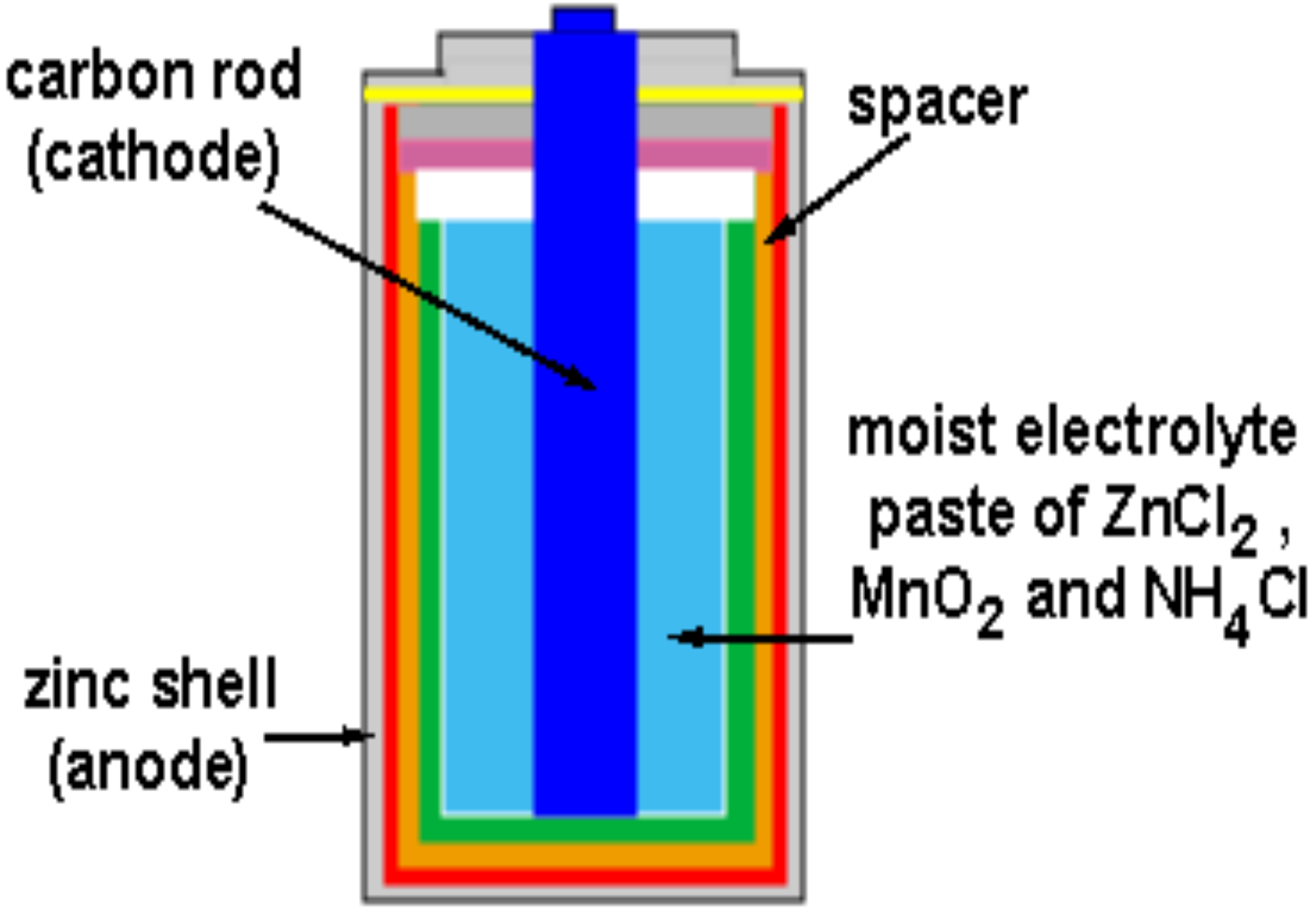
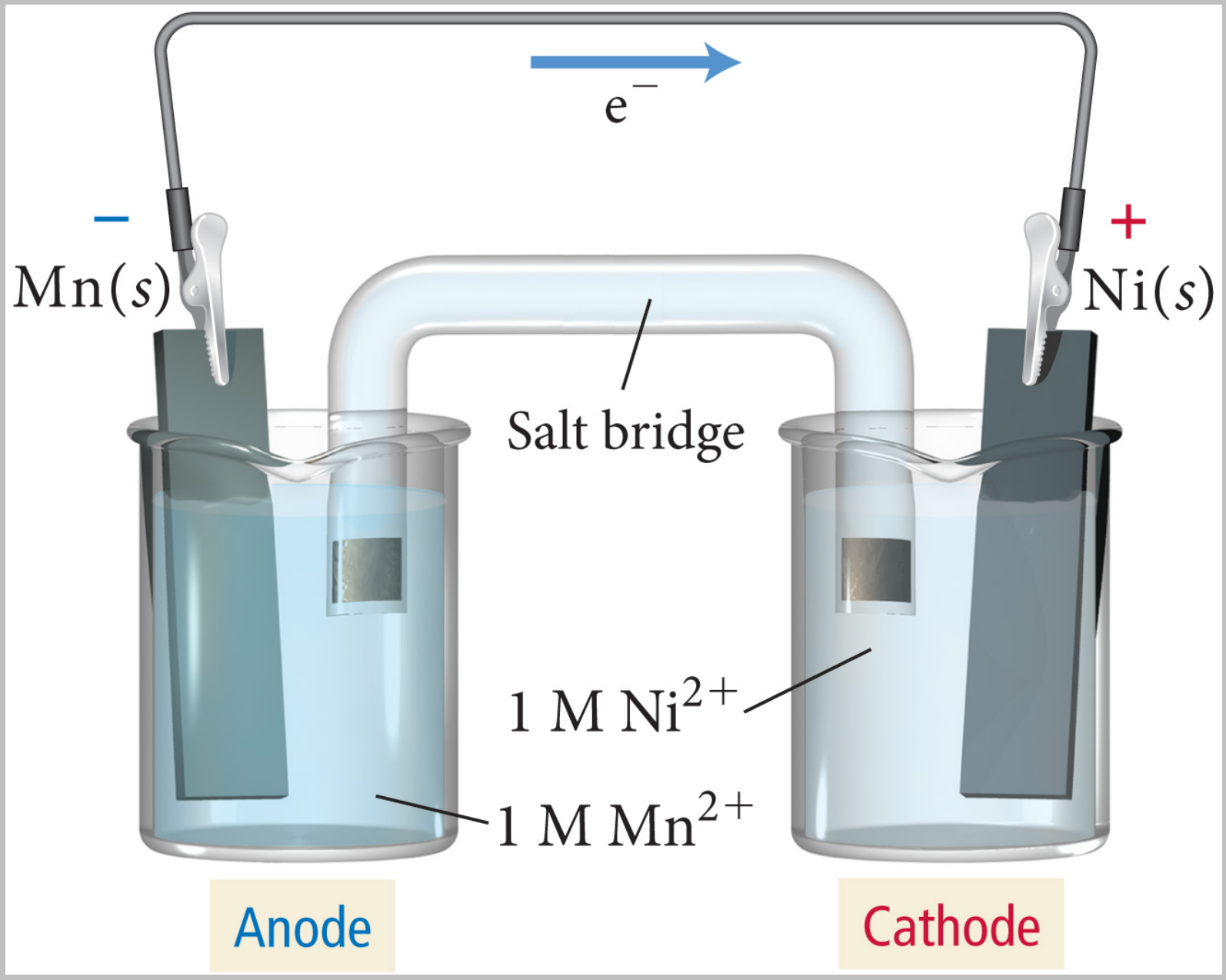
