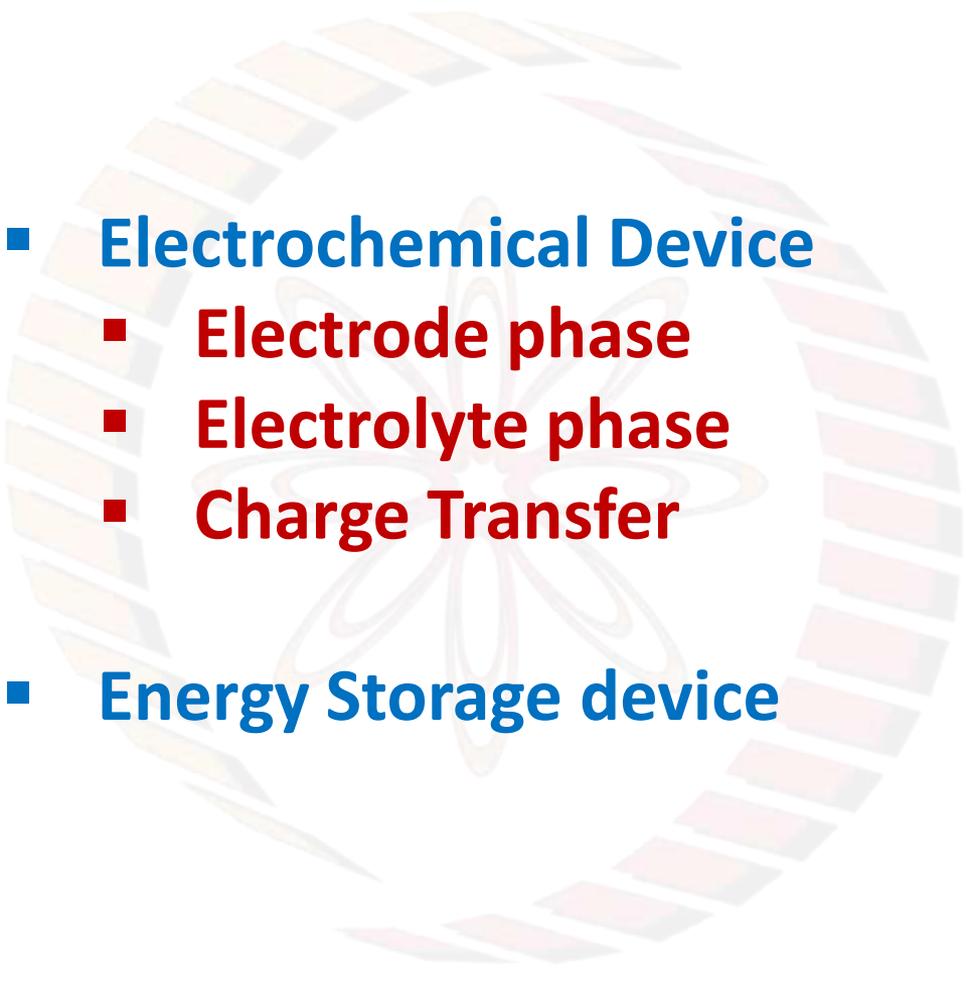




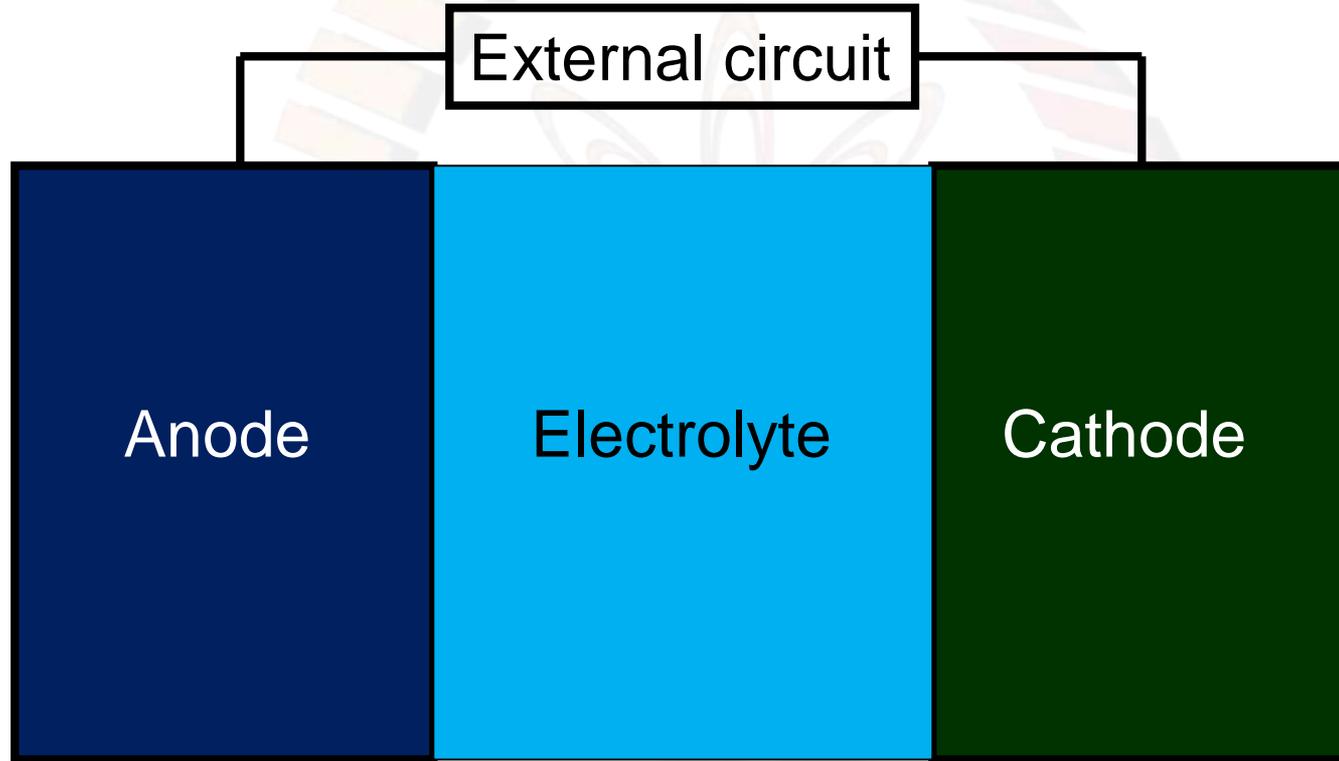
# Battery Basics

## Learning Objectives

- 1) To state the various parts of the battery and their functions
- 2) To indicate the use of the electrochemical series
- 3) To distinguish between primary and secondary batteries
- 4) To indicate the meaning of terms used in the context of battery technology

- 
- **Electrochemical Device**
    - **Electrode phase**
    - **Electrolyte phase**
    - **Charge Transfer**
  - **Energy Storage device**

