

# Describing Acids and Bases

## Reading Preview

### Key Concepts

- What are the properties of acids and bases?
- Where are acids and bases commonly used?

### Key Terms

- acid • corrosive • indicator
- base

## Target Reading Skill

**Asking Questions** Before you read, preview the red headings. In a graphic organizer like the one below, ask a what question for each heading. As you read, write the answers to your questions.

Describing Acids and Bases

Question	Answer
What is an acid?	An acid is . . .

Lab  
ZONE

## Discover Activity

### What Colors Does Litmus Paper Turn?



1. Use a plastic dropper to put a drop of lemon juice on a clean piece of red litmus paper. Put another drop on a clean piece of blue litmus paper. Observe.
2. Rinse your dropper with water. Then test other substances the same way. You might test orange juice, ammonia cleaner, tap water, vinegar, and solutions of soap, baking soda, and table salt. Record all your observations.
3. Wash your hands when you are finished.

### Think It Over

**Classifying** Group the substances based on how they make the litmus paper change color. What other properties do the items in each group have in common?

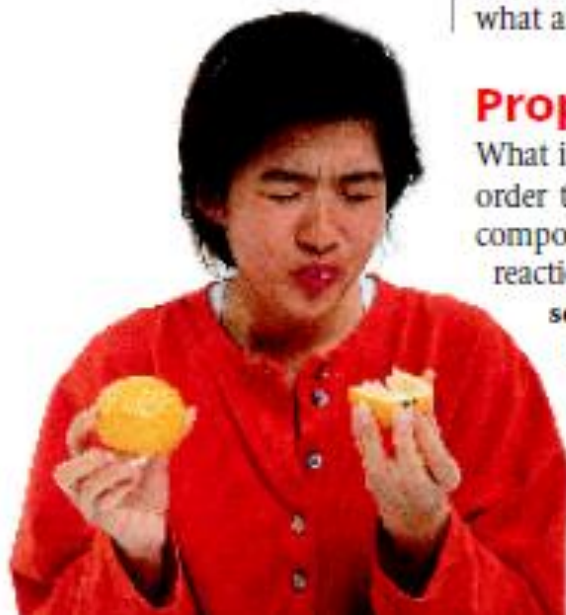
Did you have any fruit for breakfast today—perhaps an orange, an apple, or fruit juice? If so, an acid was part of your meal. The last time you washed your hair, did you use shampoo? If your answer is yes, then you may have used a base.

You use many products that contain acids and bases. In addition, the chemical reactions of acids and bases even keep you alive! What are acids and bases—how do they react, and what are their uses?

## Properties of Acids

What is an acid, and how do you know when you have one? In order to identify an acid, you can test its properties. **Acids** are compounds whose characteristic properties include the kinds of reactions they undergo. **An acid is a substance that tastes sour, reacts with metals and carbonates, and turns blue litmus paper red.** Some common acids you may have heard of are hydrochloric acid, nitric acid, sulfuric acid, carbonic acid, and acetic acid.

◀ Lemons are acidic.





**Sour Taste** If you've ever tasted a lemon, you've had first-hand experience with the sour taste of acids. Can you think of other foods that sometimes taste sour, or tart? Citrus fruits—lemons, grapefruits, oranges, and limes—are acidic. They all contain citric acid. Other fruits (cherries, tomatoes, apples) and many other types of foods contain acids, too.

Although sour taste is a characteristic of many acids, it is not one you should use to identify a compound as an acid. Scientists never taste chemicals in order to identify them. Though acids in sour foods may be safe to eat, many other acids are not.