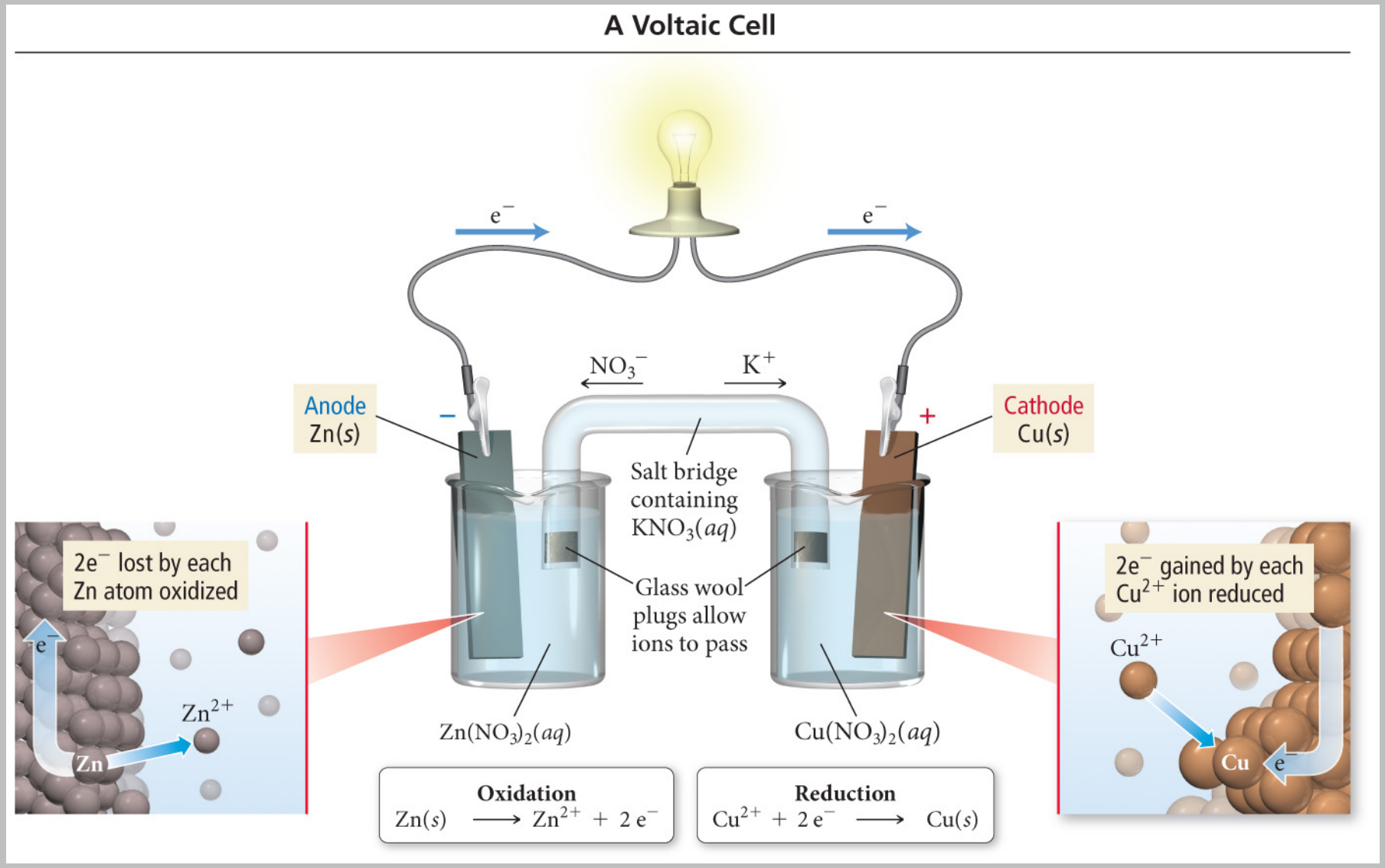
Electrochemistry - CELLS



