

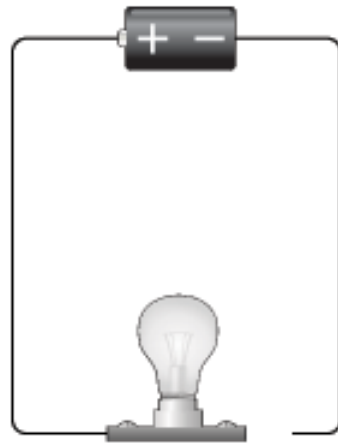
**18.5**

**Electrical Circuits and Safety**

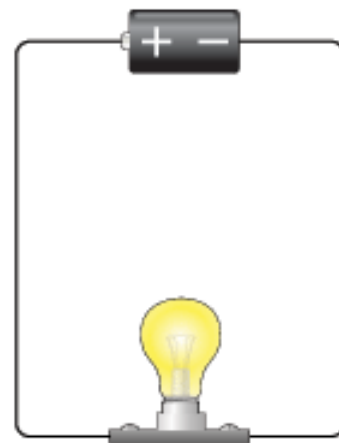
# Electrical Circuits

- An electric circuit is a **complete path** through which a charge can flow. This is called a **closed circuit**.
- When the electric current cannot flow, this is called an **open circuit**.
- For the charge to flow, the path must be a **complete loop**.

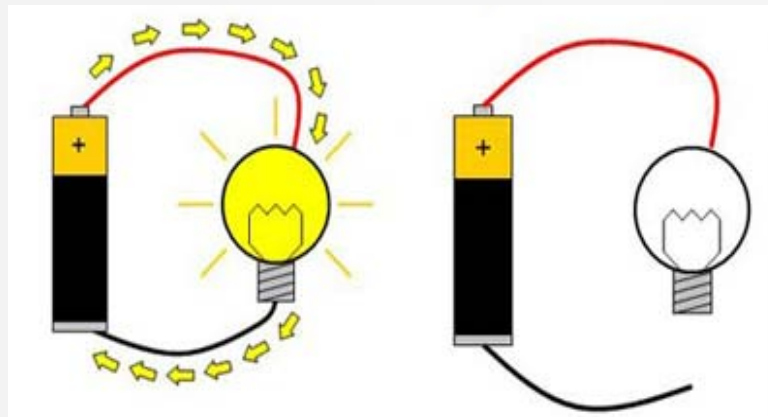
# Electrical Circuits



Incomplete circuit









Complete circuit



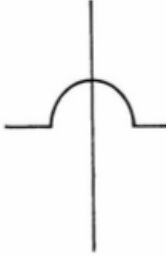


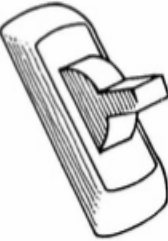


# Circuit Diagram

- Circuit diagrams use **symbols** to represent parts of a circuit, including a **source** of electrical energy and **devices** that are run by the electrical energy.
- In a simple circuit a **battery** provides the energy to operate a device such as a **bell** or a **light bulb**.
- A circuit diagram shows the possible **complete paths** in which charge can flow.

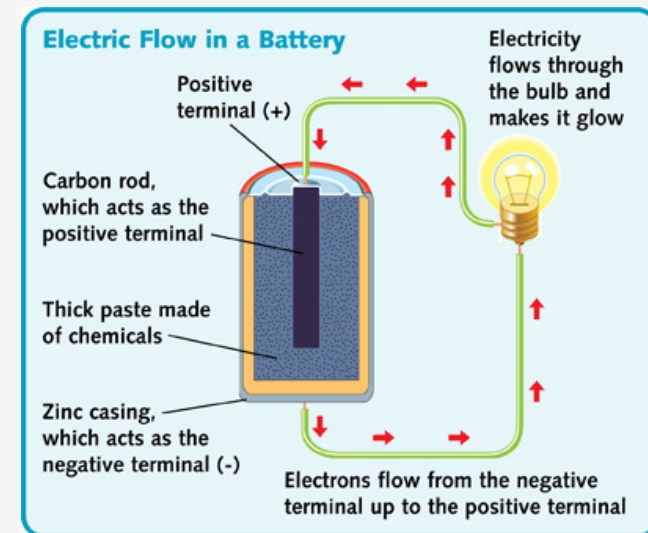
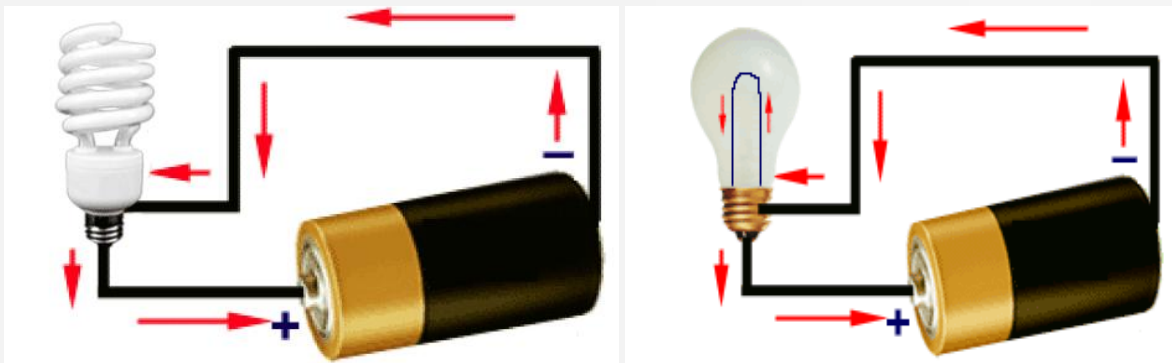
# Circuit Representations

Symbol	Picture	Meaning
		Bulb
		Battery
		Wire

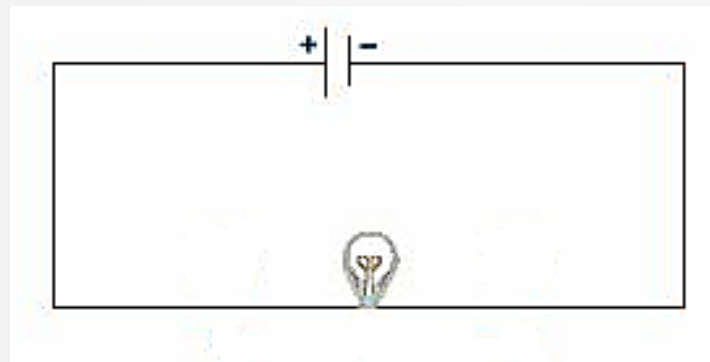
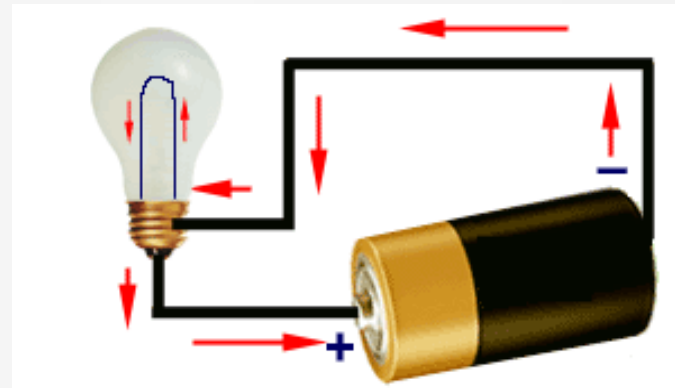
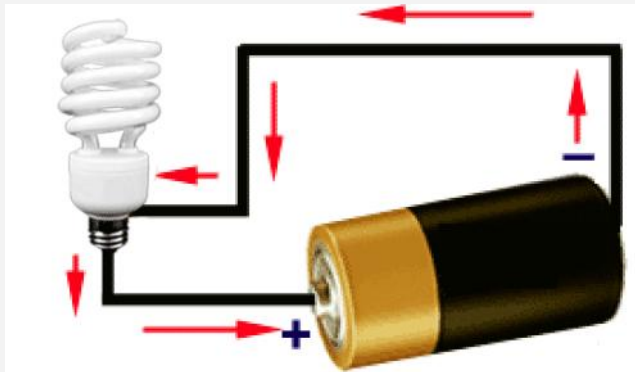
Symbol	Picture	Meaning
		Connected Wires
		Crossing Wires
		Switch

# Circuit Diagram

In the figure below, show an electrical circuit. The “+” and the “-“ on the battery indicate the positive and negative terminals. Arrows show the direction of current, from negative to positive. (Remember; the charge flowing thru the circuit is the electrons which has a “-“ charge.)



# Circuit Diagrams



# Series Circuits

- In a series circuit, charge has only **one path** through which it can flow.
- If **one** element stops functioning in a series circuit, **none** of the elements can operate.



