

# Solutions of Acids and Bases

## BEFORE YOU READ

After you read this section, you should be able to answer these questions:

- What does a strong acid or base produce in a solution?
- What does a weak acid or base produce?
- What happens when an acid reacts with a base?
- What do we use to measure pH?



California Science Standards

8.5.e

## What Is a Strong Acid or Base?

Acids and bases can be strong or weak. The strength of an acid or base is not the same as the concentration of an acid or a base. *Concentration* means the amount of acid or base dissolved in water. The strength of an acid or base depends on the number of ions formed when they dissolve in water. ✓

### STRONG VERSUS WEAK ACIDS

As an acid dissolves in water, the acid's molecules break apart to form hydrogen ions ( $H^+$ ). In water, all of the molecules of a *strong acid* break apart forming many ions. Sulfuric acid, nitric acid, and hydrochloric acid are all strong acids. But if you mix a weak acid in water, only a few of its molecules break apart. So, there are only a few hydronium ions in a solution of a weak acid. Acetic acid, citric acid, and carbonic acid are all weak acids. ✓

### STRONG VERSUS WEAK BASES

A base is strong if it forms many hydroxide ions ( $OH^-$ ) when dissolved in water. Sodium hydroxide, calcium hydroxide, and potassium hydroxide are strong bases. When only a few ions are formed, the base is a weak base. Two weak bases are magnesium hydroxide and aluminum hydroxide.



Antacids are weak bases. They help relieve your stomachache by reacting with acid in your stomach.

## STUDY TIP

**Discuss** Read this section silently. With a partner, take turns telling what it is about. Stop to discuss ideas and words that confuse you.

## READING CHECK

**1. Explain** What does the concentration of an acid or base solution tell you?

---



---



---

## READING CHECK

**2. Explain** What is the difference between a strong acid and a weak acid?

---



---



---



---



---

**SECTION 3** Solutions of Acids and Bases *continued***What Happens When Acids and Bases Mix?**

The base in an antacid reacts with the acid in your stomach. Why does your stomach feel better? Because the reaction between acids and bases makes the excess acid in your stomach neutral. This is called a **neutralization reaction**.

In a neutralization reaction, hydrogen ions ( $H^+$ ) from the acid combine with hydroxide ions ( $OH^-$ ) from the base. This reaction forms water, which is neutral. The other ions in the acid and base solution combine to form a compound called a *salt*. ✓

**READING CHECK**

**3. Describe** What is formed by a neutralization reaction?

---

**READING CHECK**

**4. Describe** What is pH?

---



---



---

**5. Name** What kind of solution has a high pH value? What kind has a low pH value?

---



---

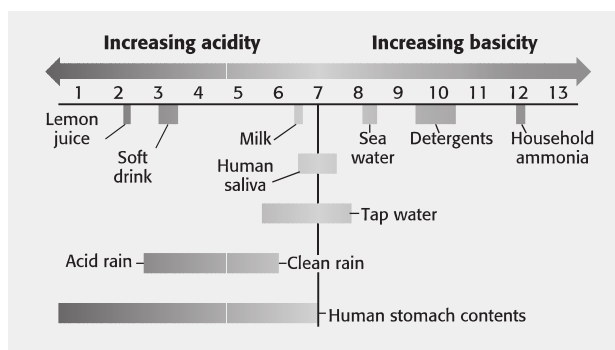


---

**THE pH SCALE**

An indicator such as litmus can show us if a solution contains an acid or a base. We use the pH scale to describe how acidic or basic a solution is.

The **pH** of a solution is a measure of how many hydronium ions it has. A solution that has a pH of 7 is neutral. A neutral solution is not acidic and it is not basic. Pure water has a pH of 7. Basic solutions have a pH greater than 7. Acidic solutions have a pH less than 7. ✓

**pH Values of Common Materials****USING INDICATORS TO FIND pH**

There are several ways to find out how basic or acidic a solution is. For example, strips of pH paper have several different indicators on them. When you dip them into a solution, the pH paper changes color. You can compare that color to a color scale to find the pH of the solution. People use this kind of indicator to test the pH of water in swimming pools.

Another way to find the pH of a solution is to use an electronic device called a *pH meter*. These meters measure hydronium ion concentration in the solution.

**SECTION 3** Solutions of Acids and Bases *continued***pH AND THE ENVIRONMENT**

Living things depend on having a steady pH in their environment. Some plants, such as pine trees, like to grow in acidic soil. The soil has a pH between 4 and 6. Other plants, such as lettuce, need basic soil that has a pH between 8 and 9.

Some plants show different traits with different kinds of soil. For example, the flowers of the hydrangea plant act as a natural indicator. The color of the flowers changes when the plants are grown in soils that have different pH values. Many plants and animals that live in lakes and streams need a neutral pH to survive.

Most rain is slightly acidic and has a pH between 5.5 and 6. Acids form when rainwater reacts with compounds in polluted air, causing the rainwater's pH decreases. In the United States, most acid rain has a pH between 4 and 4.5. However, some acid rain has a pH as low as 3. Water with low pH can harm fish and other animals.

**What Are Salts?**

When you hear the word *salt*, you probably think of the table salt you use on your food. But the sodium chloride in your saltshaker is only one kind of salt. It is one of a large group of compounds called salts.

When an acid neutralizes a base, a salt and water form. A **salt** is an ionic compound. It forms when a positive ion from a base combines with a negative ion from an acid. As shown below, sodium hydroxide (NaOH) and hydrochloric acid (HCl) make water (H<sub>2</sub>O) and sodium chloride (NaCl). ✓

Sodium + Hydrochloric → Water + Sodium  
hydroxide acid chloride



Salts have many uses. The sodium chloride in food is also used to melt the snow and ice on roads and sidewalks. We use it to make other compounds, including lye and baking soda. We use the salt sodium chloride to preserve food. Calcium sulfate is used to make wallboard for buildings. ✓

**CALIFORNIA STANDARDS CHECK**

**8.5.b** Students know how to determine whether a solution is acidic, basic, or neutral.

**6. Describe** How can the pH of rainwater be determined?

---



---



---



---



---

**READING CHECK**

**7. Describe** How is a salt formed?

---



---



---

**READING CHECK**

**8. Name** What are two uses of sodium chloride?

---



---

# Section 3 Review

8.5.e



## SECTION VOCABULARY

**neutralization reaction** the reaction of an acid and a base to form a neutral solution of water and a salt

**pH** a value that is used to express the acidity or basicity of a system

**salt** an ionic compound that forms when a metal atom replaces the hydrogen of an acid

**1. Compare** What makes an acid a strong acid? What makes a base a weak base?

---

---

---

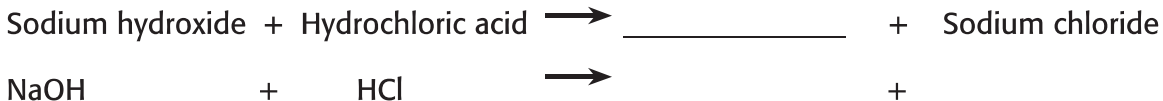
**2. Describe** What happens when an acid and a base combine?

---

---

---

**3. Complete** Fill in the equations below to show the reaction of sodium hydroxide and hydrochloric acid.



**4. Identify** What are two ways to measure the pH of a solution?

---

**5. Apply Concepts** Soap is made from a strong base and oil. Do you think the pH of soap is 4 or 9? Explain why.

---

---

**6. Explain** A lake has a low pH. Is it acidic or basic? Would fish be healthy in this lake?

---

---

---