Lesson 3-What is Air?

It Smells in Here!

Background Information

Wind is moving air. The wind has energy and can push objects in the direction it is blowing. Some objects are very small and hard to see and some objects are invisible. Ozone, for example, is an odorless, colorless gas that gets pushed by the wind. People hear in weather reports about how fast the wind is blowing. If the wind is blowing 10 miles per hour, it can push pollution ten miles in a single hour- faster than most people can run! The air can push things, like leaves and balloons, and chemicals, like different types of pollution, from one place to another.

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 can endanger public health are carbon monoxide, lead, nitrogen oxides, sulfur dioxide, ozone, and particulate matter. To protect public health and welfare, the EPA has set national emissions standards for these pollutants. However, 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 source.

This activity will help students understand the development of the movement of air and how air can transport pollutants from one place to another. It will also allow 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 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.

Objectives

After completing the lesson, the students will be able to:

1. Explain how air can move pollution from one area to another.
2. Understand how pollutants from various places can combine to form ozone.
3. Understand the importance of environmental monitoring.
4. Describe how environmental monitoring is accomplished using the experiment as a model.
5. Explain the purpose and placement of monitoring devices.
6. Describe ways technology influences human capacity to modify the environment.
7. Recognize the role citizens in southwest Oklahoma can play in environmental cleanup.

Materials Needed

1. 7 shallow plastic containers with lids (Sandwich-size containers with lids that have a lip work best.)
2. Household ammonia
3. Imitation vanilla extract (Non-alcoholic)
4. Nail polish remover (use type with strong odor)
5. Food coloring (blue, red, and yellow)
6. Classroom map for overhead
7. Large clock with second hand

8. Class set of Student Handout 1
9. Class set of Student Handout 2

Preparation

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

2. Put a small amount (just enough to cover the lid surface) of imitation vanilla extract into one of the container lids. (Again, 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 an equal amount of ammonia in another container lid.

5. Put equal amounts of a look-alike liquid in the remaining containers' lids.

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

Procedure

1. Begin class with a discussion on air. During the discussion remove the cover from the lid containing the ammonia.

2. See how long it takes for the first student to notice the smell.

3. Students should observe that the odor moves from the source to the farthest place from the source. Does anything affect how the smell is carried through the room (such as a breeze from an open window or air flow from a vent)?

4. 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 on 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 determine the source of that odor.

5. Explain that they will need to map the classroom to chart the results of the experiment. Give them the Student Handouts. The students will mark the location of each student on Handout 2 while you place the locations on the overhead map.

6. When the maps are complete, briefly describe the experiment. Tell the students that they are 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 complete his of her handout.

7. Remove the covers from the sources throughout the room containing the liquids. Leave the lids uncovered for two minutes. Announce the time every 30 seconds (for example, “A” on the handout would be T+ 0 seconds; “B” would be T+30 seconds; “C” would be T+60 seconds, and so on). Remind the students to find their place on their handout 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.

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

9. Call on a number of students in different parts of the room. (If time permits, let all students participate.) Have each student come forward and mark their location on the overhead map with the time and intensity information that they have recorded on their worksheet.

10. Lead a 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 odors come from? The students' answers should lead 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.)

11. Describe why it is necessary to determine where the 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 EPA to take steps to remove them.

Extensions

1. Have a guest presenter visit the classroom. Guest presenters could include air quality engineers, environmental scientists, EPA air monitoring specialists, or state or local air quality managers.

2. Expand the discussion following the experiment by suggesting variables (such as what if a door or window was open? 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.

3. 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.

Sources

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

"Ozone Action! Let's Clean the Air: Educational Activities Kindergarten-5th Grade" West *Michigan Clean Air Coalition.* 2003. www.wmcac.org/gradesk-5.pdf.

"Where's That Odor?" *Tulsa Outdoor Air Curriculum.* 2004. www.incog.org/Environmental/AQ%20Curriculum.

Student Handout 1

Finding Sources of Air Pollution

Major Man-Made Air Pollutants

Pollutant	Description	Sources	Signs/Effects
Carbon Monoxide	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	Metallic element	Vehicles burning leaded gasoline Metal refineries	Brain and kidney damage Contaminated crops and livestock
Nitrogen Oxides	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
Ozone	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
Sulphur dioxide	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

Student Handout 2

Front of the Classroom

Back of the Classroom

Time

A=_____

B=_____

C=_____

D=_____

Intensity

1= No odor detected at all

2= Begin to smell the odor

3= Odor is strong

4= Odor is very strong