# Electrochemical Device



**Anode**

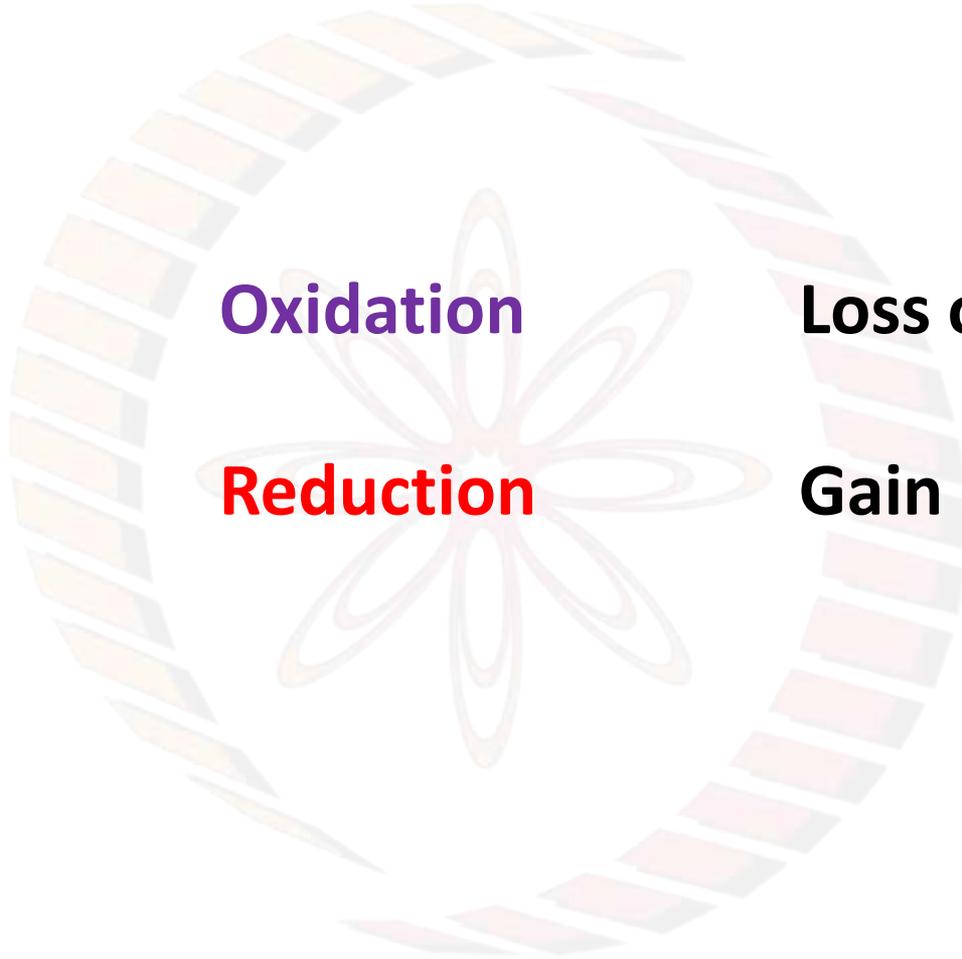
**Oxidation**

**Loss of electrons**

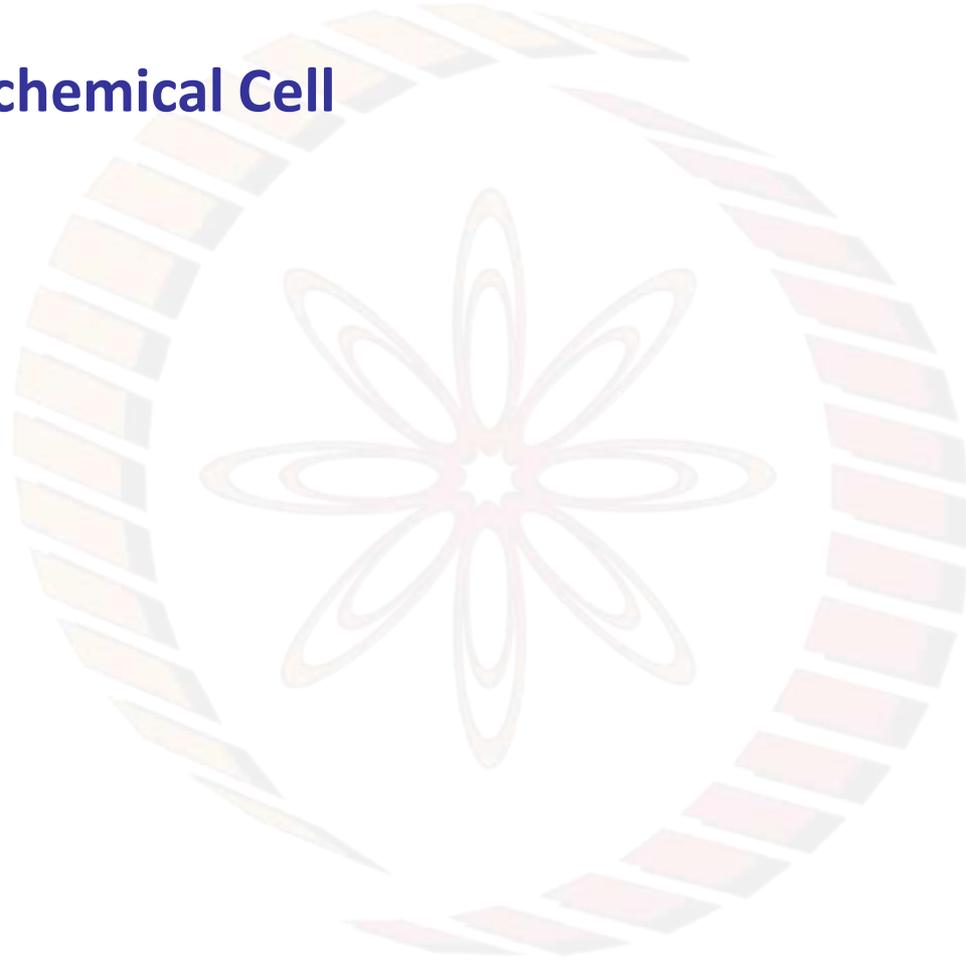