Electric Current Flowing Directly between Atoms



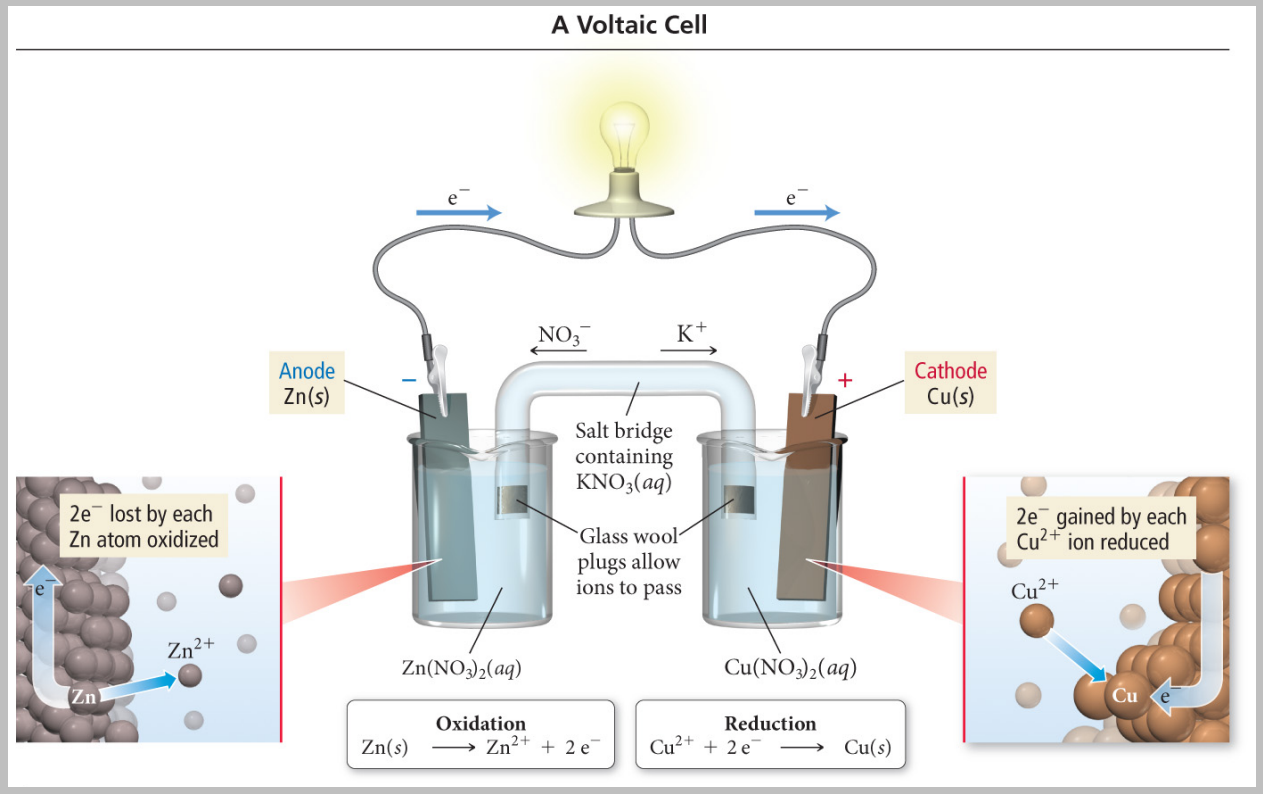
Electric Current Flowing Indirectly between Atoms