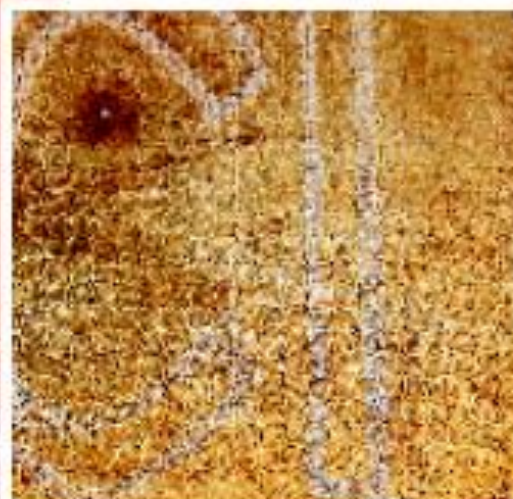
**Reactions With Metals** Do you notice the bubbles in Figure 12? Acids react with certain metals to produce hydrogen gas. Not all metals react this way, but magnesium, zinc, and iron do. When they react, the metals seem to disappear in the solution. This observation is one reason acids are described as **corrosive**, meaning they “eat away” at other materials.

The metal plate in Figure 12 is being etched with acid. Etching is one method of making printing plates that are then used to print works of art on paper. To make an etching, an artist first coats a metal plate with an acid-resistant material—often beeswax. Then the design is cut into the beeswax with a sharp tool, exposing some of the metal. When the plate is treated with acid, the acid eats away the design in the exposed metal. Later, ink applied to the plate collects in the grooves made by the acid. The ink is transferred to the paper when the etching is printed.

**FIGURE 12**

**Etching With Acid**

Metal etching takes advantage of the reaction of an acid with a metal. Lines are cut in a wax coating on a plate. Here, hydrochloric acid eats away at the exposed zinc metal, forming bubbles you can see in the close-up. **Applying Concepts** What gas forms in this reaction?





**Reactions With Carbonates** Acids also react with carbonate ions in a characteristic way. Recall that an ion is an atom or a group of atoms that has an electric charge. Carbonate ions contain carbon and oxygen atoms bonded together. They carry an overall negative charge ( $\text{CO}_3^{2-}$ ). One product of an acid's reaction with carbonates is the gas carbon dioxide.

Geologists, scientists who study Earth, use this property of acids to identify rocks containing certain types of limestone. Limestone is a compound that contains the carbonate ion. If a geologist pours dilute hydrochloric acid on a limestone rock, bubbles of carbon dioxide appear on the rock's surface.

**Reactions With Indicators** If you did the Discover activity, you used litmus paper to test several substances. Litmus is an example of an **indicator**, a compound that changes color when in contact with an acid or a base. Look at Figure 13 to see what happens to litmus paper as it is dipped in a solution containing acid. Vinegar, lemon juice, and other acids turn blue litmus paper red. Sometimes chemists use other indicators to test for acids, but litmus is one of the easiest to use.

## Properties of Bases

**Bases** are another group of compounds that can be identified by their common properties. **A base is a substance that tastes bitter, feels slippery, and turns red litmus paper blue.** Bases often are described as the "opposite" of acids. Common bases include sodium hydroxide, calcium hydroxide, and ammonia.

FIGURE 13

### The Litmus Test

Litmus paper is an easy way to identify quickly whether an unknown compound is an acid or a base. **Inferring** What can you infer about a liquid that does not change the color of blue litmus paper?





**FIGURE 14**  
**Slippery Feel of Bases**  
Most soaps contain bases, which make them feel slippery.

**Bitter Taste** Have you ever tasted tonic water? The slightly bitter taste is caused by the base quinine. Bases taste bitter. Soaps, some shampoos, and detergents taste bitter too, but you wouldn't want to identify these as bases by a taste test!

**Slippery Feel** Picture yourself washing a dog. As you massage the soap into the dog's fur, you notice that your hands feel slippery. This slippery feeling is another characteristic of bases. But just as you avoid tasting a substance to identify it, you wouldn't want to touch it. Strong bases can irritate or burn your skin. A safer way to identify bases is by their other properties.

