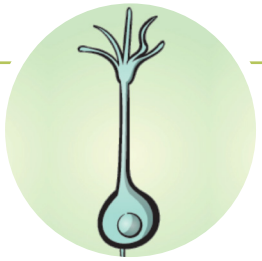
Sense of Smell and Olfactory Fatigue

A Carolina Essentials™ Investigation



Overview

This quantitative investigation allows students to explore sensation and perception with an introductory activity. The activity can be used as a unit introduction for human senses or as an isolated olfactory sensation activity. Students use fragrant oils to determine the time of olfactory fatigue for both of their nostrils and then examine the link between smell and memories. If time permits, class olfactory fatigue data can be analyzed to examine class averages or to look for possible differences based on genetics, medical conditions, or lifestyle.

Life Science
Grades: 9–12

Essential Question

How do structures in the body enable human beings to sense their environment? ?

Investigation Objectives

1. Investigate the time for the onset of olfactory fatigue.
2. Determine if odors trigger memories.

Next Generation Science Standards* (NGSS)

Science and Engineering Practices	Disciplinary Core Ideas	Crosscutting Concepts
Practice: Developing and Using Models • Develop and use a model based on evidence to illustrate the relationships between systems or between components of a system.	**LS1.A: Structure and Function** • Multicellular organisms have a hierarchical structural organization, in which any one system is made up of numerous parts and is itself a component of the next level.	**Concept: Systems and System Models** • Models (e.g., physical, mathematical, computer models) can be used to simulate systems and interactions—including energy, matter, and information flows—within and between systems at different scales.

Safety Procedures and Precautions

Students should wash their hands after entering and before exiting the lab. Students should wear safety glasses while conducting the investigation. Supervise students conducting the tasting activity.

Teacher Preparation and Disposal

Place all cotton swabs in a resealable bag and dispose of them in accordance with your school chemical hygiene plan.

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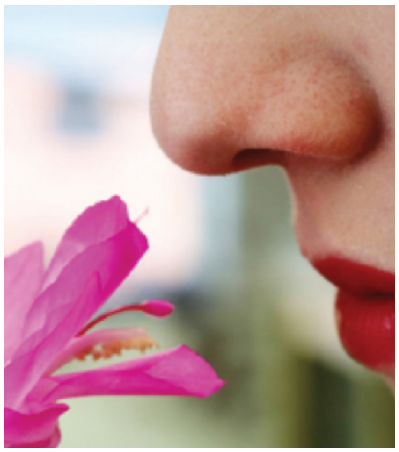

TIME REQUIREMENTS

PREP	ACTIVITY
15 min	5 days, 95 min

Teacher Prep: 15 min
Student Time: 30 to 45 min

SAFETY REQUIREMENTS

MATERIALS (PER GROUP)

Peppermint oil, 2–3 drops
Clove oil, 2–3 drops
2 cotton swabs
2 125-mL Erlenmeyer flasks
1 1-gal resealable plastic bag
Timer or smartphone

HELPFUL LINKS

Carolina BioKits™: Human Senses: Sample Teacher's Manual

The Connection Between Taste, Smell, and Flavor

REFERENCE KITS

Carolina BioKits®: Exploring Human Senses

CAROLINA®
www.carolina.com

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Student Procedure

Procedures and Disposal

1. Place a cotton swab in an Erlenmeyer flask vertically. The head of the swab should be above the rim of the flask..
2. Place the flask and swab on a level surface approximately 30 cm (1 ft) away from and just below the nose of the test subject.
3. Have the test subject close his or her left nostril by pressing on it with the left index finger.
4. Place two drops of clove oil on the head of the cotton swab.
5. Start the timer and have the subject gently waft the odor toward his or her nose, gently fanning with the right hand and inhaling through the right nostril, then exhaling through the mouth.
6. The subject will continue to sniff the odor and exhale through the mouth at a normal rate until the smell is no longer detectable or has greatly diminished.
7. Record the elapsed time in minutes and seconds in the data table below.
8. The subject should release the left nostril, close the right nostril with the right index finger, and waft the odor of the clove oil toward his or her nose with the left hand.
9. Start the timer.
10. The subject should continue to sniff the odor and exhale through the mouth at a normal rate until the smell is no longer detectable or has greatly diminished.
11. Record the elapsed time for the left nostril in minutes and seconds in the data table.
12. Place the used swab in a resealable plastic bag and seal it completely.
13. Repeat the procedure using the peppermint oil and record the results in the data table.
14. Switch roles and repeat the process until everyone in the group has been tested.

