

Interactive Classroom

Glencoe Science

CHEMISTRY

MATTER AND CHANGE

Chapter 20

Electrochemistry

**Mc
Graw
Hill** **Glencoe**

Click the mouse button or press the Space Bar to continue.

Section 20.2 Batteries

Objectives

- **Describe** the structure, composition, and operation of the typical carbon-zinc dry-cell battery.
- **Distinguish** between primary and secondary batteries, and give two examples of each type.
- **Explain** the structure and operation of the hydrogen-oxygen fuel cell.
- **Describe** the process of corrosion of iron and methods to prevent corrosion.

Review Vocabulary

reversible reaction: a reaction that can take place in both the forward and reverse directions



Section 20.2 Batteries (cont.)

New Vocabulary

battery

Fuel cell

dry cell

corrosion

primary battery

galvanization

secondary battery

MAIN Idea

Batteries are voltaic cells that use spontaneous reactions to provide energy for a variety of purposes.



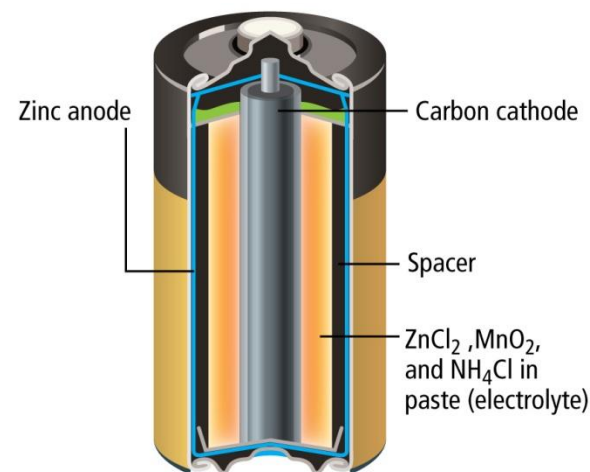
Dry Cells

- A battery is one or more voltaic cells in a single package that generates electric current.



Dry Cells (cont.)

- A **dry-cell** is an electrochemical cell in which the electrolyte is a moist paste. The paste in a zinc-carbon cell consists of zinc chloride, manganese(IV) oxide, ammonium chloride, and a small amount of water.
- The anode is the zinc shell.
- The cathode is a carbon rod, but reduction occurs in the paste.

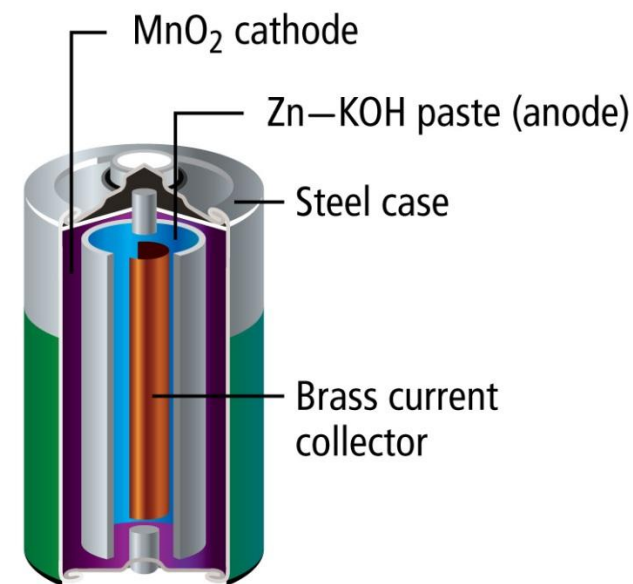


Zinc-carbon dry cell



Dry Cells (cont.)

