Current Electricity

- What is Current Electricity?
- Electrical Circuits
- Electrochemical Cells
  - Wet, Dry and Fuel Cells

Current Electricity

Current Electricity – continuous flow of electrons in a closed circuit

A flow of electrons moves continuously as long as there is:

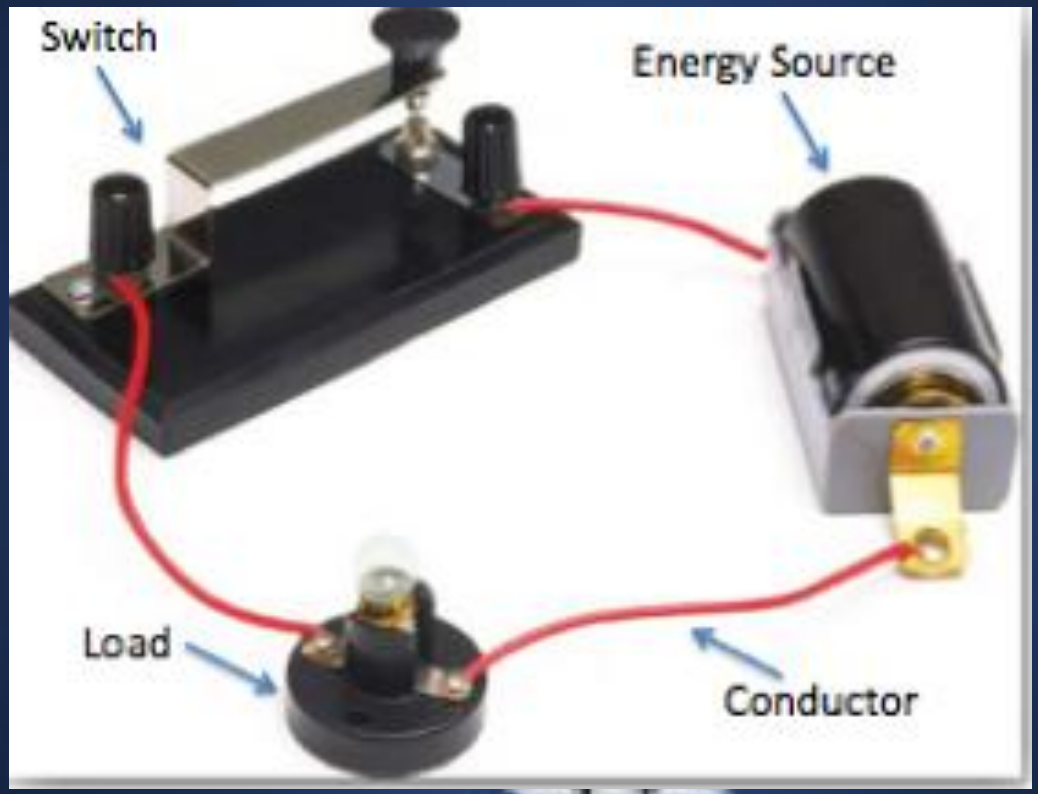
1. An energy source
2. A complete path

Electrical Circuits

Circuit = complete path of electron flow

Parts of a Circuit:

- Energy source
- Conductor
- Load
- * Switch



Electrons flow from negative to positive

Functions of the Parts of a Circuit

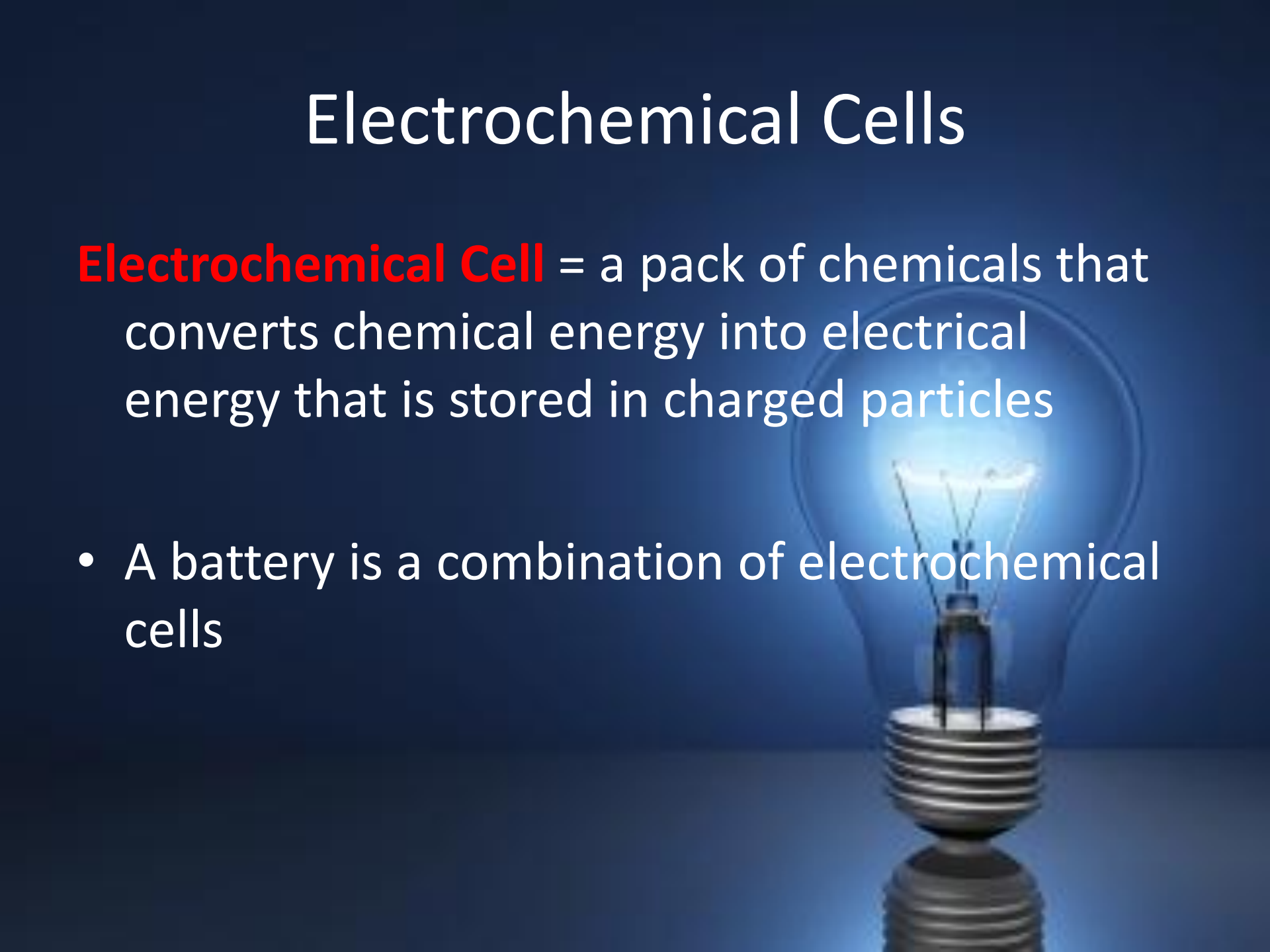
Parts of a Circuit:

- **Energy source** – provides energy for the electrons in the circuit
- **Conductor** – wires that carry the current (electrons) around the circuit
- **Load** – converts the electrical energy carried by the electrons to a useful form (light, heat, movement)
- * **Switch** – controls when the electricity can flow (not a necessary part of the circuit

Electrochemical Cells

Electrochemical Cell = a pack of chemicals that converts chemical energy into electrical energy that is stored in charged particles

- A battery is a combination of electrochemical cells



Electrochemical cells include:

