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ABSTRACT

This is one of a series of units for environmental education developed by the Highline Public Schools. The unit is designed for intermediate grade elementary school students. Emphasized in the units are air, the use of air, and air pollution. The seven lessons can be used consecutively or spaced throughout the year. Each lesson includes the concept of the lesson, materials needed, procedure, and evaluation activities. Some lessons include supplemental activities. The materials were tried and evaluated; evaluation data may be obtained from the Highline Public Schools.

(RH)

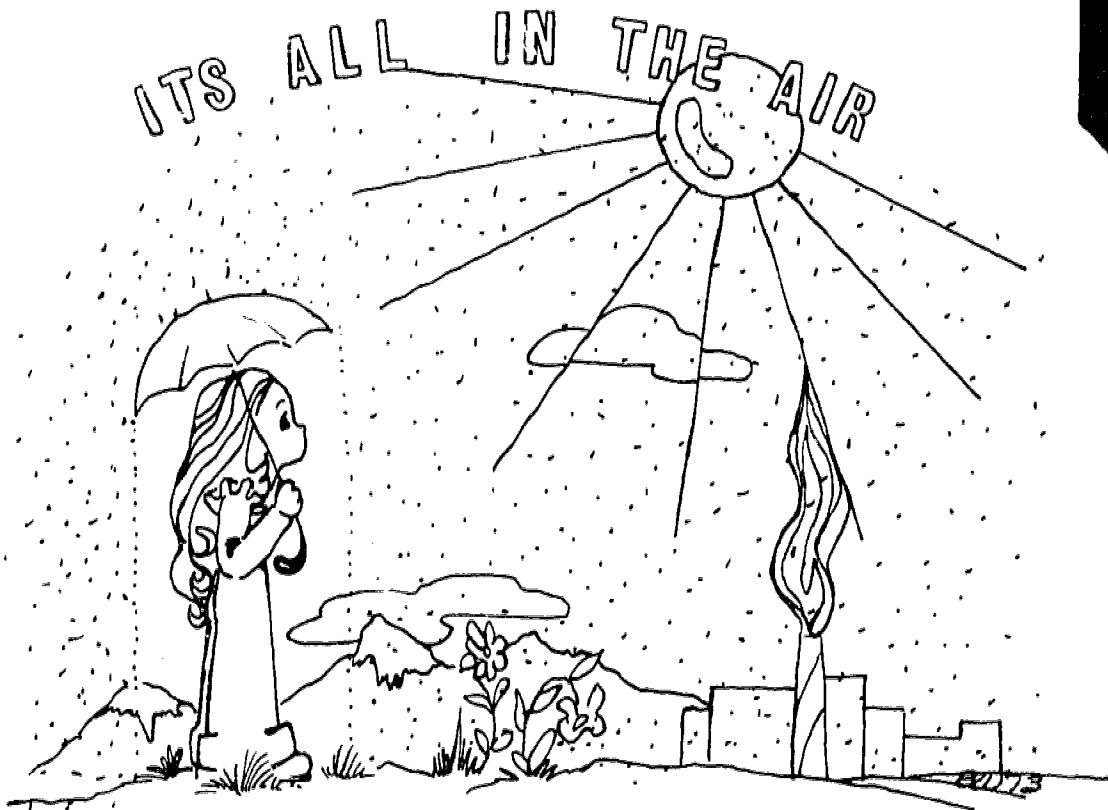
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# WRIGHT

# PAK

ED135149



by Jan Wright

An Environmental Learning Experience prepared for the intermediate grades which deals with particulates in the air. One of many "ELE PAKS" available for all areas.

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# NATURE KNOWS BEST

PROJECT ECOLOGY  
TITLE III

PROJECT ECOLOGY  
**EVERYTHING IS CONNECTED TO EVERYTHING ELSE**

**THERE IS NO SUCH THING AS A FREE LUNCH**

PROJECT ECOLOGY  
TITLE III

## *The Kids Who Participated in the Pilot Evaluation Program*

David Armstrong  
Laura Bailey  
Deena Barrett  
Kevin Bibeau  
Danial Boettcher  
Joseph Cameron  
Brian Church  
Julie Cote  
Lynn Doll  
James Falter

Darrell Farkas  
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## *The Readers Who Studied, Critiqued & Offered Suggestions & Ideas for Improvement*

Arlene Sanders, McMicken Heights Elementary, Highline District  
Ruth Amoe, Gregory Heights Elementary, Highline District  
David Jarvis, Valley View Elementary, Highline District  
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Principal

*Evaluation Results Regarding This ELE May  
Be Obtained by Including This Page and a  
Self Addressed Stamped Envelope to*

Highline Public Schools, District 401  
Instructional Division  
Project ECOLOGY ESEA Title III  
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## BACKGROUND INFORMATION

The following material is included for your information. You may also wish to duplicate it for student use.