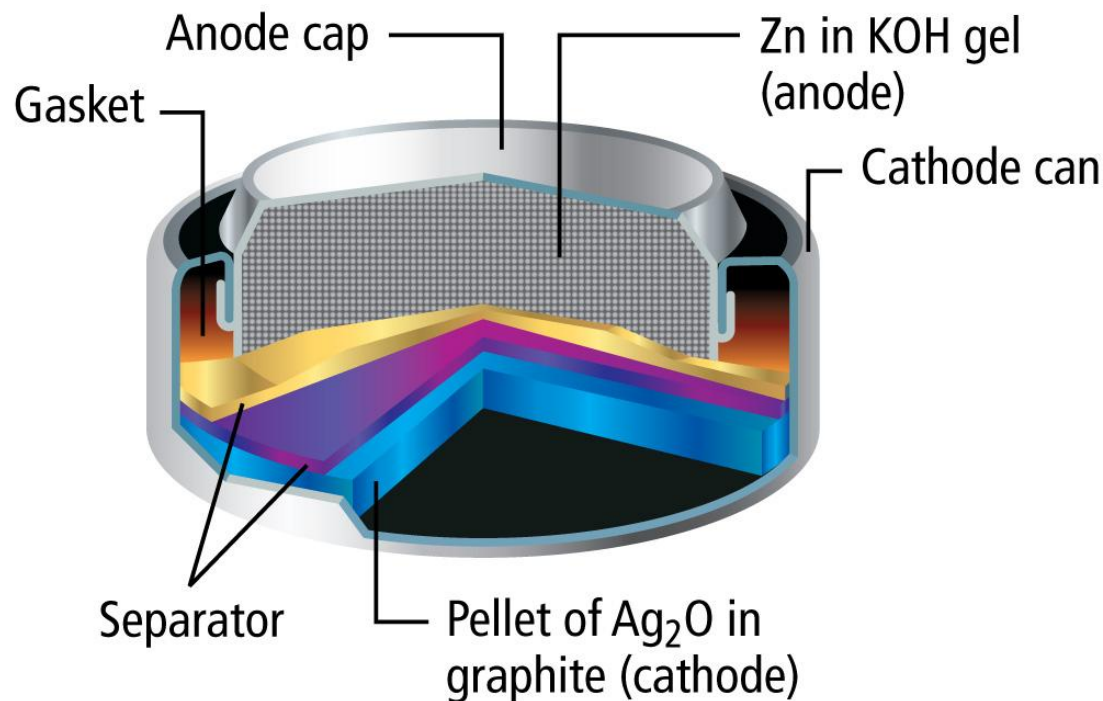
- In the alkaline cell, zinc is in a powdered form and mixed with potassium hydroxide contained in a steel case.
- Alkaline batteries are small and more useful in small devices.



Alkaline battery

Dry Cells (cont.)

- Silver batteries are similar to alkaline but smaller.

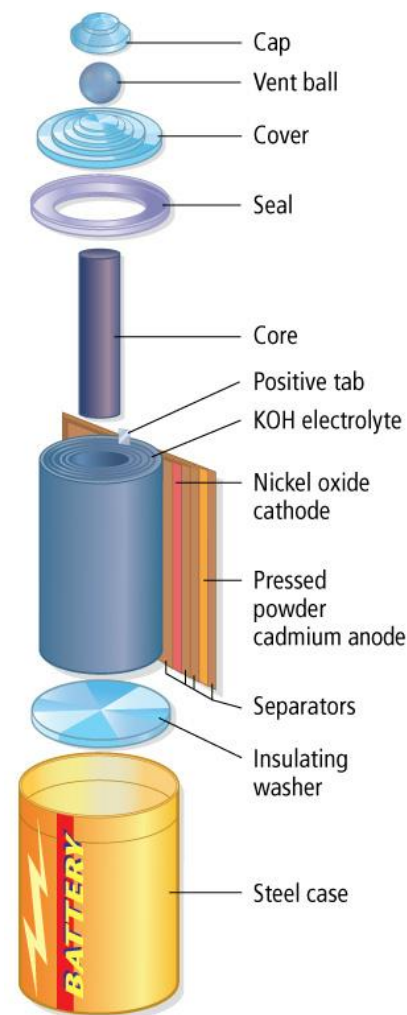


Silver button battery



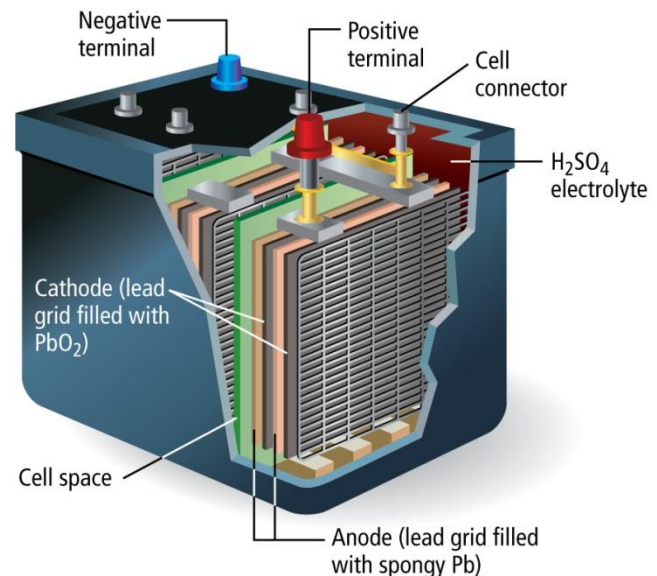
Dry Cells (cont.)