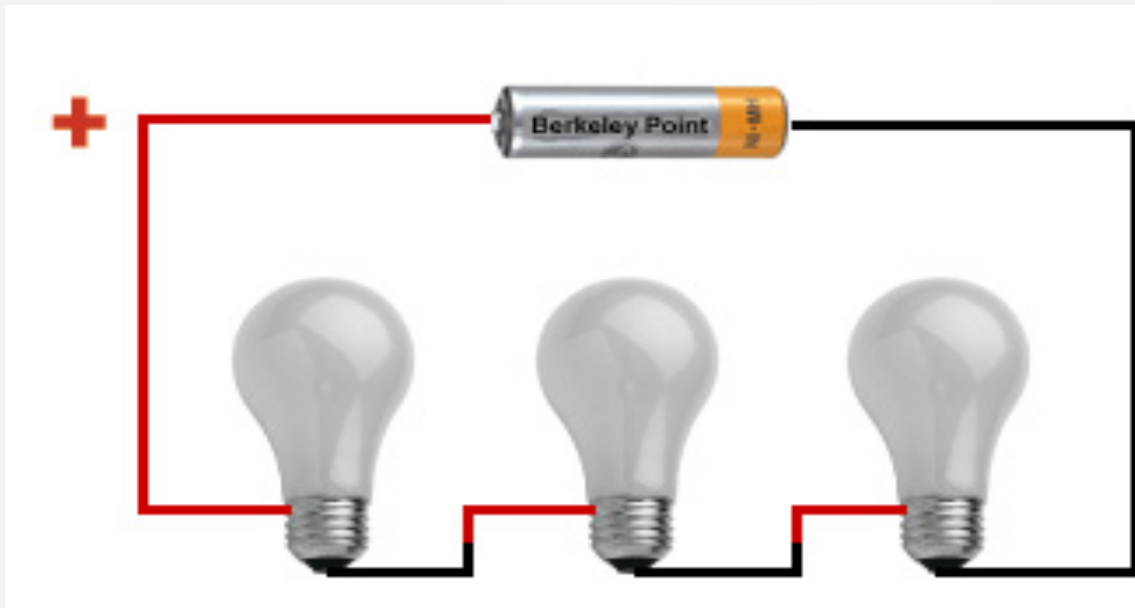
# Series Circuits

Example:

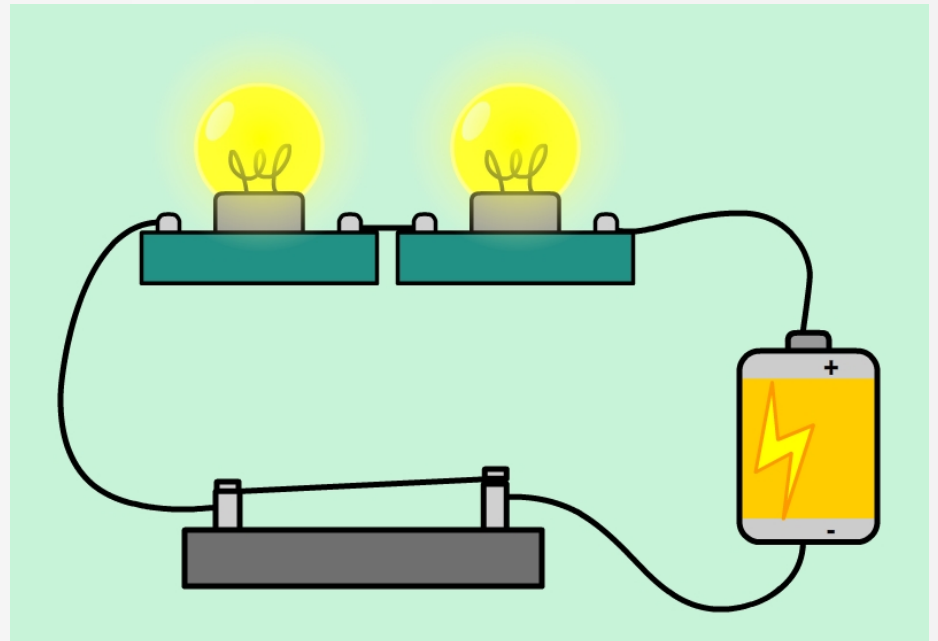
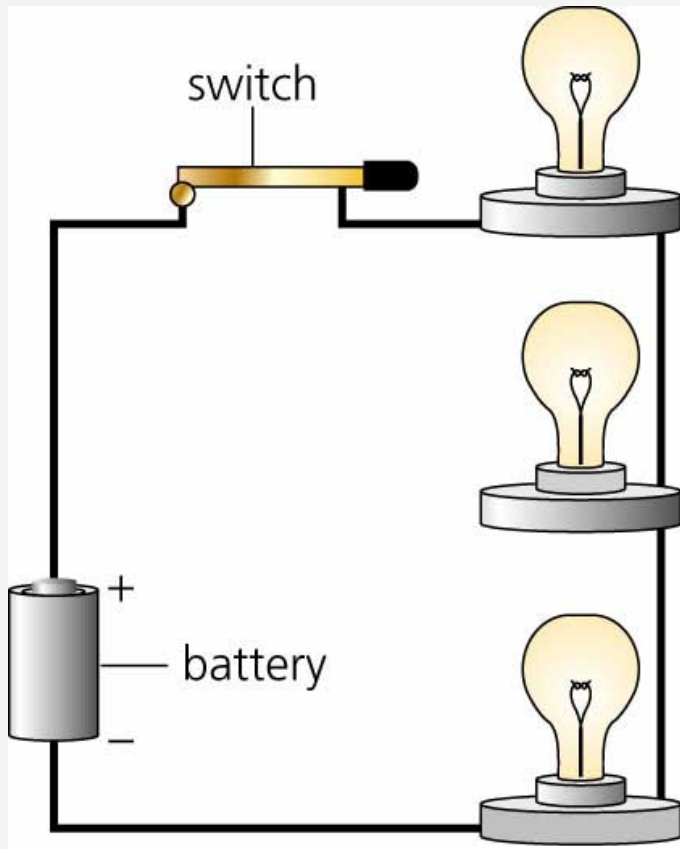
**Old Christmas Tree Lights**



# Series Circuits



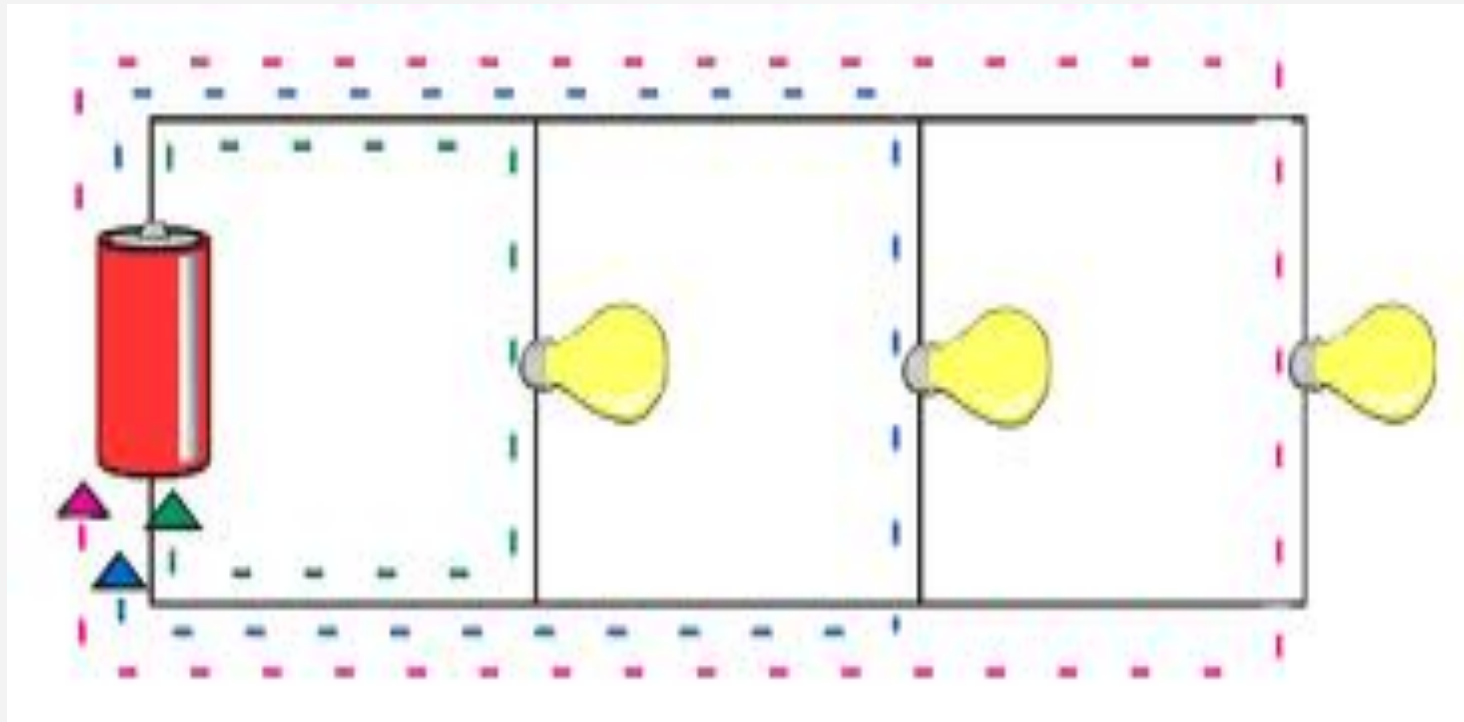
# Series Circuits



# Parallel Circuits

- In a parallel circuit, electric charge has **more than one path** that it can flow
- If **one** element stops functioning in a parallel circuit, the rest of the elements **still can operate**.

