

**Day  
1****Weekly Question****Why does metal rust?**

You know what rusty metal looks like, but have you ever wondered why you've never seen rust on a piece of wood or plastic? Rust is a sign of **corrosion**, which occurs when metal is exposed to air and moisture. Metal that is rusted may be crumbly, have holes in it, or have rough, reddish-brown patches on it.

Corrosion in metals arises from a **chemical reaction**, which is a process in which substances react to form new substances. A chemical reaction is different from a physical change. When you scratch metal, the chemical makeup of metal stays the same, even if its appearance changes. But when metal rusts, a chemical reaction takes place between water, oxygen, and iron that changes the metal into a whole new substance.

**A. Use the vocabulary words to complete the sentences.**

1. One way to protect a car from \_\_\_\_\_ is to keep it inside a garage.
2. A \_\_\_\_\_ can occur when substances are exposed to air and moisture.

**B. Explain in your own words how a chemical reaction is different from a physical change.**


---



---

Daily Science

**Big  
Idea 6****WEEK 2****Vocabulary****chemical  
reaction**

KEM-ih-kul

ree-AK-shun

*a change in which one or more new substances are formed*

**corrosion**

kuh-ROH-zhun

*a chemical wearing away of a material*

**Day  
2****Weekly Question****Why does metal rust?**

During a chemical reaction, substances called **reactants** recombine to form new substances called **products**. In the chemical reaction that forms rust, the reactants are iron and oxygen. The product they form when they recombine is a **compound** called iron oxide. Adding water speeds up the corrosion process.

Iron oxide, like all products of a chemical reaction, has properties that are different from its original substances. One difference between pure iron and iron oxide is that iron oxide takes up more space. That means that if a metal structure starts to rust, the rusted area may push apart the areas that are not rusted. This can result in cracks in the structure. The compounds that form rust are also weaker than iron, which means they crumble more easily. So you can see why a lot of rust can be bad for structures and machinery made of metal, such as bridges and cars!

**A.** What are two properties of iron oxide that are different from iron?

1. \_\_\_\_\_
2. \_\_\_\_\_

**B.** Cross out the incorrect word or phrase in each sentence and write the correct one above it to make the statement true.

1. Rust is the product of the chemical reaction between iron and oxide.
2. A compound is made from a single element.
3. The properties of reactants are the same as the properties of products.

**C.** Check the box next to the word that completes the analogy.

Iron is to **iron oxide** as **reactant** is to \_\_\_\_\_.

- product     rust     oxygen     substance

**Vocabulary****compound**

KOM-pownd  
a substance made of two or more elements that are chemically combined

**product**

PRAH-dukt  
a new substance that is formed during a chemical reaction

**reactant**

ree-AK-tent  
a substance that changes during a chemical reaction

**Day  
3****Weekly Question****Why does metal rust?**

As with any chemical reaction, the formation of rust involves the transfer of electrons. When iron reacts with oxygen and forms the new compound iron oxide, the reaction occurs because electrons move from the metal atoms to the oxygen atoms. In other words, the iron that loses electrons is **oxidized**. In the same reaction, oxygen gains electrons from the iron and is **reduced**. For every electron that is lost by a substance in a chemical reaction, an electron is gained by another substance.

The oxidation and reduction process happens all around us, all the time. In fact, many cleaning products contain substances that oxidize. Household bleach, for example, removes stains by oxidizing them.

In other situations, oxidation isn't such a positive thing. For instance, air can oxidize food, causing it to spoil or go stale. This is why some foods include substances called *antioxidants*. Antioxidants give up their electrons very easily, so they satisfy the appetite of "electron-hungry" oxygen atoms and protect the food.

**Vocabulary****oxidized**

OX-ih-dyzd  
to have lost  
electrons

**reduced**

ree-DOOST  
to have gained  
electrons

**A.** In each reaction described below, underline the substance that gets oxidized.

1. An apple turns brown after reacting with air.
2. Bleach removes a stain.
3. Oxygen picks up electrons found in food.
4. An iron key rusts in the rain.