Disposal

Leave the swabs in the resealable bag, and return the other materials to their original location.

Teacher Preparation and Tips

The essential question may be used to engage students in the laboratory investigation and to help them identify what they learned from the experience.

Ask students what noseblind means.

Check the placement of the swabs, which should be cotton-side up and about 30 cm (1 ft) from the nose.

Demonstrate the wafting technique.

Ensure students start timers quickly.

Make sure students are not moving the swab.

Make sure the time is reset to 0 before the next step begins.

Demonstrate how to record minutes and seconds.

Reinforce that the resealable bag must be completely sealed so odors do not mix.

If time permits, combine individual data and calculate the class average. Ask students what genetic, medical, or lifestyle factors they think might influence the olfactory fatigue time. Differences in gender, ethnicity, allergy diagnosis, and whether parents smoke could be interesting factors to examine.

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Data and Observations

Times will vary based on room conditions.

Fragrance	Right Nostril Fatigue (min and sec)	Left Nostril Fatigue (min and sec)
Clove Oil	*1:22*	*1:15*
Peppermint Oil	*1:38*	*1:45*

Analysis and Discussion

1. Was the peppermint oil smelled immediately after the odor of the clove oil diminished? How is the nose able to detect new or different odors?
   Yes. The nose remains immediately sensitive to any new or different odor.
2. How do the fatigue times of the clove oil and peppermint oil compare when sniffed in succession with the right nostril?
   The times are approximately the same.
3. Is the fatigue time for the left nostril significantly different from that of the right nostril?
   The fatigue times should be similar.
4. When you smelled the cloves and the peppermint, did you recall any memories associated with those odors? If so, briefly describe them.
   Student answers will vary.
5. Diagram the process of smelling the peppermint oil.
   In the human body, specialized nerve cells respond to conditions in the environment and send a signal through other nerve cells to the brain. These specialized nerve cells have structures called sensory receptors, structures that will only respond to a specific kind of stimulus. For each type of receptor, nerve cells provide information in the same all-or-nothing manner. A stimulus is either sufficient to cause a cell to fire, transmitting a nerve impulse to the brain or spinal cord, or it is not. For instance, a light receptor cell in the eye may respond only to red light. If a light receptor for red light "sees" red, it discharges. Although air is always around you, you do not feel the air unless it is moving over your skin in the form of a current or as wind.

   Nerve impulses travel through nerve fibers to the brain, where the impulses are processed. By analyzing all the inputs from the sense organs, the brain interprets the appropriate responses, which we perceive as seeing, feeling, hearing, smelling, and tasting. If an injury causes the nerves in a sense organ to be damaged or severed, the brain can no longer obtain accurate information from that nerve, even if the sense organ is healthy and might be receiving impulses from stimuli.

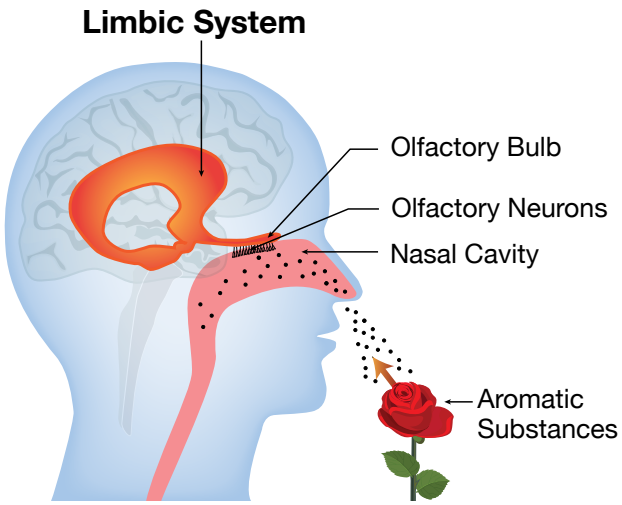
   Step 1: *Source releases aromatic compounds.*

   Step 2: *Aromatic compounds are trapped by mucus lining in the nose.*

   Step 3: *Sensory receptors in the nose are triggered.*

   Step 4: *Nerve impulse is sent to the brain.*

   Step 5: *Nerve impulse is interpreted.*



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