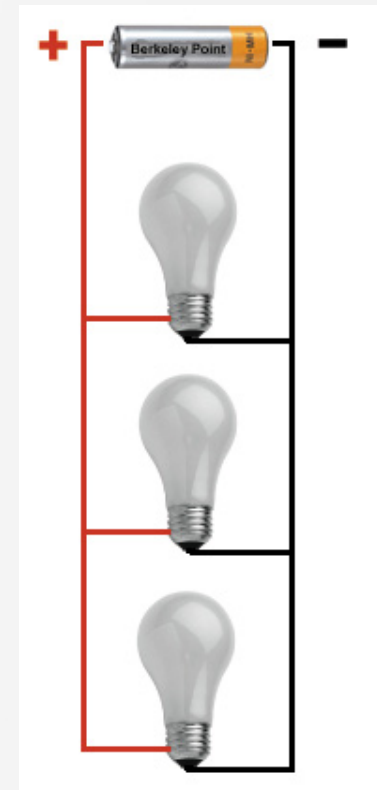
# Parallel Circuits



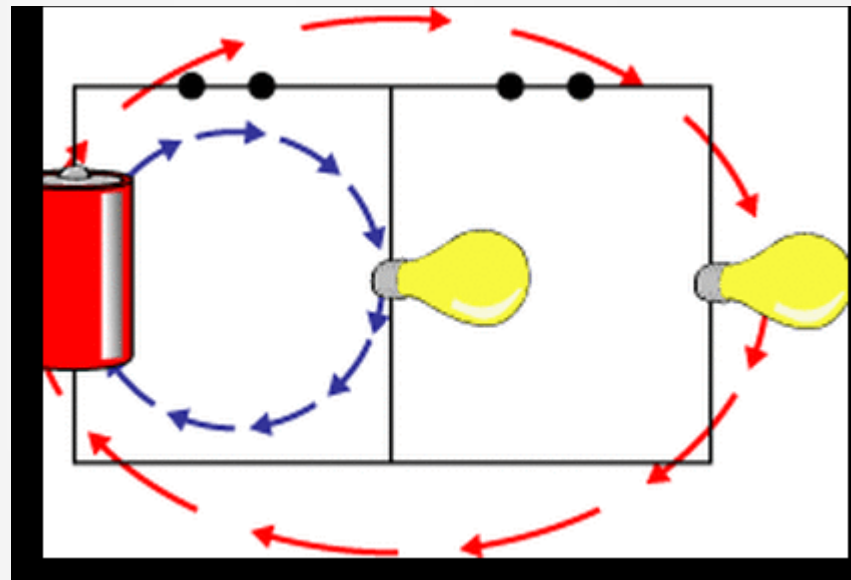
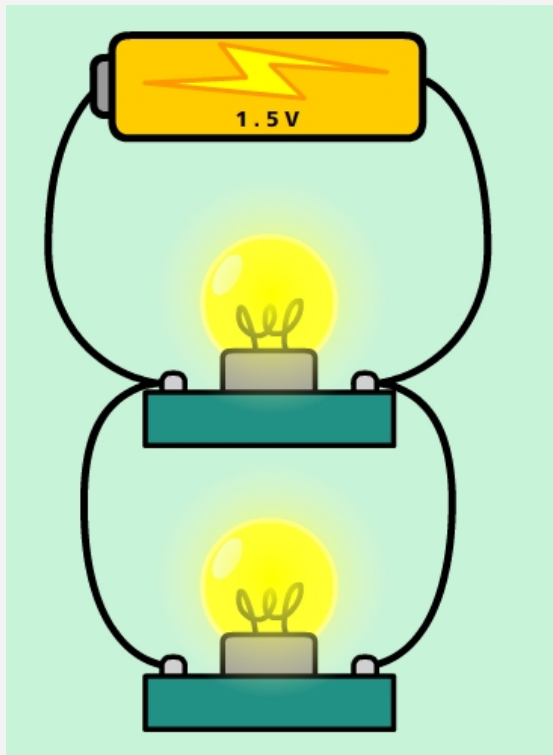
# Parallel Circuits

Example:

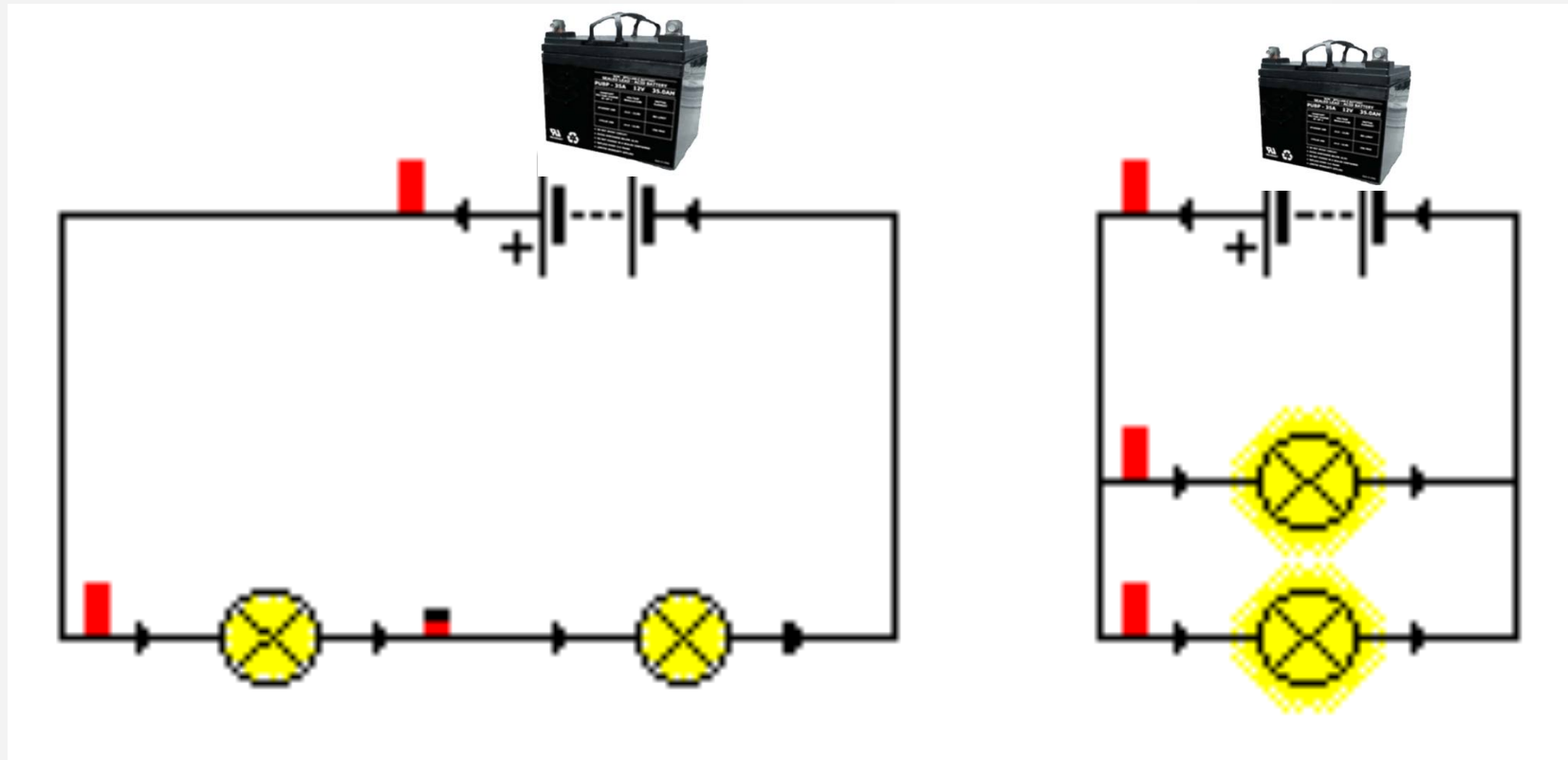
**New Christmas Tree Lights**



# Parallel Circuits

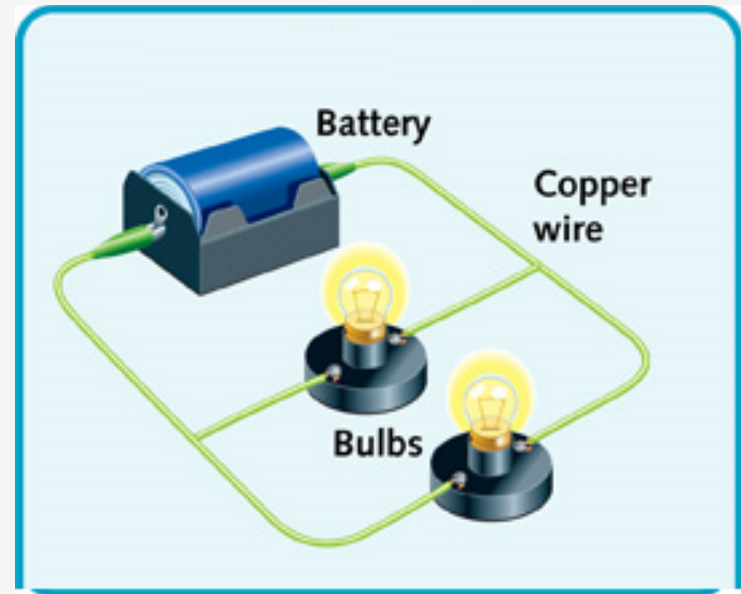
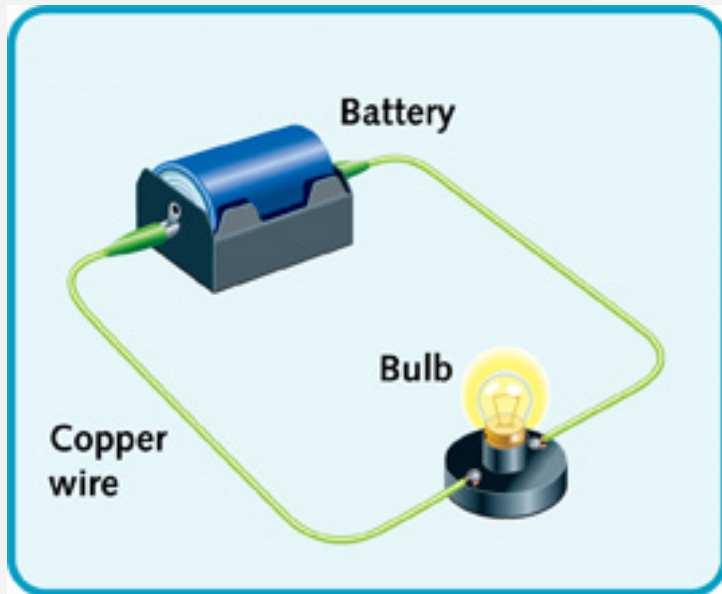


# What kind of circuit?



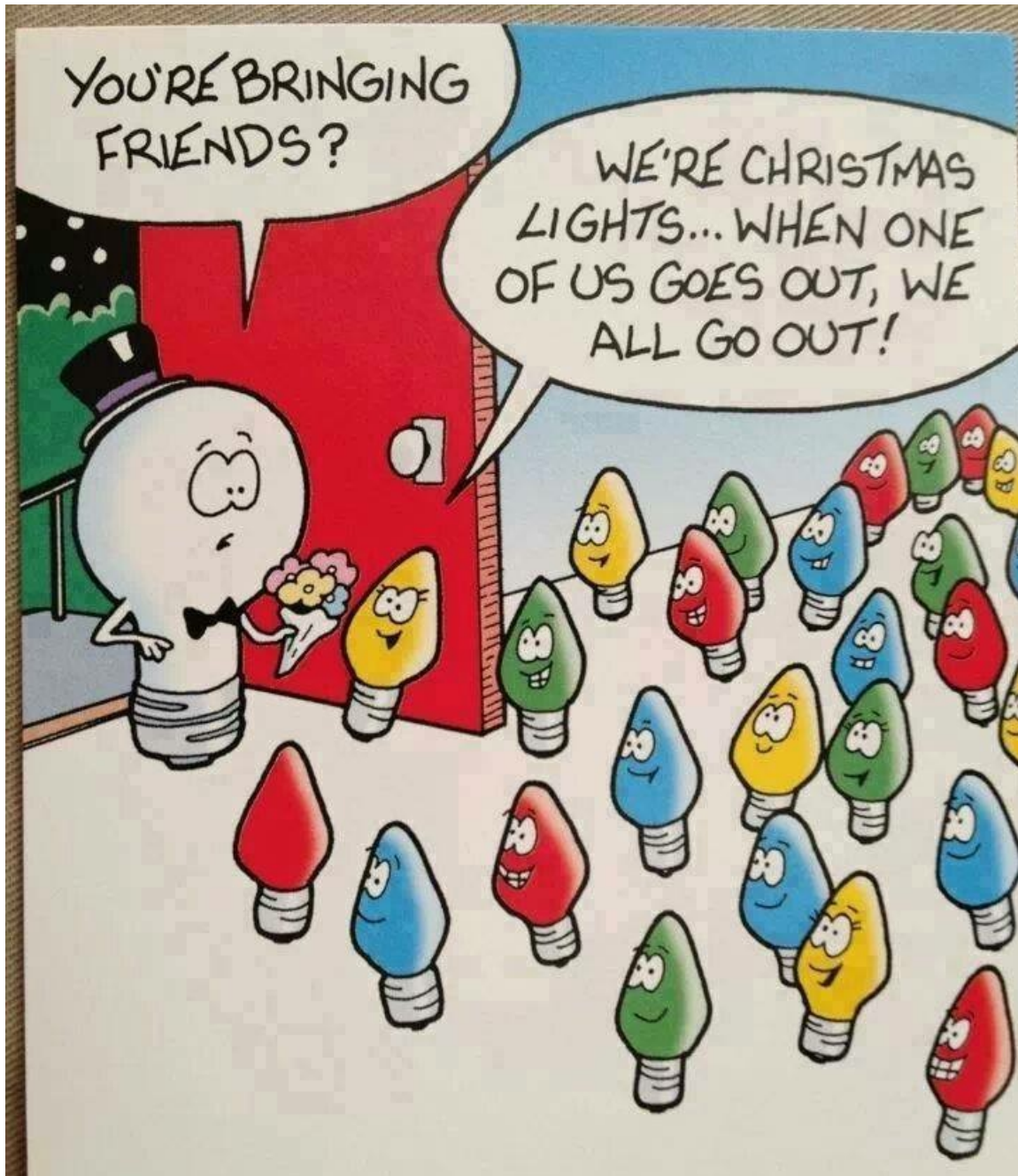


# What kind of circuit?



YOU'RE BRINGING FRIENDS?

WE'RE CHRISTMAS LIGHTS... WHEN ONE OF US GOES OUT, WE ALL GO OUT!



**CONCEPT:**  
**CHECK:**

What is the difference between a series and parallel circuit?

Series: Only one path for the current to flow

Parallel: More than one path for the current to flow.

# Electrical Safety

**Inspectors check all new houses to make sure electrical wiring is installed safely. All wires must be able to carry the maximum expected current. But correct wiring is not enough to protect electrical accidents.**

# Electrical Safety

**Electrical items installed for safety include:**

- **Correct Wiring**
- **Fuses**
- **Circuit Breakers**
- **Insulation**
- **Grounded plugs**

# Electrical Safety

**Electrical items installed for safety include:**

- **Correct Wiring**
- **Fuses**
- **Circuit Breakers**
- **Insulation**
- **Grounded plugs**