**Cathode**

**Reduction**

**Gain of electrons**



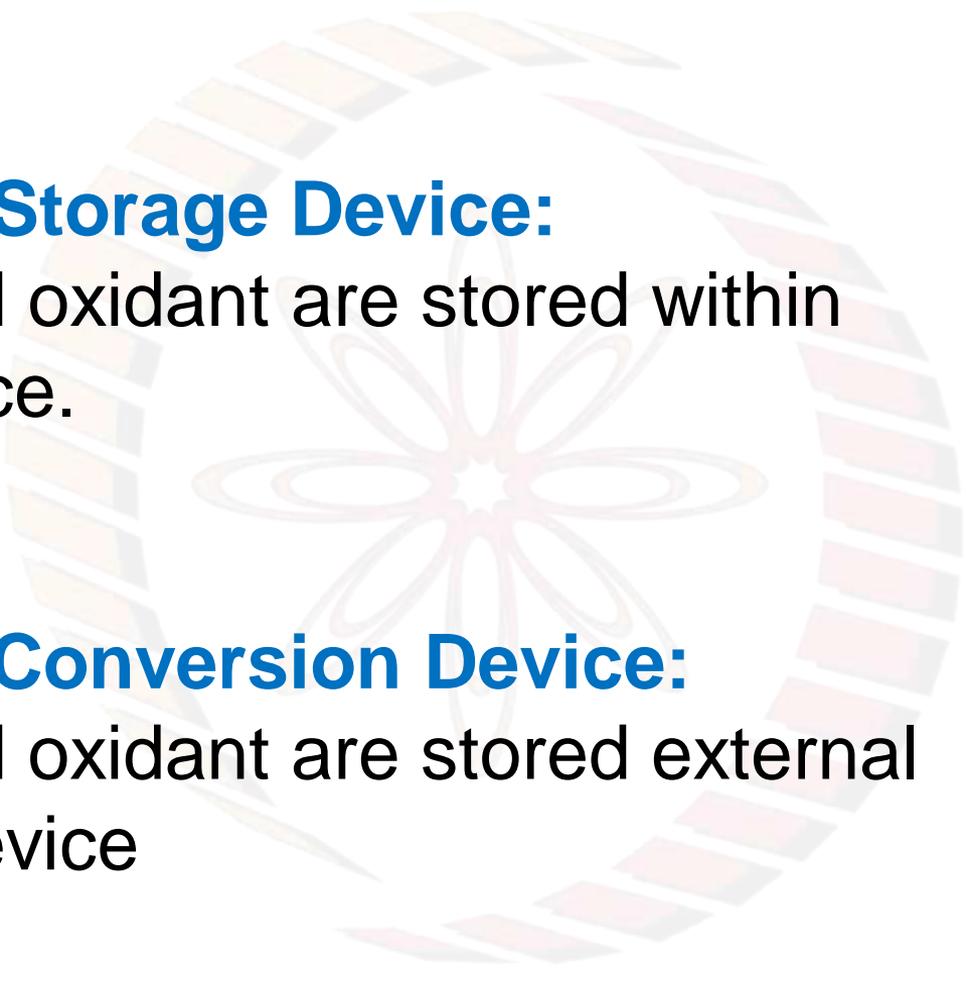
# The Electrochemical Cell



## Standard Electrode Potential

