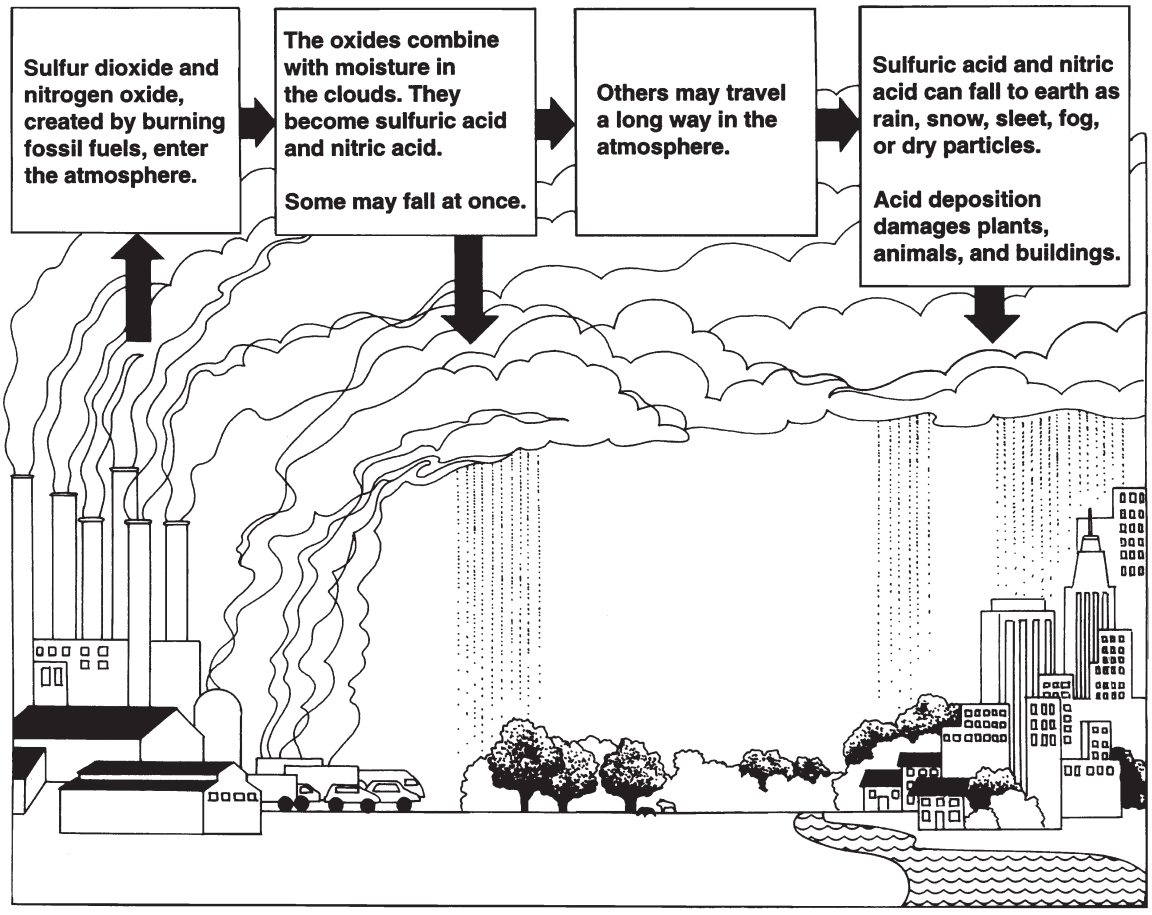
Reading Selection

The Story behind Acid Rain

There is a lot of talk these days about acid rain. Do you know what acid rain is? Do you know if humans are involved in causing it?

The problem begins when we burn coal, oil, and gas, which are called **fossil fuels.** We burn these fuels in our cars, homes, or factories. Burning fuels release sulfur and nitrogen, which chemically combine with oxygen in the air. In this new combined form, the chemicals are known as **sulfur dioxide** and **nitrogen oxide.** Sulfur dioxide and nitrogen oxide are harmful to the environment and are called **pollutants.** (A pollutant is anything that can harm living organisms when too much of it is released into an ecosystem.) Both of those pollutants escape through smokestacks, chimneys, and tailpipes and climb skyward as the fuel burns. Over 20 million tons of each of these two pollutants move into the atmosphere each year.

