**ELECTROCHEMISTRY**

**VOLTAIC CELL**
- Spontaneous chemical reaction provides electrical energy!
- Oxidation: \( Zn \rightarrow Zn^{2+} + 2e^- \)
- Reduction: \( Cu^{2+} + 2e^- \rightarrow Cu \)
- \( E^{\circ}_{\text{cell}} = +0.26 V \)

**ELECTROLYTIC CELL**
- Electrical energy is used to force a non-spontaneous reaction to occur.
- Oxidation: \( 2H_2O \rightarrow O_2 + 4H^+ + 4e^- \)
- Reduction: \( 2CuSO_4 \rightarrow 2Cu + 2H_2O + O_2 \)
- \( E^{\circ}_{\text{cell}} = +1.10 V \)

**NERNST EQUATION**
- \( E = E^{\circ} - \frac{RT}{nF} \ln Q \)
- \( E = E^{\circ} - \frac{Q}{nF} \ln Q \)

**BATTERIES**
- Primary: Reactions are not reversible.
- Secondary: Reactions are reversible.
- Fuel Cells: You refill with reactants (not recharged).