

**ENVIRONMENTAL EDUCATION CURRICULUM**  
**EXAMPLES**

**PIMA COUNTY , ARIZONA**

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### **Lesson Plan: Airborne Dust Control Presentation for Youth (Grades 5-12)**

Prepared January 2004

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karen.wilhelmsen@deq.pima.gov, 520.740.3345
- Title:** Got Dust? Ride it Down!
- Subject:** Particulate Matter air pollution: causes, effects, solutions
- Subcategory:** Airborne dust issues regarding off-road vehicle use on vacant land
- Description:** Students participate in role-play activity and discover different perspectives in a current, real-life situation regarding airborne dust in a residential neighborhood. Groups of students portray off-road vehicle riders, vacant landowner, neighbors, PDEQ field services inspector, and Pima County Sheriff Deputies, and try to resolve conflict between each group's needs. Students also learn about effects of particulate matter, and possible solutions to reduce air pollution.
- Intended Audience:** Youth grades 5-12.
- Duration:** 45-60 minutes.
- Goals:** Students will gain a greater awareness of air pollution issues, specifically regarding Particulate Matter. Individuals will be inspired to take action in their personal lives to reduce air pollution, and/or reduce their exposure to air pollution in general.
- Objectives:** Students will play different roles related to opposing perspectives on dust control issues. The issues are associated with off-road vehicle use on vacant land in a residential neighborhood.

## **Educational**

**Resources:** Background information cards and extra paper copies on: off-road vehicle riders, landowner, neighbors, Pima County DEQ, and the Sheriff's Department.

### **Props**

Props are optional, can be substituted appropriately, and are greatly beneficial in adding excitement and interest in learning. The following list includes props PDEQ uses.

*Setting up the scenario:* cloth to mimic area of land, Duplo blocks for homes, toy quad (off-road vehicle), toy bicycle, toy child

*Off-road vehicle users:* helmet, gloves

*Vacant landowner:* hat, tie

*Neighbors:* watering can, trowel, garden gloves

*PDEQ inspectors:* PDEQ "Got Dust?" hat, clipboard, pen

*Sheriff:* sheriff badges, caution tape

### **Visuals and demonstration**

Air pollutant identification posters

Particulate Matter size comparison chart

Unused and used filters from monitoring sites

Electron microscope images of Particulate Matter 2.5

Healthy/unhealthy pigs lungs comparison kit

## **Reference**

**Materials:** PDEQ Fugitive Dust Program outreach and education staff  
Brochures: *Riding Responsibly for the Environment, for Others, for Yourself*  
*Dust control on Open and Vacant Lands*  
*Airborne Dust and Your Health*

## **Activity**

### **Plan:**

#### **Provide background information**

- Facilitate discussion of air pollution in Pima County: identify major pollutants of concern (CO, O<sub>3</sub>, PM, SO<sub>x</sub>, NO<sub>x</sub>) and their sources.
- Discuss health effects of air pollution utilizing healthy/unhealthy pigs lungs if acceptable by teacher.
- Open further discussion about Particulate Matter: what it is, utilizing size comparison chart, electron microscope images of fine particles, and filters.

#### **Set up the scenario**

- Spread out the cloth explaining that this represents an area of desert land in Tucson.
- Place blocks representing homes at the perimeter of three sides of the cloth. The area inside the residential border is a large plot of vacant land owned by a company located in Phoenix.
- Indicate that the fourth side borders Tucson Mountain Park land (or other inaccessible land) that is fenced off to vehicles (although there is a break in the fence that riders squeeze through to ride on that land anyway).
- Place the toy quad and toy bicycle at different "homes," and then on the vacant land explaining that users of these vehicles ride on the vacant land without permission of

the landowner. Discuss the difference in the amount of dust raised from a BMX bicycle vs. a quad.

### **Assign roles**

- Separate students into five groups.
- Assign roles to groups by handing each the appropriate props and background information cards and copies: off-road vehicle riders, landowners, neighbors, Pima County DEQ, and Pima County Sheriff.

### **Facilitate discussion within separate groups**

- Have one person from each group read the appropriate information card aloud to their group, while others follow along on copies that came attached to the card.
- Roam from group to group encouraging discussion linked to their role's influence on airborne dust issues.
- Encourage groups to identify major points they would like to address to the group in their assumed perspective, and try to find a reasonable solution to airborne dust issues. Have them write these ideas down on poster-size paper to share with the class.

### **Facilitate group discussion**

- Taking turns, have each group discuss their perspective regarding off-road vehicle use of vacant land.
- Once each group has had the opportunity to present their points, open up the conversation to debate, making sure major points are discussed in pursuit of reasonable solutions.
- Summarize potential solutions and expand into actions the audience can use to reduce air pollution in general, and how to protect ourselves from air pollution.

### **Method of**

**Learning:** Role-play, small group discussion, large group discussion, demonstration, lecture.

**Assessment:** Written evaluation by teacher assessing presenter, visual aids, and level of learning by students.

### Match PM Air Quality Filters to Location.

West Coast The West, the Valley, Mountain	Central US Prairie, Plains	Great Lakes Industrial	Eastern North Industrial

**West Coast:** Particulate Matter, especially from off-road vehicles, has high visibility and health impacts in the West.  
**Central US:** Particulate Matter, especially from off-road vehicles, has high visibility and health impacts in the West.  
**Great Lakes:** Particulate Matter, especially from off-road vehicles, has high visibility and health impacts in the West.  
**Eastern North:** Particulate Matter, especially from off-road vehicles, has high visibility and health impacts in the West.

Choose all that apply:  West Coast,  Central US,  Great Lakes,  Eastern North

### Does Air Pollution Have Boundaries?

**West Coast:** Particulate Matter, especially from off-road vehicles, has high visibility and health impacts in the West.  
**Central US:** Particulate Matter, especially from off-road vehicles, has high visibility and health impacts in the West.  
**Great Lakes:** Particulate Matter, especially from off-road vehicles, has high visibility and health impacts in the West.  
**Eastern North:** Particulate Matter, especially from off-road vehicles, has high visibility and health impacts in the West.

**Get It? Keep It Down!**  
 West Coast, Department of Environmental Quality  
 1000 Broadway, Suite 1000, San Francisco, CA 94107

Choose all that apply:  West Coast,  Central US,  Great Lakes,  Eastern North

## Air Quality and Particulate Matter Filter Activity Board

### Objective:

- Gain an understanding of what a criteria pollutant (particulate matter) is and how it is monitored.
- Learn about the roles population and personal behavior play in affecting air quality.
- Identify causes, effects, and solutions to air pollution.
- Identify personal actions to reduce air pollution.

### Vocabulary

- Particulate Matter (PM): Mixture of solid particles and liquid droplets found in the air, harmful to breathe. PM<sub>10</sub> (coarse fraction of particles) and PM<sub>2.5</sub> (fine particles).
- Micrometers (μm): 1/1,000 of a meter, so tiny it is invisible, PM<sub>10</sub> is PM that is 10μm in size, a fraction (1/7) the thickness of a human hair.
- PM<sub>10</sub> Filters: 8"x10" soft paper-like rectangle made of quartz (or other materials) that collect particles in the air when placed in a monitor for 24 hours per EPA guidelines.
- PM<sub>2.5</sub> Filters: small disc about 2" in diameter made of Teflon (or other materials) that collect particles in the air when placed in a monitor for 24 hours per EPA guidelines.
- Air Pollution: any gas or particulate that, at high enough concentration, may be harmful to health and/or property; dirty air.

### Equipment

- PM activity boards
- Filter strips
- Water based markers

### Description of Activity:

- Open a discussion about air quality and what air pollution is
- Divide students into groups; hand out PM Activity Board to each group, looking at map side.
- Examine maps discussing atmosphere and the limited air the earth has, air flow across the globe has no boundaries; locate Arizona on U.S. map; locate Pima County on Arizona map; locate Tucson, Green Valley, and Corona de Tucson
- Discuss the human hair and PM size comparison chart; discuss size of PM (bringing in *micrometer* vocabulary if age-appropriate)
- Turn board over to photo/pouch side.
- Discuss photo of PM monitor site; discuss how the monitors and filters are used to determine air quality for PM. Show filter samples attached to each board, and explain that students are going to match the filter to which location they think they were exposed.
- Discuss unique qualities of Corona de Tucson, Green Valley, and Tucson (population, topography, city vs. rural, activities of people, industry activity – mining, farming, ranching)
- Have students discuss amongst themselves in their small groups and match sample filters to location they feel would have appropriate levels of PM. Note: the white filter is an unused filter that belongs in the pouch in the "New Filter" column.
- Discuss the results as a classroom group, brainstorming on what makes the air polluted related to human presence and activity. Note: about 60% of air pollution in Pima County comes from motor vehicle use.
- Have students write the causes with water-based markers on the activity board.
- Have small groups brainstorm on effects and solutions to air pollution, writing ideas on activity board. Discuss these ideas with the group, writing them on a chalk or white board if available, or large display paper.
- Finally, have each student commit to at least one action they will take (or continue taking) to reduce air pollution, writing them on the activity board, and sharing with the rest of the class if desired.