Sometimes these pollutants fall to the earth with dry particles, such as dust. Other times these pollutants become trapped by moisture in the clouds. When these pollutants chemically combine with water, they form new chemicals called **acids.** As you can see in the illustration, these acids (**sulfuric acid** and **nitric acid**) fall to earth in rain, snow, sleet, hail, or fog. This is polluted rain, called **acid rain** or **acid deposition.** Acid deposition can damage plants, animals, and buildings.



How acid rain is formed

How Do We Measure Acidity?
We can divide all chemicals into three categories: acid, base, or neutral. You already know some acids, such as vinegar and lemon juice. They have a sour, biting taste.

The chemical opposite of an acid is a **base.** Some bases you might know are baking soda, liquid bleach, and milk of magnesia (for acid indigestion!).

What happens when you mix an acid with a base? You make a **neutral** substance that is neither acid nor base. In other words, you have neutralized the acid with a base.

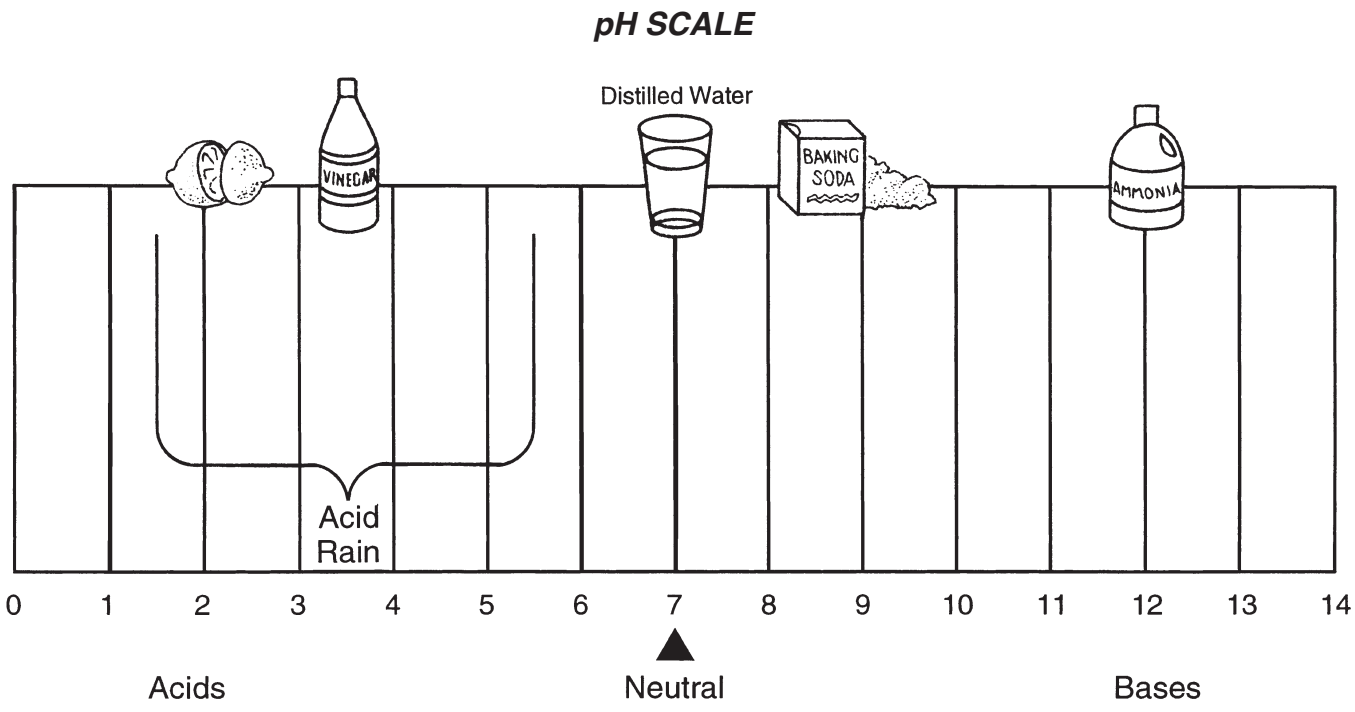
You already know there are degrees of temperature. Well, there are also degrees of acid and base. We use a special scale to measure acids and bases. It's called the **pH scale.**

The pH scale ranges from 0 (extremely acidic) to 14 (extremely basic). In between is 7, or neutral. Remember that the lower the number, the more acidic something is.

