Electrolysis

Electroplating and recharging a battery are examples of electrolysis. **Electrolysis** *is the process of passing a current through a cell for which the cell potential is negative and causing an oxidation-reduction reaction to occur.* That is, electrical energy is used to force a nonspontaneous chemical reaction to occur. For this cell reaction to occur, the external voltage must be greater than the potential that would be produced by the spontaneous reverse cell reaction.

Electrolysis is of great industrial importance. It is used to purify many metals from the ores in which they are found chemically combined in Earth's crust.

Electrolysis of Water

The electrolysis of water, shown in **Figure 16,** leads to the cell reaction in which water is broken down into its elements, H_2 and O_2. Recall that hydrogen gas and oxygen gas combine spontaneously to form water and are used to power fuel cells, which produce electricity. Therefore, the reverse process (electrolysis of water) is nonspontaneous and requires electrical energy. The following half-reactions occur at the anode and cathode.

$$\text{Anode: } 6H_2O(l) \longrightarrow 4e^- + O_2(g) + 4H_3O^+(aq)$$

$$\text{Cathode: } 4H_2O(l) + 4e^- \longrightarrow 2H_2(g) + 4OH^-(aq)$$

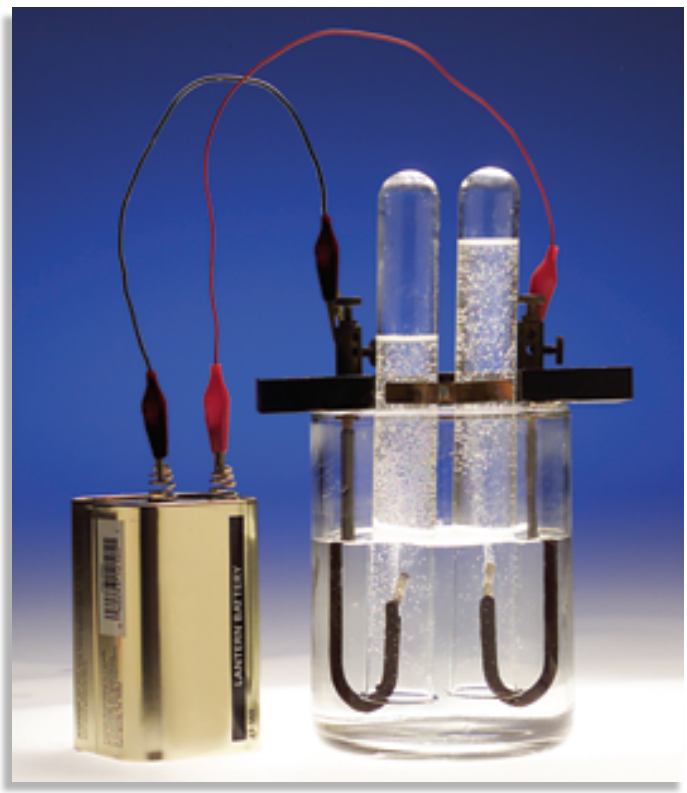

FIGURE 16 Electrical energy from the battery is used to break down water. Hydrogen forms at the cathode (left tube), and oxygen forms at the anode (right tube).