What is air pollution?

Air pollution is a change in the amount of gases, liquids or solids in the atmosphere that makes it harmful to man, animals, plants and property.

What are the basic sources of air pollution?

There are three basic sources of air pollution: combustion, industrial, and natural.

Combustion sources are those where fuel is burned to produce heat or power, or where waste, such as garbage or leaves, is burned.

Industrial sources of pollution involve such processes as crushing, grinding, drying, baking, or evaporation and include processing with chemicals and power production through nuclear reactors.

Natural sources include volcanoes, sand and dust storms, certain trees which emit terpenes, plants which emit pollen, lightning storms which create ozone, forest fires and even the oceans which thrust minute salt particles into the air.

What are some of the man-made sources of air pollution?

The automobile accounts for about 60% of the man-made air pollution followed by industry, electric power plants, furnaces, heaters, and burning refuse which account for the remaining 40%.

What are the major types of air pollutants?

The major types of air pollutants are:

1. solids, such as small particles of dust, soil, soot, or ash. These particles are placed in the air mainly by dust storms, wind, erosion, forest fires and incineration of garbage. They are eventually released from the air as dustfall or fallout.
2. gases, such as sulphur dioxide and carbon monoxide are added to the air by the burning of coal and oil, the smelting and refining of ores and natural gas by industry, and the incomplete burning of gasoline by automobiles and other vehicles. These gases usually remain in the air, and large amounts can build up over a long period of time.
3. aerosols are solid or liquid particles which are mixed with gases and are usually too small to drop out of the air. These particles are released into the air by a wide variety of industrial processes. Sometimes bad weather conditions, such as fog and winds, prevent these materials from being dispersed into the atmosphere. When this happens, smog (a combination of smoke, fog, and other pollutants) is produced. In extreme situations smog can result in illness and even death.

Why is clean air important?

Clean air is important because it is essential to life. For example, the average person breathes 35 pounds of air each day. That is several times the amount of food and liquid consumed.

How are pollutants in the atmosphere moved?

The movement of pollutants in the atmosphere is affected by several factors. Wind causes pollutants to become dispersed and to be moved from one place to another. The speed of the wind determines the rate at which the pollutants are dispersed.

Other factors affecting the movement of particles are precipitation, topography, and air masses. Atmospheric temperature variations above the surface of the earth affect the upward dispersal of pollutants.

How is air pollution measured?

Air pollution can be measured by using a Ringelmann chart (a Ringelmann chart consists of a series of grids composed of black lines ruled on a white background. When viewed at arm's length, the grids appear as graduated shades of gray that vary between all white and all black. Each shade of gray represents a certain smoke density.), by determining the amount of dustfall using dustfall pans and filters, and by using various kinds of air sampling devices.

What are some harmful effects of air pollution?

1. gradual deterioration of buildings, bridges, statues and monuments
2. corrosion of metals and wires
3. soiling and damage to textiles, rubber, and fabrics
4. discoloration and flaking of paint
5. damage to valuable paintings and other works of art
6. decline in the value of land and property located in areas of high pollution
7. damage to agricultural crops and forests
8. injury to flowers, shrubs, and ornamental plants
9. harm to the health of domestic, farm, and wild animals
10. harm to human health leading to various diseases and possibly to premature death.

How can air pollution be controlled?

Some ways of controlling air pollution are the installation of devices on the exhausts of motor vehicles to reduce the gaseous and particulate contaminants to harmless substances, the use of settling chambers, electrostatic precipitators and chemicals to control the emission of pollutants from smokestacks and other industrial sources of air pollutants; the passage of legislation making these controls mandatory; and the alerting of the public to the contributing factors and dangers of air pollution.

