WARM-UP F

WHERE'S THAT ODOR?

This exercise lets students use their noses as monitoring devices to determine the source of odors introduced into the classroom atmosphere and to demonstrate the importance of monitoring air pollution sources. It is related to the "Breathing Room," "Inventing a Monitor," and "Finding Sources of Air Pollution" activities.

CRITICAL OBJECTIVES

- Recognize the importance of environmental monitoring
- Recognize that this experiment serves as a model for how monitoring is accomplished
- Explain the purpose and placement of monitoring devices
- Recognize conflicting information
- Recognize the role citizens can play in environmental cleanup

SKILLS

- Observing
- Collecting and analyzing data
- Graphing

GUEST PRESENTERS

Guest presenters could include air quality engineers, environmental scientists, EPA air quality monitoring specialists, or state or local air quality managers.

BACKGROUND

The Earth's atmosphere is almost completely made up of invisible gaseous substances. Most of the major air pollutants also are invisible, gaseous substances that can adversely affect human health, as well as damage the environment. Among the major ambient air pollutants that may reasonably be anticipated to endanger public health are carbon monoxide, lead, nitrogen oxides, sulfur dioxide, ozone, and particulate matter. (A table describing these pollutants, their sources, and effects is included as a student handout.) To protect public health and welfare, the EPA has set national emissions standards for these pollutants. However, in order to prevent these and other potentially dangerous air pollutants from reaching harmful levels, it is important to be able to detect their presence and to identify their emission sources.

This exercise allows students to use their ability to detect and recognize odors as a model of an air monitoring device. Odor is the subjective perception of the sense of smell (olfaction). Odor intensity refers

RELATED ACTIVITIES
5, 7, 9

REFER TO READING MATERIALS
"Air Pollution"
"Indoor Air Quality"
"Health Effects"

TARGET GRADE LEVEL
4th - 12th

DURATION
40 minutes

VOCABULARY
Concentration
Intensity
Monitoring
Odor detection threshold
Odor recognition threshold

MATERIALS
6 shallow plastic containers with lids
Vanilla extract
Nail polish remover (use type with strong odor)
Food coloring (blue, red, and yellow)
Chalkboard
Chalk (white and one other color)

WORKSHEETS INCLUDED
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to the perceived strength of the odor stimulus. The minimum concentration (threshold) of an odor that can be detected (smelled) and identified is dependent primarily on the sensitivity of the olfactory cells, which vary considerably, and the method of presenting the odor stimulus (such as flow rate and purity). The odor detection threshold relates to the minimum concentration required to perceive the existence of the stimulus. An odor recognition threshold relates to the minimum concentration required to identify the odor. Detection occurs at a lower concentration than recognition. For example, the detection threshold for ammonia is about 17 parts-per-million (ppm) volume/volume, and the recognition threshold is 37 ppm (v/v). Odor thresholds are statistical values determined by sampling individuals in a given population. (See reading materials on "Air Pollution," "Indoor Air Quality," and "Health Effects.")

WHAT TO DO

Before class begins

1. Mix the blue, red, and yellow food coloring to make a color that is similar to the color of vanilla extract. (You may use any substance or combination of substances to approximate the color of the vanilla, but they should create as little odor as possible. The idea is to use this mixture as blanks or decoys for the real vanilla extract.)

2. Put a small amount (just enough to cover the lid surface) of vanilla extract into one of the container lids. (Sandwich-size containers with lids that have a lip work best for this exercise.)

3. Put an equal amount of nail polish remover in another container lid.

4. Put equal amounts of a look-alike liquid in the remaining containers lid.

5. Place the lids around the room and cover them by inverting the containers over them.

6. On the chalk board, draw two maps (with white chalk) of the classroom, one for charting time and the other for charting intensity. (Students will have one worksheet for tracking both measures.)

When class begins

1. Explain how determining what and where air pollutants come from (monitoring) is an important part of protecting people and the environment. Detection (what is there) of pollutants can be accomplished by different kinds of monitoring devices (tools). A simple example of visual detection is the dirt on the classroom window where pollutants have stuck to (or deposited on) the glass. When you breathe, the hairs in your nose act like a monitoring tool by filtering dust, and special cells (olfactory) in the back of the nose allow you to identify some chemicals in the air. Explain that because monitoring tools are expensive and take longer to use than you have in class, the students are going to

use their noses to detect and identify air chemicals. Instruct them to use their noses like scientists would use a monitoring device to detect and estimate the strength (volume or intensity) of an odor and to determine the source of that odor.

2. Explain that they will need to map the classroom to chart the results of the experiment. Hand out the worksheets. You fill in the maps on the chalkboard as each student fills in his or her own. Fill in the maps to show the location of each student. (Use white chalk.) Make sure the students understand where they are on the map.

3. When the maps are complete, briefly describe the experiment. Tell them the idea is to record when they first smell an odor and to measure how strong it is at various times. Go over the time and intensity (strength) measurements and make sure everyone understands how to fill out his or her worksheet. (Plan on taking extra time for the lower grades.)