## Standard Electrochemical Series



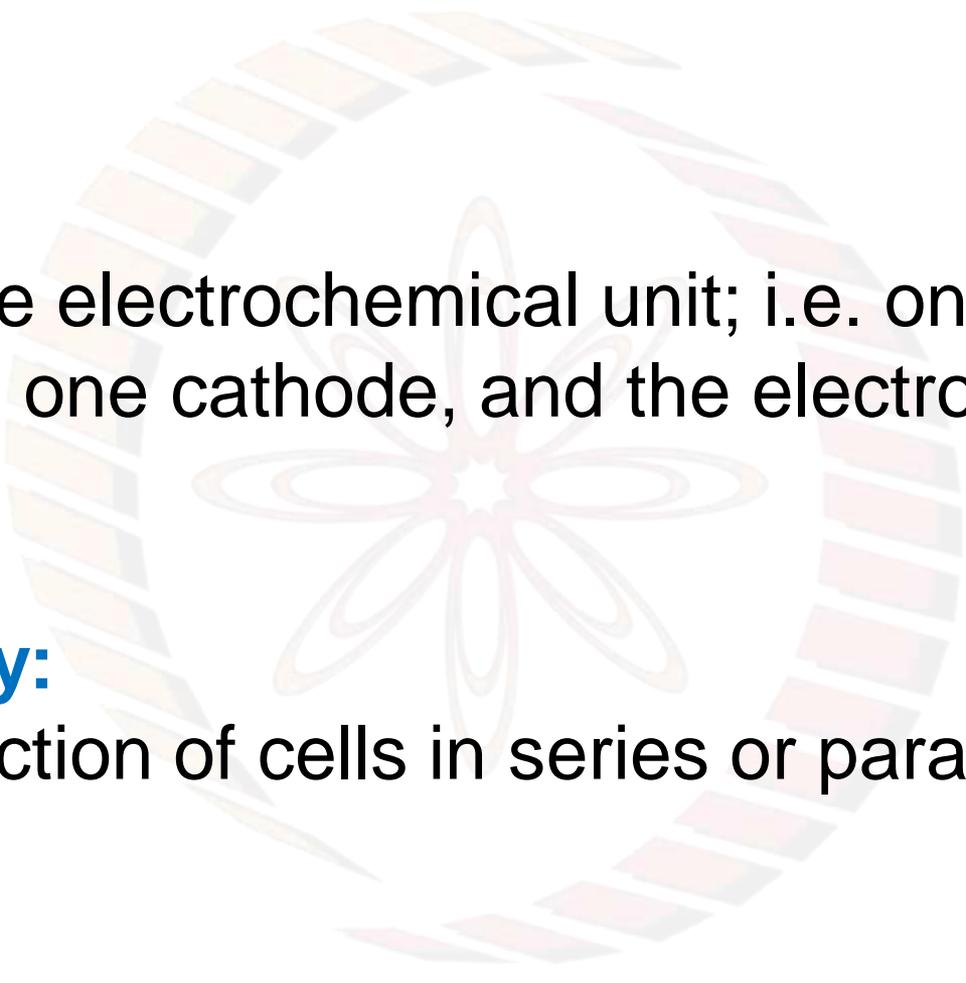


## **Energy Storage Device:**

Fuel and oxidant are stored within the device.