## **WISCONSIN**

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**Air Defenders Curriculum ([www.airdefenders.org](http://www.airdefenders.org))**

**\*\*Kit is available at the MWCOG offices.**

**Curriculum focuses on open burning. Deals with some aspects of particle pollution.**



**TEXAS NATURAL RESOURCE CONSERVATION COMMISSION**

Multiple lesson plans located at  
[www.tnrcc.state.tx.us/air/monops/lessons/lesson\\_plans.html](http://www.tnrcc.state.tx.us/air/monops/lessons/lesson_plans.html)



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## Air Quality Lesson Plans and Data

[How to use these pages](#)

### See Also:

[Small Business and Environmental Assistance](#)

[Education K-12](#)

[Air Lesson Plans](#)

[Waste Lesson Plans](#)

[TES 1999 Lesson Plans](#)

- [Acid Rain Lesson \(5th grade\)](#)
- [Acid Rain Information, Activities and Data](#)
- [Acid Rain: The Disappearing Statue \(2nd grade\)](#)
- [Harmful Effects of Acid Rain \(7th grade\)](#)
- [Air Pressure Lesson \(6th grade\)](#)
- [Air Pollution Control Lesson \(6th through 8th grades\)](#)
- [Air Pollution Emissions Information, Activities and Data](#)
- [Air Pollution Gremlins Math Lesson \(1st grade\)](#)
- [Air Pollution: Visible and Invisible Lesson \(4th grade\)](#)
- [Air: You Can't See It, But It's There Lesson \(1st grade\)](#)
- [Air Quality and Transportation Lesson \(2nd grade\)](#)
- [Air Terms Lesson \(5th grade\)](#)
- [Air Pollution Word Search Activity \(Grades 2nd through 6th\)](#)
- [Air Pollution Word Search Activity \(Grades 7th through 12th\)](#)
- [Carbon Dioxide and Air Pollution Lesson \(4th and 5th grades\)](#)
- [Carbon Monoxide Information, Activities and Data](#)
- [Conserving Electricity Lesson \(2nd grade\)](#)
- [Effects of Ozone in the Air Lesson \(5th grade\)](#)
- [Ground-level Ozone Information and Data](#)
- [Inversion Lesson \(6th grade\)](#)
- [Lead Information, Activities and Data](#)
- [Let's Catch Some Dirt from the Air Lesson \(PK and K\)](#)
- [Meteorology Data and Activity \(4th & 5th grades\)](#)
- [Ozone Lesson \(4th & 5th grades\)](#)
- [Particulate Matter Lesson \(Kindergarten\)](#)
- [Particulate Matter Lesson \(4th grade\)](#)
- [Particulate Information, Activities and Data](#)
- [Plants & Oxygen Lesson \(2nd grade\)](#)
- [Temperature Inversion Lesson \(8th grade\)](#)
- [The Awful 8 Lesson \(A play for 6th to 8th grades\)](#)
- [The Day The Air Pollution Gremlins Came To Town Lesson \(3rd grade\)](#)
- [The Path of Pollution Lesson \(7th and 8th grades\)](#)
- [Rain Forest Deforestation \(6th grade\)](#)

- [Ridesharing Lesson \(2nd through 8th grades\)](#)
- [The Rubber Band Air Test Lesson \(2nd through 4th grades\)](#)
- [Wump World Activities \(2nd grade\)](#)

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February 24, 1997

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## ***Particulate Matter: How Dirty is the Air We Breathe?***

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### **Purpose:**

To make a simple tester that we can use to collect and observe the pollution in our air.

### **Grade Level:**

4th grade

### **Essential Elements:**

Environmental Essential Elements Across the Curriculum - 75.25 (2) Acquire data through the senses. The student shall be given opportunities to (B) observe properties and patterns of objects, organisms, and events in the environment.

### **Objective:**

Students will collect and study pollution from the air.

### **Focus:**

Tell the students, "As we look outside, we see a clear blue sky. Where is the pollution? We are going to make a simple tester for air pollution so we can see the pollution."

### **Materials:**

- a plastic square (5 centimeters by 5 centimeters)
- petroleum jelly
- masking tape
- block of wood
- white paper for each child or each group of children

### **Background:**

The atmosphere is almost completely made up of invisible gaseous substances. Most major air pollutants are also invisible, although large amounts of them concentrated in areas such as cities can be seen as smog. One often visible air pollutant is particulate matter, especially when the surfaces of buildings and other structures have been exposed to it for long periods of time or when it is present in large amounts. Particulate matter is made up of tiny particles of solid matter and/or droplets of liquid. Natural sources include volcanic ash, pollen, and dust blown about by the wind. Coal and oil burned by power

plants and industries and diesel fuel burned by many vehicles are the chief sources of manmade particulate pollutants, but not all important sources are large scale. The use of wood in fireplaces and wood burning stoves also produces rather significant amounts of particulate matter in localized areas, although the total amounts are much smaller than those from vehicles, power plants, and industries.

### **Procedure:**

1. Coat the plastic square with a thin, even coat of petroleum jelly. With masking tape, fasten the square, jelly side up, to the wooden block.
2. Place the block outdoors on a post, fence, wall, window sill. Leave it for 24 hours. Remove the plastic square from the block. Lay it on white paper.
3. Let the students examine the pollution which was collected on the petroleum jelly
4. Let the groups record the findings of their tester.
5. Have groups share their findings with the other groups. Did you collect any dirt particles? How does your square compare to those of the other groups? In what places does the air seem to be the dirtiest?

We have seen dirt where we saw nothing. We must have air to live. We must do everything we can to clean the air we have and keep our future air clean.

### **Extensions:**

- See the Particulate Matter "[Information, Activities and Data](#)" page for suggested activities using particulate matter data collected by the Texas Natural Resource Conservation Commission and provided in the "El Paso Particulate Data" "Houston Particulate Data," "El Paso Particulate Map," and "Houston Particulate Map" files.
- Have students write a paper and explain the differences they observed among the plastic squares.
- Have students take their tester home to test the pollution for 24 hours. Students will then report to the class of their findings.
- Ask students to leave the tester outside for a week, a month (shelter from precipitation). Students will keep a journal of its progress each day and report to the class.
- Have students compile data on their findings and write the mayor about their samples.

### **Reference:**

Holt Science 6th. Holt, Rinehart, and Winston Publishers, New York. p. 257.

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### **Acknowledgement:**

Alica L. Smith and Stacy Butler, Stephen F. Austin University Nacogdoches TES Course, 1994



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## ***Particulate Matter Information, Activities and Data***

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### **Background:**

Particulate matter is made up of tiny particles in the atmosphere that can be solid or liquid (except for water or ice) and is produced by a wide variety of natural and manmade sources. Particulate matter includes dust, dirt, soot, smoke and tiny particles of pollutants. Some particles attract and combine with amounts of water so small that they do not fall to the ground as rain. Major sources of particulate pollution are factories, power plants, trash incinerators, motor vehicles, construction activity, fires, and natural windblown dust. Particles below 10 microns in size (about seven times smaller than the width of a human hair) are more likely to travel deep in the respiratory system, and be deposited deep in the lungs where they can be trapped on membranes. If trapped, they can cause excessive growth of fibrous lung tissue, which leads to permanent injury. Children, the elderly, and people suffering from heart or lung disease are especially at risk. Particles of 10 microns or less are also referred to as PM10.

The Texas Natural Resource Conservation Commission samples particulate matter with a monitor that holds a filter which collects the tiny particles over one day. The captured particles are then examined and counted to determine if the size and the amount are within a safe range. The standard set by the United States Environmental Protection Agency is 150 micrograms of dust per cubic meter of air. Therefore, if a site has a reading of 150 or more, then an exceedance of the standard set to protect health has occurred.

Large amounts of pollution particles in the air cause haze and can lower visibility. Particulate matter concentrations may worsen in the winter due to wood-burning and coal-burning fires that produce tiny particles of pollutants. Vehicles also emit particulate matter, which can cause higher pollution levels in more densely populated areas. Highs or lows may also be caused by area-wide weather conditions such as dust storms or rain. Some areas within a city may be worse than others if they are located closer to major pollution sources such as industry.

