



Lesson 6 Activity 1

Reading 1

Since the beginning of time, humans have learned to make use of many things in nature such as fire and electricity. From the early times through the Industrial Revolution to the Space Age, humans have produced inventions that use many of the earth's varied energy resources to make living easier. In many cases the energy comes from burning fossil fuels—coal, oil and natural gas.

Some of the inventions that make our lives easier are also causing pollution. Pollution is the release of harmful substances into the environment. One form of pollution is acid rain. Acid rain is any form of rain that is more acidic than normal (with a pH lower than 5.6). Pure water has a pH of 7, normal rainfall has a pH of a bit less than 7, but acid rain can have a pH of about 5.0-5.5, and even in the 4 range in the northeastern United States.

Acid rain can damage plants, animals, soil, water, building materials, and people. Scientists have discovered that air pollution from the burning of fossil fuels is the major cause of acid rain. People burn fossil fuels such as coal and oil to make electricity. Electricity heats and lights buildings and runs appliances such as televisions and video recorders. Fossil fuels power our cars, buses, and airplanes. The air pollution created when these fuels burn does not stay in the air forever. It can return to the earth as acid rain. And when it does, it may weaken the plant and animal life it contacts. Acid rain is only one form of pollution that results from burning fossil fuels. It is one of particular interest, however, because it can be transported over long distances. Scientists, engineers, and researchers are learning how to measure the amount and effects of pollution in the air, forests, water, and soil. They are inventing ways to reduce the amount of pollution that enters the environment and prevent new damage in the future.

The smoke and fumes from burning fossil fuels rise into the atmosphere and combine with the moisture in the air to form acid rain. The main chemicals in air pollution that create acid rain are sulfur dioxide (SO_2) and nitrogen

oxide (NO_x). Acid rain usually forms high in the clouds where sulfur dioxide and nitrogen oxides react with water, oxygen, and oxidants. This mixture forms a mild solution of sulfuric acid and nitric acid. Sunlight increases the rate of most of these reactions. Rainwater, snow, fog, and other forms of precipitation containing those mild solutions of sulfuric and nitric acids fall to earth as acid rain.

The chemical reactions that change air pollution to acid rain can take from several hours to several days. Years ago, when smokestacks were only a few stories high, pollution from smokestacks usually stayed near the ground and settled on land nearby. This caused unhealthy conditions for plants and animals near the smokestacks. To reduce this pollution, the government passed a law permitting the construction of very tall smokestacks. At that time, people thought that if the pollution were sent high into the air it would no longer be a problem. Scientists now know that this is incorrect. Sending pollution high into the sky increases the time that the pollution stays in the air. The longer the pollution is in the air, the greater are the chances that the pollutants will form acid rain. In addition, the wind can carry these pollutants for hundreds of miles before they become joined with water droplets to form acid rain. For that reason, acid rain can also be a problem in areas far from the polluting smokestacks.

The region of the Continental United States most affected by acid rain is the Northeast, where pH levels of between 4.0 and 4.5 are commonplace. Notably, the most rapid increase in acid precipitation in the U.S. seems to be in the Southeast, an increase paralleling the expansion of Southeastern urban and industrial activities that result in sulfur and nitrogen emissions.

West of the Mississippi, rain is generally neutral or even alkaline. Colorado, the Los Angeles Basin, the San Francisco Bay Area, Spokane, Tucson, and Portland are the known exceptions. In these locations, as in the Northeast, precipitation ranges from between pH 4.0 to 5.0.

Source: *Acid Rain. A Student's First Sourcebook.* EPA, Washington, DC



WHAT IS ACID RAIN

Lesson 6 Activity 1 STUDENT WORKSHEET 1

1. Define acid rain: _____

2. Explain the pH difference between acid rain and pure water: _____

3. Describe the major cause of acid rain: _____

4. Why is acid rain of particular interest? _____

5. What are the main chemicals in air pollution that create acid rain? _____

6. How long does the chemical reactions take that change air pollution to acid rain? _____

7. What did the U.S. government do at first to reduce the pollution from smokestacks? _____

8. How successful was this government action? _____

9. Which region of the Continental United States is the most affected by acid rain? _____

10. Which region is the least affected by acid rain? _____