## **Energy Conversion Device:**

Fuel and oxidant are stored external to the device

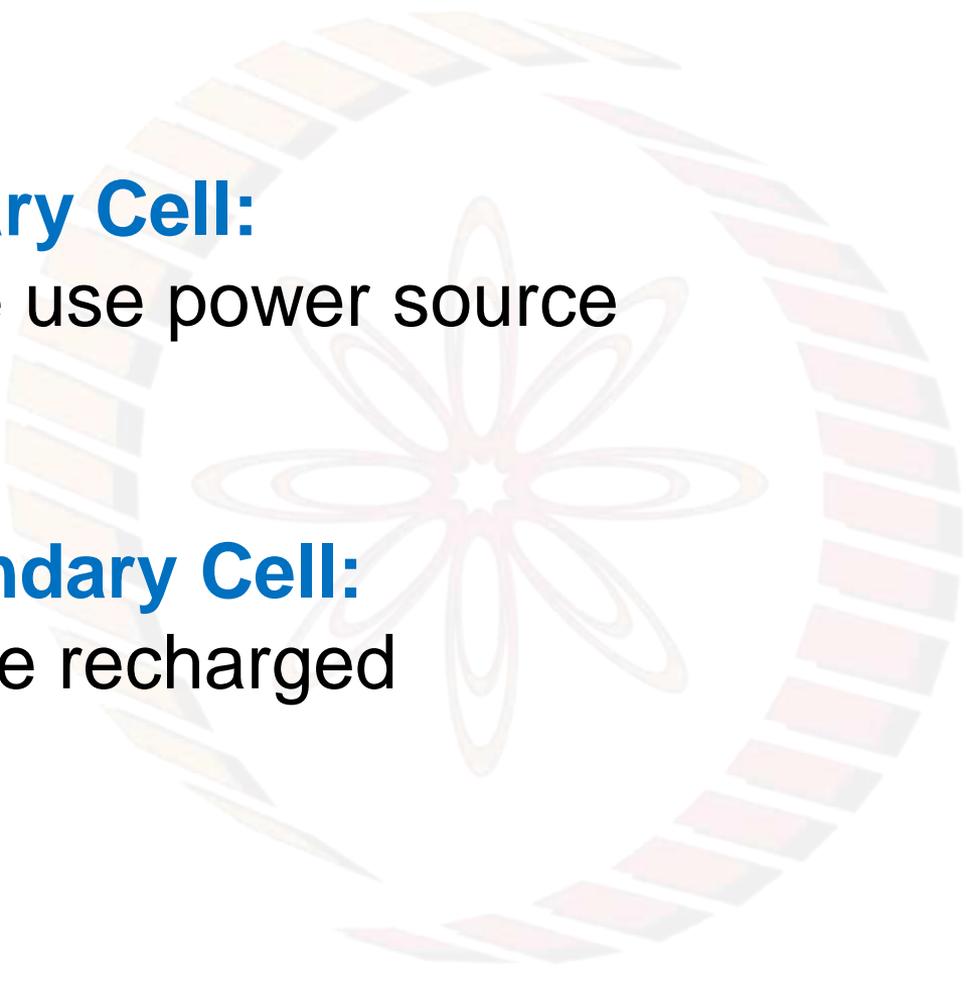


## **Cell:**

A single electrochemical unit; i.e. one anode, one cathode, and the electrolyte

## **Battery:**

A collection of cells in series or parallel



**Primary Cell:**

Single use power source

**Secondary Cell:**

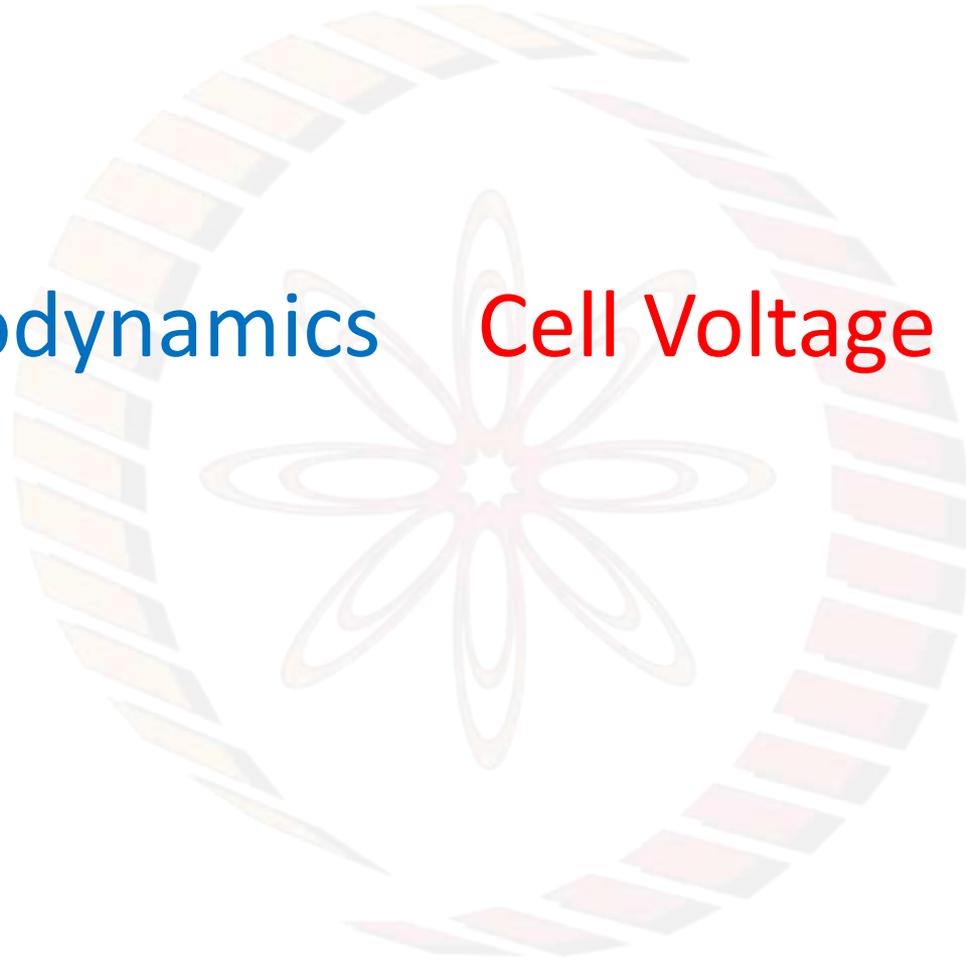
Can be recharged

# Thermodynamics



Thermodynamics

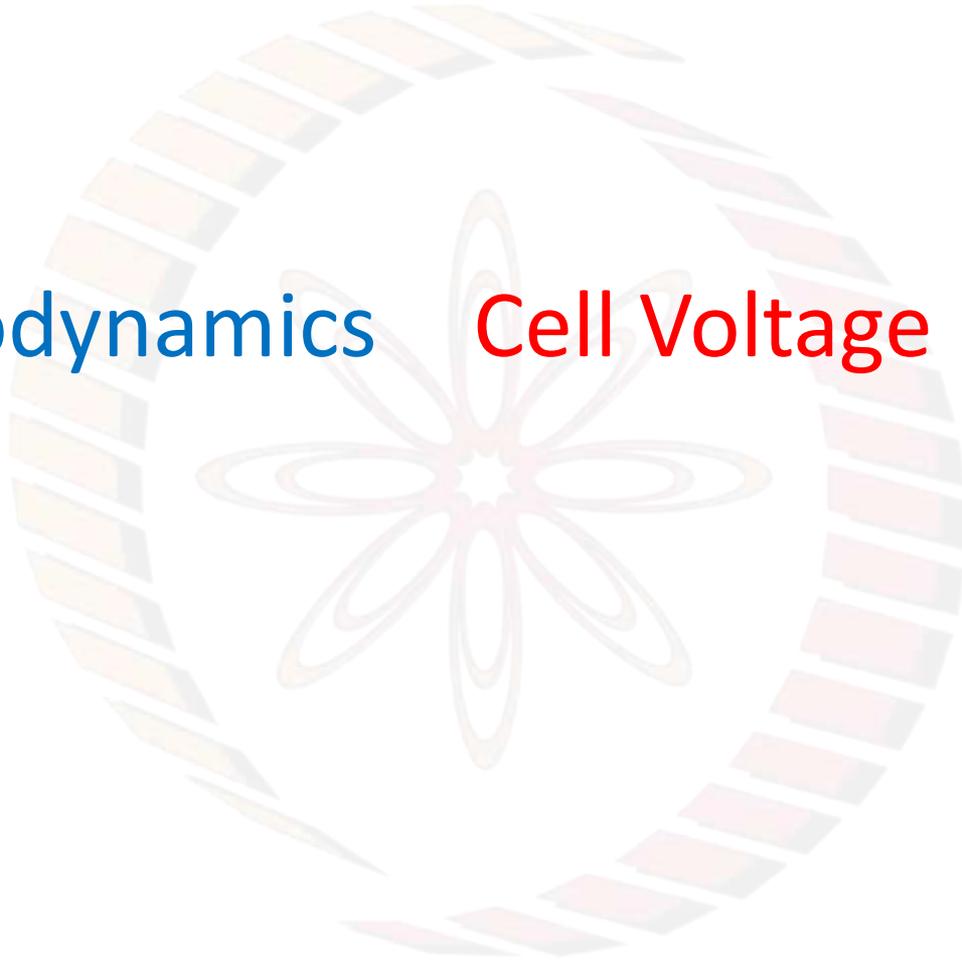
Cell Voltage