- **Primary batteries** produce electric energy by means of redox reaction that are not easily reversed.
- **Secondary batteries** depend on reversible redox reactions and are rechargeable.



Lead-Acid Storage Battery

- Lead-acid storage batteries are common in automobiles.
- The electrolyte solution is sulfuric acid, hence the name.
- The anode consists of grids of porous lead.
- The cathode consists of lead grids filled with lead(IV) oxide.



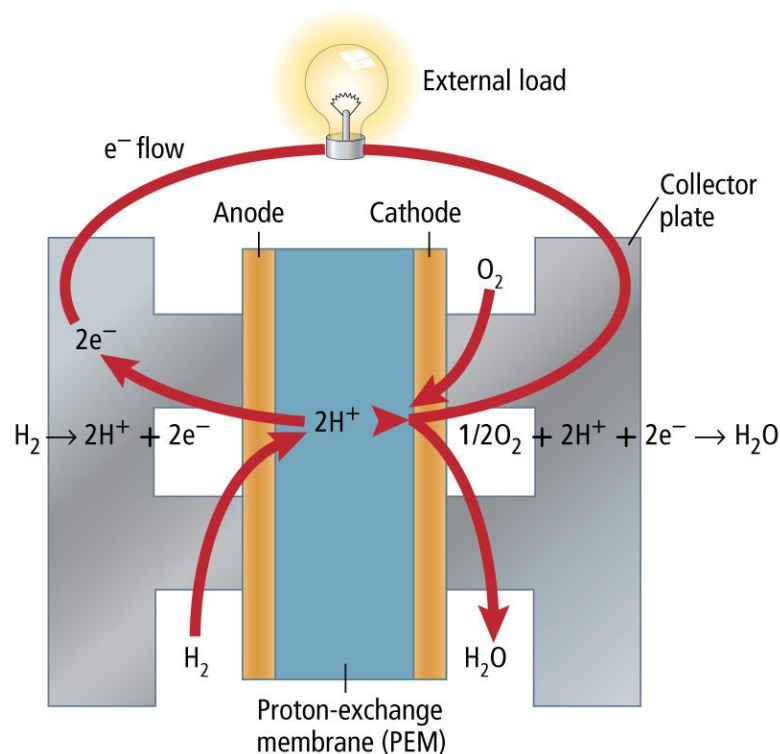
Lithium Batteries

- Lithium is the lightest known metal and has the lowest standard reduction potential of the metallic elements.
- Lithium batteries can be either primary or secondary.



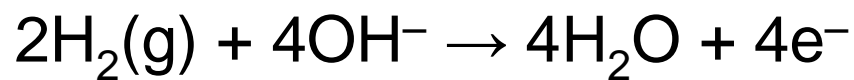
Fuel Cells

- A **fuel cell** is a voltaic cell in which the oxidation of a fuel is used to produce electric energy.

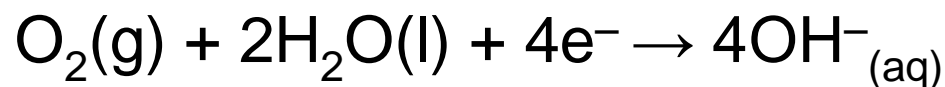


Fuel Cells (cont.)

- How a fuel cell works
 - Potassium hydroxide is often the electrolyte.
 - The oxidation half reaction



- The reduction half reaction

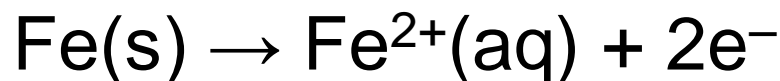


- When combined, the equation is the same as burning hydrogen in oxygen to form water.



Corrosion

- **Corrosion** is the loss of metal resulting from an oxidation-reduction reaction of the metal with substances in the environment.
- Rusting begins in a chip or pit in the iron surface, which become the anode.