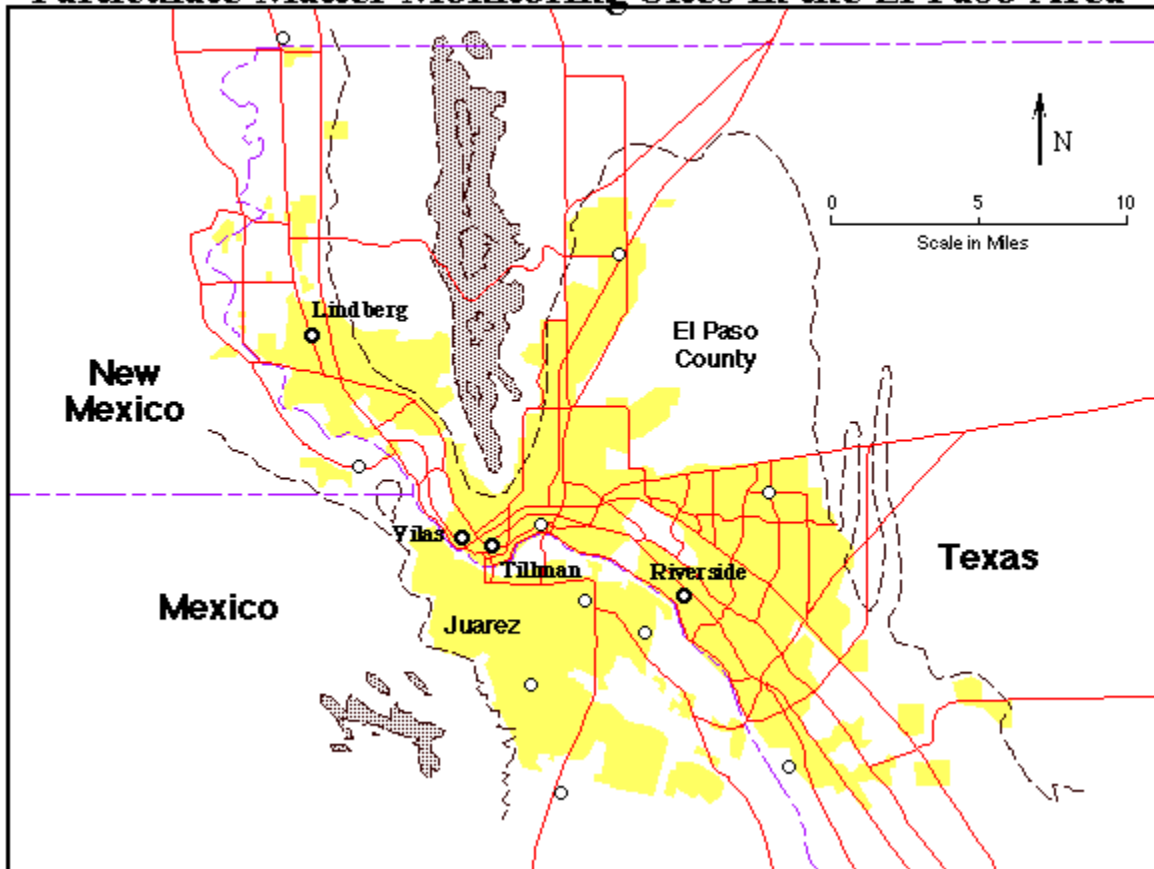
Sand and dust from the Sahara Desert in Africa can rise into the air and be carried across the Atlantic ocean, the Caribbean, and the Gulf of Mexico to Texas. This may be why high particulate matter levels are sometimes measured all across the state on the same day.

## Suggested Activities:

### Activity 1:

Use the data listed in the file [El Paso Particulate Data](#) for this activity. Divide the class into four groups. Give each group the 1991 set of data from a monitoring site in El Paso and a different color marker. Have the groups plot the data points on transparencies placing the year on the X axis and the particulate matter measurement on the Y axis (or use different colors of chalk and plot on the chalkboard). Label each color according to its corresponding location. Lay all the transparencies for El Paso on top of each other and project the image.

### Particulate Matter Monitoring Sites in the El Paso Area

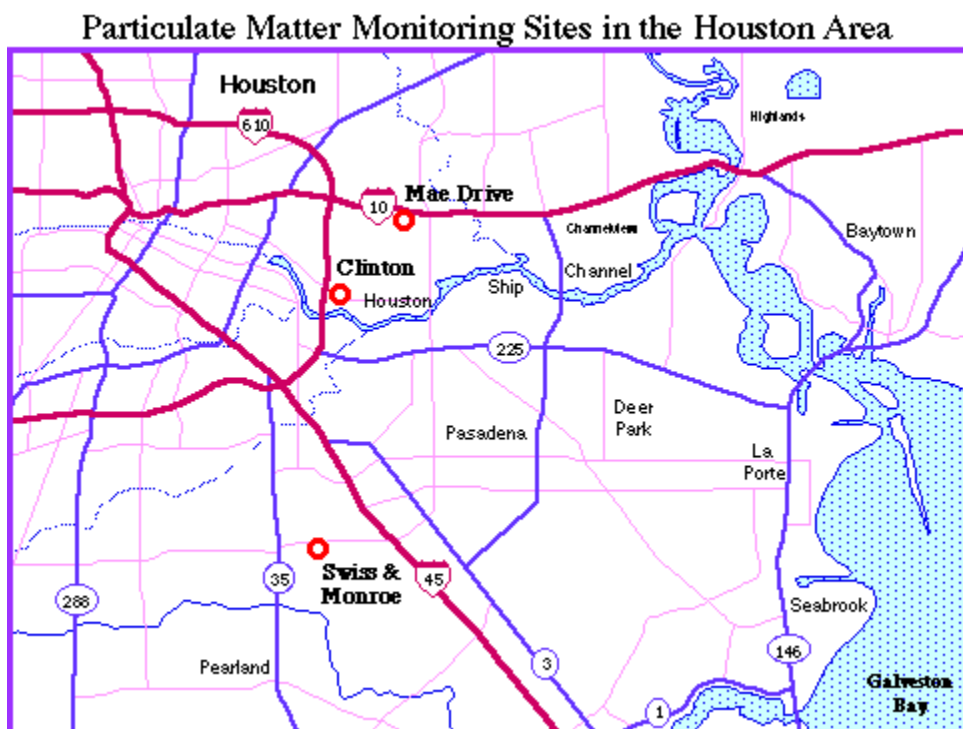


Show a city map that locates the monitoring sites. Have the students determine the patterns for each location and, relating them to the map, give possible reasons for highs, lows and patterns according to the location. For example, if all sites had higher than average readings on a particular day, possible explanations are dust storms, strong winds, or an increase in area-wide behavior such as wood or coal burning. The Tillman monitoring site is downtown, located in a sandy valley just across the Mexican border from a densely populated area that has a lot of wood, tire and coal burning. The Lindberg monitoring site is in an open area that is less populated.

Click here to view and save the [El Paso Area Map](#).

### Activity 2:

Use the data listed in the file [Houston Particulate Data](#) for this activity. Break the class into three groups. Give each group the 1991 set of data from a monitoring site in Houston and a different colored marker. Have the group plot the data points on transparencies placing the date on the X axis and the particulate matter measurements on the Y axis. (or use different colors of chalk and plot on the chalkboard.) Label each color according to its corresponding location. Lay all the transparencies for Houston on top of each other and project the image.



Click here to view and save the [Houston Area Map](#).

If one or two sites are high while the others are low, there could be a pollution source, such as industry along the Houston Ship Channel, operating with excess emissions near the sites with high measurements on those days. If all sites are well below the standard, area-wide weather may be a factor or major pollution sources may be less active (as on weekends).

### Activity 3:

Conduct the same activities as above using the El Paso and Houston data collected during 1992.



#### **Activity 4:**

Students will observe differences between suspended particulates and a solution, and classify common atmospheric gases and particulates.

#### **Materials:**

1 clear glass bowl or large clear plastic glass  
1 tablespoon of milk  
1 teaspoon of pepper  
1 plastic spoon  
water

This activity takes approximately 15 to 20 minutes. Students can do this in small groups using clear disposable cups instead of the glass bowl. If the teacher does this as a demonstration with the clear glass bowl, it helps to have a light or white paper behind the pepper so it is easier to observe. Tell the students the water in the bowl is a model of the air in the atmosphere.

#### **Procedure:**

1. Fill clear glass bowl or clear disposable cup half full with water.
2. Add one tablespoon of milk to water, stir to mix.
3. Add one teaspoon of pepper to water, stir.
4. Observe the differences between the milk and the pepper.