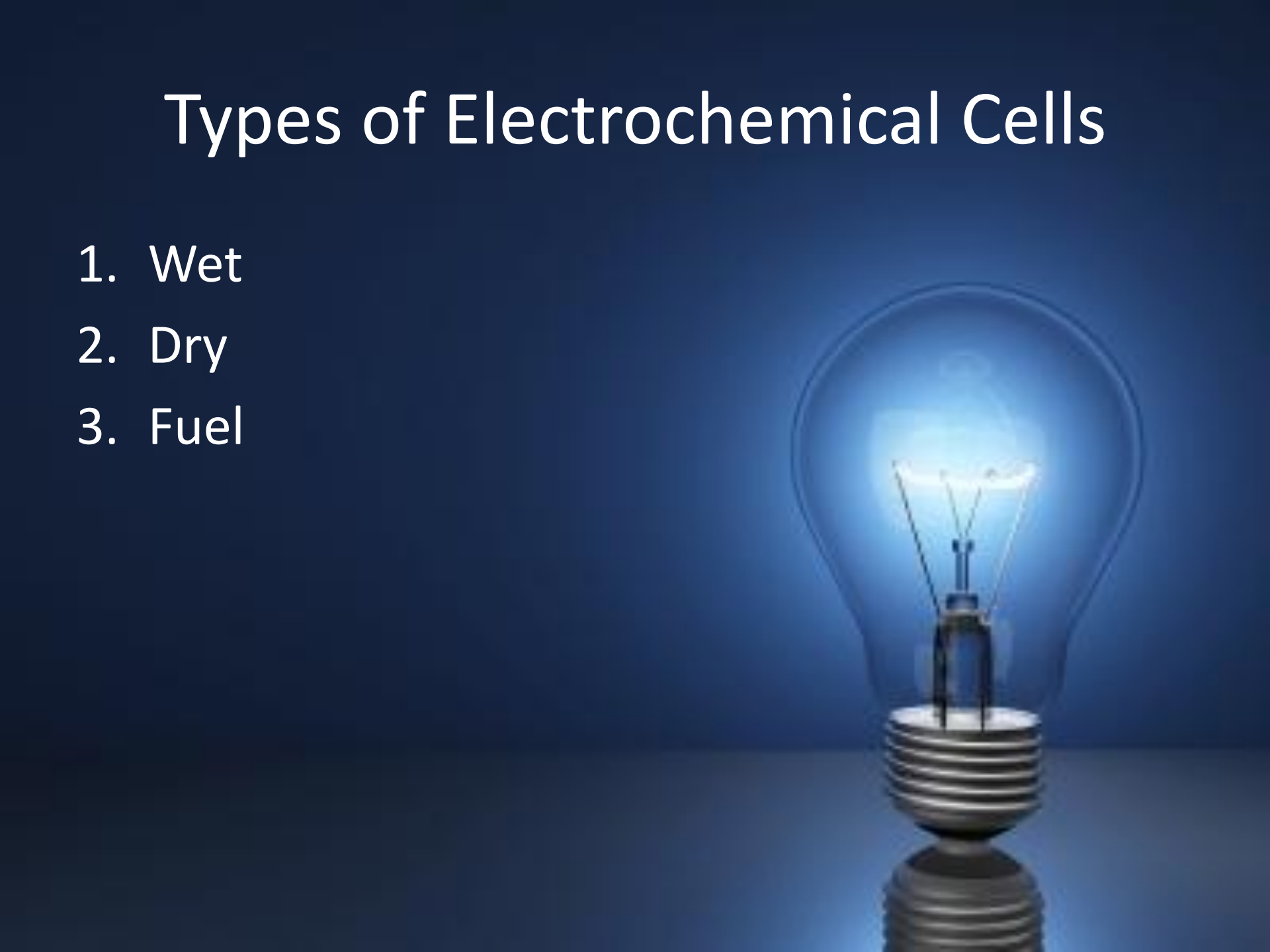
- 1 Electrolyte
  - Liquid or paste that conducts electricity
  - Contains chemicals that form ions
  - Ex. Citric acid

- 2 Electrodes
  - Metal strips that react with the electrolyte
  - Ex. Zinc and Copper

Reaction → electrons collect on one of the electrodes (- charge), and electrons are lost from the other electrode (+ charge)

Types of Electrochemical Cells

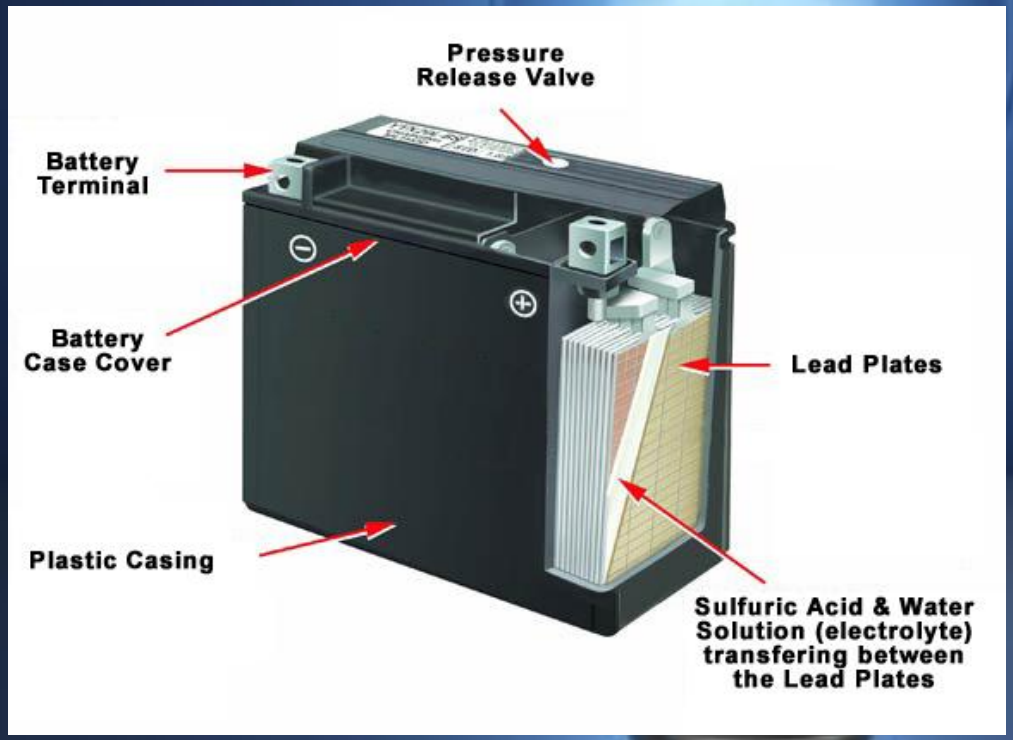
1. Wet
2. Dry
3. Fuel



Wet Cells

= an electrochemical cell that has a liquid electrolyte

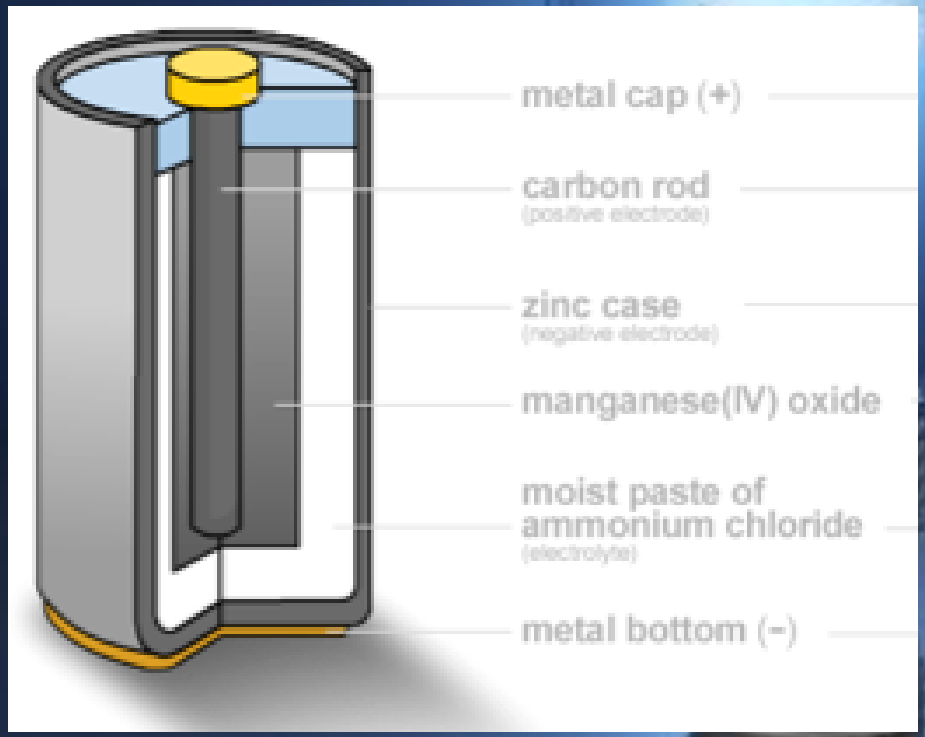
Example: Car battery



Dry Cells

= an electrochemical cell that has a paste electrolyte

Example: Simple batteries



Fuel Cells

= an electrochemical cell that generates electricity directly from a chemical reaction with fuel

