**Overview of Chapter 20**

**Electrochemistry**
- Oxidation/Reduction (Redox) Reactions
- Electrochemical Cells
- \( E^\circ \) and \( E \)
- \( E^\circ \) and \( K \)
- \( E^\circ \) and \( \Delta G \)

**Today’s Topics:**
- Electrochemical cells
- Calculating Voltage
- Voltage at non standard conditions

**Today’s Demos:**

- \( \text{Cu}^{2+}(aq) + \text{Zn}(s) \rightarrow \text{Zn}^{2+}(aq) + \text{Cu}(s) \) reaction
  - direct reaction
  - indirect reaction: Voltaic cell
  - With 1M concentrations of ions
  - With 0.1M concentration of \( \text{Cu}^{2+} \)

- Electrolysis of \( \text{H}_2\text{O} \)

**Electrochemical Cells**
- A redox reaction where electrons are transferred through an external connector.
- If a product favored reaction:
  - voltaic or galvanic cell
  - electric current produced
- If a reactant favored reaction:
  - electrolytic cell
  - electric current used to cause chemical change

- Batteries are voltaic cells

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**Electrochemistry**

- Oxidation: \( \text{Zn}(s) \rightarrow \text{Zn}^{2+}(aq) + 2\text{e}^- \)
- Reduction: \( \text{Cu}^{2+}(aq) + 2\text{e}^- \rightarrow \text{Cu}(s) \)
- \( \text{Cu}^{2+}(aq) + \text{Zn}(s) \rightarrow \text{Zn}^{2+}(aq) + \text{Cu}(s) \)

**Electrochemical Cells**
- To obtain a useful current, we separate the oxidizing and reducing agents so that electron transfer occurs through an external wire.
- This is accomplished in a **galvanic** or **voltaic** cell.
- A group of such cells is called a **battery**.
Electrochemical Cells

• Electrons travel through external wire.
• Salt bridge allows anions and cations to move between electrode compartments.

Zn $\rightarrow$ Zn$^{2+}$ + 2e$^-$  \hspace{1cm} Cu$^{2+}$ + 2e$^-$ $\rightarrow$ Cu

Oxidation \hspace{1cm} Reduction
Anode \hspace{1cm} Cathode
Negative \hspace{1cm} Positive

\[ E_{\text{cell}} = E_{\text{cathode}} - E_{\text{anode}} \]

where $E_{\text{cathode}}$ and $E_{\text{anode}}$ are the standard reduction potentials.