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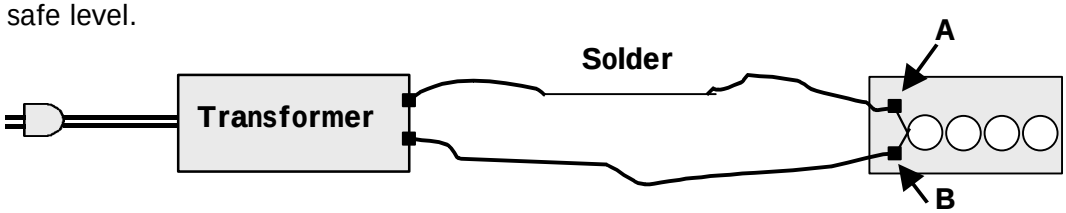
Period 14 Activity Sheet: Electrical Safety and Transmission

Activity 14.1: How Do Fuses and Circuit Breakers Prevent Fires?

a) **Fuse Demonstration with a Short Circuit** Connect a piece of solder and a four bulb tray in series to a step-down transformer using connecting wires. Solder is thin wire with a low melting point that represents a fuse in this activity. The transformer lowers the voltage to a safe level.



Note the brightness of the bulbs. Then create a short circuit by attaching a connecting wire between points A and B.

1) How does the path of the current change after you attach the wire between point A and point B? Describe what happens to the circuit when you add the connecting wire.

2) Which has greater resistance – the bulb tray or the wire connecting A and B? Explain how you know.

3) What happens to the current flowing through a circuit if the circuit resistance is decreased? How can this cause an electrical fire?

b) **Fuse Demonstration with an Overloaded Circuit** Your instructor will demonstrate an overloaded circuit with a fuse. Describe what happens as more bulbs in the circuit are lit.

c) **How Can Fuses Prevent Fires?**

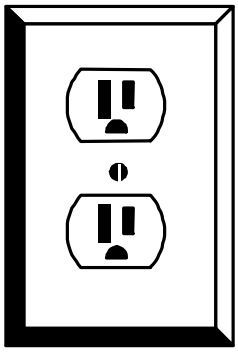
1) How is connecting more light bulbs in a circuit similar to shorting a wire across a bulb?

2) Circuit breakers serve the same purpose as fuses. Explain how fuses and circuit breakers prevent electrical fires.

Activity 14.2: Which Safety Devices Can Prevent Electric Shock?

a) **Polarized and Three Prong Plugs** Make sure that the electric power strip on your table is connected to the ground fault interrupter above the table. To determine which of the two slots in an outlet in your power strip is "hot," connect one wire of a neon test light to the ground of the power strip. Carefully touch the loose wire of the test light to each of the two slots in an outlet. When the test light wire is inserted into the "hot" slot, the bulb in the tester lights.

1) Using the results of your experiments with the test light, label the hot outlet slot and the neutral or ground slot in the diagram.



2) Explain the purpose of the third (round) hole in the outlet, which is called the safety ground slot. Is the safety ground part of the circuit during normal operation of an appliance?

3) How can you safely use appliances with 3-prong plugs in 2-hole outlets?

b) **Ground Fault Circuit Interrupters (GFCI)** Examine the ground fault circuit interrupter.

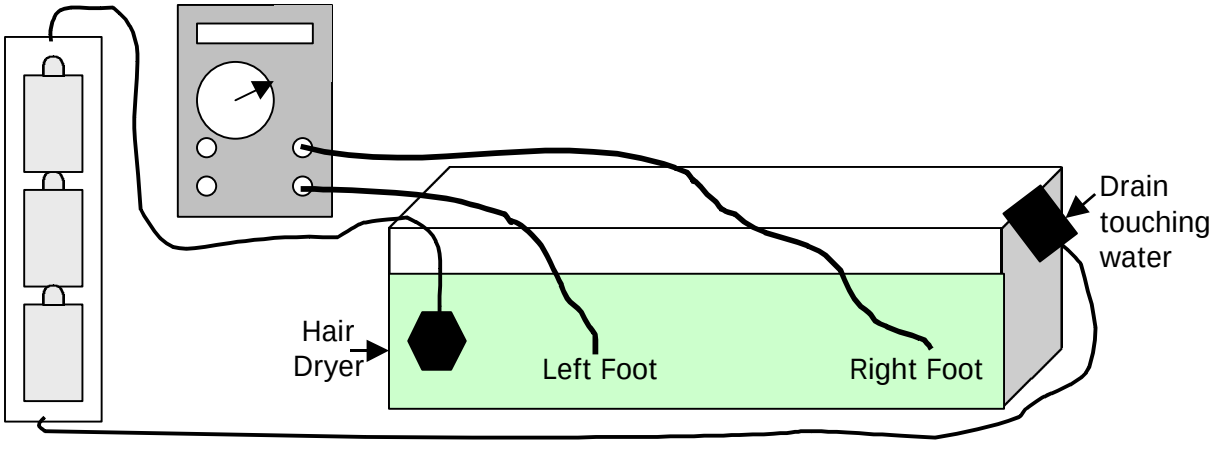
1) When does a GFCI interrupt a circuit?

2) How can a GFCI save you from an electric shock?