Example: Electric Car Battery

Homework

A. Questions 1-5 pg. 436
B. Handouts
   - The Wet Cell
   - How a Dry Cell Battery Works

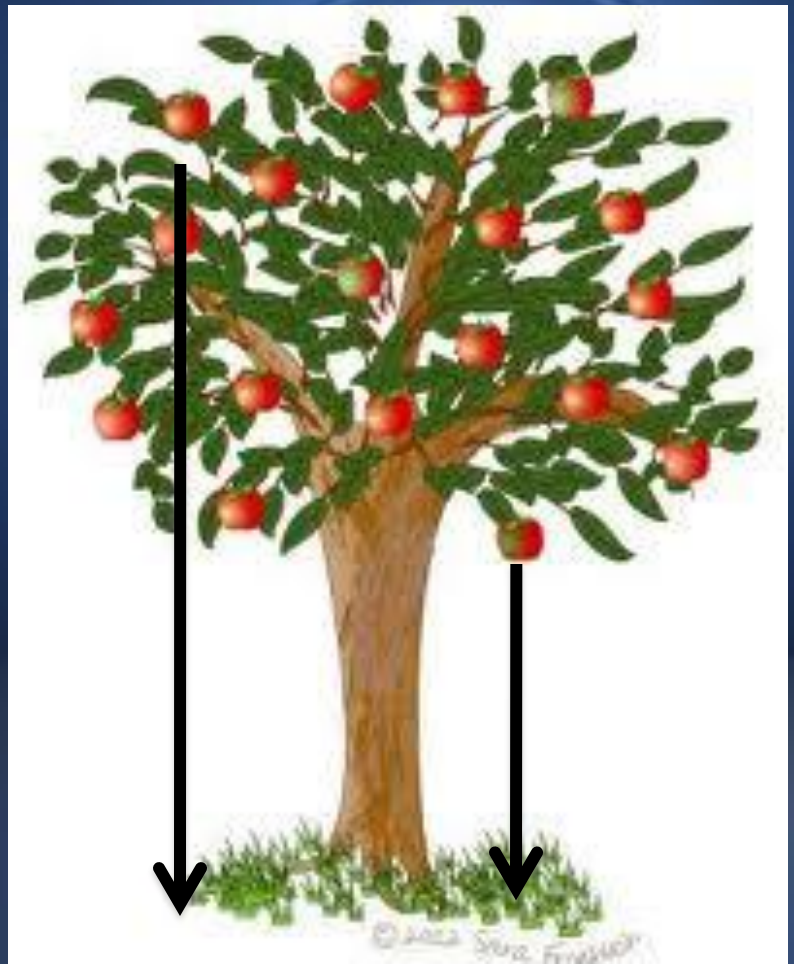
Potential Difference, Current and Resistance

- Voltage
- Current
- Resistance
- How to Measure Voltage, Current and Resistance

Potential Energy

Potential Energy = the energy stored in an object

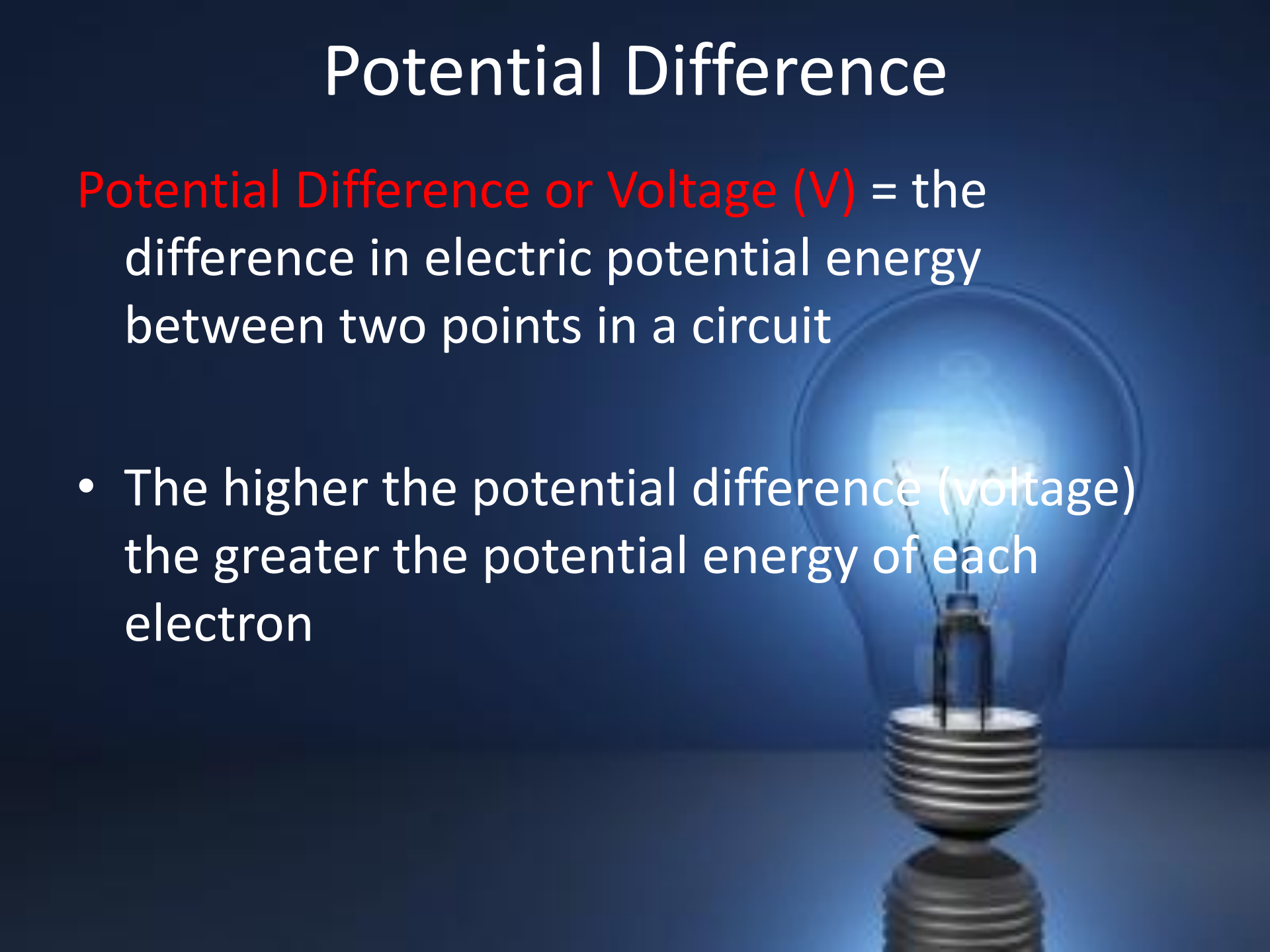
- **Every electron has potential energy**



Potential Difference

Potential Difference or Voltage (V) = the difference in electric potential energy between two points in a circuit

- The higher the potential difference (voltage) the greater the potential energy of each electron



