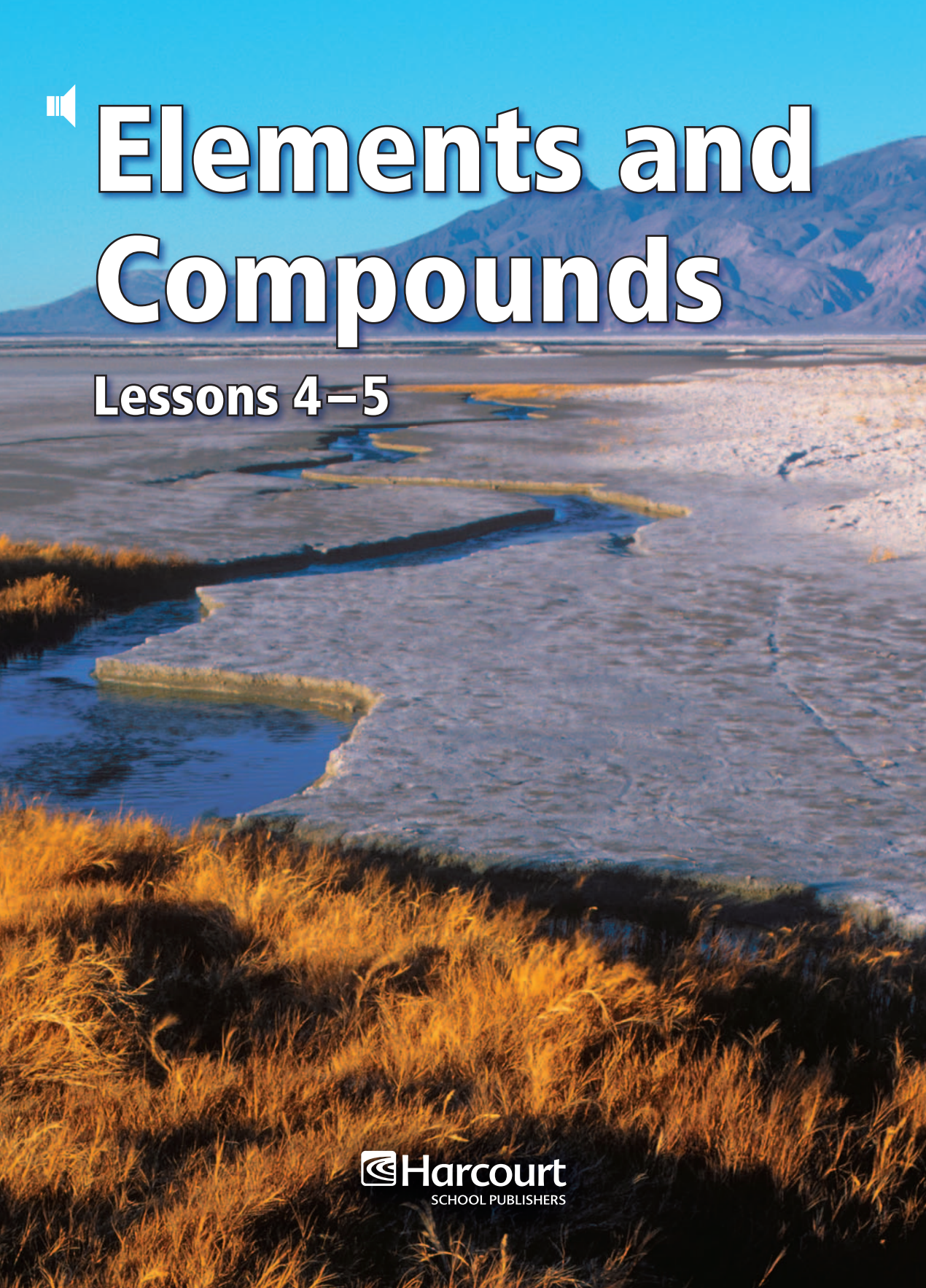


The background of the cover is a photograph of a vast, arid landscape. In the foreground, there is a field of tall, dry, golden-brown grass. Beyond the grass, a large, flat, light-colored area, possibly a dry lake bed or salt flat, stretches towards the horizon. In the distance, a range of rugged, brown mountains is visible under a clear, bright blue sky. The title text is overlaid on the upper portion of the image.