**B.** Fill in the bubble next to the activity that slows down oxidation.

- |   |                              |
|---|------------------------------|
| (A) removing the lid from a jar of food | (C) peeling an apple         |
| (B) keeping a car in a dry garage       | (D) adding bleach to a stain |

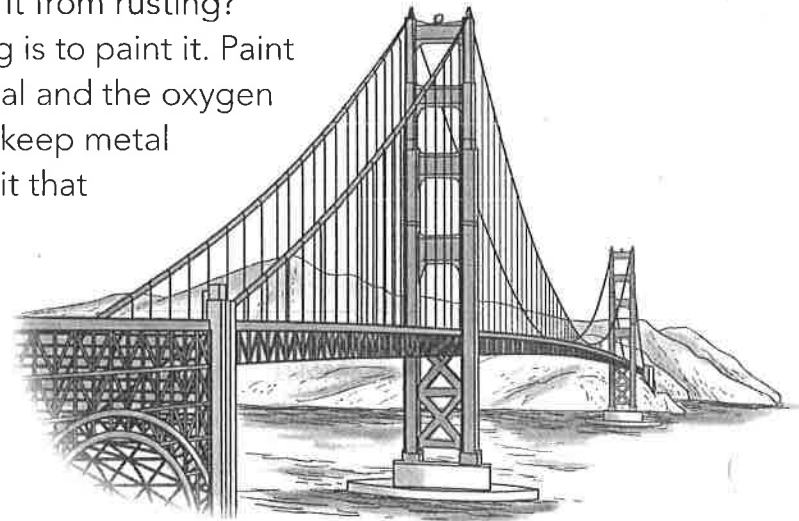
Day  
4

## Weekly Question

## Why does metal rust?

Metal is used to build many types of structures, appliances, and other everyday items because it is strong, easy to shape, and relatively cheap and plentiful. But most metals react with water and oxygen, which is present in almost every environment on Earth. So how do people use metal and keep it from rusting?

One way to keep metal from rusting is to paint it. Paint forms a protective barrier between metal and the oxygen and moisture in the air. Another way to keep metal from oxidizing is to add a substance to it that makes the metal less able to give away its electrons. For example, stainless steel is made from iron that has carbon and chromium added to it. Stainless steel doesn't oxidize or corrode as quickly as ordinary iron. That is why knives are often made of stainless steel. Their blades stay sharp longer.



The Golden Gate Bridge in San Francisco is actually painted orange, not gold.

A. What are two ways to keep metal from rusting?

1. \_\_\_\_\_
2. \_\_\_\_\_

B. Name two ways stainless steel is different from ordinary iron.

1. \_\_\_\_\_
2. \_\_\_\_\_

C. Check the object that is the *least* likely to be made of stainless steel.

- sauce pan    
  plate    
  scissors    
  refrigerator door

Name \_\_\_\_\_



**Day 5**

**Weekly Question**

# Why does metal rust?

**A.** Use the words in the box to complete the paragraph.

oxidized    reactants    compound    reduced  
product    corrosion    chemical reaction

New substances created through a \_\_\_\_\_ have properties that are different from the starting materials, and one example of this is rust. In the reaction that creates rust, iron and oxygen are the \_\_\_\_\_, and a \_\_\_\_\_ called iron oxide is the \_\_\_\_\_. During the reaction, electrons move from the metal atoms to the oxygen atoms. When the metal atoms lose electrons, they are \_\_\_\_\_. When the oxygen atoms gain electrons, they are \_\_\_\_\_. The result of this process is the \_\_\_\_\_ of metal.

**B.** Write *true* or *false*.

1. One way to keep metal from rusting is to paint it. \_\_\_\_\_
2. Exposure to air and water can cause iron to break down. \_\_\_\_\_
3. Electrons can't be shared or moved between atoms. \_\_\_\_\_
4. Rust is created by the oxidation of iron. \_\_\_\_\_
5. Antioxidants cause food to spoil faster. \_\_\_\_\_

**Day 1**

**Weekly Question**

**Why do batteries die?**

Many materials—from potatoes and lemons to stacks of metal coins—can be used to make a battery. All you need is a material that has the ability to produce a flow of electrons. The first battery, demonstrated by Count Alessandro Volta in 1800, was a stack of discs made of alternating kinds of metal separated by paper soaked with salt water. It was that simple.

