

## **Title: Local Air Pollution**

### **Brief Overview:**

This lesson creates an awareness of environmental pollution by focusing on the issues air pollution and acid rain. The students will discuss the causes and effects of acid rain, and perform investigations to measure contributing pollutants in their local areas.

### **Links to NCTM 2000 Standards:**

#### **Measurement**

The students will make various measurements in order to calculate the chemical contents of local water supplies.

#### **Problem Solving**

Students will calculate the amount of pollutants and use mathematics to determine possible solutions to the identified problems.

#### **Communication**

Students will graph their findings to communicate their results with others

### **Links to Maryland Learning Outcomes Math Process and Math Content Stems:**

- **Process of Mathematics**

Students will use reasoning to solve problems in mathematics, and communicate the processes and solution(s). They will make connections with mathematics to other disciplines and to the real world.

- **Statistics and Probability**

Students will collect, organize, display, analyze and interpret data to make decisions and predictions. They will use observed data to determine probabilities of the predictions predictions.

### **Links to National Science Education Standards:**

- **Science as Inquiry**

The students will demonstrate the ability to employ the language, instruments, methods, and materials of science.

- **Applications of Science**

The students will demonstrate the ability to apply scientific information to various situations.

- **Science and Technology**

The students will demonstrate the ability to use the principles of technology while exploring scientific concepts.

### **Links to Maryland High School Science Core Learning Units:**

- **Science as Inquiry**

The students will demonstrate the ability to employ the language, instruments, methods, and materials of science.

- **Applications of Science**

The students will demonstrate the ability to apply science information in various situations.

- **Science and Technology**

The students will demonstrate the ability to use the principles of technology when exploring scientific concepts.

**Grade/Level:**

Grades 7-8

**Duration/Length:**

One rainy day and a weekend for follow up and extension.

**Prerequisite Knowledge:**

Students should have working knowledge of the following skills:

- Making scientific measurements
- Graphing
- Collecting data
- Limited internet use

**Student Outcomes:**

Students will be able to:

- define the term air pollution.
- describe the chemicals that contribute to air pollution and acid rain.
- use scientific equipment to collect pollution data.
- develop suggested solutions to the air pollution problem.
- utilize the internet to compare findings with other areas of the world.

**Materials/Resources/Printed Materials:**

- Funnels
- Beakers
- Filter paper
- Magnifying glass
- pH meter or pH paper
- Local Maps
- Internet access

**Development/Procedures:**

1. Define the term air pollution.
2. Describe the relationship between air pollution and acid rain.
3. Have the students gather articles that discuss the problems and possible solutions to acid rain from various sources such as; "National Geographic", "NASA Global Climate", "Water Ecology", "Air Ecology", magazine articles, educational text, and industrial and chemical factories.
4. Test for pollutants in the air by making a pollution collector. (See activity 1)
5. Determine the type of pollutants in a local area. (See activity 2)
6. Determine the pH of the rain in a local area (See activity 3)
7. Compare activity findings with other area findings by having an Internet pen pal do the same activities. (Extension/follow up)

**Assessment:**

- The activities have built in questions that will allow the teacher to determine the students understanding.
- The teacher will also be able to determine the students' understanding by setting up a debate about the possible solutions of pollution and acid rain based on the articles that the students were able to retrieve.

**Extension/Follow Up:**

Have the students establish an Internet pen pal who is able to perform the same acid rain and pollution activities. The students can then make comparisons of their local area to other areas around the world.

**Authors:**

Wavie Gibson III  
 Baltimore Polytechnic Institute  
 Baltimore City, MD

Peter Ezekwenna  
 University of Maryland Eastern Shore  
 Princess Anne, Maryland

Nicole Wise  
 Department of Defense

# Activity One

## Collecting Air Pollution

The air is full of particles. Many of these particles are pollutants. Sometimes these pollutants are picked up by the rain and carried to the ground. This activity will help determine how much air pollution there is in your area.

### Materials (per group):

3 Funnels  
(3) 500 ml beakers  
3 different mils of filter paper  
Magnifying glass

### Procedures:

1. Fold a circular piece of filter paper into a cone shape and place it into the funnel. Repeat this for each funnel and piece of filter paper. (See any chemistry lab book for shaping the filter paper into a cone)
2. Place the funnels into the beakers. (You may need to use a triangle to hold the funnel up right).
3. Monitor the weather forecast to see when it is going to rain. Then place the apparatus outside to collect the rain.
4. Monitor the wind direction on the day that it rains to help determine where the pollution might be coming from.
5. Remove the filter after the rain stops, open it and let it dry.
6. Examine the filter paper with a magnifying glass.
7. Record your observations.
8. You may want to determine the mass of the filter paper before and after the collection in order to help determine if any particles were collected.

### Questions and Analysis:

1. Are there any particles of pollution?
2. Where do you think the pollution particles come from?
3. Explain why wind direction is important in this activity.

## Activity Two

### Sulphur Dioxide Pollution

Sulphur Dioxide ( $\text{SO}_2$ ) is one of the chemical components of acid rain. It can come from many different sources. However, it primarily comes from coal burning facilities. One of the indicators of  $\text{SO}_2$  is lichens. You will use the presence of lichens to determine the amount of  $\text{SO}_2$  in a local area.

#### Materials:

Map of the local area

#### Procedures:

1. Define lichens and shrubs and identify what they look like.
2. Look at the buildings in your area (buildings, walls, roofs, and gravestones) to find lichens.
3. Mark the spots where lichens were found on the map of the local area.
4. Identify the differences in the areas where the lichens were found.

#### Note:

Lichens will not be found where there is an enormous amount of pollution, but they thrive in the presence of sulfur dioxide.

#### Questions:

1. If you start in the middle of town and move toward the outskirts of town, do you see a difference in the quantity of lichens? Explain why there may be a difference.
2. Draw or paste a picture of lichens here.
  
3. How do lichens help you to determine sulphur dioxide levels?

## Activity Three

### pH of Rain

Acid rain is the result of nitrous oxide and sulphur oxide products mixing with the water in the atmosphere. Rain is naturally acidic, however, when the  $\text{SO}_x$  and  $\text{NO}_x$  compounds mix with the rain the pH is even more acidic. This activity will determine the pH of local rain water.

### Materials:

500ml beaker  
pH meter or pH paper

### Procedures:

1. Monitor the weather forecast to see when it is going to rain in your area. Then place a 500ml beaker where it can collect rain water.
2. Use pH paper or a pH meter to determine the pH of the rain water.
3. Make note of the wind direction on that day.
4. Record your results.

### Questions and Analysis:

1. What is the normal pH of rain?
2. What is the pH of the rain water that was collected?
3. Explain why wind direction is important in acid rain.
4. What factors could contribute to a low pH of acid rain?