# Electrical Safety

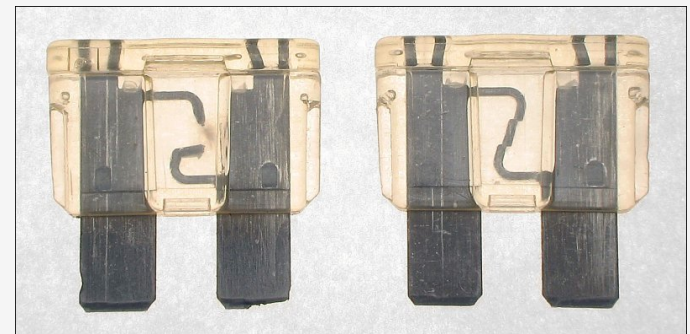
## Correct Wiring

TYPE	CURRENT FLOW IN AMPS															
	5A	10A	15A	20A	25A	30A	40A	50A	60A	70A	80A	90A	100A	120A	150A	200A
3% VOLTAGE DROP Critical																
0 to 6 ft	16 AWG	16 AWG	14 AWG	14 AWG	12 AWG	10 AWG	8 AWG	6 AWG	6 AWG	6 AWG	4 AWG	4 AWG	4 AWG	2 AWG	1 AWG	2 0 AWG
10 ft	16 AWG	14 AWG	12 AWG	12 AWG	10 AWG	10 AWG	8 AWG	6 AWG	6 AWG	6 AWG	4 AWG	4 AWG	4 AWG	2 AWG	1 AWG	2 0 AWG
15 ft	16 AWG	12 AWG	10 AWG	10 AWG	8 AWG	8 AWG	6 AWG	6 AWG	6 AWG	4 AWG	4 AWG	4 AWG	4 AWG	2 AWG	1 AWG	2 0 AWG
20 ft	14 AWG	10 AWG	10 AWG	8 AWG	6 AWG	6 AWG	6 AWG	4 AWG	4 AWG	4 AWG	2 AWG	2 AWG	2 AWG	1 AWG	0 AWG	3 0 AWG
25 ft	12 AWG	10 AWG	8 AWG	6 AWG	6 AWG	6 AWG	4 AWG	4 AWG	2 AWG	2 AWG	2 AWG	1 AWG	1 AWG	0 AWG	2 0 AWG	3 0 AWG
30 ft	12 AWG	10 AWG	8 AWG	6 AWG	6 AWG	4 AWG	4 AWG	2 AWG	2 AWG	1 AWG	1 AWG	0 AWG	0 AWG	2 0 AWG	3 0 AWG	4 0 AWG
40 ft	10 AWG	8 AWG	6 AWG	6 AWG	4 AWG	4 AWG	2 AWG	2 AWG	1 AWG	0 AWG	0 AWG	2 0 AWG	2 0 AWG	3 0 AWG	4 0 AWG	4 0 AWG
50 ft	10 AWG	6 AWG	6 AWG	4 AWG	4 AWG	2 AWG	2 AWG	1 AWG	0 AWG	0 AWG	2 0 AWG	3 0 AWG	3 0 AWG	4 0 AWG	4 0 AWG	4 0 AWG
60 ft	8 AWG	6 AWG	4 AWG	4 AWG	2 AWG	2 AWG	1 AWG	0 AWG	2 0 AWG	3 0 AWG	3 0 AWG	4 0 AWG	4 0 AWG	4 0 AWG	4 0 AWG	4 0 AWG
70 ft	8 AWG	6 AWG	4 AWG	2 AWG	2 AWG	1 AWG	0 AWG	2 0 AWG	3 0 AWG	3 0 AWG	4 0 AWG	4 0 AWG	4 0 AWG	4 0 AWG	4 0 AWG	4 0 AWG
80 ft	8 AWG	6 AWG	4 AWG	2 AWG	2 AWG	1 AWG	0 AWG	2 0 AWG	3 0 AWG	3 0 AWG	4 0 AWG	4 0 AWG	4 0 AWG	4 0 AWG	4 0 AWG	4 0 AWG
90 ft	8 AWG	4 AWG	2 AWG	2 AWG	1 AWG	0 AWG	2 0 AWG	3 0 AWG	3 0 AWG	4 0 AWG	4 0 AWG	4 0 AWG	4 0 AWG	4 0 AWG	4 0 AWG	4 0 AWG
100 ft	6 AWG	4 AWG	2 AWG	1 AWG	1 AWG	0 AWG	2 0 AWG	3 0 AWG	4 0 AWG	4 0 AWG	4 0 AWG	4 0 AWG	4 0 AWG	4 0 AWG	4 0 AWG	4 0 AWG
110 ft	6 AWG	4 AWG	2 AWG	1 AWG	0 AWG	2 0 AWG	3 0 AWG	4 0 AWG	4 0 AWG	4 0 AWG	4 0 AWG	4 0 AWG	4 0 AWG	4 0 AWG	4 0 AWG	4 0 AWG
120 ft	6 AWG	2 AWG	2 AWG	1 AWG	0 AWG	2 0 AWG	3 0 AWG	4 0 AWG	4 0 AWG	4 0 AWG	4 0 AWG	4 0 AWG	4 0 AWG	4 0 AWG	4 0 AWG	4 0 AWG
130 ft	6 AWG	2 AWG	2 AWG	1 AWG	0 AWG	2 0 AWG	3 0 AWG	4 0 AWG	4 0 AWG	4 0 AWG	4 0 AWG	4 0 AWG	4 0 AWG	4 0 AWG	4 0 AWG	4 0 AWG



# Electrical Safety

A **fuse** prevents current overload in a circuit. A wire in the center of the fuse melts if too much current passes through it. This melting is known as “**blowing a fuse**”.

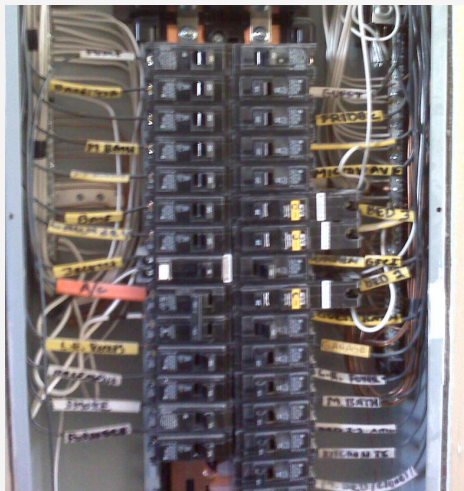




# Electrical Safety

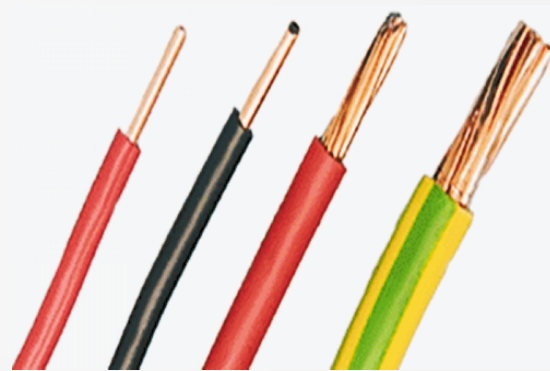
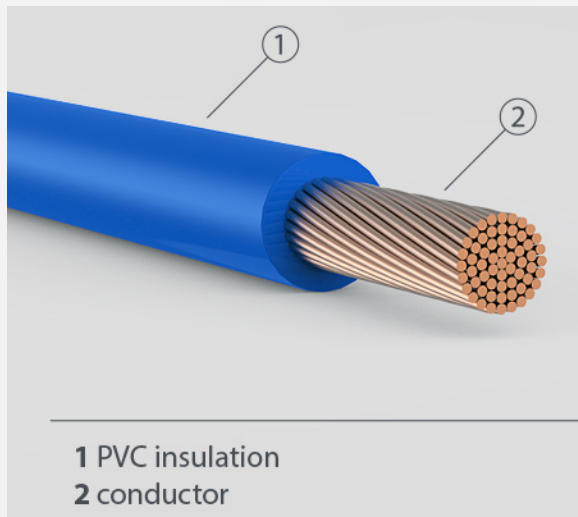
Most **houses** today use **circuit breakers** instead of fuses.

A **circuit breaker** is a switch that opens when the current in a circuit is too high. The circuit breaker must be reset before the circuit can be used again.



# Personal Safety

Electrical wiring in a home is **insulated** to protect people. If the insulation is **damaged**, you may accidentally touch the bare wire and get a **shock**.



# Personal Safety

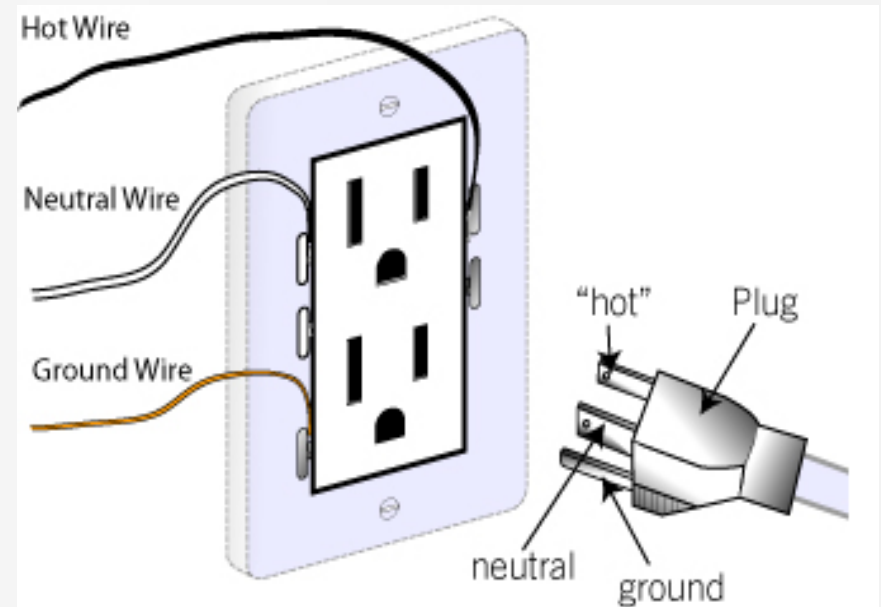
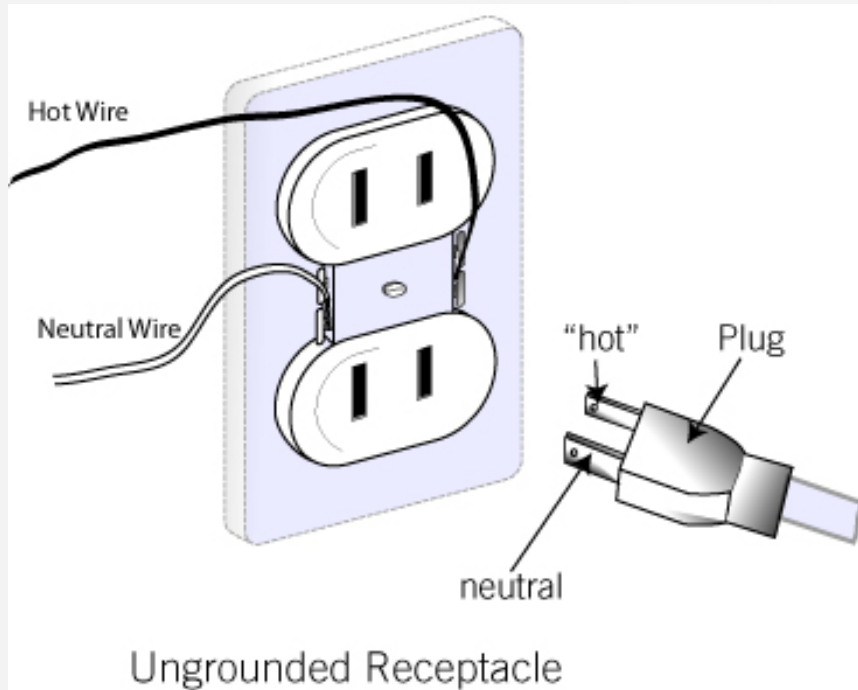