3) Electrical codes now require ground fault interrupters for new installations in bathrooms, kitchens, and outdoors. Why are GFCIs particularly important in these locations?

4) How are GFCIs different from circuit breakers?

c) **Safety with Appliances and Water** This activity simulates what happens if a hair dryer or other appliance falls into water. The plastic tray represents a bathtub with water, the metal nut represents a hair dryer, and the metal at the end of the tray represents the grounded tub drain. The two leads from the multimeter represent your feet.



Connect the battery tray to the "drain" on the tub and to the metal nut in the water. Place the multimeter leads in the water. Set the digital multimeter to read DC voltage.

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1) Measure the voltage when the two leads are close together in the water. _____

2) Measure the voltage when the two leads are far apart in the water. _____

3) If an appliance falls into a bathtub, would it be more dangerous if a person was lying down in the tub or standing in the tub with feet together and not touching anything else? Why?

d) **Consequences of Electric Shock**

1) How much current would flow through a person with **dry** hands (resistance = 20,000 ohms) if that person were connected across a 120 volt power line? _____

2) Describe how this much current affects a person.

3) How much current would flow through a person with **wet** hands (resistance = 5,000 ohms) if that person were connected across a 120 volt power line? _____

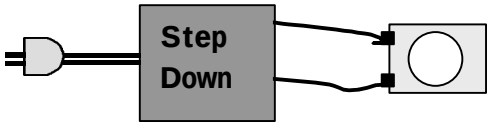
4) How would this much current affect a person?

Activity 14.3: How Do Transformers Affect Current Flow?

Your instructor will demonstrate transformers used in electric circuits.

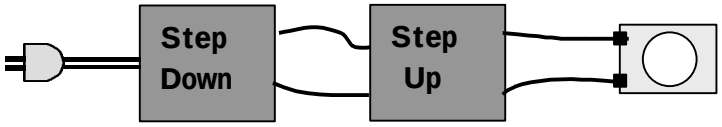
a) Circuit #1: One light bulb: Note the brightness of one bulb with no transformer.

b) Circuit #2: A step-down transformer connected to one light bulb



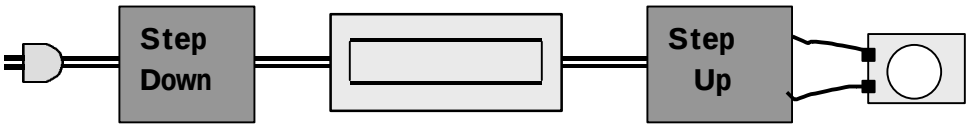
How does the brightness of the bulb compare to the brightness in circuit #1? Explain any difference in brightness.

c) Circuit #3: A step-down transformer, a step-up transformer, and one bulb



How does the brightness of the bulb compare to the brightness in circuit #1? Explain any difference in brightness.

d) Circuit #4: A step-down transformer, high resistance wires, a step-up transformer, and one bulb



How does the brightness of the bulb compare to the brightness in circuit #1? Explain any difference in brightness.

e) Group Discussion Question: What would happen to the brightness of the bulb if you replaced the step-down transformer in Circuit #4 with a 3 battery tray?

Activity 14.4: How Do Transformers Trade Voltage for Current?

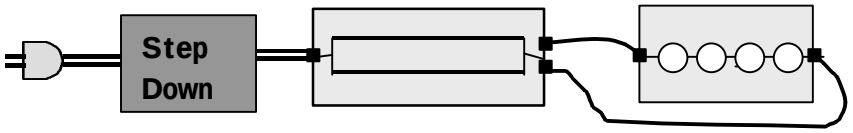
a) A circuit has 2.0 amps of current flowing across a wire. If you wanted to change the current flowing across the wires to 1.0 amp but keep the total power constant, would you add a step-up transformer or a step-down transformer to the circuit? Explain why.

b) In another circuit, a current of 10 amps flows with a voltage of 120 volts. You want to change this current to 15 amps using a transformer and keep the total power constant. How much voltage out of the transformer must the circuit have?

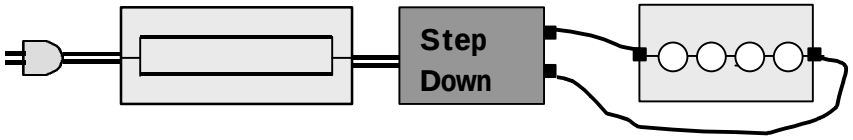
Activity 14.5: How Is Electricity Transmitted?

a) Your instructor will demonstrate two methods for transmitting electricity using high resistance nichrome wires, step-down transformers, and 4 bulb trays. In circuit #1, the step-down transformer reduces the voltage **before** the current flows across the high resistance wires. In circuit #2, the voltage is reduced **after** the current has crossed the high resistance wires.

Circuit #1



Circuit #2



1) In which circuit are the bulbs brighter?

Prediction: _____ **Answer:** _____

2) Which of the two circuits transmits electricity at a higher voltage through the high resistance nichrome wires? Explain why.

3) Which circuit has more current flowing through the high resistance nichrome wires? Explain why.

4) Which circuit wastes more energy as joule heating? Explain why.

b) Group Discussion Question: What are the advantages and disadvantages of transmitting electricity at high voltages?