- Iron(II) becomes part of the water solution.

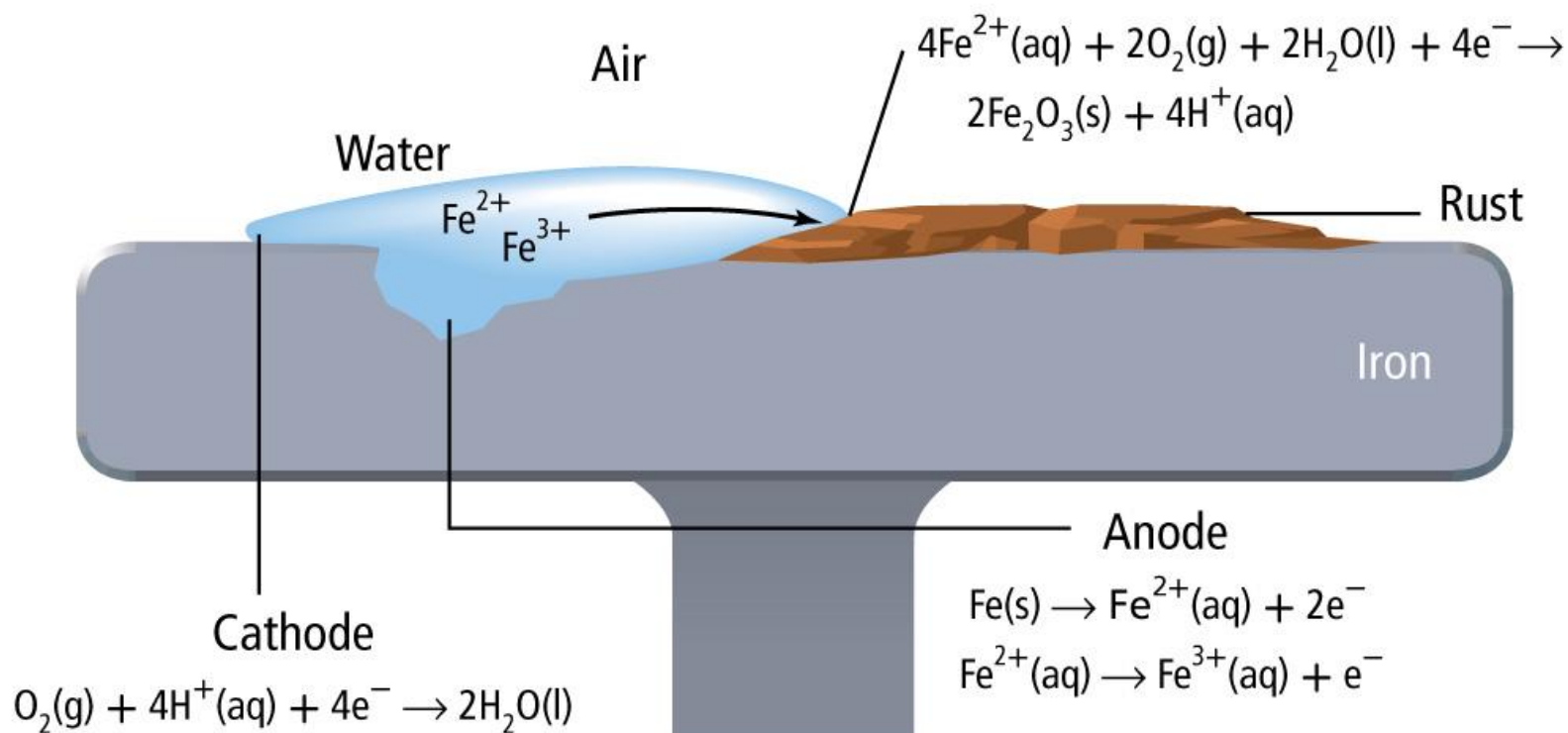


Corrosion (cont.)

- The cathode is usually at the edge of the water drop where water, iron, and air come into contact.
- The reduction reaction is $\text{O}_2(\text{g}) + 4\text{H}^+(\text{aq}) + 4\text{e}^- \rightarrow 2\text{H}_2\text{O}(\text{l})$.
- Next the oxidation $4\text{Fe}^{2+}(\text{aq}) + 2\text{O}_2(\text{g}) + 2\text{H}_2\text{O}(\text{l}) + 4\text{e}^- \rightarrow 2\text{Fe}_2\text{O}_3(\text{s}) + 4\text{H}^+$.
- Rusting is slow, but salts speed the process.