# Personal Safety

A **three-prong plug** can prevent shocks caused by short circuits. The third prong, which connects to the **ground**, are used on devices that have metal devices. If a short circuit develops, you might get a shock by holding the object, instead of entering your body, the current takes a path to the **ground**.

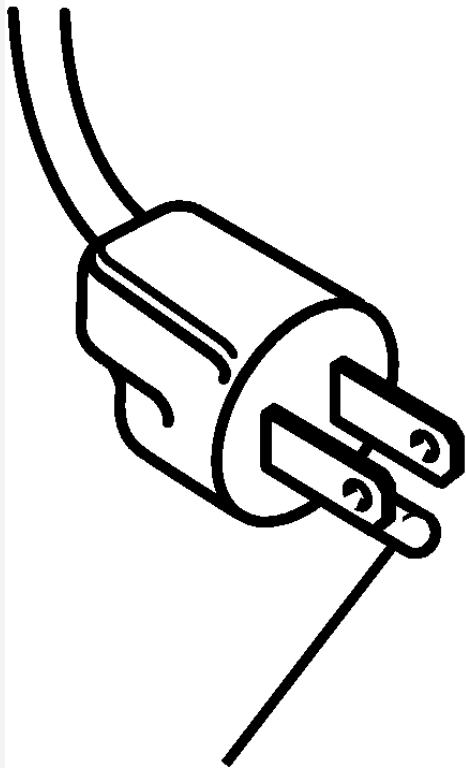


# Personal Safety

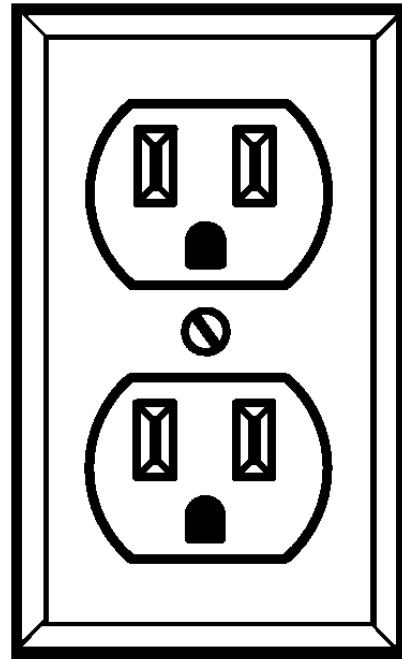




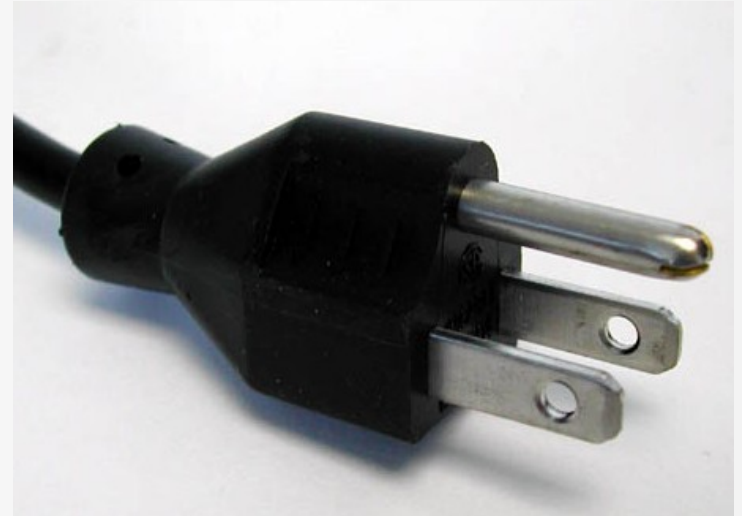
# Personal Safety



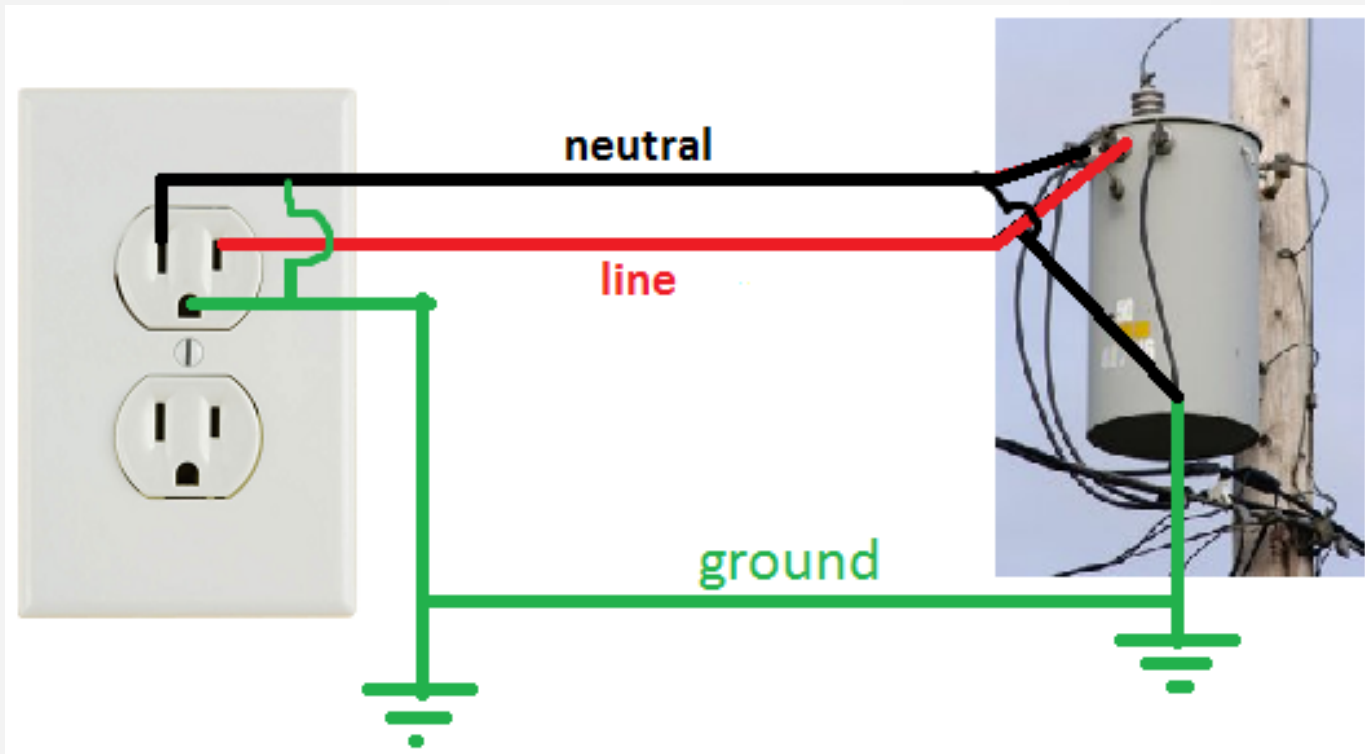
GROUNDING  
PIN



COVER OF GROUNDED  
OUTLET BOX



# Personal Safety



# Personal Safety

The transfer of excess charge through a conductor to Earth is called **grounding**.