Elements and Compounds

Lessons 4–5

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Elements and Compounds

Lessons 4–5



Lesson 4

How Are Chemical and Physical Properties Used? 2



Lesson 5

What Are Chemical Reactions? 8

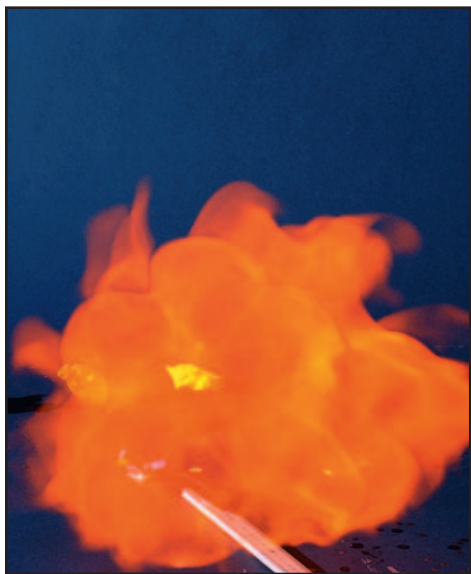


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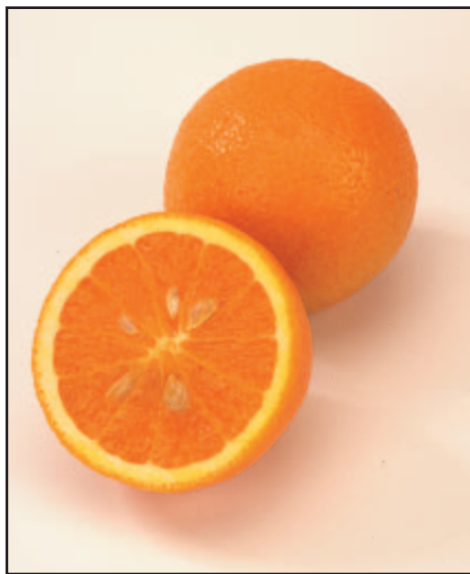
How Are Chemical and Physical Properties Used?

VOCABULARY

- chemical property
- acid
- base



Flammability, or the ability to catch on fire, is one kind of **chemical property**.



The juice in these oranges is a weak **acid**.



▶ This soap has the properties of a weak **base**.

READING FOCUS SKILL

MAIN IDEA AND DETAILS

The **main idea** is what the text is mostly about.

Details tell more about the main idea.

The **main idea** is that physical and chemical properties are used in different ways. Look for **details** about how mixtures are separated

Separating Mixtures

Sometimes it is easy to separate the parts of a mixture. At other times, it is not so easy. It would be easy to separate raisins from flakes in cereal. It would not be easy to separate flour and sugar mixed together.

Physical properties can help you separate mixtures. The picture shows how to separate a mixture of rocks, dirt, iron and salt.

To separate a mixture of rocks, dirt, iron and salt:

1. Screen out the rocks.
2. Use a magnet to take away bits of iron.
3. Pour water through a filter to remove dirt.
4. Boil the water.
5. Only salt is left behind.



Chemical properties can also be used to separate mixtures. A chemical property describes a *reaction*. It shows how substances react when they combine to make new substances.

Most metals in nature are found in minerals. These minerals are called *ores*. Ores are compounds.

The metal must be removed from the ore before it can be used. Chemicals are used to do this. Then the metal can be used.