Use the pH scale below to answer these questions:

- Look at the pH scale and find pure distilled water. What is its pH? Is it an acid, base, or neutral?
- Locate the section labeled acid rain. What is the range of pH for acid rain? What are some other things that fall into the same range?
- Normal, uncontaminated rain is slightly acidic. Put your finger on the scale to show where normal rain might fall.

Why Are We Worried about Acid Rain?
A little acid in rain is normal. But a lot of acid rain disturbs many ecosystems, especially aquatic ones. For example, some kinds of animals are more sensitive to acid than others. While an adult wood frog can live in water with a pH level of 4, certain fish (like the rainbow trout and the smallmouth bass) cannot survive below pH 5.



Clams, crayfish, snails, and mayflies are in trouble at pH 6. The eggs and larvae of aquatic creatures seem even more sensitive to low pH. Fewer eggs hatch, and fewer creatures grow to adults.

It's not easy for experts to measure acid rain's effects on terrestrial ecosystems. But it seems that too much acid in the soil may harm plants' root systems. Acid rain also seems to damage the leaves of sensitive trees.

Acid rain seems to change the soil, too. Acid releases certain chemicals (like aluminum) that normally stay locked up in the soil. These chemicals can poison some plants.

What Can We Do to Help?

Do you remember that when we burn fossil fuels, we generate the pollutants that form acid rain? The energy in fossil fuels heats, cools, and lights our homes. It also runs our vehicles, cooks our food, and runs our machinery. We aren't going to stop doing these things altogether. But we can each try to cut down. Every time we walk or bike instead of driving, or turn down the heat, or shut off extra lights, we help prevent pollution.

Reading Selection

Crops and Cows—What's the Problem?

Farming, or **agriculture,** produces the fruits, vegetables, and grains we need to survive. But the fertilizer used to grow these crops also pollutes our water systems. How can this be? Chemical fertilizers run off from fields. And animal manure runs off from barnyards and feedlots. Both are washed into ponds, streams, rivers, oceans, and even the water that runs underground.

Agricultural runoff

How Can a Fertilizer Pollute?
These **fertilizers** are rich in nutrients, especially nitrogen, phosphorus, and potassium. That's how they help crops grow. But if you think of a pollutant as anything that can harm living organisms when too much of it is released into the ecosystem, then fertilizers can be pollutants, too. Excess fertilizer can provide too many nutrients in a water system. So the body of water and the plants in it become too "well fed."

Overfed plants can grow so quickly that they choke waterways. When overfed, algae also reproduce rapidly. (This is called an **algae bloom,** which turns the water a bright green.) When the plants use up the nutrients in the water, they die and rot. When bacteria feed on this dead material, they use up valuable oxygen.

Manure is rich in nutrients, too. It also carries bacteria with it. In the water, these bacteria have a population explosion. This increase in bacteria takes away oxygen from the water. Sometimes, the bacteria use up so much oxygen that the plants and animals in the water suffocate and die.

What Can We Do?
We want to keep growing good crops. And many farmers need to keep raising cattle. So we will need to find solutions for the runoff problem. Many experts are researching ways to keep pollutants out of the water. They're trying to find out exactly how much fertilizer to spread on the soil for each type of crop. That way we won't use any more than we need. And the extra fertilizer won't wash into the water. Other scientists are experimenting with ways to recycle manure cheaply. What are your ideas?

Reading Selection

When Salt Isn't Safe

Have you ever ridden in a car in a snowstorm? Then you probably know that the roads can get awfully slippery. And that makes driving dangerous. In parts of the country where winters are fierce, the highway departments spread a mixture of sand and **road salt** on the roads. The sand helps tires get a grip. And the salt melts ice.