# Personal Safety

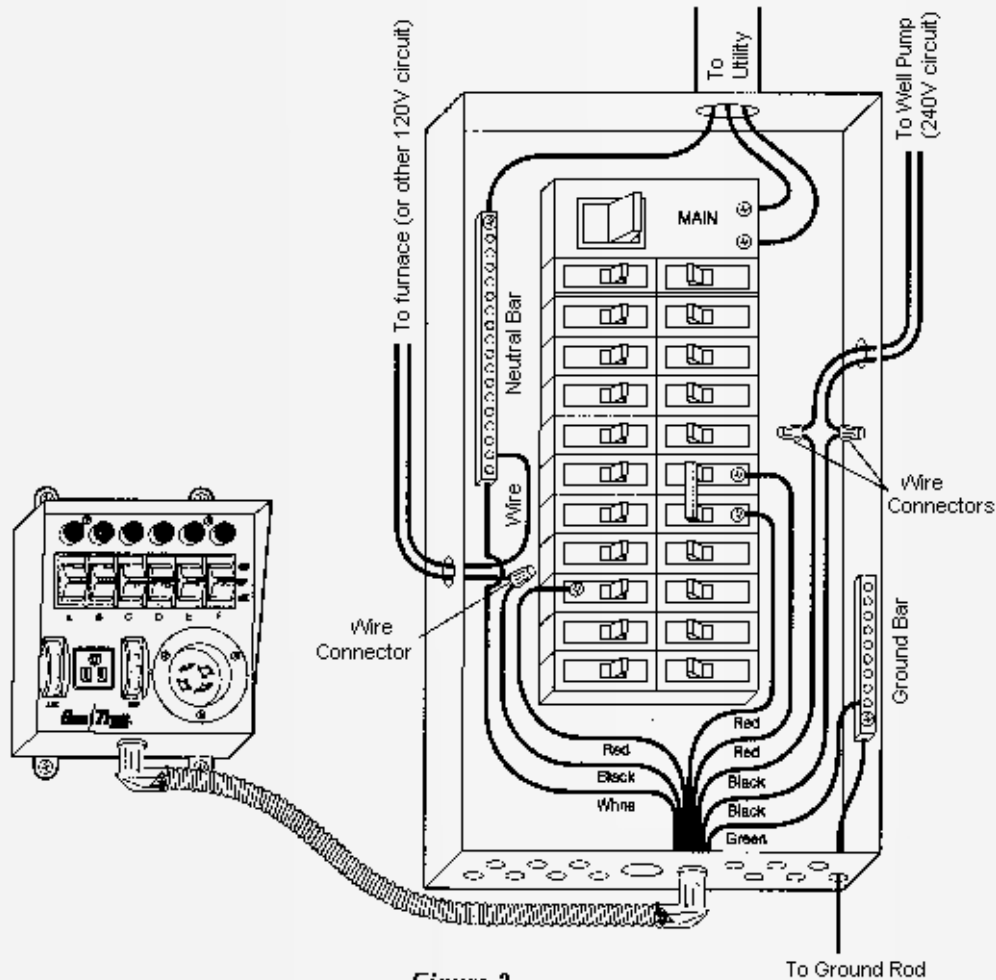
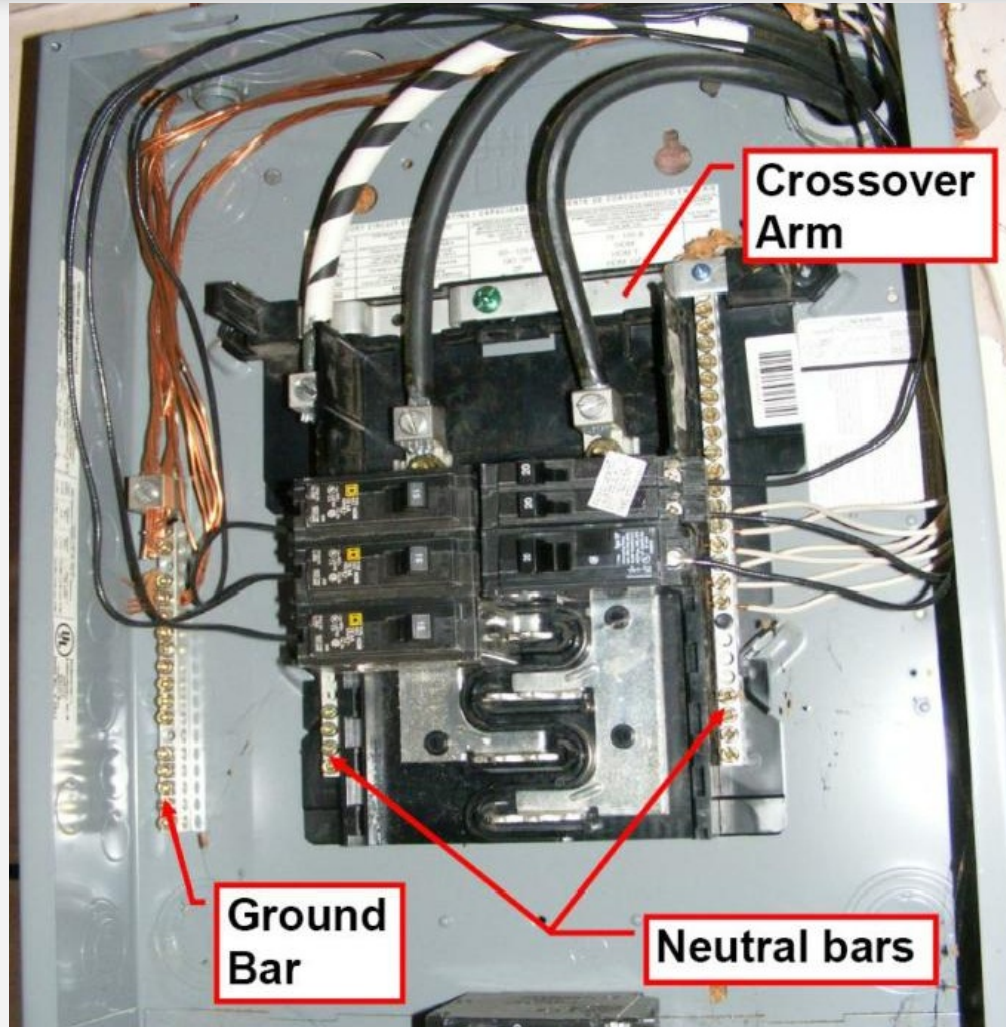
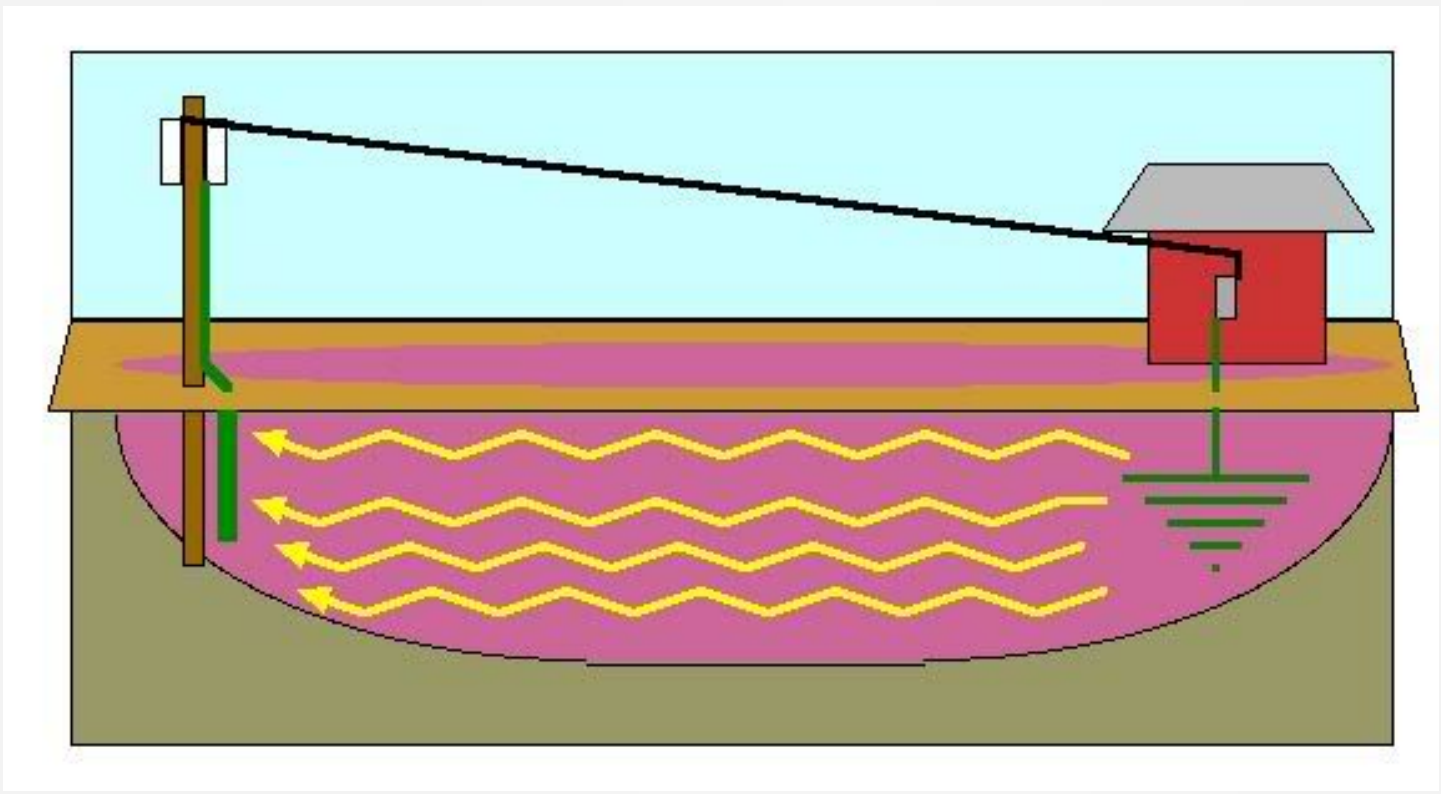