**Reactions With Indicators** As you might guess, if litmus paper can be used to test acids, it can be used to test bases, too. Look at Figure 13 to see what happens to a litmus paper as it is dipped in a basic solution. Bases turn red litmus paper blue. Like acids, bases react with other indicators. But litmus paper gives a reliable, safe test. An easy way to remember which color litmus turns for acids or bases is to remember the letter *b*. Bases turn litmus paper blue.

**Other Reactions of Bases** Unlike acids, bases don't react with carbonates to produce carbon dioxide. At first, you may think it is useless to know that a base doesn't react with certain chemicals. But if you know what a compound doesn't do, you know something about it. For example, you know it's not an acid. Another important property of bases is how they react with acids. You will learn more about these reactions in Section 4.



What is one safe way to identify a base?



For: Links on acids and bases  
Visit: [www.SciLinks.org](http://www.SciLinks.org)  
Web Code: scn-1233



FIGURE 15

## Uses of Acids

Acids play an important role in our nutrition and are also found in valuable products used in homes and industries.

### Acids and Food ▼

Many of the vitamins in the foods you eat are acids.



Tomatoes and oranges contain ascorbic acid, or vitamin C.

Folic acid, needed for healthy cell growth, is found in green leafy vegetables.

### Acids in the Home ▶

People often use dilute solutions of acids to clean brick and other surfaces. Hardware stores sell muriatic (hydrochloric) acid, which is used to clean bricks and metals.



### Acids and Industry ▼

Farmers and manufacturers depend on acids for many uses.



Nitric acid and phosphoric acid are used to make fertilizers for crops, lawns, and gardens.



Sulfuric acid is used in car batteries, to refine petroleum, and to treat iron and steel.

## Uses of Acids and Bases

Where can you find acids and bases? Almost anywhere. You already learned that acids are found in many fruits and other foods. In fact, many of them play important roles in the body as vitamins, including ascorbic acid, or vitamin C, and folic acid. Many cell processes also produce acids as waste products. For example, lactic acid builds up in your muscles when you make them work hard.

Manufacturers, farmers, and builders are only some people who depend on acids and bases in their work. **Acids and bases have many uses around the home and in industry.** Look at Figure 15 and Figure 16 to learn about a few of them. Many of the uses of bases take advantage of their ability to react with acids.



Reading  
Checkpoint

What vitamin is an acid?



FIGURE 16  
**Uses of Bases**

The reactions of bases make them valuable raw materials for a range of products.



#### Bases and Industry ▲

Mortar and cement are manufactured using the bases calcium oxide and calcium hydroxide. Gardeners sometimes add calcium oxide to soil to make the soil less acidic for plants.

#### Bases in the Home ▶

Ammonia solutions are safe to spray with bare hands, but gloves must be worn when working with drain cleaners.



#### Bases and Food ▼

Baking soda reacts with acids to produce carbon dioxide gas in baked goods. Without these gas bubbles, this delicious variety of breads, biscuits, cakes, and cookies would not be light and fluffy.



## Section 3 Assessment

**Target Reading Skill Asking Questions** Work with a partner to check the answers in your graphic organizer.

### Reviewing Key Concepts

- Listing** What are four properties of acids? Of bases?
  - Describing** How can you use litmus paper to distinguish an acid from a base?
  - Applying Concepts** How might you tell if a food contains an acid as one of its ingredients?
- Reviewing** What are three practical uses of an acid? Of a base?
  - Making Generalizations** Where are you most likely to find acids and bases in your own home? Explain.

- Making Judgments** Why is it wise to wear gloves when spreading fertilizer in a garden?

### Writing in Science

**Wanted Poster** A bottle of acid is missing from the chemistry lab shelf! Design a wanted poster describing properties of the missing acid. Also include descriptions of tests a staff member from the chemistry lab could safely perform to determine if a bottle that is found actually contains acid. Add a caution on your poster that warns people not to touch any bottles they find. Instead, they should notify the chemistry lab.