 **How are physical properties used to separate mixtures?**



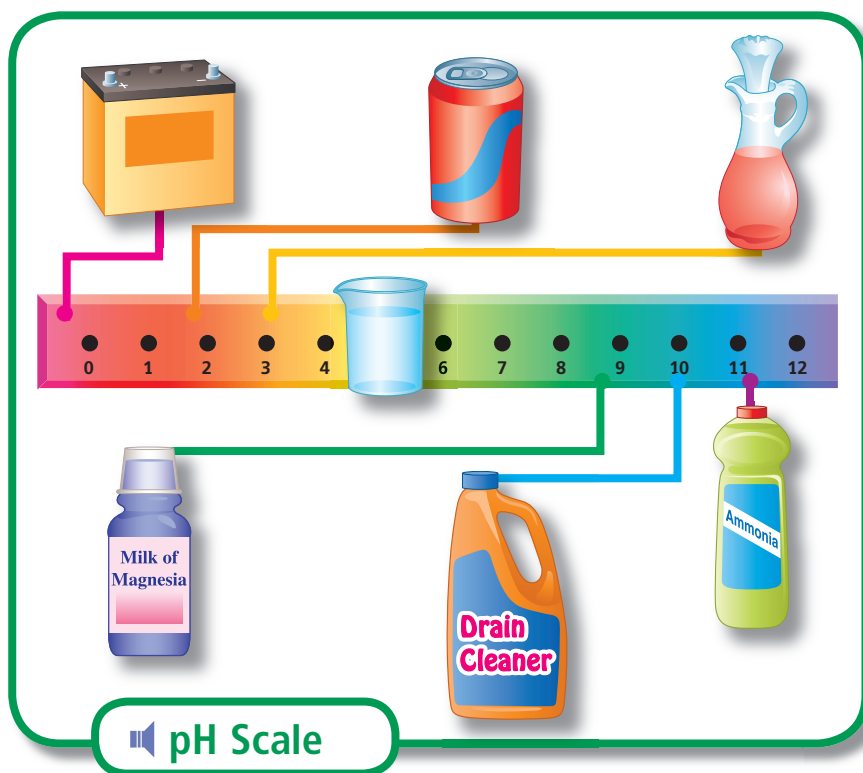
In nature, copper is usually found combined with oxygen or sulfur.

Identifying Elements and Compounds

Chemical properties help identify elements and compounds. You can find out if a substance is an **acid** or a **base**. *Litmus paper* is used. It has chemicals in it that change colors. An **acid** turns blue litmus paper red. A **base** turns red litmus paper blue.

Some acids and bases are stronger than others. Scientists rank acids and bases on a scale. This scale, called the *pH scale*, has numbers from 0 to 14. An acid has a pH of less than 7. A base has a pH of more than 7.

Water and some other substances are *neutral*. They have a pH of 7. They are neither acids nor bases.



- ▲ Battery acid is strong. It can have a pH of 0. Lemon drink has a pH of about 2. Drain cleaners are strong bases. They have a pH of about 10. Ammonia has a pH of about 11.

Physical properties help identify substances. Metals can be identified by their melting points. Texture is another physical property. Some things are *brittle*. They break or crush easily. *Solubility* also helps identify elements and compounds. Sugar dissolves easily in water. Salt dissolves less easily.

Chemical properties can also be used to identify substances. But, you have to change the substance itself.

 **What are three physical properties that help identify substances?**



Review



Complete this **main idea** statement.

-  1. Physical and chemical _____ help identify elements and compounds.

 Complete these **detail** statements.

2. _____ changes colors when put into an acid or a base.
-  3. An _____ turns blue litmus paper red.
-  4. A _____ turns red litmus paper blue.

What Are Chemical Reactions?

VOCABULARY

- chemical reaction
- reactant
- product
- salt



Rusting is one kind of **chemical reaction**.



When combined, vinegar and baking soda are **reactants**.



Carbon dioxide is a **product**. It comes from combining baking soda and vinegar.



Table **salt** is just one kind of **salt**.



READING FOCUS SKILL

COMPARE AND CONTRAST

You **compare** when you look at how things are alike.
You **contrast** when you look at how things are different.
Compare and **contrast** different chemical reactions.



Changing Properties

Paper tears. Glass breaks. Sugar dissolves in water. These are physical changes. They are not chemical changes. In a chemical change, the substance cannot be changed back easily.



A **chemical reaction** is a chemical change. If you touch a lit match to wood, the wood burns. When something burns, it combines with oxygen. This produces other gases. You may not see the gases. But you know that something is gone. You see the ashes.

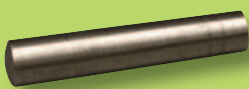


When candles burn, oxygen from the air causes a chemical change.

▶ You can tell when a chemical change takes place. You know because the properties of the materials are different. New substances with different properties have formed.

▶ There are clues that tell you when a chemical change is taking place. When you see bubbles after adding one substance to another, this is a clue. When you see color changes, this is another clue.