#### **What the students will do:**

- Students will observe the differences between what happens with the milk and what happens with the pepper.
- Students will observe how long it takes the pepper to settle to the bottom.
- Students will discuss the results with the class.

#### **Discussion:**

##### **Ask before the experiment:**

- What is the water in the bowl a model of? (Air)
- What is the milk and pepper supposed to represent? (The milk represents gaseous air pollution; the pepper represents particulate air pollution.)

##### **Ask after the experiment:**

- What kind of pollutant(s) did the milk act like in the water? (Gases)
- What kind of pollutant(s) did the pepper act like in the water? (Particulates)
- Would it be easier to get the milk or the pepper out of the water? (Pepper)
- Would it be easier to remove the gases or particulates out of the air? (In a controlled area, particulates can be removed by filtering the air. To remove gases

from the air is more difficult. Some gases can be removed by using industrial "scrubbers.")

- How can we measure the gases in the air when we can't see them? (Equipment called a gas chromatograph can be used to test for some gases; also air samples can be taken for a lab analysis.)

**Assessment:**

Students will classify air pollutants on the [student worksheet](#) as either particulates, gases or both. ([Teacher worksheet](#) provides the answers.)



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## ***Ozone Pollution: Smog Alert***

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### **Purpose:**

To help students understand ozone pollution and make them aware of how it is formed.

### **Level:**

4th and 5th grades

### **Essential Elements:**

Environmental Essential Elements Across the Curriculum - 75.25 (4th grade) (3) Classify, order, and sequence data. The student shall be given opportunities to (B) classify matter and energy, organisms, actions, and events from the environment according to similarities and differences. (4) Communicate data and information in appropriate oral and written form. The student shall be given opportunities to (D) describe changes that occur to objects and organisms in the environment.

75.25 (5th grade) (4) Communicate data and information in appropriate oral and in appropriate form. The student shall be given opportunities to: (B) describe objects, organisms, and events from the environment, (D) describe changes that occur to objects and organisms in the environment.

### **Objectives:**

Student will simulate the development of smog and infer how it occurs in nature.

### **Focus:**

Hold up a news headline about air pollution. Ask if anyone knows what ozone pollution or smog is.

### **Materials:**

- glass jar
- water
- aluminum foil
- 2 or 3 ice cubes
- paper
- ruler

- scissors
- matches

### **Background:**

Ozone is the same molecule regardless of where it is found, but its significance varies. Stratospheric ozone is found 9 to 18 miles high where it shields us from harmful ultraviolet rays from the sun. High accumulations of ozone gas in the lower atmosphere at ground level is air pollution and can be harmful to people, animals, crops and other materials.

Elevated levels above the national standard may cause lung and respiratory disorders. Short-term exposure can result in shortness of breath, coughing, chest tightness, or irritation of nose and throat. Individuals exercising outdoors, children, the elderly, and people with pre-existing respiratory illnesses are particularly susceptible. Chemists have found that the materials damaged by ozone include rubber, nylon, plastics, dyes, and paints.

Ozone pollution, a component of smog, is mainly a daytime problem during summer months because sunlight plays a primary role in its formation. Nitrogen oxides and hydrocarbons are known as the chief "precursors" of ozone. These compounds react in the presence of sunlight to produce ozone. The sources of these precursor pollutants include cars, trucks, power plants and factories, or wherever natural gas, gasoline, diesel fuel, kerosene and oil are combusted. These gaseous compounds mix like a thin soup in the atmosphere, and when they interact with sunlight, ozone is formed.

Large industrial areas and cities with heavy summer traffic are the main contributors to ozone formation. When temperatures are high and the mixing of air currents is limited, ozone can accumulate to unhealthy levels.

Weather conditions such as lack of wind or a "thermal inversion" can cause smog to build up in an area. A thermal inversion occurs when a layer of warm air settles over a layer of cool air that lies near the ground. This condition prevents the smog from rising and scattering. Mountain ranges near cities may also trap smog in an area.

### **Procedure:**

This activity should be done with adult supervision. Do not breathe in the "smog."

1. Cut a strip of paper about 15 centimeters X 1 centimeter. Fold the strip's length in half and twist the paper.
2. Make a "lid" for a glass jar by shaping a piece of aluminum foil over the open end of the jar. Remove the foil and put it aside.
3. Put some water in the jar and swish it around so that the inside walls of the jar are wet. Pour out the water.
4. Place two or three ice cubes on top of the foil lid to make it cold.

5. Light the strip of paper and drop it and the match into the damp jar. Put the foil lid on the jar and seal it tightly. Keep the ice cubes on top of the foil, in the middle. You must do all of this very quickly.
6. What do you see in the jar? How is this like real smog? when you're finished, release the "smog" outdoors.

**Extensions:**

See the Ozone "[Information, Activities and Data](#)" page for suggested activities using ozone data collected by the Texas Natural Resource Conservation Commission and provided in the Texas Cities Data, Houston and El Paso Data for 1993 and Houston Data for 20 Years files.

Does your local newspaper or weather channel have a pollution index or other type of report on pollution in your area? Record this information over several days and see how it changes.

**Reference:**

Taken from: Dr. Milton Payne's Outdoor Education Class. Spring 1994. Dr. Milton Payne, Department of Elementary Education, Stephen F. Austin State University, P.O. Box 13017, Nacogdoches, TX 75962.



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## Air Quality and Transportation

### ***Purpose***

This experiment will help us to see that using [carpools](#) and other alternative means of transportation are necessary to lessen air pollution.

### ***Grade Level***

2nd grade

### ***Essential Elements***

Environmental Essential Elements Across the Curriculum - 75.25 (2)  
Acquire data through the senses. The student shall be given opportunities to (B) observe properties and patterns of objects, organisms, and events in the environment, and (E) explore the environment.

(3) Classify, order, and sequence data. The student shall be given opportunities to (B) classify matter, forces, energy, organisms, actions, and events from the environment according to similarities and differences.

(4) Communicate data and information in appropriate oral and written form. The student shall be given opportunities to (D) describe changes that occur to objects and organisms in the environment.

### ***Objective***

To learn about air pollution and the effects it has on our Earth.

### ***Focus***

Ask the students how they get to school and graph the types of transportation used.

### ***Background***

Air pollution is a problem in many areas. Air pollution is air that is dirty

compared to its original state. Air pollution can be harmful to people, animals, plants, and structures. Vehicles produce a large percentage of air pollution. Vehicle exhausts contains carbon monoxide and small traces of volatile organic compounds. These compounds, on hot, sunny days with light winds, can produce ground level ozone. Ozone is an air pollutant that can cause health problems after high levels of exposure. Ozone is a main component of smog. (More [information and activities on ozone](#) are available.) Another common pollutant is airborne particulate matter. Some examples are tiny particles of soil, ash, or emissions from some factories that can get into your lungs and cause health problems.

In order to control air pollution, the government has placed restrictions on how much of these contaminants can be released into the air. One thing you can do to keep the air clean is to encourage your family or friends to walk or ride a bike when possible instead of driving. (More [information on ridesharing](#) is available.)

### ***Procedures***

1. Students will tally cars on a sheet that has been categorized as follows:

One person in car

Two persons in car

Three or more persons in car

2. Have students go to the front of the school in the morning or afternoon when there is the most traffic.
3. Have students tally the cars for five minutes.
4. Return to the classroom and have the students discuss their observations.
5. Graph the outcomes of the experiment.
6. Ask the students to discuss alternatives to driving alone.

### ***Enrichment***

Make a list of the different alternatives to driving and discuss how they can help lessen air pollution.

### ***Reference***

Integrated Thematic Unit Scholastic

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## ***Acknowledgment***

Teresa Ayala, University of Texas at El Paso TES Course, 1995





- [Index](#)
- [Agency](#)
- [Search](#)
- [Home](#)

**See Also:**

[Small Business and Environmental Assistance](#)

[Education K-12](#)

[Air Lesson Plans](#)

[Waste Lesson Plans](#)

[TES 1999 Lesson Plans](#)

## Effects of Ozone in the Air

### **Purpose**

To measure ground-level ozone.

### **Grade Level**

5th grade

### **Essential Elements**

Environmental Essential Elements Across the Curriculum - 75.25 (2)  
Acquire data through the senses. The student shall be given opportunities to (B) observe properties and patterns of objects, organisms, and events in the environment, and (E) explore the environment.

(3) Classify, order, and sequence data. The student shall be given opportunities to (B) classify matter, forces, energy, organisms, actions, and events from the environment according to similarities and differences.

(4) Communicate data and information in appropriate oral and written form. The student shall be given opportunities to (D) describe changes that occur to objects and organisms in the environment.

### **Objective**

Students will learn how ground-level ozone is an air pollution problem.