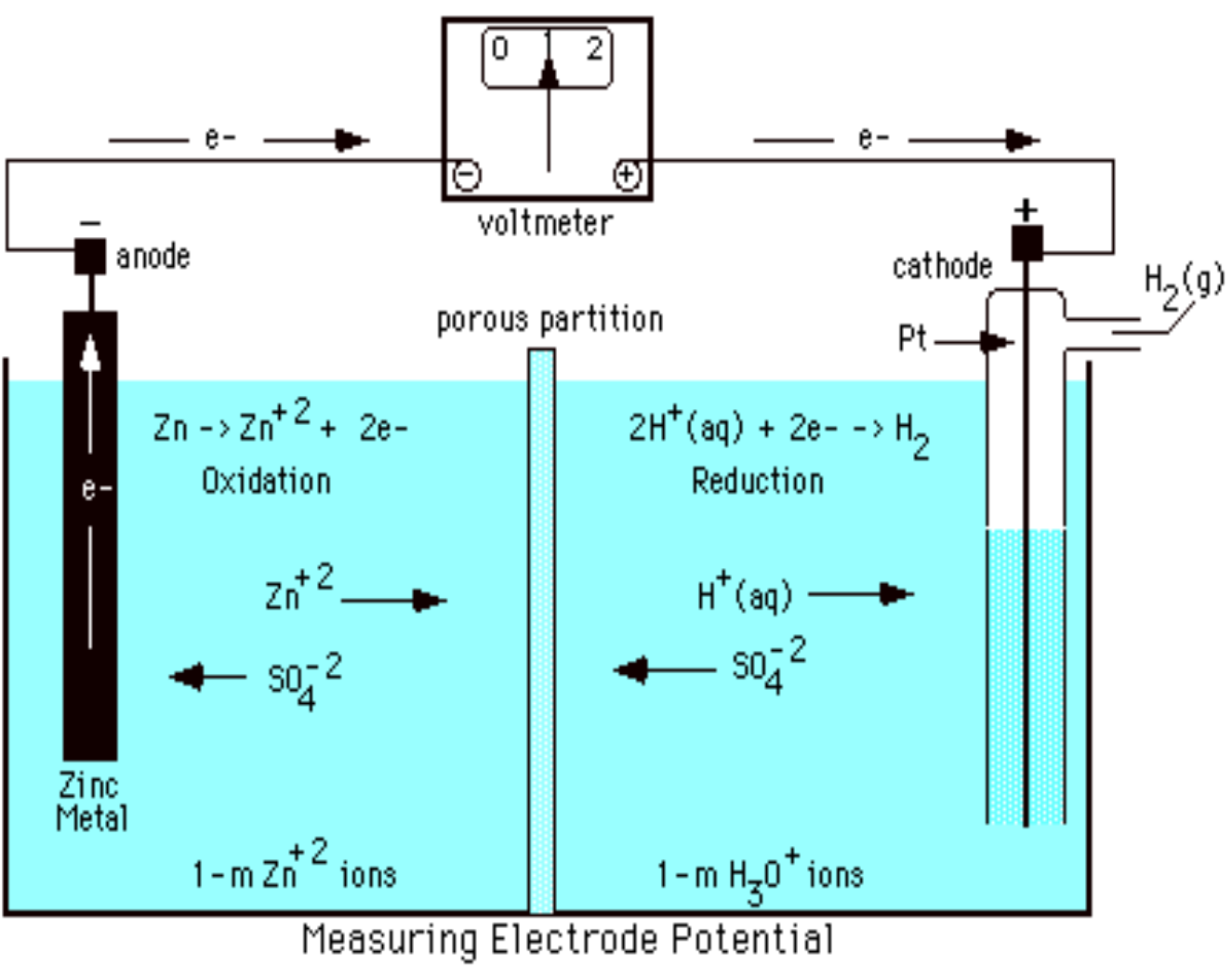
Electrodes

- **Anode**
  - Electrode where oxidation occurs
  - Anions attracted to it
  - Connected to positive end of battery in an electrolytic cell
  - Loses weight in electrolytic cell
- **Cathode**
  - Electrode where reduction occurs
  - Cations attracted to it
  - Connected to negative end of battery in an electrolytic cell
  - Gains weight in electrolytic cell