## MASTER MATERIALS LIST

stopwatch  
baking soda - 1 box  
teaspoon  
pint jar  
vinegar - 1 quart bottle  
matches  
flashlight

waxed paper  
vaseline - 2 jars  
cardboard

3" x 5" plain index cards - 7 dozen  
felt pens - 6  
masking tape - 1 roll

gram scale  
hand lens or microscope

white facial tissue - 1 box  
cardboard tube - 12"-15" long  
angel hair - 1 package

nylon stockings - 1 pair  
assorted pieces of dyed fabric  
Louvered Shelter

2 geranium plants

## CONCEPTUAL OVERVIEW OF UNIT

1. Living things require air.
2. Solid particles in our environment are continually floating in the air.
3. The type and amount of particles in the air vary depending on the surrounding environmental activity.
4. Weather affects the amount of particulates found in the air.
5. Automobiles and other types of motor vehicles add pollutants to the air.
6. Air pollution affects nylon and dyed fabrics.
7. Air pollution affects green plants.

### NOTE TO THE TEACHER:

The lessons in this unit are designed to either be presented consecutively, allowing approximately two or three one hour class periods plus the necessary monitoring time for each, or spaced at intervals throughout the school year.

These lessons have been successfully used with students in a sixth grade classroom.

## LESSON 1

CONCEPT: Living things require air

MATERIALS: stopwatch  
baking soda  
teaspoon  
pint jar  
vinegar  
matches  
flashlight

PROCEDURE: This lesson is included to help students understand the importance of air - especially clean air - to living things.

1. Use a stopwatch.

*When I say "begin", count the number of breaths you take in one minute. I will tell you when to stop counting.*

2. You may wish to repeat step #1 3 times so as to have a more accurate, average figure for each student. (This should be approximately 14-18 breaths per minute.)

3. Compute the average number of breaths taken by the average class member in an hour, in a day.

4. Use a stopwatch.

*I want you to sit quietly for the next three minutes. I will watch the time. Suppose that during this 3 minute period of time, there had been no air in this room for us to breathe. (What would have happened? We would be either close to death or dead.*

5. *Why is air important?* It is necessary for life.

6. *What is air made of?* (Students may have rather scanty knowledge of the make-up of air. The following is for your information.)

### A. Gases

Nitrogen - 78% - serves primarily as a space filler. However, certain kinds of bacteria extract nitrogen from the air and use it to make compounds which green plants need.

Oxygen - 21% - very active chemically. Oxygen unites with rocks and causes them to decompose. It reacts with iron to form rust, with fuels when they burn and with foods to release energy in most kinds of living things. The quantity of oxygen remains relatively



constant because the amount used is replaced by oxygen that is released by green plants during photosynthesis.

argon, carbon dioxide and minute amounts of other gases - 1%

- B. Water Vapor - invisible, varies greatly from time to time and one place to another. Water vapor in the atmosphere supplies the water that forms clouds, dew, frost and the various forms of precipitation.
- C. Pollutants - air of a particular region is said to be polluted if its normal composition is changed by the addition of pollutants, thus making it harmful to living things.
7. *What is a pollutant?* A material which, when added to another material, makes it dirty.
8. Light a match and let it burn down. Light another match and blow it out. *By breathing out when I blew the match out did I add another material to the air or did I return something I couldn't use? (Returned something I could not use.) Did I pollute the air? (No, except that caused by the burning match). Does anything in nature use the material that we breathe out? (yes - green plants) What does nature "breathe out" in return? (oxygen) Is this a good exchange? (Yes)*
9. Make some carbon dioxide chemically. Divide students into small groups of four or five. You may wish to put the directions for the experiment on the board or the overhead projector. Students may wish to repeat the experiment.
- Put 1 teaspoonful of baking soda in a pint jar.
  - Add 4 teaspoonfuls of vinegar. The bubbling action produces carbon dioxide.
  - Put a lighted match into the upper part of the jar. The flame will go out. Ask *Why?* Discuss.
  - Discuss with students:  
*Could we say that when we combine materials we sometimes produce another material? (yes)*  
*Could some of these materials pollute our air? (yes)*  
*Let's suppose that we live in a crowded city, far from any ocean - and without trees or any other green plants. What would happen to all the carbon dioxide that the thousands of people would breathe back into the atmosphere? (It would remain there.)*  
*What would happen to all the carbon dioxide that is produced by burning fossil fuels in homes and industry? (It would be released into the atmosphere.)*

Is carbon dioxide invisible? (yes)  
 Could it be dangerous? (yes - in large amounts)  
 Can some invisible materials be dangerous? (yes)  
 Can some invisible materials be called pollutants? (yes)

10. Darken the room and light a flashlight. Students should be able to observe dust particles in the air. (We have said that oxygen, nitrogen, and carbon dioxide are invisible. Is dust invisible? (no) Is dust in the air a pollutant? (yes) Can dust be called a visible pollutant? (yes)

EVALUATIVE  
ACTIVITY:

Ask students to write a few paragraphs or a poem (creative or factual) titled "There's Something in the Air".

