

Testing Acid, Tracking Rain

Air pollution occurs in two forms—particulate and gaseous. Particulate pollution consists of small liquid or solid particles, such as tiny droplets, ash, and soot. Wind currents carry these particles until they settle out after the wind has calmed. Gaseous pollution consists of chemical gases that are vaporized during combustion and industrial processes. The gases mix with air and sometimes chemically combine to form other substances. Oxides of nitrogen, sulfur, and carbon react with water vapor to form acids. When these acidic vapors condense into liquid droplets, the result is acid rain.

Acid rain has both direct and indirect effects on organisms. Direct effects include the death of aquatic plants and animals and the injury and death of trees that take up acidic water. Indirect effects include the leaching of elements from soil and the deaths of organisms that depend on other organisms killed directly by acid rain.

The major source of sulfur and nitrogen oxides is the combustion of fossil fuels, including coal burned in power plants and gasoline burned in vehicles. Because these gaseous pollutants are airborne, they can easily travel hundreds of miles from their source before combining with water and falling to Earth's surface as rain, snow, or sleet. In this lab, you will test various substances for acidity and examine how acid rain is formed and distributed.

OBJECTIVES

Describe the acidity of common substances.

Interpret the distribution of acid rain to determine its source.

MATERIALS

- distilled water
- dropper pipet
- Erlenmeyer flask
- pH paper
- soda straw, disposable
- solutions, variety, from acid to base



Testing Acid, Tracking Rain *continued*

Procedure**PART I—WHAT'S YOUR PH?**

First, you will learn how to measure acidity using the pH scale. pH is a measure of the number of free hydrogen ions in a solution. Ions are atoms or groups of atoms that have a positive or negative electrical charge. Solutions with a low pH have many hydrogen ions (H^+) and are called acidic. Solutions with a high pH have relatively few hydrogen ions and are called basic. Your teacher will give you a variety of common chemical solutions.

- 1. CAUTION: Exercise extreme care when handling strong acids and bases.** Put on safety goggles and a lab apron.
- 2.** Place a drop of each solution on a fresh piece of pH paper.
- 3.** Match the resulting color to the pH scale, and identify the pH.
- 4.** List the substances and their pH values below.

- 5.** How does your pH paper indicate an acid? A base? What color indicates a pH of 7?

- 6.** Which of the substances you tested are strong acids? Which are strong bases?

PART II—DRAGON BREATH

Did you know that you could create acid by breathing? Carbon dioxide from your breath combines with water vapor in the air to form carbonic acid, H_2CO_3 , which separates into H^+ and HCO_3 in liquid. You will need a soda straw, an Erlenmeyer flask, distilled water, and pH paper.

- 7.** Check the pH of the distilled water, and record it in the chart below.
- 8.** Gently blow through the straw into the water for 10 seconds. Check and record the water's pH again.

Testing Acid, Tracking Rain *continued*

9. Blow for 10 more seconds and record the pH. **CAUTION: Be sure to pause and rest between each 10-second interval so that you do not hyperventilate and become dizzy.**
10. Repeat the procedure until you have exhaled through the water for 120 seconds.

pH of Water into Which You Exhale													
Time (s)	0	10	20	30	40	50	60	70	80	90	100	110	120
pH													

11. Describe the change in pH in the water when you exhaled. Did this form a strong or weak acid?

PART III—FIND THE RAIN'S FINGERPRINT

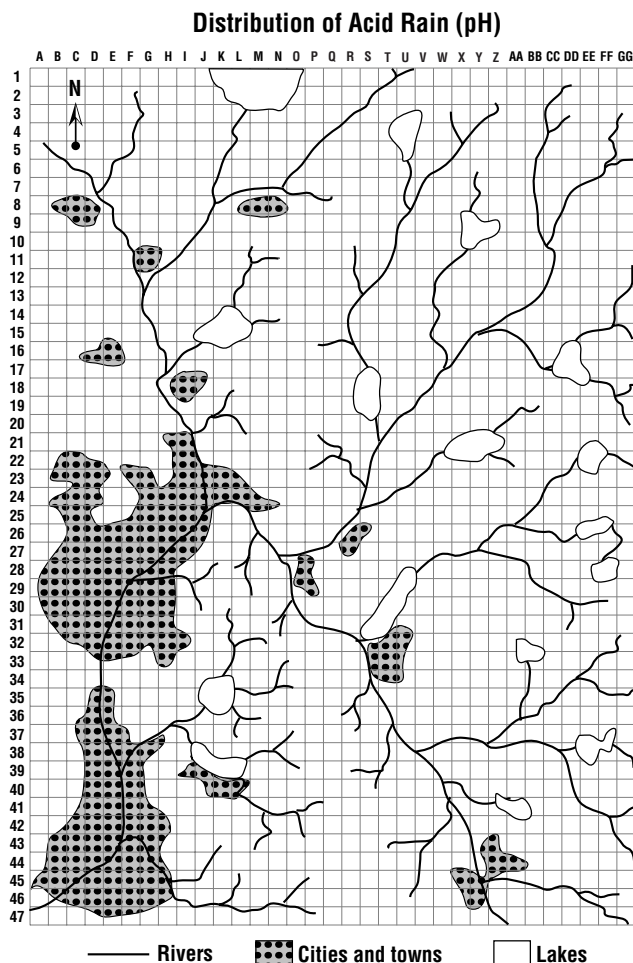
Rainwater normally has a pH of about 5.6. This is slightly more acidic than the pH of pure water, which is about 7. Acid rain has a pH of 5 or lower. By conducting pH tests and studying the distribution of acidified water bodies, you can trace acid rain to its source.

Analysis

1. **Organizing Data** Use the information in the chart below to find areas with pH values of 5 or lower. Then mark these areas on the following map. The prevailing winds in this region blow from west to east. Using this information, study the map and determine where you think the most likely source of the acid rain is, and mark the spot with an "X." Draw an arrow on the map showing the direction that the acidic pollution travels from its source.

pH at Various Coordinates on the Map								
Coordinates	M2	U4	L8	Y10	G13	K15	S19	DD17
pH	7.4	7.2	7.3	7.3	7.3	7.0	7.1	7.1
Coordinates	Y22	EE22	N27	FF26	FF28	J22	J26	029
pH	6.7	4.9	6.2	4.7	4.8	7.3	6.8	5.0
Coordinates	U30	BB33	K35	K39	FF38	AA41	U38	F42
pH	4.5	5.0	6.0	6.5	5.8	6.0	5.5	6.7

Testing Acid, Tracking Rain *continued*



Conclusions

2. Analyzing Graphs Write a paragraph in which you identify the source of the air pollution and its general path through the region. Describe how you made your choice, and provide evidence to support your decision. Hint: Sulfur dioxide, produced primarily by power plants that burn fossil fuels, mixes with air. It takes time to form sulfuric acid, so the acid rain is likely to fall some distance from the sulfur dioxide source.