### **Focus**

Show a picture of a car tail pipe with exhaust coming out.

### **Materials**

Ecobadge Smog Patrol Kits from [Vistanomics Inc.](#), 230 N. Maryland Ave., Suite 310, Glendale, CA 91206, Telephone: 818/409-9157. (The TNRCC references this product for information only and does not endorse

this product.)

## **Background**

Ozone is a colorless gas. It is found in two layers in the atmosphere. High level ozone is about 10 to 30 miles above the earth. It is there naturally. This ozone layer protects the earth from the sun's harmful ultraviolet light. Without this protection, the ultraviolet light would be harmful to humans. Ground-level ozone reaches from the ground to about 10 miles above the earth. Ozone at ground level is formed as a result of chemical reactions between oxygen and volatile organic compounds (mainly come from automobile exhaust) and nitrogen oxides (mainly come from industries and power plants) in the presence of sunlight. High concentrations of ground-level ozone are produced during warm weather (summer months). Ground-level ozone can be very harmful. It can cause breathing problems in humans. It can also injure forests and other vegetation and damage crops.

See [ground-level ozone](#) for more information.

EcoBadge is a device that measures ozone levels. Treated paper in the badge can be read at short terms (1 hour) and long terms (8 hours).

## **Procedure**

During the right weather conditions for the formation of ozone, divide students into groups of 4 or 5. Give each group an EcoBadge kit. Review instructions in kit. Each group will measure ozone levels for 4 or 5 days (depends on the number in each group). Each student will wear the EcoBadge for 8 hours and record the ozone level measured. After each member of the group has worn the EcoBadge, the group will graph its results for the 4- to 5- day period.

Have each group answer the following:

1. What does your graph tell you about the ozone level in your area?
2. During what part of the day is the ozone level the highest? Why do you think this is?
3. What contributes to the ozone level in your area?
4. What is being done to decrease harmful ground-level ozone?  
(Possible answers - Smokestacks and cars are now equipped with air pollution controls. People are becoming more conscious of conserving energy.)
5. Have the students write what they see happening.
6. Discuss their observations and inferences.

7. Add corrected notes to notebook.

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To participate in a World Wide Web site for hands-on, inquiry-based science involving ozone monitoring by students around the state of Texas, visit <http://chico.rice.edu/armadillo/Ftbend/TESE/tesi.htm>

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### ***Acknowledgment***

Mary Sloan, University of Texas at El Paso TES Course, 1995

**SOUTH COAST AIR QUALITY MANAGEMENT DISTRICT**

Multiple lesson plans located at [www.aqmd.gov/kidspage/stuff/actfrm8.html](http://www.aqmd.gov/kidspage/stuff/actfrm8.html).



## SKY BLUE, SUNSET RED

### RAINBOWS OF LIGHT

Here's a cool way to see how particles can change the color of air or water. They act the same way because they scatter visible light. Visible light, like sunlight, looks white but is really made up of a rainbow of light.

### WHY A BLUE SKY?

Different things absorb or reflect these colors in different ways. Why does the sky look blue? Because molecules in air scatter much more of the sun's blue light than any other.

### THREE JARS OF WATER

Do this: Fill three jars with cold water. Add nothing to the first jar. Add one teaspoon of milk to the second jar. Add three teaspoons of milk to the third jar.

### MAGIC IN THE DARK

Now lower the lights in your room, and shine a flashlight beam through the jars. What color is the jar with plain water in it? What colors are the two other jars? The milk in the water acts just like particles do in the air.



## BE A SCIENTIST

Stop, look, and smell the things all around you.

Find out how much air pollution you can discover in your community in one week. Get a notebook and write down the sources of pollution you find.

At the end of the week, write down the results on an Air Pollution Search chart.

My whole class did this one week. We put all the things we found on a big chart on a classroom wall. It was fun to see how many sources of air pollution we found!

	Elm St.	Park	Main St.	Play ground
hydrocarbons				
nitrogen oxides				



## READ THE LABEL

## FIND PRODUCTS THAT CREATE OZONE

When you read the labels of the products around your house, and in your garage you'll probably find ones that create [ozone](#). I did! The ones that make ozone are easy to spot because they dry very quickly. So are ones that are used to clean or dissolve grease.

Here are some ingredients to look for:

- highly aromatic [solvents](#)
- [terpene](#)
- aliphatic [hydrocarbons](#)
- [glycols](#)
- [benzines](#)

## MAKE A LIST OF THE PRODUCTS YOU FOUND

Make a list of all the products you found that make ozone. Spray paint, spray deodorants, lighter fluid and car wax were on my list. Bring your list to school and compare yours with other kids you know. After we created a giant list, we talked about how the same products could have been made without being ozone-producers.

## WHAT'S THAT SMELL?

Have your eyes ever started to burn all of a sudden? Or have you suddenly smelled something burning? This activity taught me how things you can't even see that blow in the wind can affect you!

## YOU NEED VOLUNTEERS

Get three of your classmates to be the research scientists. They will control the experiment. The rest of the class gets to be "monitoring instruments" in different parts of a city -- but it's actually your classroom!

## FOLLOW THAT SMELL

Here's what you do: Cut an onion open and let the smell travel through your "city" made up of the kids in your class. As the smell moves, have each "instrument" raise their hand when they smell it.

## MEASURE THE SMELL

Now your scientists can get to work. Have one of them draw a rough map of your city on the chalk board, and track the path of the onion smell. Have another scientist use their watch to time how long it takes - - from the first hand raised to the last lowered -- for the smell to go away. Have the last scientist count the number of "instruments" with watering eyes.

## MAKE IT FLY

After my class did this we turned on a fan and sliced up another onion. Then we took the same measurements to see how wind affects air pollution.





## PLAN YOUR OWN CITY

### YOU ARE IN CHARGE

Have you ever thought about why traffic is so bad? Or Why your mom has to drive so far to do her grocery shopping? I have. Here's a cool way to imagine how things could be better when you made yourself in charge of a city.

### NAME YOUR CITY AFTER YOURSELF!

You can be the chief community planner for a small imaginary city. Since my name is Kristie I called mine call Kristieberg!

### PLAN TO DO THINGS BETTER

Try to plan ways to limit [air pollution](#) and make the most of public transportation. Think about ways to arrange housing and commercial areas to reduce travel time.

### WHAT TO DO IN A JAM

You might even start thinking about this the next time your car is caught in a traffic jam!



## MONITOR AIR QUALITY

Here's a way for your class to actually find out how the AQMD works.

### DIVIDE INTO THREE GROUPS

Have the first group call AQMD at (1-800-288-7664). Ask which of their monitoring stations is closest to where the group lives. Look at the map on the AQMD home page. This first group will collect and record [Pollutant Standards Index](#) (PSI) readings for different pollutants in their areas every day for two weeks. Readings are in the newspaper, on AQMD's website and daily phone recordings.

### DIRECTIONS FOR THE SECOND GROUP

If you live in a large city, have the second group study a smaller town. If you live in a less-populated area, this can study a large city nearby.

### WHAT THE THIRD GROUP DOES

Have the third group contact the California Air Resources Board at 818-575-6800 or go to [the ARB web site](#). They will be able to give you information about the whole state. New information is available every four months.

### AFTER ALL THE INFORMATION IS GATHERED

When all three groups have gathered their information, they can share it with the class by creating a chart. Read the chart to see which day of the week the pollution the highest and which day is the lowest. Can you tell how much the pollution changes? What is the most common type of pollution? How does it affect the large city or small towns?



## BE AN ENVIRONMENTAL REPORTER

Air pollution affects people's jobs!

Get together with a group of classmates and make a list of people whose jobs are affected by air pollution.

Find people in the know!

There are a lot of people, like airline pilots, meteorologists, farmers and biologists that you can talk to who can tell you about how they might be affected by air pollution.

### ASK THEM QUESTIONS

Make a list of questions you want to ask each person. I asked questions like "What do you think is polluting the air?" and "Do you have any solutions to the problem of air pollution?"

### USE YOUR AUDIO OR VIDEO RECORDER

If you can borrow a tape recorder or video camera to record the interviews it will work really well. When the interviews are completed, discuss and share the results with your class.



## WHAT YOU CAN DO

### REDUCE THE ELECTRICITY YOU USE

When you use less electricity you help reduce pollution. So help by doing a couple of these things:

- Open the curtains or blinds in your home to let the daylight in
- Use lower-watt and high efficiency light bulbs
- Set the temperature in your refrigerator to between 38 and 42 degrees
- Make sure that when your family buys things like: refrigerators, air conditioners, or washers that they are energy efficient.