Thermodynamics

Cell Voltage

Kinetics

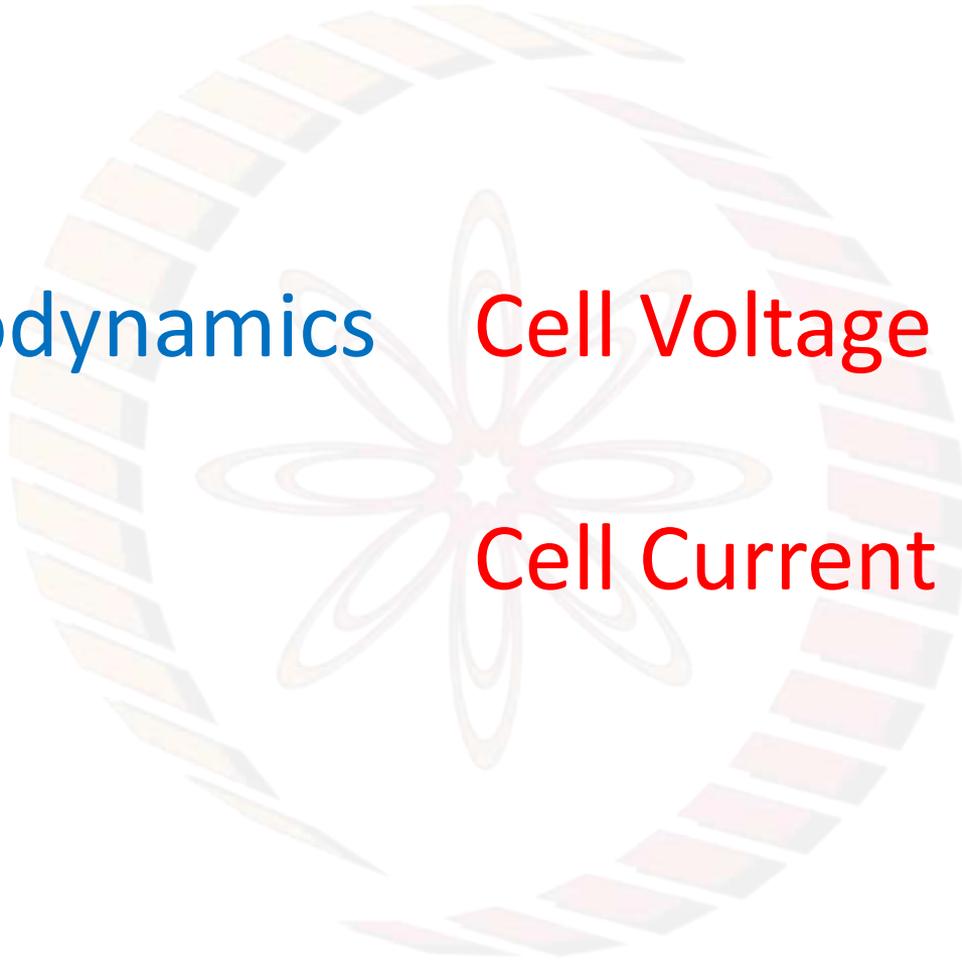


Thermodynamics

Cell Voltage

Kinetics

Cell Current



## Cell characteristics:

**Capacity:** Total charge in cell  
Coulombs or Ah

**Voltage**


$$\text{Power} = V * I$$

**Current**

**Watts**

**Time**

**Energy:**

**Power \* Time**  
**Joules or Wh**

## Conclusions

- 1) Batteries have specific parts that can have dramatically opposite functions
- 2) The electrochemical series is the starting point to understand Battery voltages
- 3) Primary and secondary batteries are both commonly used

A decorative circular graphic in the background. It features a central stylized flower with eight petals, rendered in a light pinkish-red color. Surrounding the flower is a circular border composed of many small, overlapping rectangular segments in shades of orange, yellow, and pink, creating a starburst or sunburst effect.

# **Common Battery Types**



# **Battery Testing and Performance**



# Lithium ion Batteries