    - Electrode where plating takes place in electroplating

Voltaic Cell



The salt bridge is required to complete the circuit and maintain charge balance.



Measuring Electrode Potential

Measuring Standard Electrode Potential

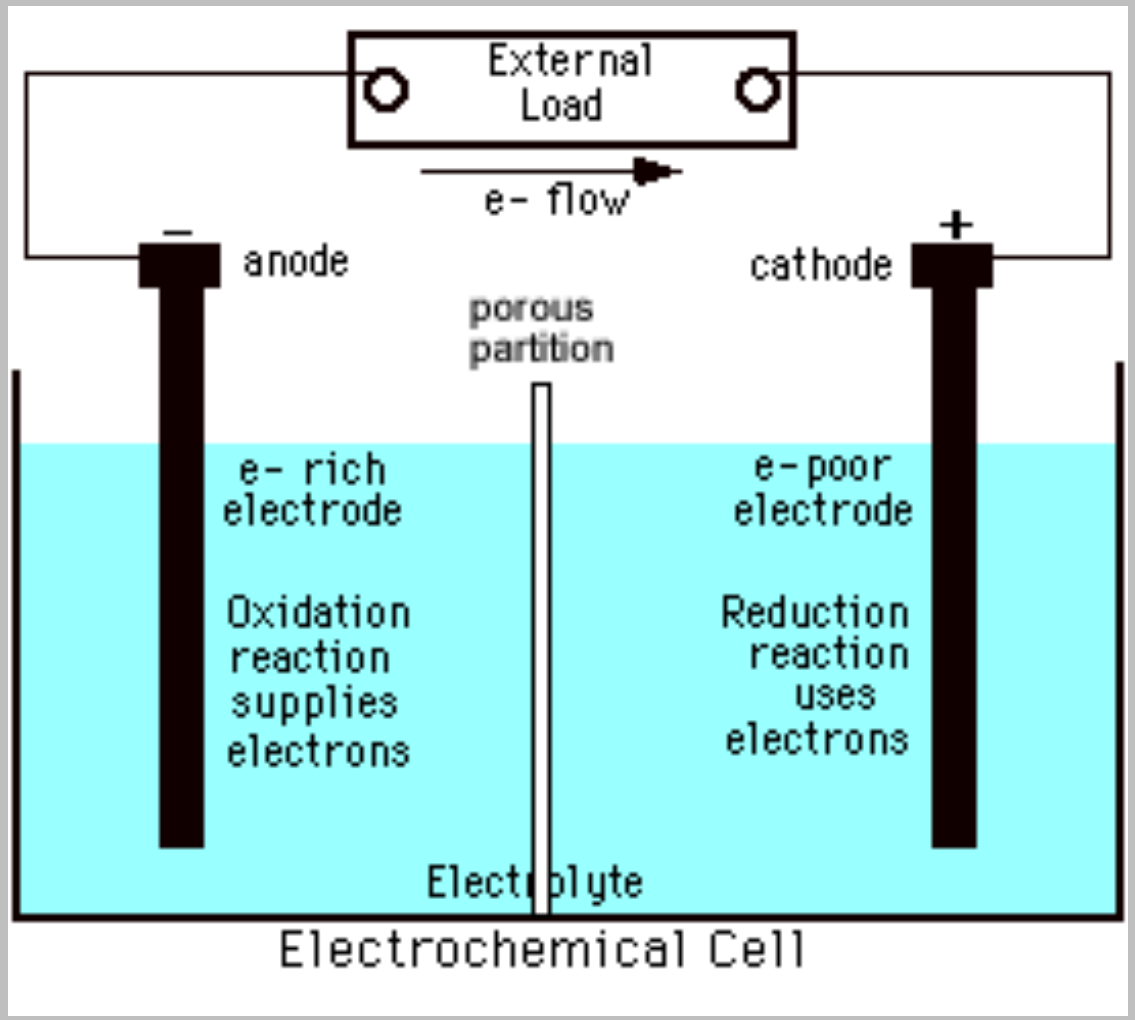
Potentials are measured against a hydrogen ion reduction reaction, which is arbitrarily assigned a potential of **zero volts**.