### REDUCE THE ENERGY USED TO HEAT YOUR HOME

- Keep the thermostat as low as you can in the winter.
- Weather-strip windows and doors in the cold weather.
- Tell your parents about thermostats with timers that turn down the heat automatically when no one is home or at night.

### SAVING WATER ALSO SAVES ENERGY

- Wash only full loads in dish and clothes washers.
- Water lawns only during the cooler part of the day.
- Use a water displacement device in the toilet tank.
- Install a low-flow shower head.
- Use a broom rather than a hose to clean driveway, patios and walkways.

## TRY ALTERNATIVE TRANSPORTATION

Take public transportation when possible.  
Walk or ride a bike for short trips.  
When your family buys a car, ask your parents to buy the most energy-efficient and least polluting model.

## DON'T LET YOUR FAMILY BUY TOXIC OR HAZARDOUS PRODUCTS

Look for non-toxic products to clean your house instead.  
Recycle used automotive fluids.  
Use water-based rather than oil-based paints.

## CREATE LESS TRASH!

Reuse items by giving them away or repairing them.  
Recycle newspaper, glass, aluminum, tin cans, plastic soda bottles, milk cartons, telephone books and corrugated cardboard.  
Save all the leaves and lawn trimmings and make a compost heap that can be used to fertilize your garden!



Print this page out and put it in your own notebook!

## 1) MAKE "SMOG CATCHERS"

Do this experiment to find out where the smoggiest places are.

### Materials you'll need:

- 1 heavy plastic bag
- 1 pair of kid's, blunt-edged scissors
- 3 tablespoons of Vaseline

### Here's how you do the experiment:

- 1) Cut out three 2" by 4" strips of heavy plastic from a plastic trash bag.
- 2) Spread Vaseline on your plastic strips.
- 3) Think of three different places where you'd like to measure the smog levels. (I put mine on my classroom window sill, along the road in front of my house, and on a tree in my town park!)
- 4) Place the strips in the three different places.
- 5) Seven days later, collect the strips, and put them in a baggy labeled with the location.
- 6) Look at the different strips under a microscope.
- 7) Which places were dirtier?
- 8) Describe what you found.

**NORTH AMERICAN ASSOCIATION for ENVIRONMENTAL EDUCATION**

Website contains multiple lesson plans and resources for teachers on different aspects of the environment.

<http://eelink.net/pages/Grants+-+EE+Specific+Resources>

## ***Air Quality Issues***

by Catherine Ditto

### **Lesson: Air Garbage**

Background:

Tiny pieces of material that float in the air are called "particulate matter." These very tiny particles can be dust, pollen, mold spores, lint, cooking grease and oils, and animal hair. Some particles are too small to be trapped by filters such as vacuum cleaner bags.

Hypothesize that a vacuum cleaner does not trap all of the particles that it sucks up. If this proves to be true, then people should vacuum their home before they dust the furniture, because it will actually take some particles from the rug and throw them into the air.

Illinois State Goals:

Students will have a working knowledge of:

the concepts of basic vocabulary of biological, physical, and environmental sciences and their application to life and work in contemporary society.

the principles of scientific research and their application in simple research projects.

the processes, techniques, methods, equipment, and available technology of science.

Materials

vacuum cleaner, cellophane tape

Procedure:

Stick two long strips of cellophane tape along the side of a vacuum cleaner bag. Either upright or a round canister type vacuum can be used. Take one strip off. Examine it to see if any particles of paper from the vacuum bag came off. If it did, we know that we will expect to see those particles on the test strip when our experiment is done, and we will not count those particles a part of the experiment. Run the vacuum cleaner over all the rugs in your home (floor or rugs in your classroom for our purposes). When done, carefully remove the test strip of tape, and examine it. Can you detect the presence of any particles that traveled through the bag? Place the tape against a white sheet of paper to make any trapped particles more easily observed. Was your hypothesis correct?

Going Further:

Will different tape locations on the bag vary the results? Is there a difference if the tape is placed on the inside bag instead of the outside bag?

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### **Lesson: Temperature Inside a Closed Container**

Background:

The sun heats the air in both jars, but the air in the closed jar cannot leave the jar. The air in the closed jar gets much warmer than the air in the open jar.

A closed car behaves the same way as a closed jar. It becomes very hot sitting in the sun.

It is not wise or safe to leave pets or small children in a closed car for more than five



minutes during the summer. Even with the windows partially opened, the temperature rises so much that a pet or a child could get hot and even die.

**Materials:**

two identical jars with lids, thermometers, paper, pencil.

**Procedure:**

1. Place the jars outside in the hot sun.
2. Measure the temperature in each jar. Write them down. Call these the "starting temperatures".
3. Put the lid on one of the jars.
4. Wait 60 minutes and measure the temperature again. Record the temperatures. Call these the "ending temperatures."

# ***Air Quality Issues***

by Rhona Bitterman

## **Lesson 1**

Background:

When solid or liquid fuels burn, they sometimes burn incompletely. It is well known that gases from the tail pipe of a car contain poisonous carbon monoxide. This poisonous gas is caused by incomplete burning of gasoline. Carbon monoxide, however, can itself burn and form carbon dioxide. While incomplete burning of gases is also easily done, the results of incomplete burning of fuel are very commonly seen as in the smoke of a chimney or smoke from an exhaust pipe of a truck, car, or airplane.

This experiment shall cause incomplete burning by cooling a flame. Incomplete burning can also be caused by a low supply of air (or of oxygen.)

Objectives:

1. To observe what causes air pollution.
2. To observe a byproduct of combustion.
3. To identify what soot (particulate matter) looks like.
4. To recognize that air pollution is caused by mankind.

Materials:

candle holder, strip of aluminum foil, sheet of white paper, matches

Procedure:

1. Light candle and place where it can be seen easily from all parts of the room.
2. When the candle is burning brightly hold a piece of aluminum foil briefly in the flame above the wick and in the lightest part of the flame. Remove it.
3. After the aluminum is cooled rub it against a sheet of white paper. The paper should show a dark, sooty streak. A black material (soot) was formed.
4. Sometimes the flame can be cooled by waving one's hand near the flame. A smoke puff of black smoke can be seen. The smoke becomes more easily seen if a piece of white paper is used as a background.

Questions:

1. Does the foil make the temperature of the flame higher, lower, or produce no effect? (lower, cooler)
2. What is the effect of putting the foil into the flame? (soot formed on the foil).
3. From what part of the flame is the soot formed most readily?
4. How is soot on the foil different from the soot in the flame? (soot is cooled on the foil). Warm, even hot soot is in the flame. In fact, the soot in the flame is so hot that it glows. This glowing soot makes the candle flame a source of light.

#### Further Discussion:

Fires that burn incompletely and produce soot put soot particles in the air. These fires cause air pollution. Smoke can be seen coming from chimneys, and diesel engines, especially if it is going uphill. Jets at take-off may cause and scatter as much as 80 lbs. of soot. In each case incomplete burning takes place. The air does have a way of purifying itself with rain. Raindrops form around tiny particles.

#### Assessment:

1. Student should be able to write the answer to the question: How is soot formed and why is it caused?
2. Older students should be able to write up the experiment using the scientific method.
3. Identify sources of pollution in a picture of the neighborhood (car, truck, jet, factory, barbecue, lawn mower, chimney)

This plan can be adapted to primary and intermediate grades.

State Goal 1 Gr. K Give examples of pollution.

State Goal 1 Gr. 2 List 2 ways that technology is causing pollution in the community.

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## **Lesson 2**

#### Background:

This activity will help students become aware of pollution in the air through direct observation. They will then gain a better understanding of the effects of pollution on the environment on plants, animals and humans.

Natural and human made pollution has a great deal of impact on the earth. Resources such as air, water soil, minerals, plants and animals are seriously affected by pollution. Because pollution is responsible for many illnesses and diseases, quality of life is related to pollution. Students need to realize that human behaviors create pollution and that only changes in human behaviors can reduce it.

#### Objective:

1. To collect particles from the air.
2. To observe and classify particles according to properties.
3. To make inferences about sources of particles in the air.

#### Materials:

magnifiers, masking tape, petroleum jelly, plastic sandwich bags, plastic sheets, string, worksheet 1, paper punch, scissors.

#### Questions:

1. What kinds of particles can you find in the air? (dust, pollen, smoke)
2. What happens when the air becomes thick with particles? (People have a hard time seeing or breathing)
3. Identify places that might have many particles in the air. (home, school, industrial areas)

Procedure:

1. Distribute worksheet 1. Students will test for particles in the air.
2. Select 3 places to test and use the worksheet scale to record predictions about the degree of pollution expected each place to have.
3. Make particle detectors by cutting a sheet of plastic into 4 pieces. Each student needs only 3 sheets.
4. Punch a hole at the top of the 3 pieces of plastic.
5. Insert a 12cm piece of string through each hole and tie the string into a loop.
6. Place a thin coating of petroleum jelly on both sides of each piece of plastic and place in plastic bag. Use masking tape to label it with the area where it will hang. Remove detector from bag.
7. After 5 days bring particle detector bag to school.
8. Use a magnifier to observe particles. Record on chart 1 the actual degree of pollution and on chart 2 the sizes, shapes, colors and textures of particles.