▶  **Compare and contrast physical and chemical changes.**

	Physical Properties	Chemical Properties
▶ Water 	▶ colorless ▶ odorless ▶ liquid at room temperature ▶ boils at 100°C ▶ melts at 0°C	▶ made up of hydrogen and oxygen ▶ reacts with some metals to produce bases
▶ Silver 	▶ shiny ▶ soft ▶ silver in color ▶ boils at 2163°C ▶ melts at 962°C	▶ reacts with few substances ▶ does not react with air ▶ reacts with ozone or sulfur to form tarnish
▶ Iron 	▶ shiny ▶ hard ▶ grayish silver in color ▶ boils at 2861°C ▶ melts at 1538°C	▶ reacts easily with many substances ▶ reacts with oxygen to form the minerals hematite and magnetite ▶ reacts with oxygen in presence of water to form rust
▶ Sulfur 	▶ dull ▶ brittle ▶ yellow ▶ boils at 445°C ▶ melts at 115°C	▶ reacts with any liquid element ▶ reacts with any solid element except gold and platinum ▶ reacts with oxygen to form sulfur dioxide, a form of air pollution

Reactants and Products

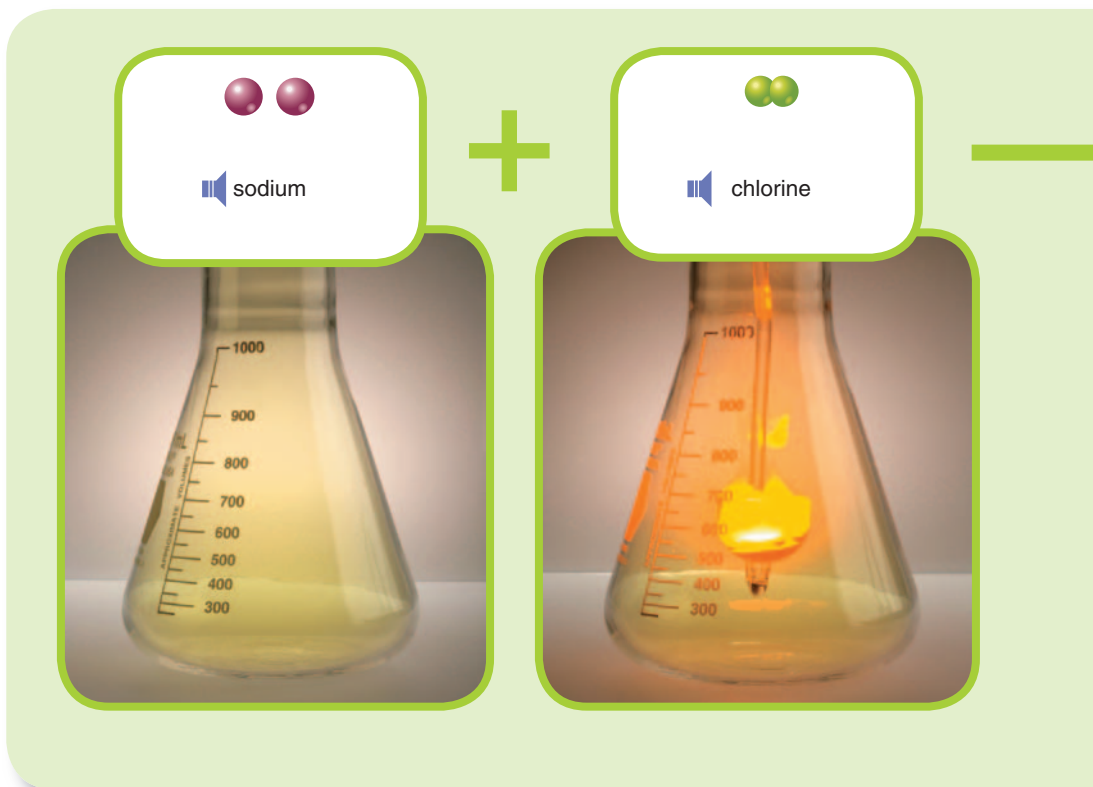
Every chemical reaction begins with one or more **reactants**.

A reactant is one of the starting materials in a chemical reaction.