4. Remove the covers from the sources throughout the room containing the liquids. Leave the lids uncovered for 2 minutes. Announce the time every 30 seconds (for example, "A" on the worksheet would be T+30 seconds; "B" would be T+60 seconds, and so on). Remind students to find their place on their worksheet map and fill in the letter (time) and number (intensity) the FIRST TIME they smell an odor. If they detect more than one odor, they should fill in the letter (time) and number (intensity) the first time they smell EACH odor.

5. At the end of two minutes, cover all the sources again.

6. Call on a number of students in different parts of the room. (If time permits, let all students participate.) Have each, in turn, come forward and mark their location (in colored chalk) on each of the maps on the board with the time and intensity information they have recorded on their worksheet.

7. Lead a student discussion of the results of the experiment. Ask why some students recorded stronger odors sooner than others. Did the odor move in one direction more than another? If so, what does that suggest about the way pollutants move in the air? Did anyone detect more than one odor? Where did the odor(s) come from? The students' answers should point you to the real sources. (If not, be prepared to point out the real sources and explain how real scientists might use additional trials or put out more monitors to be sure the results are accurate.)

8. Describe why it is necessary to determine where contaminants, particularly invisible ones, are coming from (health effects, environmental and ecological effects). Give some examples. Explain that if the contaminants in the experiment had been harmful, finding out where they were coming from would make it possible for their local officials and EPA to take steps to remove them.

SUGGESTED EXTENSIONS (OPTIONAL)

- Expand the discussion following the experiment by suggesting variables (such as what if a door or window were opened? What if there were more people in the room?) that could influence the path and speed with which the odor moves. Encourage the students to discuss the potential impact of these variables and, by extension, how variables complicate the process of monitoring air pollution.

- Ask the students how they might design a monitoring system that could locate the worst source (that which releases the highest volume) of a pollutant among multiple emission sources of the same pollutant? Suggest that they use the classroom model to help structure their thinking.

SUGGESTED READING

Bailey, Donna. *What Can We Do About Noise and Fumes*. New York: Franklin Watts (1991).

Baines, John. *Conserving Our World, Conserving the Atmosphere*. Austin, TX: Steck-Vaughn Company (1990).

Bearden, Nancy. "Ah! The Aroma: Coming to Our Senses." *Total Health*, 13 (June 1991) p. 24.

Black, Pamela J. "No One's Sniffing at Aroma Research Now." *Business Week*, (23 December 1991) p. 82.

Monmaney, Terence. "Are We Led By the Nose?" *Discover*, 8 (September 1987) p. 48.

Pacchiolo, David. "Potent Aromas." *Discover*, 12 (November 1991) p. 16.

Rifkin, Janey M. "When Breathing is Hazardous to Your Health." *Let's Live*, 59 (August 1991) p. 62.

"What Noses Don't Know (How the Brain Identifies Odors)." *USA Today Magazine*, 120 (October 1991) p. 16.

STUDENT HANDOUT

FINDING SOURCES OF AIR POLLUTION

MAJOR MAN-MADE AIR POLLUTANTS

POLLUTANT	DESCRIPTION	SOURCES	SIGNS/ EFFECTS
Carbon monoxide (CO)	• colorless, odorless gas	• vehicles burning gasoline • indoor sources, including kerosene, wood-burning, natural gas, coal, or wood-burning stoves and heaters	• headaches, reduced mental alertness, death • heart damage
Lead (Pb)	• metallic element	• vehicles burning leaded gasoline • metal refineries	• brain and kidney damage • contaminated crops and livestock
Nitrogen oxides (NO_x)	• gaseous compounds made up of nitrogen and oxygen	• vehicles • power plants burning fossil fuels • coal-burning stoves	• lung damage • react in atmosphere to form acid rain • deteriorate buildings and statues • damage forests • form ozone & other pollutants (smog)
Ozone (O_3)	• gaseous pollutant	• vehicle exhaust and certain other fumes • formed from other air pollutants in the presence of sunlight	• lung damage • eye irritation • respiratory tract problems • damages vegetation • smog
Particulate matter	• very small particles of soot, dust, or other matter, including tiny droplets of liquids	• diesel engines • power plants • industries • windblown dust • wood stoves	• lung damage • eye irritation • damages crops • reduces visibility • discolors buildings and statues
Sulphur dioxide (SO_2)	• gaseous compound made up of sulphur and oxygen	• coal-burning power plants and industries • coal-burning stoves • refineries	• eye irritation • lung damage • kills aquatic life • reacts in atmosphere to form acid rain • damages forests • deteriorates buildings and statues

STUDENT WORKSHEET 1

WHERE'S THAT ODOR?

CLASSROOM MAP

			Front of classroom				
			Back of classroom				

TIME

A = _____
B = _____
C = _____
D = _____
E = _____

INTENSITY

1 — No odor detected at all
2 — Begin to smell the odor
3 — Odor is strong
4 — Odor is very strong