Questions:

Which type of particle is most common? What areas had the most particles in the air? (heavy traffic areas, closed in areas, areas close to chimneys, blowers or moving air.)  
Have students discuss ways to limit air pollution.

Worksheet 1      Air Pollution

Chart 1: Degree of Pollution

1. Record where you plan to put each particle detector.
2. Record your prediction of the degree of pollution you think you will find  
(use the particle Pollution Scale below).
3. Record the actual degree of pollution for each area.

Particle	Area	Predicted degree	
Actual degree			
detector	tested	of pollution	of
pollution			

- 1.
- 2.
- 3.

Particle Pollution Scale

Degree	Description
--------	-------------

low	a few scattered particles
medium	spots on detectors or light layer overall
high	dark layer of particles overall

Chart 2: Analysis of Particles

1. For each particle detector, draw the size of the smallest and largest particle.
2. Record information about the shapes, textures, and colors of the particles.

Particle textures of detector particles	smallest colors of particle particles	largest particle	shapes of particles
---	---------------------------------------	------------------	---------------------

- 1.
- 2.
- 3.

If you wanted to clean up the air in the dirtiest area you found, what would you do?

Assessment:

An evaluation chart for each student listed to demonstrate ability to observe, classify, compare, organize data, interpret data, record data and make predictions.

This plan can be adapted to all grades.

State Goal 2 Gr. 6 Interpret the environmental implications of the changing lifestyles in society.

### Lesson 3

Background:

Contact the EPS's speaker bureau. Invite an air pollution expert to speak to students on air pollution and its effects and probable solutions. Also discuss air pollution standards. Introduce vocabulary: air pollution and density.

Objectives:

To estimate smoke density students will need to make a Ringelmann Smoke Density Chart.

Materials:

1-3x5 white index card per student, pencils and or crayons, paper

Procedure:

1. On a 3"x5" white index card draw four squares of equal size across the top.
2. Draw the same number and size of squares at the bottom of the card.
3. In the middle of the card, draw a rectangle 4 inches long and 1/2 inch wide.

4. Starting with the first square, shade it light grey with a pencil or crayon.
5. Shade the next square a little darker, the third square even darker, and so on, through all eight squares.
6. Number the squares in order by graduation, 1-8.
7. Cut out the center rectangle. This makes a Ringelmann Smoke Density Chart with which to observe smoke from smokestacks.
8. Observe smoke from factory smokestacks.
9. The gradations of density will approximate that of professional charts.
10. On a piece of paper, record the date, time, location and number from the smoke density chart which is closest to the color of the smoke coming from the smokestack.
11. Hold the chart up and sight through the slit to determine the best number.
12. Record the same data every day for a week or two and average the numbers.
13. Determine if this number meets air pollution standards in our area using information from the EPA air pollution guest speaker.

Discussion:

1. Discuss color associated with air pollution. Make an air pollution color chart: black, gray, red, yellow, orange.
2. Collect magazine pictures showing smog, smokestacks, and car exhaust. Post on a bulletin board next to the color chart. Discuss pictures and colors, their causes, effects and possible solutions.
3. Extend activity taking a poll of people's opinions on air pollution causes, effects, and solutions. Ask if pollution affects them physically and/or mentally.

Assessment: Students should be able to determine amounts and kinds of smoke in the air using the Ringelmann Smoke Density Chart and explain their findings.

This lesson is appropriate for intermediate and upper grades.

State Goal 2 Gr. 4 Compare and contrast specified environmental conditions.

State Goal 3 Gr. 4 Chart the changes in the physical environment that result from human activity.

# ***Air Quality Issues***

by Rosa M. Santos

a paper for background information

## **AIR**

When talking about air quality one must understand that there are certain components in the air. There are different levels on earth known as lower atmosphere, atmosphere, and stratosphere.

In the lower atmosphere, where we live, air is a gas composed of seventy eight percent nitrogen and twenty-one percent of oxygen (by volume). Water vapor is also present. The atmosphere is mixed with argon and carbon dioxide as high as the stratosphere.

Ozone is a gas in the stratosphere that absorbs large amounts of ultraviolet light from the sun, heating the stratosphere and protecting life on earth from solar radiation.

There are other gases which are human-made highly poisonous, like dioxin.

The level of oxygen must be high enough as for every living thing to survive breathing, but it also cannot be so high or it will cause damage to the whole planet, like catching on fire. Every single one those gases, no matter what the smallest amount may be, is important, playing a vital part in the protection of life on earth.

Balance has been the factor keeping all those gases for millions of years. Now man is upsetting such balance thus paying a high price by the problems that he is facing.

The ozone layer is being destroyed. The damage to the ozone layer will take fifty years to return to normal. The loss of ozone is believed to be caused by different chemicals and pollutants that decrease the concentrations that occur naturally in the stratosphere. Skin cancer is one bad consequence, skin rashes headaches, intestinal problems, birth defects; though scientists do not agree on these facts necessarily to be true.

Air pollution is the accumulation in the atmosphere of substances that endanger human health. Some major sources of pollution are burning oil, coal and natural gas which are power and heat generators. Others are the burning of solid wastes, industrial processes and vehicles. Whenever these are burned, waste products are polluting the air.

In Hawaii, measurement of carbon dioxide suggests that it is increasing in the atmosphere at a rate of twenty percent every year. It may alter the earth's climate increasing the average global temperature. The one pollutant that has affected humans more than any other is smog. It is a combination of two words smoke and fog in the air of cities, mostly from burning coal. It was recorded in London, England, of 4000 deaths in a severe fog in 1952. Visibility is affected by smog and it irritates the respiratory system; it contributes to malignancies of many types like eye infections and an increased number of coronary

cases have been observed. Very valuable pieces of art are deteriorated while exposed to the environment.

Two other very dangerous gases are carbon dioxide and methane from burned fossil fuels and from rotting vegetation from swamps or from mining. Methane also causes a slow down in the rate at which pollutants act, like sulfur dioxide that causes acid rain.

Meteorological conditions and land forms can influence air pollution concentrations like in cities located in valleys. That atmosphere can carry clouds to where it is then precipitated as acid rain thus causing serious damage to vegetation, waterways and constructions.

Herbicides is one product use to solve certain terrain problems, that has caused worst damage, like the one known as Agent Orange, used in the Vietnam War; now veterans are having health problems . There are also many more forms of air pollution like radioactivity. This one can not be seen or smelled. A very good example is what happened at Chernobyl, an accident at a nuclear power station, in Ukraine, in 1986, an explosion took place and many people were exposed to radioactivity.

Many cities are affected by air pollutants; among them are: Los Angeles, Detroit, Michigan, Chicago, New York, Gary (Indiana), Dallas, Philadelphia, and Birmingham (Alabama).

Air pollution is caused by lots of different pollutants. Cars and trucks are the greatest sources of pollution in USA More than 50% comes from motor vehicles, aircraft, trains, and boats, forest fires, even home's fireplaces. More than 200 million tons of air pollutants are released into the air over U.S. By 1900, air pollution became a serious problem and it has increased as time passes and population increases together with the growth of industrial centers.

In 1960 Congress passed the first law: The Clean Air Act, to help protect our environment. It is intended to reduce air pollution and acid rain. Deadlines to meet clean air standards have been set to control the amount of pollutants that plants can produce.

Also the Environmental Protection Agency helps protect environment. It was established in 1970 as it safeguards the environment in the USA It sets policies and standard; and does research. It is a part of the Federal government.

Numerous methods have been proposed for removing pollutants from the atmosphere, but nothing has worked. The only thing that has been practical is controlling at the source of production. So for one, automobiles now are equipped with catalytic devices to decrease emissions of carbon dioxide because for every 25 miles that car runs one pound of pollution is emitted into the air. Filters have been installed at power plants. Still it is not enough. Recycling is a solution for the situation, or the refusal of burying products that are dangerous. Also by reusing some materials.



We also have to be aware of the fact that we live depending on one another. Somehow, we have to consider what there is for us to do about this cause. We have to understand that we damage the atmosphere, the environment where we live, that we depend on it, we are part of it. We must learn and begin to show respect for the world we live in.