Students will share completed compositions with the class and/or display on a bulletin board.

## LESSON 2

CONCEPT: Solid particles in our environment are continually floating in the air.

MATERIALS: waxed paper  
vaseline  
cardboard

PROCEDURE: This lesson provides an opportunity for students to collect and observe particulates found in the air. Begin the lesson by asking,

*What kinds of visible pollutants do you think we might find in the air?* Allow students to brainstorm for a few minutes, recording responses on the board.

*Let's see if we can collect some of the solid particles found in the air.*

Give each student 5 2½" squares of waxed paper. (It is helpful to have the waxed paper squares cut ahead of time.) Tape or staple the waxed paper to a piece of cardboard. Cover the waxed paper with a thin coat of vaseline. (It is easier for students to apply the vaseline at home just before putting the collector papers outside.)

Each collector paper should be numbered so that students can keep an accurate account of the collector paper and the location in which it is put.

At the end of the allotted exposure time instruct students to carefully collect the collector papers and bring them to school for class examination. (Collector papers should be placed flat in a shoe box or similar container.)

Examine the materials which have stuck to the vaseline with a hand lens or microscope.

### EVALUATIVE ACTIVITY:

1. Student records information on data sheet. (sample attached)
2. Divide students into groups of five or six to discuss and compare data collected. Each group will share its findings with the class.
3. Discuss the results of the data collected with the students.

*What kinds of material did you find on the collector papers?  
What was the most common type of material found?  
Which types of material may have come from your house?  
Which types of material may have come from an industry?  
Which types of material would you normally expect to find in  
the air?*

Which types of material may have been carried by the wind?

Did each collector paper contain approximately the same type of material?

What does the number of particles on each collector paper indicate about the amount of air pollution in your area?

### SAMPLE DATA SHEET

Collector Paper	Location	Type of Material Found dust, pollen, insects, ash, etc.
#1		
#2		
#3		
#4		
#5		

### LESSON 3

**CONCEPT:** The type and amount of particles in the air vary depending on the surrounding environmental activity.

**MATERIALS:** 3" x 5" plain index cards                      gram scale  
vaseline    hand lens or microscope  
felt pens  
masking tape

**PROCEDURE:** Review the results of the experiment in Lesson 2 with the students. Then ask,

*Do you suppose we would find the same type of particles in the air outside the classroom as we would find on the inside?*

*Let's experiment and see.*

Divide the students into small groups of 5 or 6. Give each group 10 3" x 5" index cards.

Number two sets of cards with the felt tip pen from 1-5 to represent each day of the school week. Cover each card with a thin layer of vaseline. Tape one set of five cards to the outside of a classroom window and tape the other five on the inside.

*Ask: Would the amount of time a card is outside make any difference in the results?*

Collect the inside and outside "1" cards at the end of the school day.

Collect the "2" cards the next day and so forth.

**EVALUATIVE  
ACTIVITY:**

Each card should be weighed and the weight recorded.

As each set is removed students should examine each card carefully and record their observations. Identifying, if possible, the kind, shape, size and amount of particles collected. (see data sheet attached).

Discuss similarities and differences in particles found inside and outside the classroom window.

SAMPLE DATA SHEET

	PARTICLES			WEIGHT
	KIND	SHAPE	SIZE	
Card No. 1				
Inside				
Outside				
Card No. 2				
Inside				
Outside				
Card No. 3				
Inside				
Outside				
Card No. 4				
Inside				
Outside				
Card No. 5				
Inside				
Outside				

## LESSON 4

**CONCEPT:** The effect of weather on the amount of particulates found in the air.

**MATERIALS:** waxed paper  
vaseline  
cardboard

**PROCEDURE:** The purpose of this lesson is to give students an opportunity to explore and discover the effect of weather on the amount and type of air pollution. You may begin by asking,

*Do you think weather has any affect on the amount of particulates found in the air? Allow time for discussion. Let's see if we can find out.*

Discuss with the students various places where collector papers could be placed.

Divide the class into groups of 5 or 6 students per group.

Assign or let each group choose a particular location on the school ground to monitor.

Prepare collector papers.

1. Cut a  $2\frac{1}{2}$ " square of waxed paper.
2. Staple waxed paper to a piece of cardboard.
3. Cover waxed paper with a thin layer of vaseline.
4. Place collector papers in assigned place.