If an electric charge goes through water, bubbles form. The bubbles are hydrogen and oxygen gas. The reactant is water. Hydrogen and oxygen are **products**. They are the result of the chemical reaction.

Sodium and chlorine are elements. Adding water to them makes the sodium and chlorine react. The product of this chemical reaction is sodium chloride. It is table salt.

Another reaction is an iron nail rusting. The iron reacts with oxygen in the air. The iron and oxygen combine. They make the product, iron oxide. You know iron oxide as *rust*. Rust has different properties than iron or oxygen.



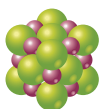
When silver *tarnishes*, it becomes silver sulfide. One reactant is the element silver. The other reactant is the compound hydrogen sulfide.

 **Compare and contrast reactants and products.**

Silver reacts with hydrogen sulfide in the air. This makes silver sulfide, or tarnish.



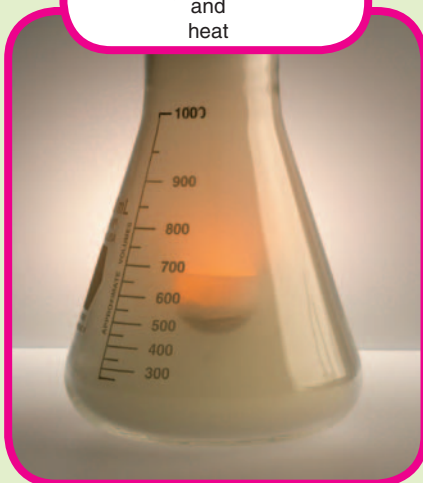
▼ Sodium reacts with chlorine. Energy is given off as heat and light. Sodium chloride—table salt—is made.



sodium chloride
crystal



light
and
heat

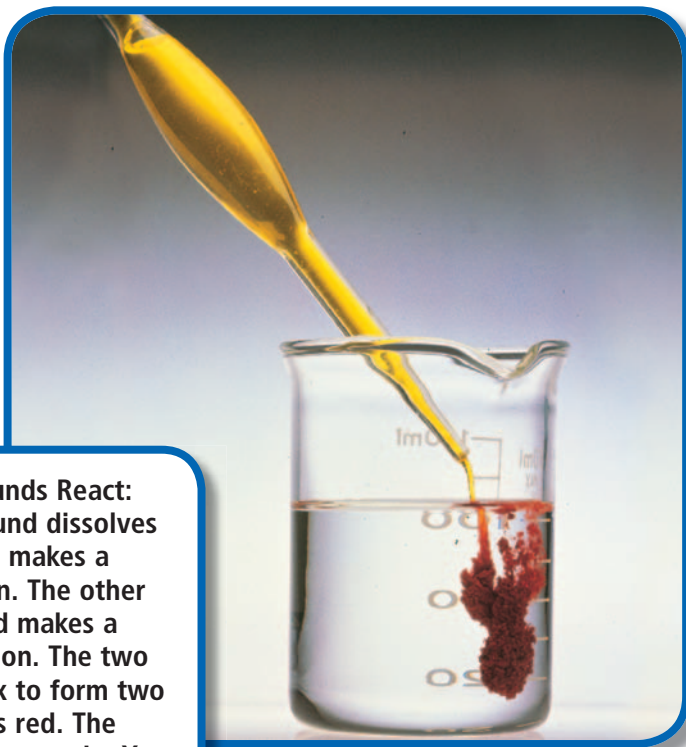


Making New Substances

Reactions of elements and compounds create all the kinds of matter in the world. Sometimes a compound breaks apart to make new substances. It breaks into its elements. In a chemical change, water breaks into the elements hydrogen and oxygen.

 In another kind of reaction, two elements *combine*. They come together to make a compound. Hydrogen combines with oxygen to make water. This is the opposite of the first reaction.

 **Two Compounds React:**
One compound dissolves in water and makes a clear solution. The other dissolves and makes a yellow solution. The two solutions mix to form two solids. One is red. The other dissolves again. You don't see it.





▲ Baking bread is a chemical change.
A new substance is formed.

Elements and compounds combine in other ways to form new compounds. Many carbon compounds have long chains of molecules. They look like paper clips linked together. The chains are found in plastics, proteins, and DNA.