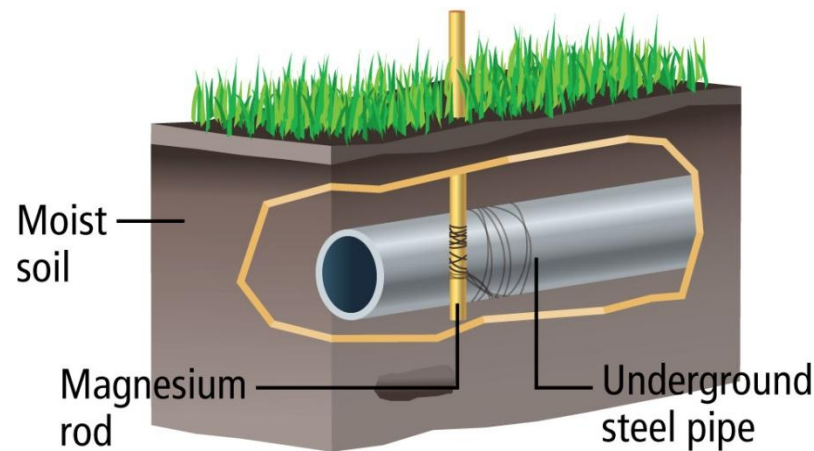


Corrosion (cont.)



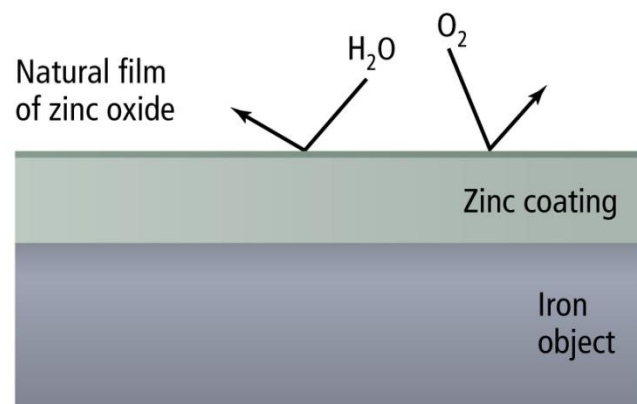
Corrosion (cont.)

- Paint and other covers seal out moisture to prevent corrosion.
- Blocks of metal that are more easily oxidized than steel, such as magnesium, aluminum, or titanium, are often attached to the hulls of ships—they corrode while the iron in the hull is protected.

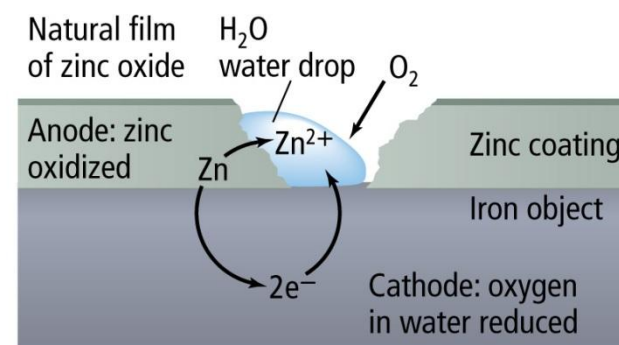


Corrosion (cont.)

- **Galvanization** is the process of coating iron with a layer of zinc.
- Zinc oxidizes at the surface, creating a layer of metal-oxide that protects from further corrosion.



Galvanized object with zinc coating intact



Galvanized object with zinc coating broken

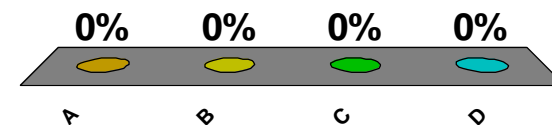


Section 20.2 Assessment



Which type of battery has a reversible spontaneous reaction?

- A. alkaline battery
- B. secondary battery**
- C. primary battery
- D. zinc-carbon battery



Section 20.2 Assessment



Which is **NOT** a method of preventing corrosion?

- A. painting
- B. galvanization
- C. coating with electrolytes**
- D. sacrificial anode