Figure 2

# Personal Safety

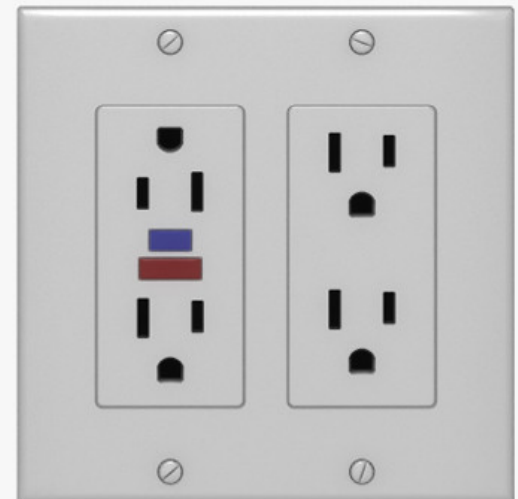
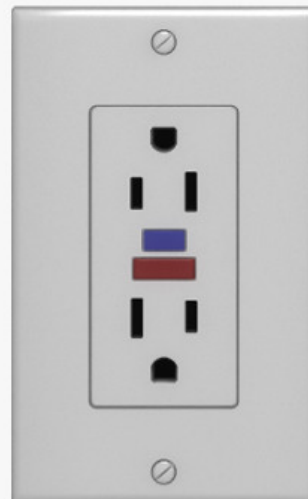


# Personal Safety



# Personal Safety

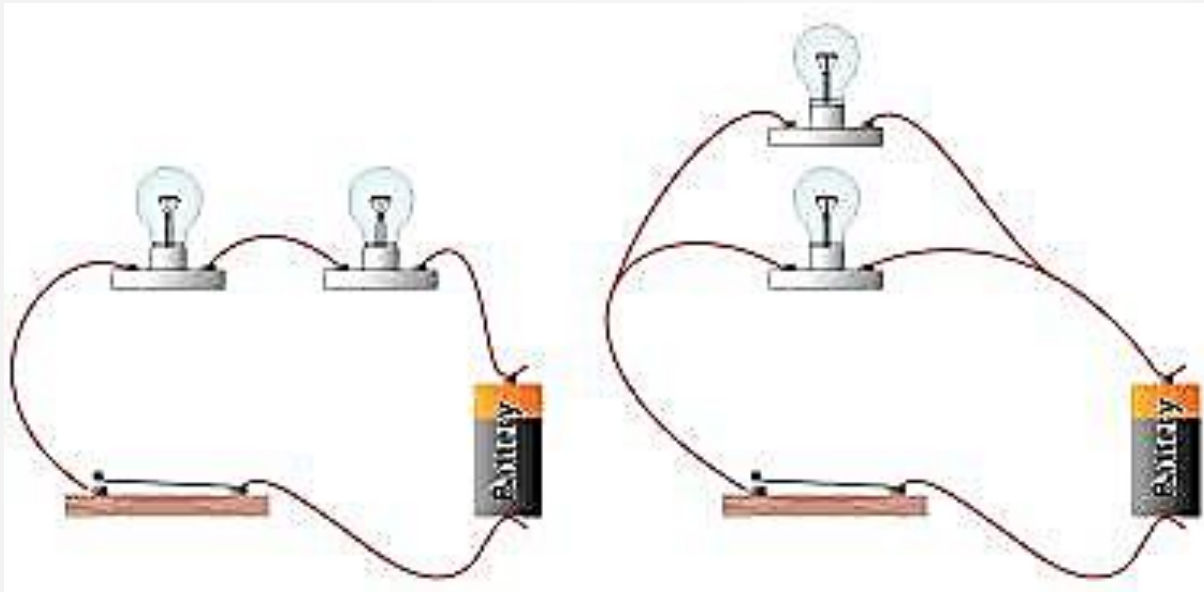
A **ground-fault circuit interrupter (GFCI)** is an electrical safety outlet.



# 18.5 Assessment

## Question #1

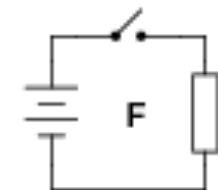
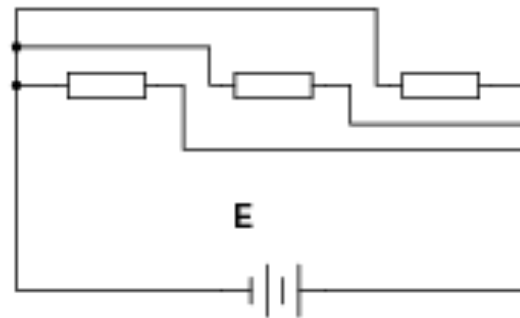
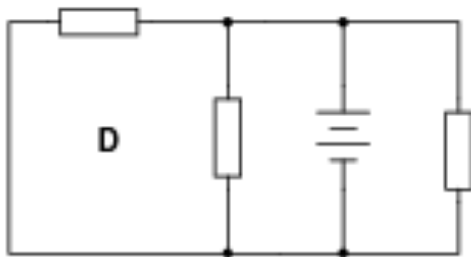
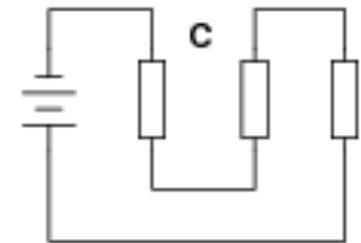
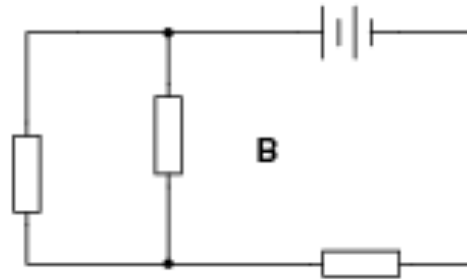
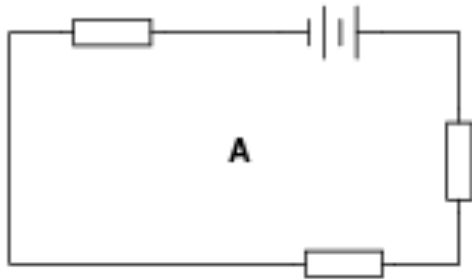
Identify each circuit as either a series circuit or a parallel circuit.



# 18.5 Assessment

## Question #2

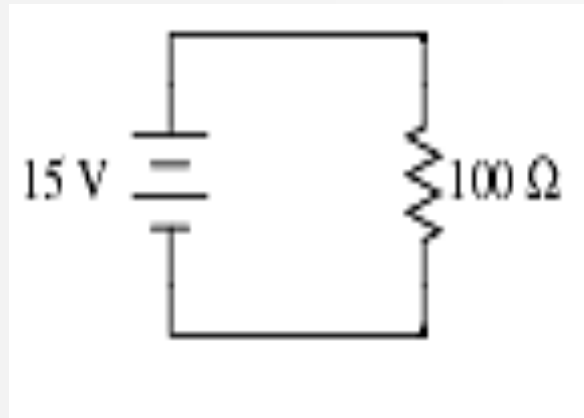
Identify each circuit as either a series circuit or a parallel circuit.



# 18.5 Assessment

## Question #3

- Identify the type of circuit
- Using Ohm's Law, calculate the current in the circuit.



# 18.5 Assessment

## Question #4

Name three things are needed to make a complete circuit diagram?

- **Source of electrical energy**
- **Wires**
- **Device to operate (bell or light)**



# 18.5 Assessment

## Question #5

What is needed to make charge flow through a circuit?

**Source of electrical energy**

# 18.5 Assessment

## Question #6

**Draw a simple series circuit.**

# 18.5 Assessment

## Question #7

**Draw a simple parallel circuit.**

# 18.5 Assessment

## Question #8

**Name five safety devices used with electric current.**

- **Correct Wiring**
- **Fuses**
- **Circuit Breakers**
- **Insulation**
- **Grounded plugs**