Galvanic (Electrochemical) Cells

Spontaneous redox processes have:

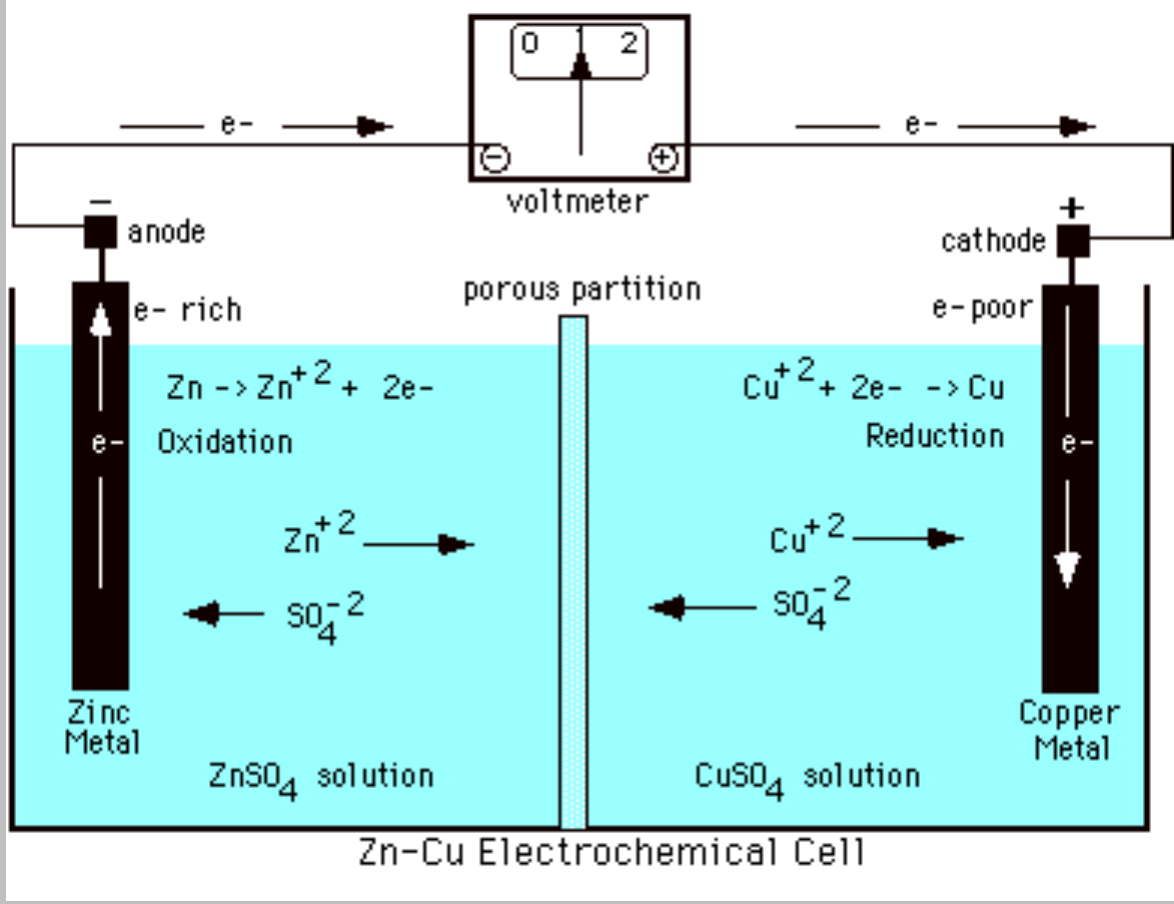
A positive cell potential, E^0

A negative free energy change, $(-\Delta G)$



Zn - Cu Galvanic Cell

From a table of reduction potentials:



