste and Smell**

8. What are the 5 tastes?
9. Explain how smell and taste work together to create flavor.
10. In which test was it easiest to determine the flavors of the jellybean?
11. Why does food have little to no taste when you are sick with a cold or have allergies?

### **Activity D: Sense of Taste**

12. How many sensory neurons are found in each taste bud?
13. Which nerves contribute to our sense of taste?
14. What is the difference between vallate, fungiform, foliate, and filiform papillae?
15. In which part(s) of your tongue did you taste salt?
16. In which part(s) of your tongue did you taste bitter?
17. In which part(s) of your tongue did you taste sweet?
18. In which part(s) of your tongue did you taste sour?
19. **CONCLUSION:** In 1-2 paragraphs summarize the procedure and results of this lab.

## **Review Questions** - on a separate sheet of paper complete the following

1. Give one example of how smell or taste may alert us to danger within our environment.
2. Explain how you would be able to smell a scent molecule from a rose.
3. How many odors are humans capable of detecting? Approximately how many receptor cells are located in our nasal cavities? If dogs have 200 million olfactory cells, how many more odors should dogs be able to detect?
4. What is the olfactory bulb and where is it located? What nerve is responsible for smell?
5. How are taste buds and papillae related?
6. What is the difference between a supertaster and a non-taster? Explain why a supertaster is more sensitive to spicy foods.
7. What can cause disorders of taste and smell?
8. List and explain two disorders of smell.
9. List and explain two disorders of taste.
10. Terminology Review! Based on the names of various disorders listed in the Background, what would a word with –geusia denote? How about –osmia?