Measuring Potential Difference

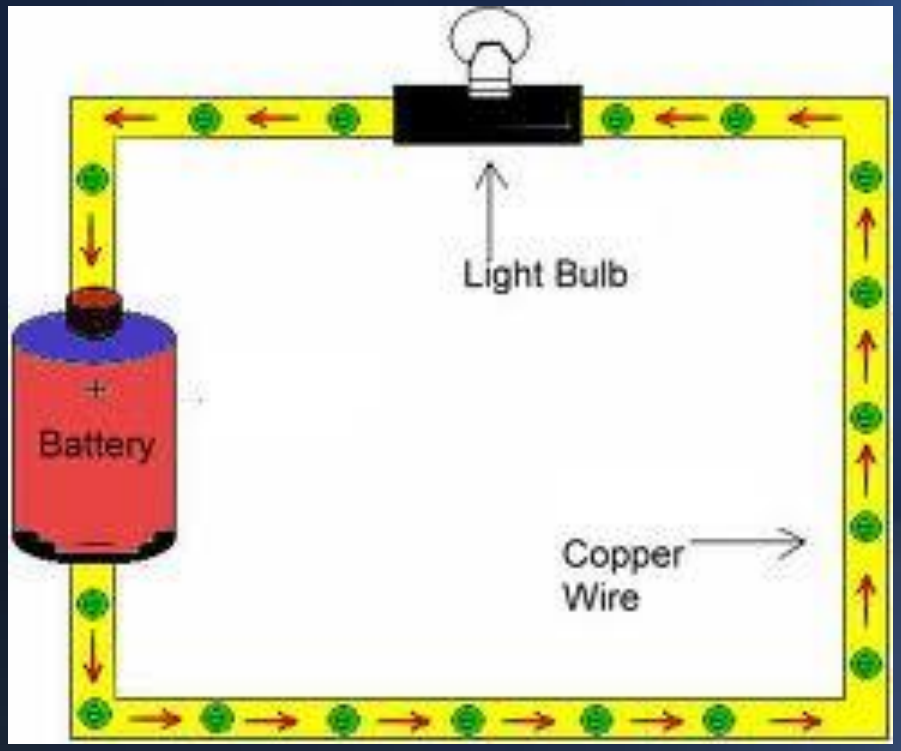
Volt (V) – is the unit used to measure potential difference

Voltmeter

- Measures the potential difference between two locations in a circuit

Electrical Current

Electrical Current = is a measure of the amount of electrical charge that passes by a point in an electrical circuit each second