We want people who travel on these icy roads to be safe. But we are also concerned about the damage salt does. When spring comes and the snow and ice melt, salt dissolves in the water. Then passing cars wash or spray the salty water out to the roadside.

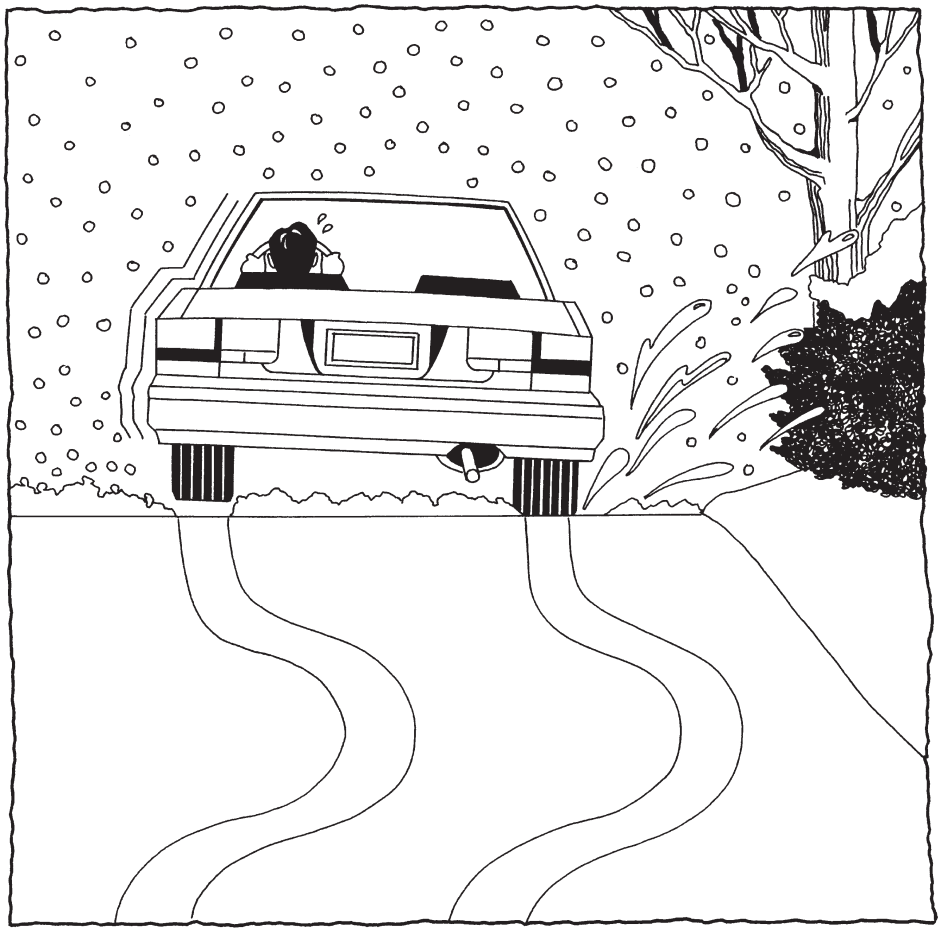
At the roadside, salt coats the bark of trees and soaks down into their roots. It "burns" the tops of tender new plants just coming out of the soil. Salt also covers plants that roadside animals such as rabbits and woodchucks depend on for food and shelter. It goes down through the soil to the water system below ground. Eventually, it runs into other bodies of water.

When salt enters a body of water such as a stream or a lake, it can cause harm there, too. Both plants and animals are sensitive to salt in different degrees. Take the egg and larval stages of many aquatic animals, for instance. Even the slightest increase in salt can kill them.

Is there a solution? We know that there are other chemicals that can melt ice just as well as salt does. However, these chemicals are more expensive. And while officials want the roads to be safe, they must consider costs when they make their decisions.

It's a Trade-off

Some areas have started using less harmful, but more expensive, chemicals. But many other areas are still dumping tons of salt on the roads every winter. If you were an official, what would you do?



Salt helps melt the ice and lets tires grip the road, but it can be harmful, too.