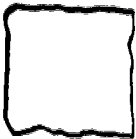
**EVALUATIVE  
ACTIVITY:**

Each group should keep a chart or graph which will show location, date and length of exposure, weather conditions and the collector paper after it has been collected. These charts or graphs will make an effective bulletin board display if desired.

Discuss similarities and differences in the data collected.

This activity could be effectively repeated at different times throughout the school year and data compared.

Sample Chart

<p><u>Location</u> - N. side of Gym. 4 ft. from ground - Center of bldg.</p> <p><u>Date</u> - Oct. 15-16, 2 days</p> <p><u>Weather</u> - sunny - no rainfall - wind speed light</p> <p> collector paper</p>
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## LESSON 5

CONCEPT: Automobiles and other types of motor vehicles add pollutants to the air.

MATERIAL: cardboard  
cardboard tube  
white facial tissue  
angel hair

PROCEDURE: Ask students, *What effect does the automobile and other motor vehicles have on the quality of the air? What is being done to combat the problem of emissions from motor vehicles?* (low lead gasoline, anti-smog devices on automobiles, rapid transit, etc. Discuss.

Divide the class into small groups of 5 or 6. Students may do the actual testing individually, but will work in groups to compile and discuss data collected.

An effective way to conduct the activity is to discuss and prepare the collector papers in class and have students do the actual testing of the exhausts at home and in the neighborhood. Collector papers should then be carefully returned to school for examination and classification.

Prepare collector paper by taping a 3 inch square of facial tissue to a long strip of cardboard.



The back of each cardboard should contain the following information:

1. year the vehicle was made
2. name of company which manufactured vehicle
3. type of vehicle - (auto, truck, bus, boat, snowmobile, motorcycle, etc.)
4. type of fuel burned (gasoline, regular or super, diesel, etc.)
5. Approximate length of time since last motor tune-up.

Each group of students should test at least 12 different vehicles. The greater the variety the better. Encourage students to include lawnmowers, boats, motorcycles, snowmobiles, etc. in their testing samples.

Discuss safety precautions with students before any testing is done.

1. Ask permission of the driver or operator of the motor vehicle being tested so that he knows you are testing and will not move the vehicle before testing is completed.
2. Keep your face as far away from the exhaust as possible. Remember, invisible poisonous fumes are also given off by running motors.
3. All motor vehicles can be dangerous. Keep away from moving parts such as lawnmower blades.



### Instructions for testing the exhaust of motor vehicles.

1. Hold the collector paper 6 inches from the mouth of the exhaust pipe of a vehicle whose motor is running for 1 minute. It is better if the engine is warm and idling instead of racing.
2. Use a different collector paper for each vehicle tested.
3. Don't forget to record the necessary information on the back of the cardboard before you test!

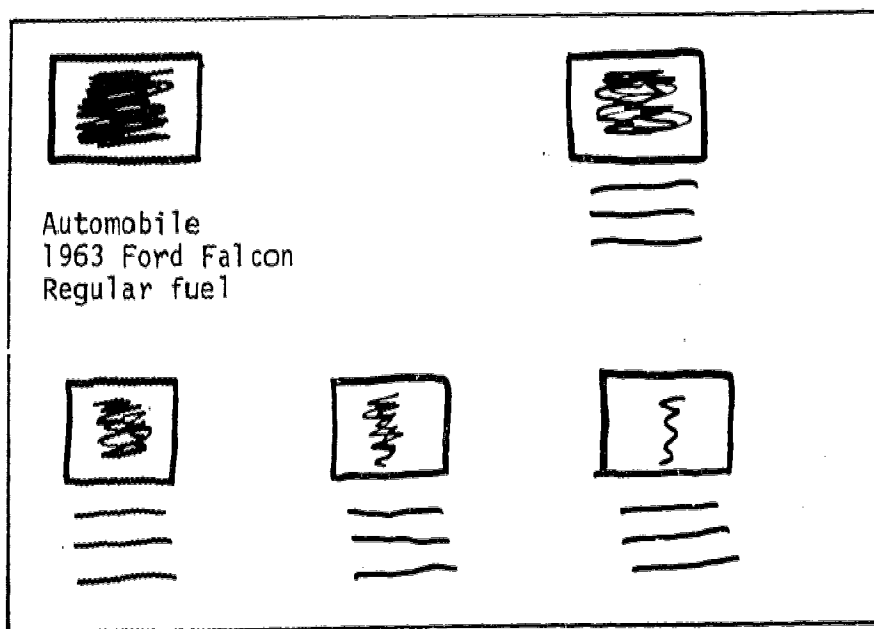
### EVALUATIVE ACTIVITY:

When the testing is complete carefully return the collector papers to school.