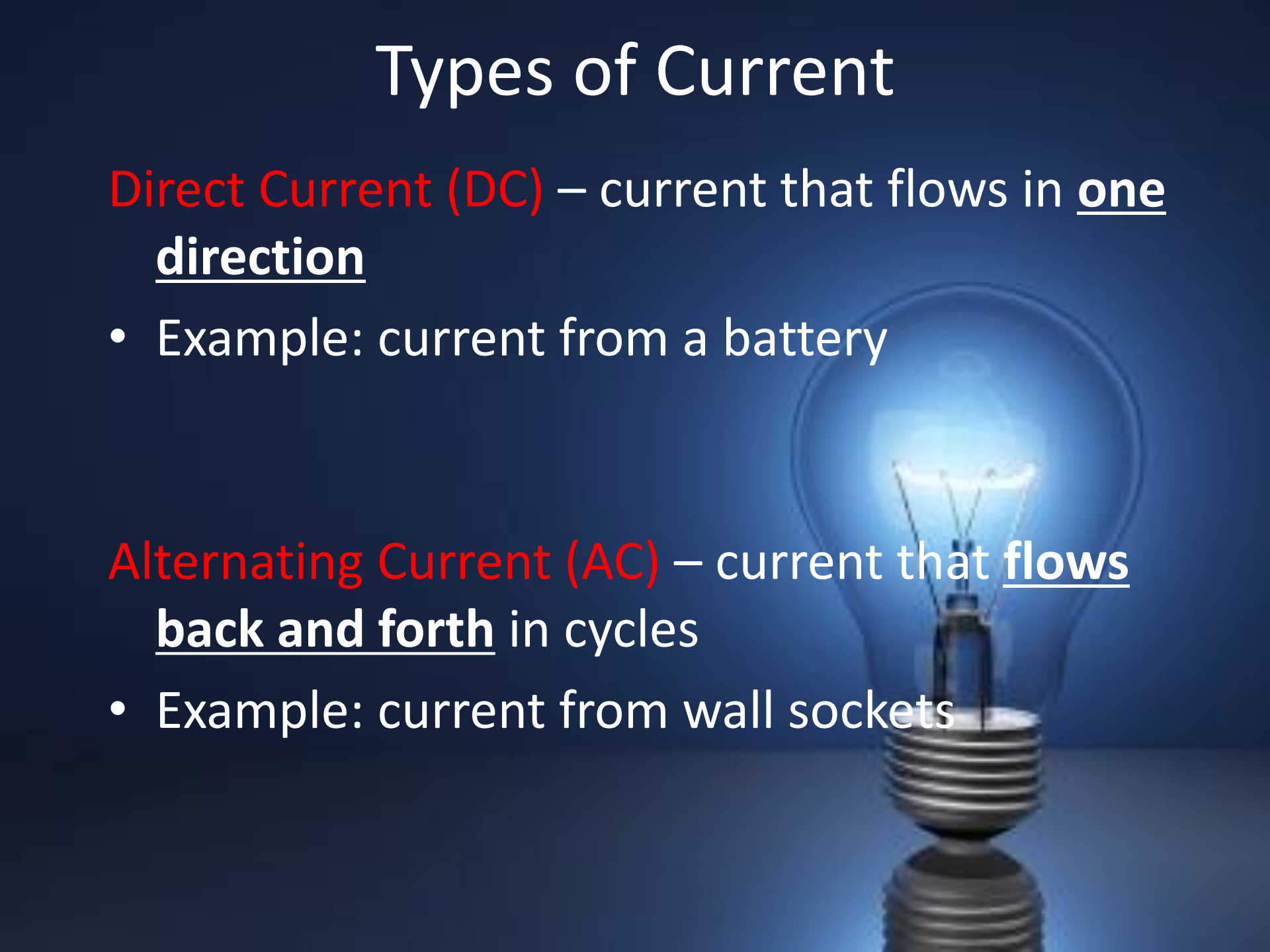
Types of Current

Direct Current (DC) – current that flows in **one direction**

- Example: current from a battery

Alternating Current (AC) – current that **flows back and forth** in cycles

- Example: current from wall sockets



Measuring Current

Ampere (A) – the unit used to measure electric current

Ammeter

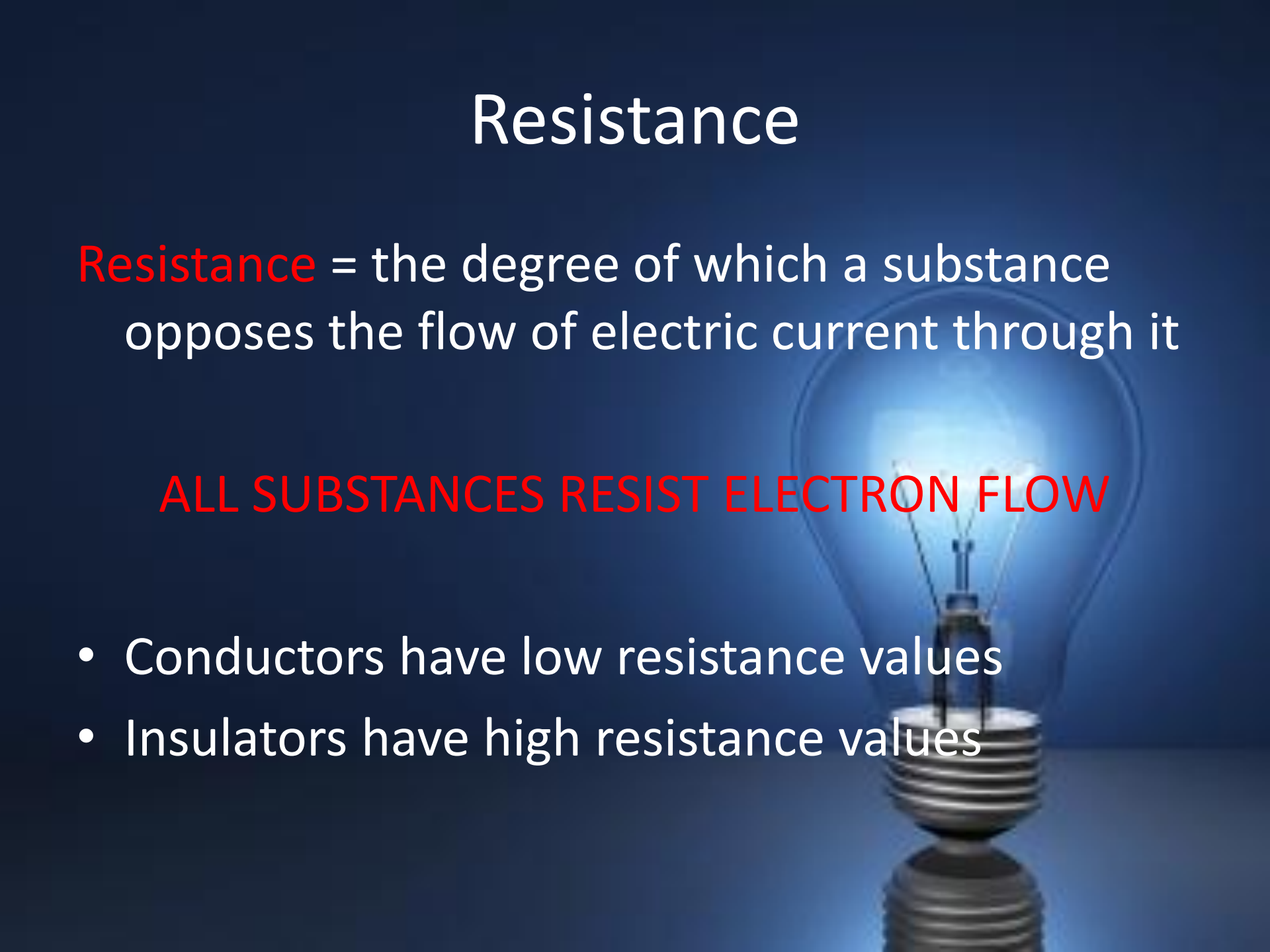
- Measures current in a circuit

Resistance

Resistance = the degree of which a substance opposes the flow of electric current through it

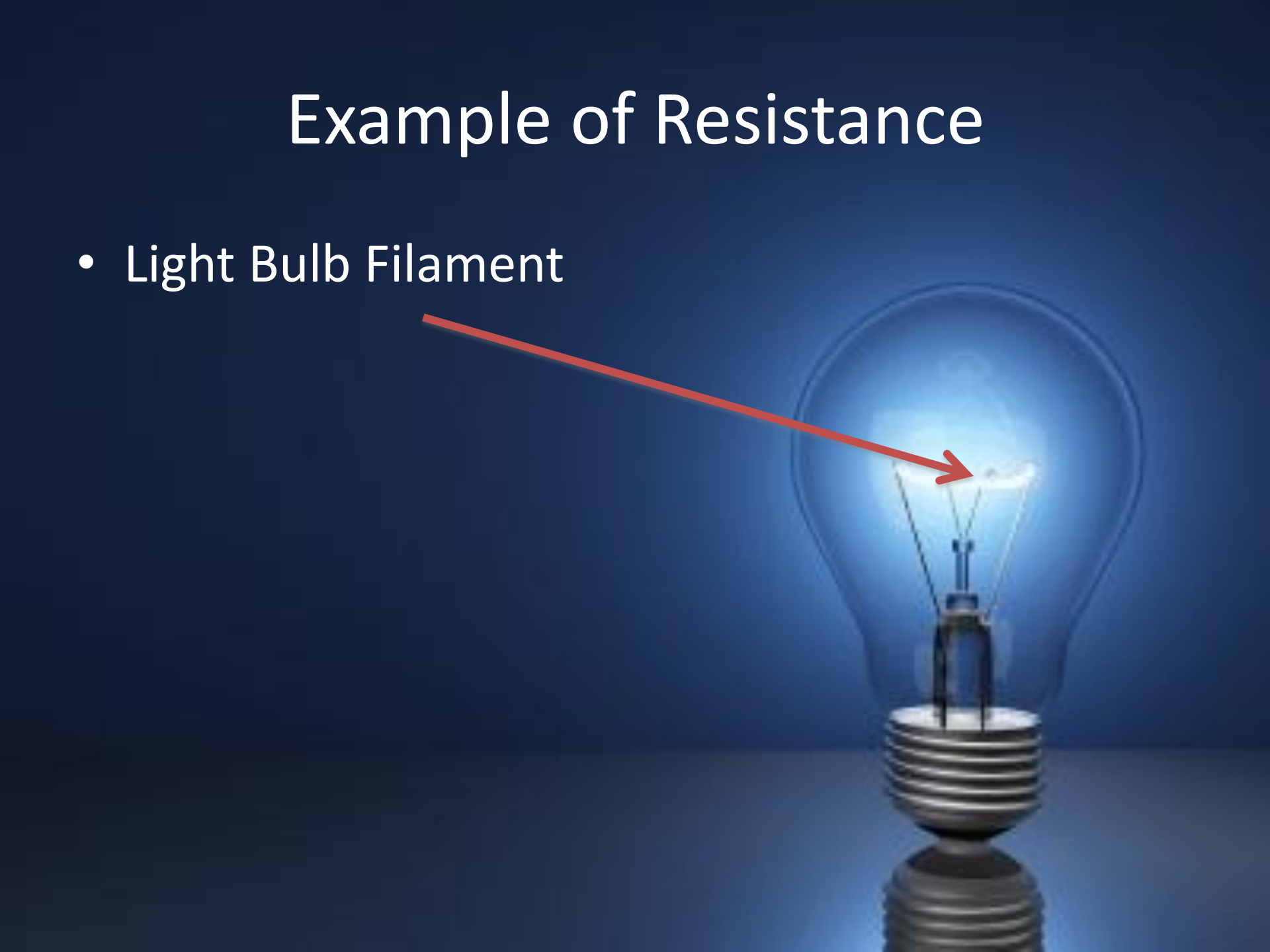
ALL SUBSTANCES RESIST ELECTRON FLOW

- Conductors have low resistance values
- Insulators have high resistance values



Example of Resistance

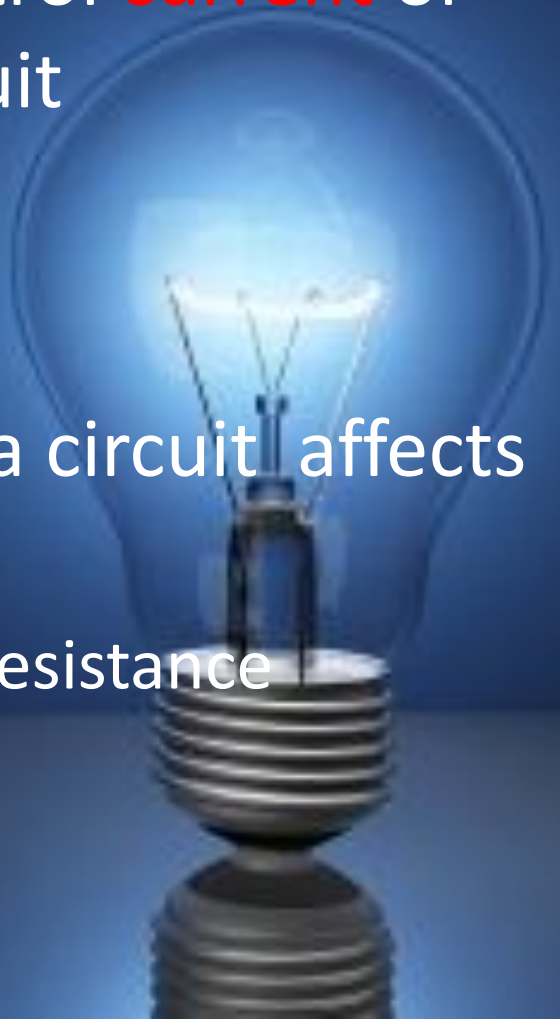
- Light Bulb Filament



Resistors

- Resistors can be used to control current or potential difference in a circuit

- The amount of resistance in a circuit affects the electrical current
  - Current decreases if you add resistance