 Compare ways that compounds combine.



Cooking may change food. But it does not create or destroy it.

Conservation of Mass

During a chemical change, new substances form. These substances are not new matter. The same atoms that were in the reactants are in the products. They are just combined in different ways.

You can measure the mass of the sodium and chlorine gases used in a reaction. After they have changed to salt, you can measure the salt's mass. The masses will be the same. No new matter has been made. No matter was destroyed. This is called the *Law of Conservation of Mass*.

■ If you burned a marshmallow in a sealed box, you would not lose matter. You could measure mass before and after your test. The marshmallow is smaller but gases were created.

In any chemical reaction, no new matter is formed. Matter is *conserved*. The amount of matter remains the same.

■  **Compare the products of a chemical reaction to the masses of the reactants.**

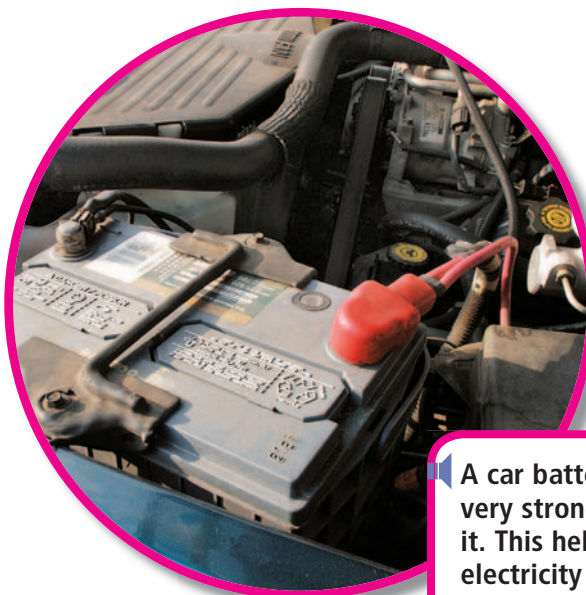


Salts

Litmus paper shows when something is an acid or a base. Orange juice is an acid. So is the vinegar used in salad dressing.

 Household products like ammonia and soap are bases. So are detergent, shampoo, and drain cleaner. Strong bases are dangerous. So are strong acids. They can burn skin.

 When you add vinegar and baking soda, you get bubbles. A chemical property of acids and bases is that they react with one another.



 A car battery has very strong acid in it. This helps make electricity to start the car.

Salt is the product formed when an acid and a base react. There are many salts. Table salt is just one kind of salt.

Most salts are made when strong acids react with strong bases. Salts also form when some metals react with strong acids.

 **Contrast two household products that are acids and bases.**



Review



Complete these **compare** and **contrast** statements.

-  1. In _____ changes, the properties of the materials change.
-  2. In one kind of chemical reaction, a compound breaks apart. In another, _____ combine.
-  3. _____ changes don't create bubbles, but chemical changes do.
-  4. _____ are present at the start of a chemical reaction, and products are present at the end.

GLOSSARY

-  **acid** (AS•id) A chemical compound that turns blue litmus paper red and has a pH of less than 7.
-  **base** (BAYS) A chemical compound that turns red litmus paper blue and has a pH of more than 7.
-  **chemical property** (KEM•ih•kuhl PRAP•er•tee) A property that involves the ability of a substance to react with other materials and form new substances.
-  **chemical reaction** (KEM•ih•kuhl re•AK•shuhn) A change in which one or more new substances are formed.
-  **product** (PRAHD•uhkt) A substance that is formed by a chemical reaction.
-  **reactant** (ree•AK•tuhnt) A substance that changes during a chemical reaction.
-  **salt** (SAWLT) A substance that is made by combining an acid and a base.

Think About the Reading

-  **1.** You learned about the chemical properties of some common substances. Are there other substances you would like to learn about?
-  **2.** Where can you go to find out about other substances and their chemical properties?

Hands-On Activity

-  **1.** Identify two examples of different chemical reactions.
-  **2.** Make a list that describes the changes that take place when each chemical reaction occurs.
-  **3.** Discuss your list with someone in your class.

School-Home Connection

Talk to your family about acids and bases. Show them products in your home that are acids. Show them products that are bases. Tell them what happens when you mix an acid and a base.