#### Bibliography

Brown, M., *The Toxic Cloud: A Cross-Country Report on the Poisoning of America's Air*, 1987.

Mackenzie, J.J., *Air Pollution's Toll on Forests*, 1990.

Nebel, B.J., *Environmental Science*, 1990.

# Air Quality

by Jane Wang Moy

## Lesson I

Objectives: Students will develop knowledge into the topic of ozone.

Recommended Time: one class period, 50 minutes

Materials:  
blackboard  
chalk  
pen  
paper

Advance Preparation:

Obtain copies of EPA publications: "Protecting the Ozone Layer"; "A Check List for Citizen Action Ozone Action Days."

Procedure:

Students will read the EPA literature. Students will list any type of vehicle or appliance or electric usage for a week. Have each student set up a schedule for the use of electricity and the appliance which add up to destroy the ozone.

Hands On Activity:

Make a TV schedule of popular programs for the class. Count the hours per person viewing. Then discuss by popular choice which programs could be eliminated from viewing. Discuss how many hours of electricity were saved. This is a solution to emitting charges into the ozone. Could the class decide a day and time to have a TV blackout to save the ozone?

Related Activities and Concepts:

Students could make signs to turn off appliances and lights not in use.

Concept to Other Everyday Examples:

Have students create daily schedules when certain appliances and conveniences should/shouldn't be used.

Summary:

By developing awareness into what depletes the ozone, students will take appropriate action to decrease electric charges which hurt the ozone.

**Home Activity/Parental Involvement:**

Students and parents could look for labels identifying products manufactured with or containing ozone depleting substances and consider alternatives.

**Lesson Assessment:**

Students will identify products and appliances which are harmful to the ozone through the emissions into the air. Students will explain the effects of certain gases from certain products which are harmful to the ozone.

**Lesson II**

**Objectives:**

Students will develop critical thinking and identify pollutants found in the home.

Recommended Time: 1 class period, 50 minutes

**Materials:**

posters

blackboard

EPA literature "The Inside Story of Air Pollution"

pen

paper

**Advance Preparation:**

Acquire copies of the EPA literature.

**Procedure:**

Have students work in groups. Each group will list the possible sources in each room of the chart of biological pollutants, smoke, hazardous vapors, gases and radon. After 30 minutes have each group report per room and list on the board those elements harmful to air quality.

**Hands On Activity:**

Students can take their list home and check sources of air pollutants they found in their home.

**Related Activity and Concept:**

Students can list or chart the pollutants and pass them out to survey and in form what is in the community. What materials and products could be eliminated from use?

**Connect to Everyday Examples:**

The home is one of the most dangerous areas due to the collection of possible pollutants or contaminating products.

**Summarize:**

Most homes have various hazardous areas of products in the kitchen, shower, fire place,

etc. Air pollution is invisible and requires awareness and vigilance for dangers such as radon or carbon dioxide.

**Home Activity/Parental Involvement:**

Share the list developed in class and discuss the source of pollutants in the home.

**Lesson Assessment:**

Given a list of materials and products, students will explain how it can be a source of pollution: disinfectant sprays, fireplaces, lead paint or lead pipes, car exhaust, sewage pipes, gas stoves, etc.

### **Lesson III**

**Objective:** Students will develop knowledge into the various ways a vehicle is an agent for pollution. Students will develop familiarity with cause and effect.

**Recommended Time:** 2 class periods, 100 minutes

**Materials:**

-EPA literature: "Your Car and the Environment"

**Advance Preparation:**

Acquire copies of the EPA literature.

**Procedure:**

Distribute booklets. Have students read myths and facts. Students will be responsible for discovering the various ways their vehicle and parts are agents of pollution. Divide the class in groups to prepare statements on the following: emissions, idling and revving, travel schedules, motor oils and filters, air conditioning, road conditions, reformulated gas, tires, batteries, spark plugs. Have students report and discuss cause and effects of auto parts and pollution.

**Hands On Activity:**

Students could create diagrams of cars and parts of cars which cause pollution as a check list.

**Related Activity and Concept:**

Students could list all the parts that a chop shop could reuse from a car. What items could not be recycled or reused?

**Connect to Other Everyday Examples:**

Cars require a sense of responsibility. Cars are necessary conveniences but through proper maintenance and use, it will not quickly become a source of pollution.

**Summary:**

Everything can be used or abused. Human behavior and a sense of responsibility helps decrease the problem of wasteful consumption which can reveal itself in types of pollution harmful to the environment.

Lesson Assessment:

Students will answer the question, "What is the energy efficiency rating of appliances in the home? What parts of the car require maintenance to reduce pollution?"

# Air Quality

by Bao Quach

## **Lesson I - Major Air Pollutants**

(7th grade L.E.P. students. Duration: 40 min.)

Objective: The students will be able to determine what are the potential sources of major air pollutants.

### Materials:

a piece of candle

matches

a plastic box with cover

### Activities:

-Show pictures of some heavily air-polluted cities where motorcyclists had to cover their noses and mouths with handkerchiefs knotted behind their heads, or news clippings about carbon monoxide poisoning.

-Students light the candle fixed inside the box. Cover the box. Measure the time elapsed until candle light went off.

-Have students explain the phenomenon and relate to life science.

-What is there in common between candle wax and gasoline?

-What is fossil fuel? Is it renewable or not?

-What substances are there in a car exhaust? Name the major pollutants.

-Divide class into groups of 3. Designate each group to find information in available reference books concerning a couple of pollutants then report to class.

-Reports should include sources of contaminant, actions and effects, remedial solutions individually and collectively.

-Major air pollutants:

carbon monoxide, what is incomplete combustion?

nitrogen oxides

sulfur dioxide

ozone

lead

asbestos

particulates

-Define level of tolerance.

### Evaluation:

What do you think is the key word for air pollution control? What would you do as an individual to reduce air pollution?

### Extension:

Besides the above-cited pollutants, what other physical factors do you think are potential

air pollutants susceptible to harm your body and mind as well?

## **Lesson II - Ground Level Ozone**

(6th grade L.E.P. students. Duration: 40 min.)

Objectives: The students will:

- understand where, when, and how ozone is generated
- distinguish the nocent effects of ground level O<sub>3</sub> from the protective effect of atmospheric ozone.

Materials:

a battery run toy car  
battery

Activities:

- Put the car on and hold it in your hand. Wait for 5 minutes.
- What did you smell? Was the odor due to heated paint or oil?
- Try again. Was it the same odor?
- Explain: Atmospheric oxygen combined to ionized oxygen under electrical discharge to form a new gas called ozone.
- Explain: ozone is not directly emitted into the air like other major air pollutants but is formed through reactions between NO<sub>x</sub> and volatile organic compounds in the presence of sunlight.
- Can you explain why we may smell ozone during heavy thunderstorms?
- What are the major sources of ozone?  
motor vehicles  
petroleum refineries  
oil storage tanks  
household products, petroleum marketing, chemical manufacturing, surface coating and printing industries.
- What are rush hours in cities? Can you predict what time ozone reaches peak levels in a day? Why?
- Ozone affects the lungs: asthma, lung functions reduced, chest pain coughing, wheezing and congestion
- Ozone affects vegetation: plant yield reduced (tomato, bean, soybean, snap bean, peanut and corn crops, premature leaf-drop in forests).
- Ozone causes cracking of rubber products, weakening of textiles, changes in dyes and premature cracking of paint.
- Projection of pictures of Los Angeles smog (if available).
- What can be done? Individual: reduce emissions, use solvent-free household products.  
Industries: regulations to reduce emissions.
- Distinguish with beneficial atmospheric ozone: U.V. protector.

Evaluation:

- What are the major sources of ground level ozone?

- What process keeps G.L.O. from joining atmospheric ozone? (t inversion)
- What can an individual do to reduce harmful G.L.O.?



**AIR & WASTE MANAGEMENT ASSOCIATION**

A&WMA curriculum on air quality located in the MWCOG offices.

## **U.S. EPA RESOURCES**

*AirNow:*

<http://www.airnow.gov/>

*EPA Student Center:*

<http://www.epa.gov/students/>

Curriculum resource page includes a list of website to gather further information.

*Particle Pollution :*

<http://www.epa.gov/air/urbanair/pm/>

EPA's Satellite Downlink Network offered a broadcast called "Air Quality Kits To Go -- Particle Series." The broadcast shows Agency employees at local schools teaching lessons dealing with air pollution, with a focus on Particulate Matter. Four teaching modules are included, each with a different grade level (K-2; 3-5; 6-8; and 9-12).

**NATIONAL 4-H COUNCIL**

“Going Places, Making Choices”

Transportation and the Environment – curriculum designed for grades 9 – 12

\*\*Kit is available at the MWCOG offices