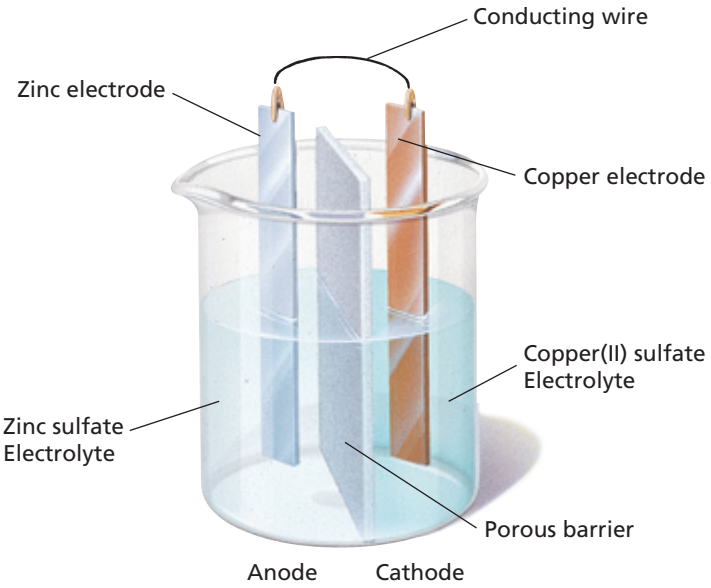
FIGURE 2 An electrochemical cell consists of two electrodes. Each electrode is in contact with an electrolyte; the electrode and the electrolyte make up a half-cell. The two electrodes are connected by a wire, and a porous barrier separates the two electrolytes.



If, however, we separate the substance that is oxidized from the substance that is reduced, the electron transfer is accompanied by a transfer of electrical energy instead of energy as heat. One means of separating oxidation and reduction half-reactions is with a *porous barrier,* or *salt bridge.* This barrier prevents the metal atoms of one half-reaction from mixing with the ions of the other half-reaction. Ions in the two solutions can move through the porous barrier, which keeps a charge from building up on the electrodes. Electrons can be transferred from one side to the other through an external connecting wire. Electric current moves in a closed loop path, or *circuit,* so this movement of electrons through the wire is balanced by the movement of ions in solution.

Altering the system in **Figure 1** as just described would simply involve separating the copper and zinc, as shown in **Figure 2.** The Zn strip is in an aqueous solution of $ZnSO_4$. The Cu strip is in an aqueous solution of $CuSO_4$. Both solutions conduct electricity, so, as you learned in Chapter 12, they are classified as electrolytes. *An* **electrode** *is a conductor used to establish electrical contact with a nonmetallic part of a circuit, such as an electrolyte*. In **Figure 2,** the Zn and Cu strips are electrodes. *A single electrode immersed in a solution of its ions is a* **half-cell.**

The Half-Cells

In the half-cell that contains the Zn electrode in aqueous $ZnSO_4$ solution, the half-reaction is $Zn(s) \longrightarrow Zn^{2+}(aq) + 2e^-$. The Zn metal loses two electrons to form Zn^{2+} ions in solution, and therefore oxidation is taking place in this half-cell. *The electrode where oxidation occurs is called the* **anode.** In the half-cell that contains the Cu electrode in aqueous $CuSO_4$ solution, the half-reaction is $Cu^{2+}(aq) + 2e^- \longrightarrow Cu(s)$. In this half-reaction, the Cu^{2+} ions in solution gain electrons to become Cu solid; that is, reduction is taking place. *The electrode where reduction occurs is called the* **cathode.**