Today, batteries come in a variety of materials with different properties. Batteries can be disposable or rechargeable, and they can be made of various compounds such as lithium ion, nickel cadmium, or metal hydride. The different materials used to construct batteries result in differences in the amount of electric **current** produced, the size and cost of the battery, and the lifetime of the battery. But no matter what material is used, eventually every battery “dies” and stops producing electricity.

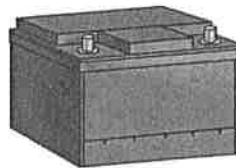
voltaic pile



alkaline batteries



car battery



lemon battery



**Different Kinds of Batteries**

**A. Write true or false.**

1. Only metals can be used to make a battery. \_\_\_\_\_
2. Eventually, a battery stops producing electricity. \_\_\_\_\_
3. Batteries have the ability to generate a flow of electrons. \_\_\_\_\_

**B. Name four ways that batteries can differ from one another, depending on the different materials used to construct them.**

1. \_\_\_\_\_
2. \_\_\_\_\_
3. \_\_\_\_\_
4. \_\_\_\_\_



**Vocabulary**

**current**

KUR-int  
the flow of electricity through a conductor

**Day  
2****Weekly Question****Why do batteries die?**

Batteries generate electricity through a type of chemical reaction called an *electrochemical* reaction. During this particular kind of reaction, the reactants combine to create new substances and, in the process, produce electrons.

Whether or not a reaction produces electrons depends on the **chemical properties** of the reactants. Chemical properties are determined by the chemical composition of a substance and, in turn, control a substance's ability to undergo a particular chemical change. For example, a substance might have the tendency to rust, to catch on fire, to form an **acid**, or to explode. Unlike a physical property, which can be observed without changing a substance's composition or structure, a chemical property can be observed or measured only when a substance undergoes a chemical change.

**A.** Next to each example of a substance's property, write whether the property is *physical* or *chemical*.

1. Hydrogen explodes when ignited. \_\_\_\_\_
2. Copper is a reddish-orange, shiny metal. \_\_\_\_\_
3. Silver reacts with moisture to form tarnish. \_\_\_\_\_
4. Metal corrodes when exposed to air. \_\_\_\_\_
5. Water freezes at 32°F. \_\_\_\_\_

**B.** Explain in your own words the difference between physical and chemical properties.

---



---

**Vocabulary****acid**

AS-sid  
a chemical compound that, when dissolved in water, produces hydrogen that is missing its electron

**chemical properties**

KEM-ih-kul  
PRAH-per-teez  
characteristics that determine the chemical changes that a substance can undergo

**Day 3**

**Weekly Question**

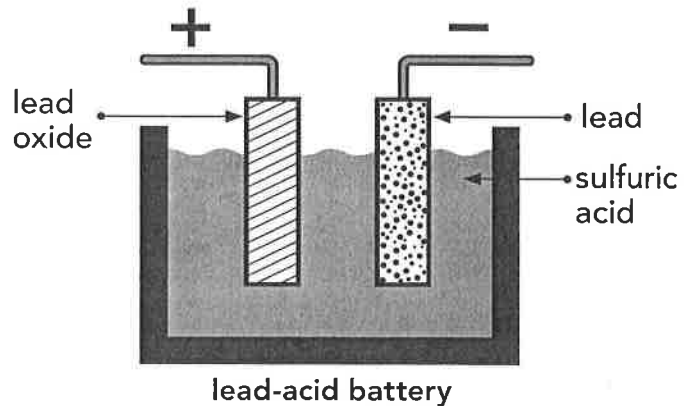
**Why do batteries die?**

Think of a battery as a reaction chamber filled with chemicals. For example, a typical car battery consists of a series of compartments, each containing a pair of **electrodes** immersed in a kind of acid called sulfuric acid. One electrode is made of lead, and the other electrode is made of lead oxide. Electrodes are where a battery's electrochemical reactions take place, and different reactions take place on different electrodes.