Factors Affecting Resistance

Table 11.1: Page. 443

Factor	How Factor Affects Resistance
Material	• The material used in a circuit effects the resistance on the circuit • Copper is used most frequently as conducting wire
Temperature	• High temperatures have a higher resistance • Low temperatures have a lower resistance
Length	• Longer wires have more resistance • Shorter wires have less resistance
Cross-sectional Area	• Wide wires have less resistance • Short wires have more resistance

Measuring Resistance

Ohm (Ω) – the unit used to measure resistance

Ohmmeter

- Measures electrical resistance

Homework

A. Questions 3-5 pg. 438
B. Questions 1-3 pg. 442
C. Questions 3,4,5,7,8,10 pg.447

Ohm's Law

$$V = IR$$

Georg Ohm

- Helped us discover the relationship between voltage, current and resistance

- Ohm's Law states:

As long as temperature remains the same, V=IR

  - V = potential difference
  - I = current
  - R = resistence

Ohm’s Law

Steps for Solving Ohm's Law

1. State the information given in the equation and what is required

2. Calculate the solution

   SHOW ALL YOUR WORK !!!!

3. Write a therefore statement

Example Problem 1

A current of 4.0 A flows through a 40-Ω resistor in a circuit. What is the Voltage in the circuit?

(1) GIVEN

I (current) = 4.0 A

R (resistance) = 40 Ω

REQUIRED

Voltage?

(2) SOLUTION

V = I R

= (4.0 A) (40 Ω)

= 160 V

(3) Therefore the voltage in the circuit is 160 V.

Example Problem 2

A off road jeep has a searchlight with a resistance of 60 Ω that is placed across a 24-V battery. What is the current in this circuit?

R = 60 Ω

V = 24 V

I = ?

$V = I R$

$I = \frac{V}{R}$

$= \frac{24\ V}{60\ \Omega}$

$= 0.4\ A$

Therefore the current in the jeep searchlight is 0.4 A

Try this one yourself!

A current of 35 A is flowing through a light bulb that is connected to a 124 V power supply. What is the bulbs resistance?

I = 35 A

V = 124 V

R = ?

$V = I R$

$R = \frac{V}{I}$

$= \frac{124\ V}{35\ A}$

$= 3.5\ \Omega$

Therefore the resistance in the light bulb is 3.5 Ω.

Homework

A. All 9 Practice Problems pg 460-461

B. Review Question 1-11 & 13 pg. 447

C. Study for QUIZ

Tomorrow

- Quiz
- Drawing Circuit Diagrams

Drawing Circuit Diagrams

Circuit Diagram – a drawing that uses symbols to to show the components and connections in a circuit.

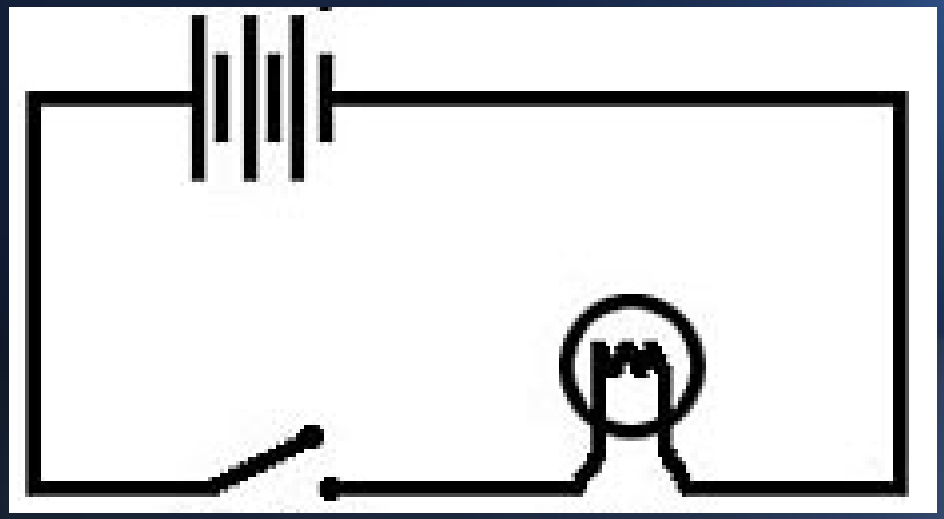
Help to determine how:

- current flows
- device functions

Rules for Drawing Circuit Diagrams

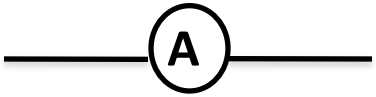
1. Always use a ruler

1. Make right-angle corners



Circuit Diagram Symbols

Table 11.2, pg. 450

Symbol	Component	Function
	Wire	- Conductor; allows electrons to flow
	Cell or Battery	- Electrical source; longer side is positive terminal, shorter side is negative
	Lamp (light bulb)	- Specific load; converts electricity into like and heat
	Resistor	- General load; converts electricity to heat
	Switch	- Opens and closes the circuit
	Ammeter	- Measures current through a device, connected in series
	Voltmeter	- Measures voltage across a device, connected in parallel

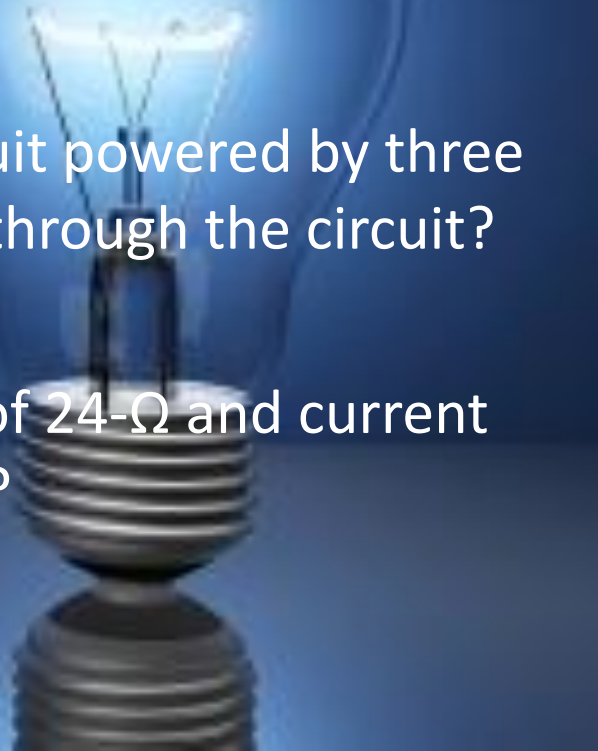
Ohm's Law Review Questions

1. The current in a circuit is 0.5-A. The circuit has two batteries each with a power supply of 1.3-V. What is the resistance in the circuit?