Examine the collector papers with a microscope or 1and lens. Note and record the size of particles, small, medium, or large, and the color, light grey, dark grey or black. Record any other information you might observe.

*As a group arrange your collector papers on a piece of tagboard in order from the exhaust with the worst solid particle air pollution to the exhaust with the least.*

*Transfer the information from the back of the cardboard to the tagboard before gluing the collector paper in place.*



*Give your display an appropriate title.*

Organize a traveling display with a student speaker from each group. Share the display with other classes.

Discuss the results of your testing experiment.

SUPPLEMENTAL     Removing some of the solid exhaust particles.  
ACTIVITY:

Construct a filter

1. Use a cardboard tube such as the core of paper towels or gift wrap.
2. Loosely pack the tube with angel hair (use gloves).
3. Test the cars exhaust with a collector paper.
4. Insert the filter into the exhaust pipe.
5. Use a second collector paper to test the exhaust with the filter installed.
6. Compare the two filter papers. Label one before and the other after.
7. Remove the filter and examine it carefully.
8. Which collector paper had the least amount of deposit on it? Why?
9. How often would the filter need to be changed to be effective?


LESSON 6  
(optional)

CONCEPT: The effect of air pollution on nylon and dyed fabrics.

MATERIALS: nylon stocking  
cardboard for frame  
cardboard  
dyed fabric samples  
1 Louvered shelter (if available)

PROCEDURE: Divide class in half. Then divide each half into two or three small groups. One half of the class will test the effects of air pollution on nylon while the other half of the class tests the effects of air pollution on dyed fabrics.

Does air pollution affect nylon?

1. Make a window using cardboard as a frame with an inside dimension of 6" x 6". 
2. Cut a nylon stocking 8" long to be used as the pane.
3. Stretch the nylon over the frame giving two nylon surfaces for exposure.
4. Place "window" in a place where it will be exposed to the wind.

Students wishing to conduct a dry test should cover the window so it will not get wet when it rains. If Louvered Shelter is available place it on the roof of your school with the nylon window inside of it.

5. Exposure should be for a ninety day period.

Does air pollution affect dyed fabrics?

1. Cut 2" square holes in a piece of cardboard. (The number of holes will depend upon the number of pieces of fabric students wish to test.)
2. Cut fabric into 3" squares placing them under the holes in the cardboard. (The unexposed part of material will let the students compare any changes taking place.)
3. Tape fabric squares in place.
4. Cardboard with fabrics needs to be sheltered from direct sunlight, but exposed to the wind. A Louvered Shelter on a roof top is ideal.

EVALUATIVE  
ACTIVITY:

Nylon Experiment -

1. Examine the window approximately every 10 days with a microscope or project it on the overhead.
2. Note and record any change in the nylon pane.

## Fabric Experiment -

1. Examine the fabrics approximately every 10 days.
2. Note and record any change in the fabrics.
3. Identify, if possible, any particulates found.
4. Discuss the cost of air pollution in terms of clothing and home furnishings' bills - both cleaning and purchasing.
5. Students may wish to make a bulletin board displaying the nylons and fabrics tested as well as nylons and pieces of the original fabric which were not tested. Include copies of the data sheets kept by each group and a summary of the results of the test.

## SAMPLE DATA SHEET

Date	Material Tested	Observations

LESSON 7  
(optional)

- CONCEPT: Air pollution affects green plants.
- MATERIALS: 2 geranium plants  
vaseline
- PROCEDURE: Show the class two nearly identical potted plants - geraniums are excellent.

Coat the leaves of one plant with vaseline.

Check the plants at regular intervals. Students should keep written observations of the plants.

Discuss the results of the experiment with the class.

*Why are leaves so important to the plant and to people?*

*Try to imagine this plant is growing outdoors. What might clog the stomata (small mouth-like openings) on the leaves and cause the plant to die?*

*Have you ever seen plants withering and dying along the freeway? What are possible reasons for this?*

*What other effects might air pollution have on plants.*

- ADDITIONAL ACTIVITY: On the "control" plant coat the underside of a few leaves, the upper side of others and leave some uncoated.

Record observations.