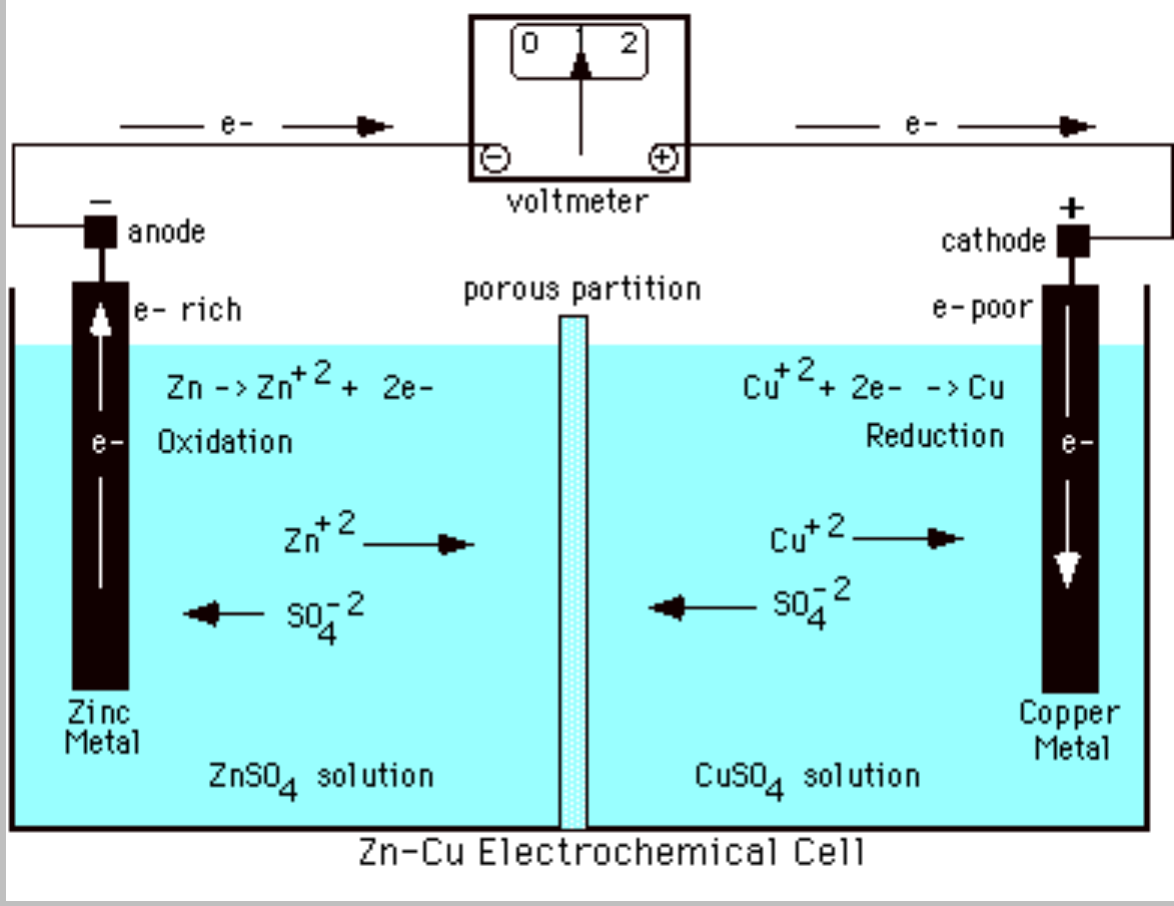
Zn-Cu Electrochemical Cell

$Zn^{2+} + 2e^- \rightarrow Zn$ E = -0.76V

$Cu^{2+} + 2e^- \rightarrow Cu$ E = +0.34V

Zn - Cu Galvanic Cell

The less positive, or more negative reduction potential becomes the oxidation…



$$Zn \rightarrow Zn^{2+} + 2e^- \qquad E = +0.76V$$

$$Cu^{2+} + 2e^- \rightarrow Cu \qquad E = +0.34V$$

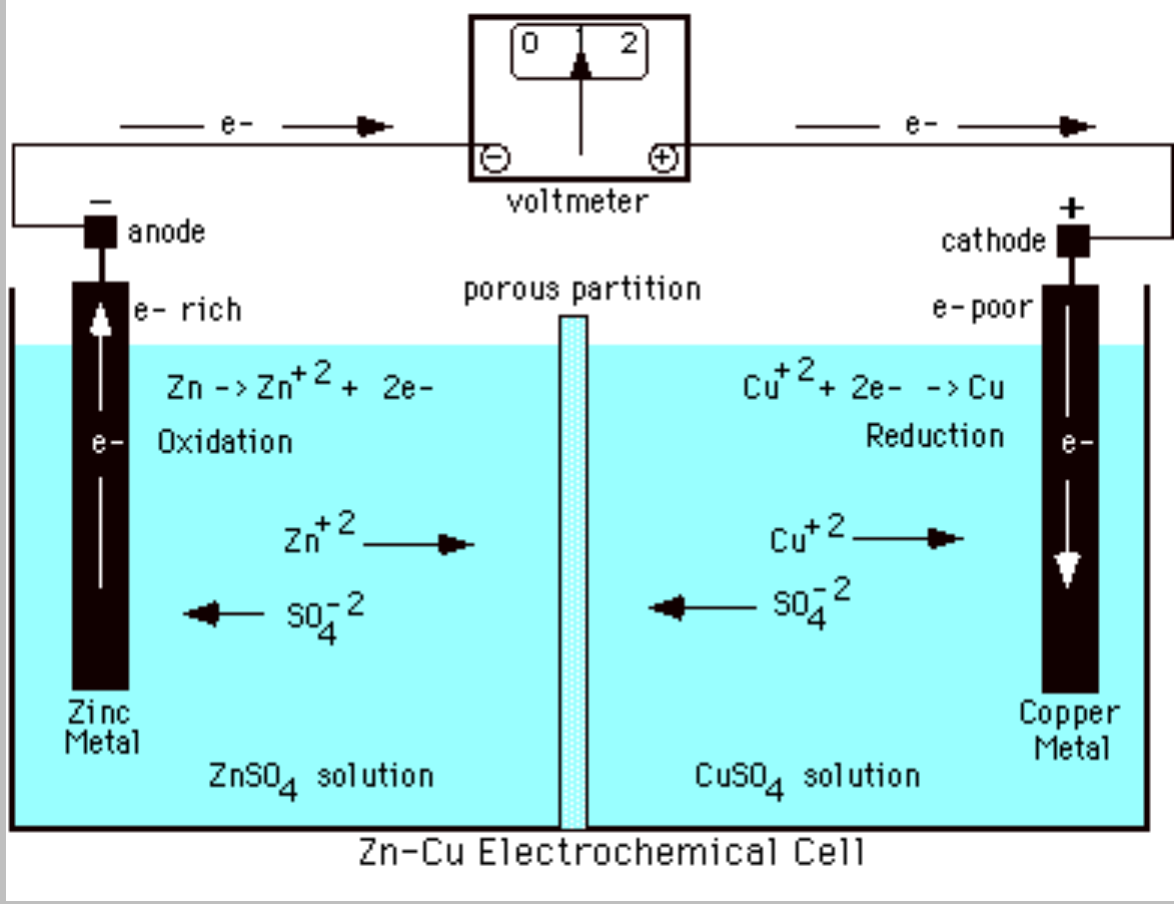
$$Zn + Cu^{2+} \rightarrow Zn^{2+} + Cu \qquad E^0 = +1.10\ V$$

Cell (Line) Notation

- Shorthand description of a voltaic cell
- Electrode | electrolyte || electrolyte | electrode
- Oxidation half-cell on the left; reduction half-cell on the right
- Single | = phase barrier
  - If multiple electrolytes in same phase, a comma is used rather than |
  - Often use an **inert electrode**
- Double line || = salt bridge

Line Notation

An abbreviated representation of an electrochemical cell



$$Zn(s) \mid Zn^{2+}(aq) \parallel Cu^{2+}(aq) \mid Cu(s)$$

Anode material | Anode solution || Cathode solution | Cathode material