1. A current of 400mA runs through a bulb that is connected to two 15-Ω resistors. What is the voltage in the circuit?

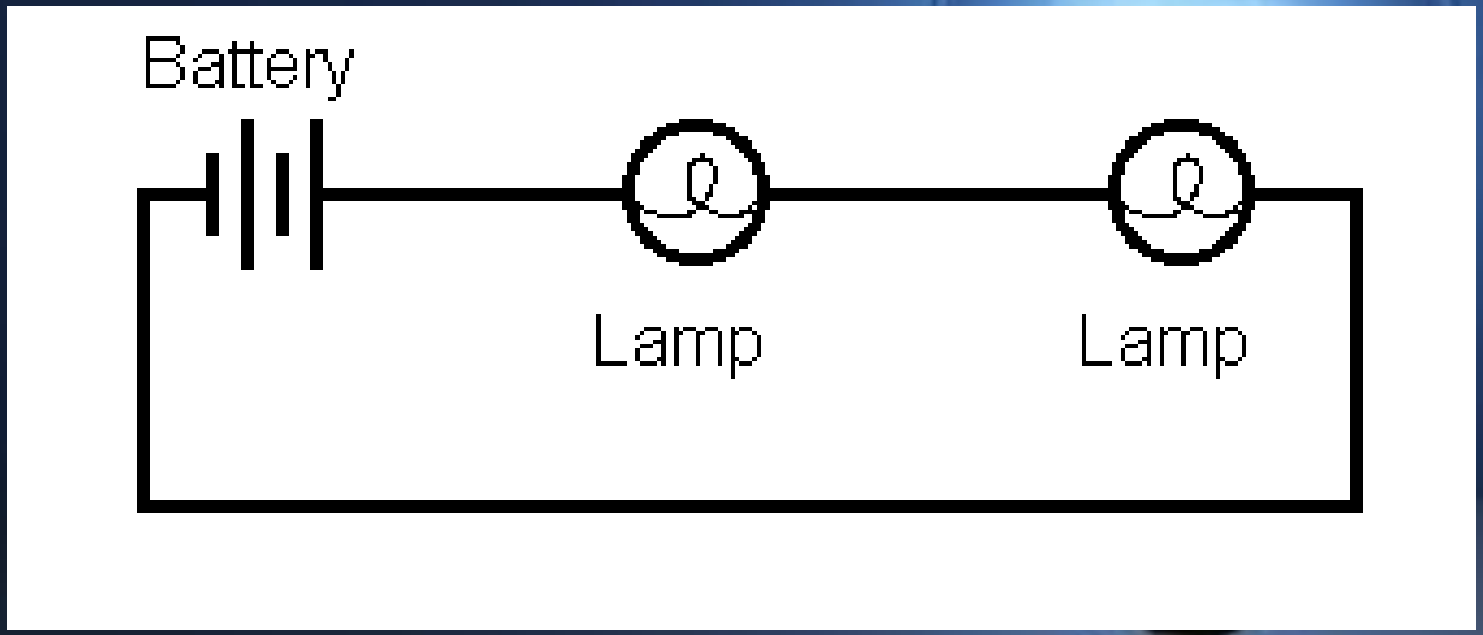
1. A light bulb has a resistance of 10-Ω in a circuit powered by three 0.5-V batteries. What is the current running through the circuit?

1. A circuit with two batteries has a resistance of 24-Ω and current of 0.5-A. What is the voltage of each battery?



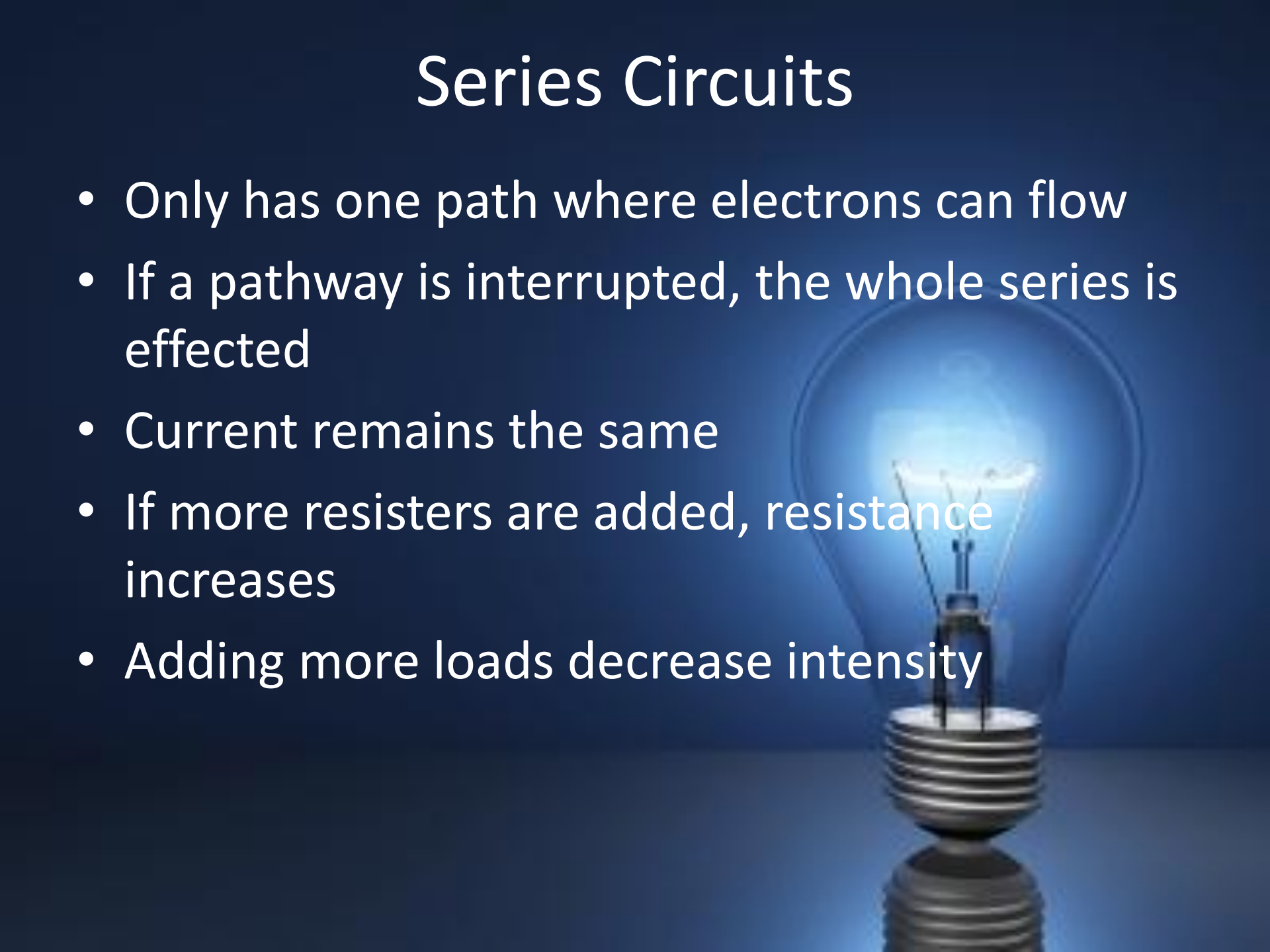
Series Circuits

Series Circuit – an electrical circuit where the components are arranged one after another in a series.



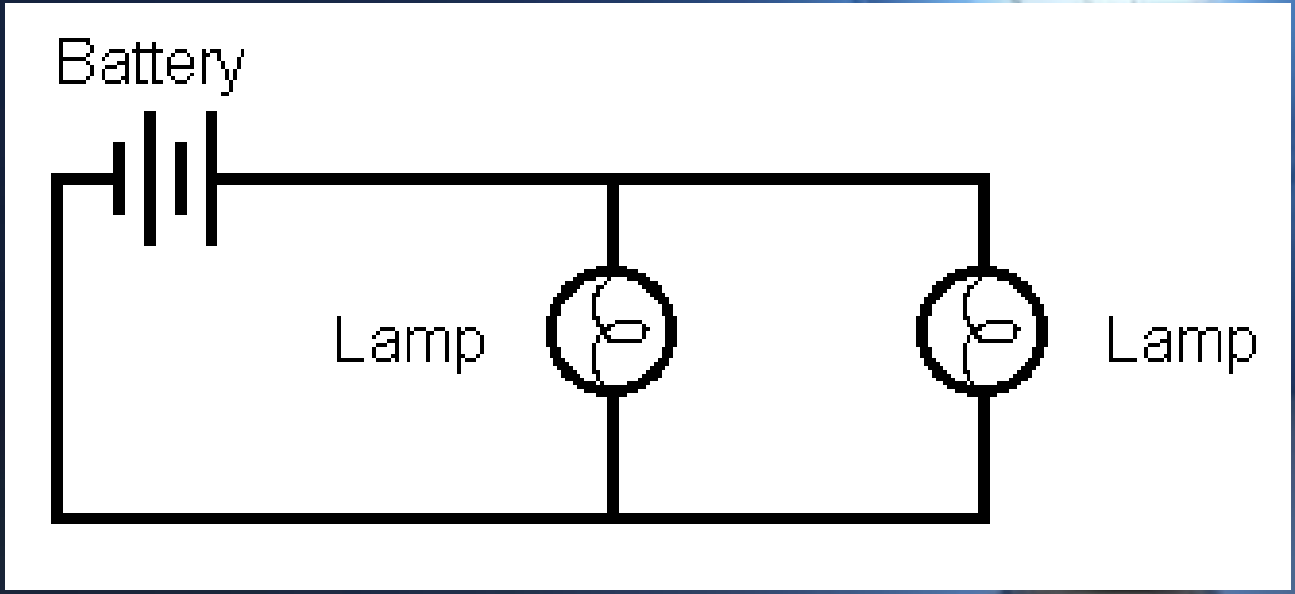
Series Circuits

- Only has one path where electrons can flow
- If a pathway is interrupted, the whole series is effected
- Current remains the same
- If more resisters are added, resistance increases
- Adding more loads decrease intensity