On the lead electrode of a car battery, the lead reacts with sulfuric acid to form a new compound called lead sulfate. This reaction produces electrons, and negative charges build up on the lead electrode.

On the lead oxide electrode, the material also reacts with sulfuric acid to produce lead sulfate. However, this reaction removes

electrons from the electrode. As a result, positive charges collect on the lead oxide electrode. When the two electrodes are connected in an electrical circuit, electrons flow from the negatively charged electrode to the positively charged electrode, and electricity is produced.



**Vocabulary**

**electrode**  
ee-LEK-troh-d  
a metal rod or plate that can conduct electricity into or out of a battery

**A. Complete the analogy.**

Sulfuric acid is to reactant as lead sulfate is to \_\_\_\_\_.

**B. Use words from the passage to complete the paragraph.**

The lead electrode in a car battery reacts with the acid solution to form \_\_\_\_\_, and this reaction \_\_\_\_\_ electrons.

The lead oxide electrode reacts with the solution to form the same compound, but this reaction \_\_\_\_\_ electrons.



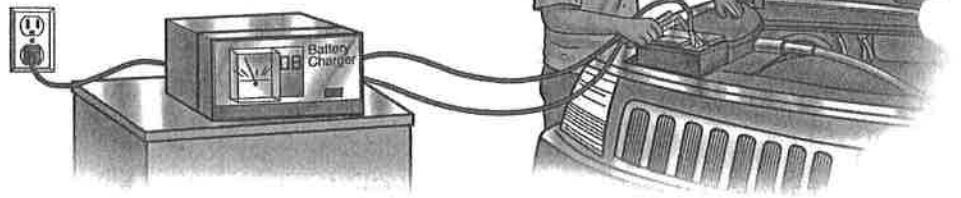
**Day  
4****Weekly Question****Why do batteries die?**

Daily Science

**Big  
Idea 6****WEEK 3**

A battery contains only a fixed amount of reactants, so as soon as these reactants have been used up, the reaction stops and the battery goes dead. A dead battery produces no more electrons and no more electricity.

However, some batteries can be recharged by connecting them to a source of electricity such as a wall outlet. This is possible because the electrochemical reactions that create electricity are reversible. When a battery is recharging, electricity flows in the opposite direction. In a car battery, this allows the lead sulfate that coats both of the electrodes to dissolve back into the acid solution. Lead and lead oxide re-form on each of the electrodes. This process of recharging uses energy itself, but when the battery is reconnected to the car, the electrochemical reaction that produces electricity can start all over again.



**A. Number the steps in the correct order to show how a battery is recharged.**

- \_\_\_ Lead sulfate dissolves into the acid solution.
- \_\_\_ The battery is connected to a source of electricity.
- \_\_\_ Lead and lead oxide re-form on the electrodes.
- \_\_\_ The battery produces electrons.

**B. Name two devices you have used or seen that have rechargeable batteries. Then name the source of the energy that you would use to recharge them.**

1. \_\_\_\_\_
2. \_\_\_\_\_

Name \_\_\_\_\_



**Weekly Question**

**Why do batteries die?**



**A.** Use the words in the box to complete the sentences.

chemical properties    electrodes    acid  
electrochemical        current

1. Batteries generate electricity through \_\_\_\_\_ reactions that take place on \_\_\_\_\_.
2. An \_\_\_\_\_ is a substance that generates a form of hydrogen when it dissolves in water.
3. The way a substance reacts or combines with other substances to create new substances is determined by its \_\_\_\_\_.
4. Different kinds of materials used in batteries result in different amounts of electric \_\_\_\_\_ produced.

**B.** Write *true* or *false*.

1. The chemical properties of a substance are determined by its chemical composition. \_\_\_\_\_
2. The chemical reactions that power a car battery are irreversible. \_\_\_\_\_
3. All batteries have the ability to produce a flow of electrons. \_\_\_\_\_
4. When a battery's reactants are used up, it no longer produces electricity. \_\_\_\_\_
5. All electrochemical reactions produce light. \_\_\_\_\_