Parallel Circuits

Parallel Circuit – an electrical circuit where the parts are arranged so that electrons can flow along more than one path



Parallel Circuits

- The point where a circuit divides into different paths is called a junction point
- A break in one pathway does not effect the others
- Adding a new pathway with resistance decrease the total resistance in the circuit
- Most electrons will follow the path with the least resistance; the current on this path is greater

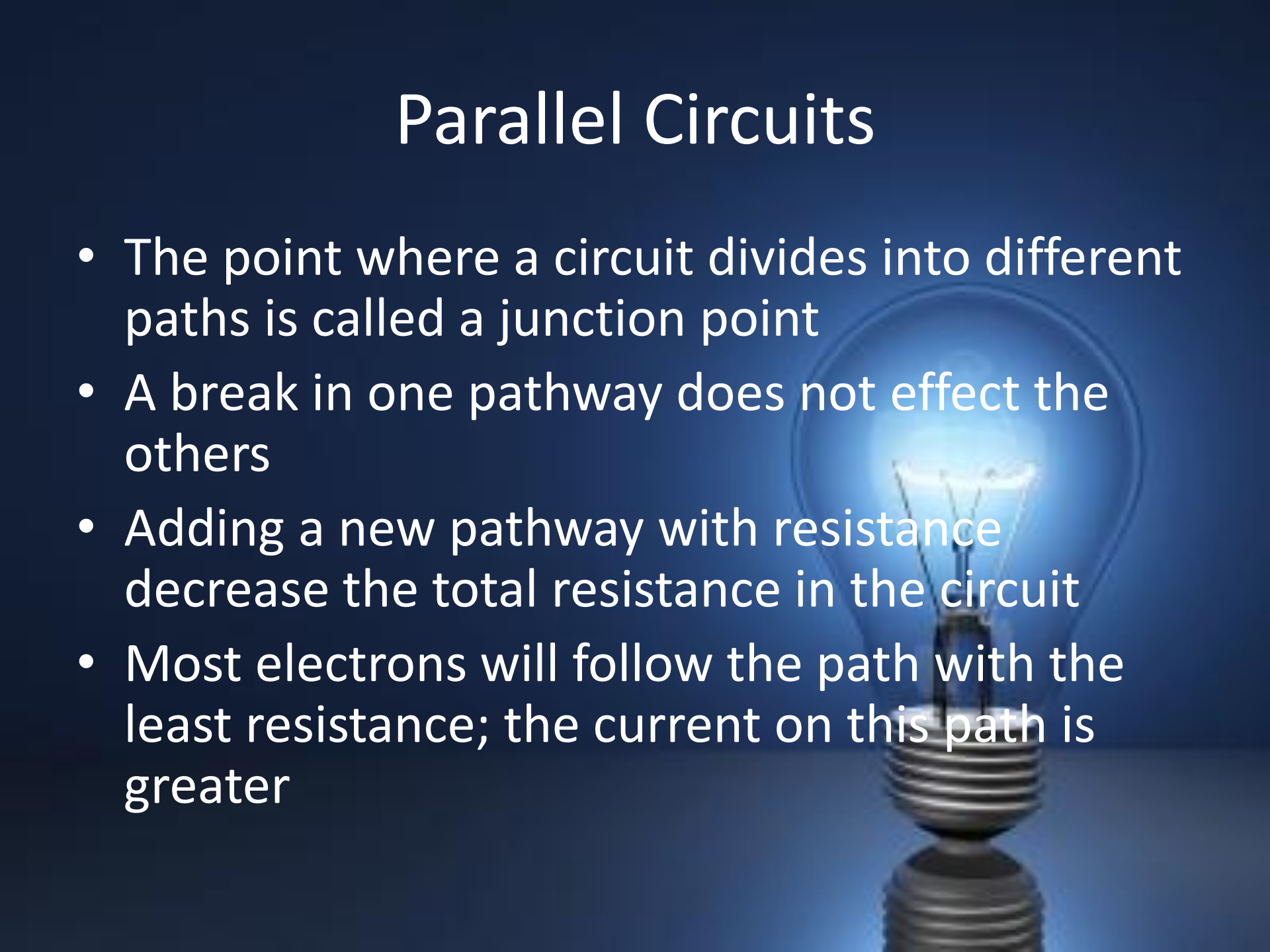


Table 11.3 Potential Difference, Current, and Resistance in Series and Parallel Circuits

Circuit	Potential Difference	Current	Resistance
Series Circuit	Each load uses a portion of the total potential difference supplied by the battery.	The current is the same throughout a series circuit.	The current decreases with more resistors are added.
Parallel Circuit	Each load uses the potential difference supplied by the battery.	The current divides into different paths. A pathway with less resistance will have greater current.	Adding resistors in parallel decreases the total resistance of the circuit.

Homework

A. Questions 1-5 pg.453
B. Copy Table 11.3 on pg.452 into your notes

Tomorrow

Lab: Series and Parallel Circuits

Short Circuits and Electrical Safety

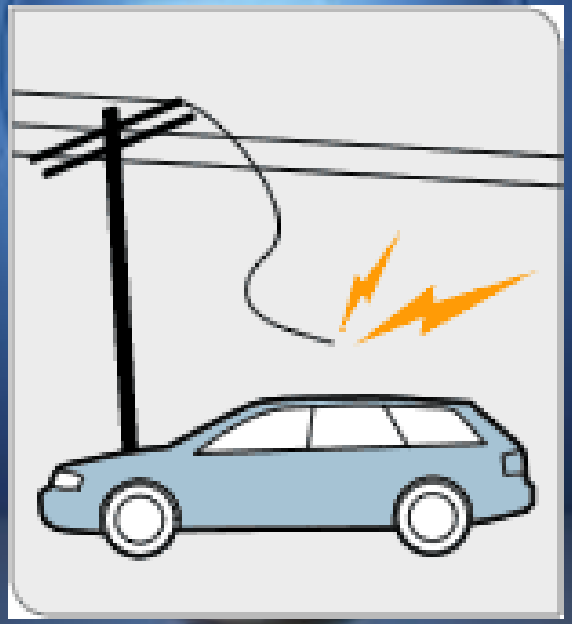
Short Circuits

Short Circuit – an accidental low-resistance connection between two points on a circuit, causing excess electron flow

- Can be dangerous

Example:

  – Knocked down telephone line



Electrical Safety

- All electrical appliances present risk
- Some devices retain a charge even when they are unplugged

Three Prong Plug

- The third prong connects the device to the ground wire of the building
- In case of a short circuit

Fuses and Circuit Breakers

Fuse – a safety device in a electrical circuit that has a metallic conductor with a low melting point compared to the circuit wires

Circuit Breakers

Circuit Breaker – does the same job as a fuse except the wire inside does not melt; it heats up and bends to trigger a spring mechanism

Ground Fault Circuit Interrupter (GFCI)

- A device that detects change in current and opens the current; stopping flow

Homework

- Create an poster, song, or website to help promote electrical safety awareness to an elementary school class. Choose information that is relevant and engaging to your audience.

DUE: TUESDAY, APRIL. 26

- Lab Report: Due Tomorrow