Name: _____ Date: _____

Student Exploration: Circuit Builder

Vocabulary: circuit, closed circuit, conductor, current, fuse, insulator, open circuit, parallel circuit, series circuit, short circuit

Prior Knowledge Questions (Do these BEFORE using the Gizmo.)

1. What do a light bulb, a toaster, a radio, and a computer all have in common?

   _____

2. Suppose you connect a battery to a small light bulb with a single wire. What do you think will happen? Explain your answer.

   _____

   _____

Gizmo Warm-up: Build a circuit

1. Using the **Standard components** in the upper left of the Gizmo™, try to get a light bulb to light up! You can drag as many bulbs, wires, batteries, switches and fuses as you like onto the circuit board.

   A **circuit** is a path containing easily moveable charges. When the light bulb lights up, charges (electrons) are flowing through the wire and light bulb. This flow of charge is called **current**.

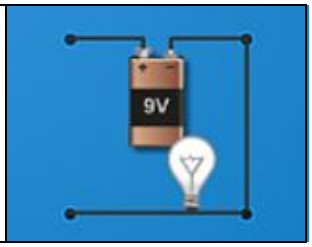
2. Now try to light the bulb with the smallest number of components.

   Make a sketch of your simple circuit in this space:

3. Based on what you have seen, what must be true for a circuit to light a bulb? _____

   _____

   _____

Activity A: **Closing a circuit**	Get the Gizmo ready: • Click **Clear**. • Turn on **Show current**. (Current is represented by moving arrows.) • Set up components as shown to the right.	

Introduction: You should have just built an **open circuit** (shown above). The gap on the left prevents the flow of charges. There are no gaps in a **closed circuit**, so charges flow.

Question: What materials will close a circuit?

1. Predict: **Conductors** are materials with easily movable charges, allowing electrical current. **Insulators** do not have easily movable charges, so current is not easily produced. Look at the nine **Materials** at lower left. Which do you think are conductors? Which are insulators?

   A. Predicted conductors: _____

   B. Predicted insulators: _____

   C. How could you use your open circuit to test if a material is a conductor or insulator?

   _____

2. Experiment: Drag each material into the gap of the open circuit. If the light bulb lights, the material is a conductor. If not, the material is an insulator. Keep track of your findings below.

Conductors	Insulators

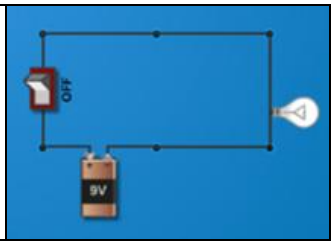
3. Analyze: Look at your list of conductors.

   A. What kind of material are most conductors? _____

   B. Did any conductor have a different effect on the light bulb than the others? Explain.

   _____

   _____

Activity B: **Series circuits**	Get the Gizmo ready: • Click **Clear**. • Check that **Show current** is on. • Build the circuit shown to the right.	

Question: In a series circuit, components are arranged in a single loop. What are the characteristics of series circuits?

1. Observe: Turn the **switch** to **ON**, which allows charges to flow through the circuit. Notice how brightly the bulb is lit and how much current (shown by the arrows) there is. Now start replacing wire segments with light bulbs. You can fit up to four bulbs in this series circuit.

   A. What do you notice about the brightness of the bulbs as you add more bulbs?

   _____

   B. Do all the bulbs have the same brightness? _____

   C. Look at the current arrows in each part of the circuit. Are there any parts of the circuit that have more current than other parts? _____

2. Explore: Now remove a light bulb from your series circuit, leaving a gap. What happens to the remaining bulbs? _____

3. Extend your thinking: Build another series circuit with several light bulbs, a 1.5-volt AA battery, and at least a few wire segments. Turn the **switch** to **ON**.

   A. How does a circuit with a 1.5-volt battery compare to a circuit with a 9-volt battery?

   _____

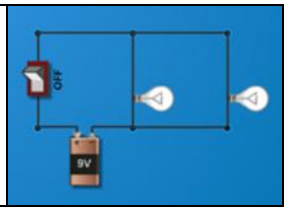
   B. Replace one of the wire segments with another 1.5-volt battery. What happens?

   _____

4. Compare: Compare a series circuit powered by six 1.5-volt batteries to a series circuit powered by a single 9-volt battery. Make sure there are equal numbers of light bulbs in each circuit and that the batteries are all in the same orientation.

   What do you notice? _____

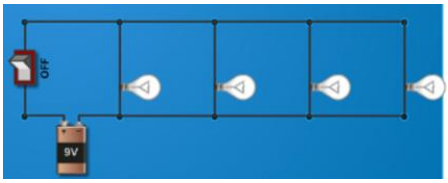
   Why is this true? _____

Activity C: **Parallel circuits**	Get the Gizmo ready: • Click **Clear**. • Check that **Show current** is on. • Build the circuit shown to the right.	

Question: In a parallel circuit, there is more than one path that current can take. What are the characteristics of parallel circuits?

1. Observe: Turn the **switch** to **ON**, which allows charges to flow through the circuit. Notice how brightly each bulb is lit and how much charge is flowing in each part of the wire.

   Are the two bulbs equally bright? _____



2. Experiment: Add two more light bulbs to the circuit, as shown to the right. Turn the **switch** to **ON**, and observe the brightness of the bulbs.

   A. Did the brightness of the bulbs change? _____

   B. Remove one light bulb. What happens? _____

   C. How did the parallel circuit respond differently to these changes than a series circuit?

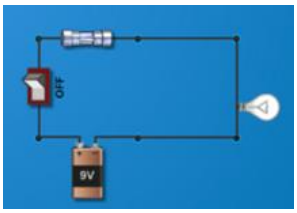
      Adding bulbs: _____

      Removing bulbs: _____

3. Observe: Replace one of the light bulbs in your circuit with a wire. Now there is a path in the circuit with no light bulb to slow down the moving charges. What happens?

   _____

   This situation is called a **short circuit**. The red arrows indicate enormous current. This is very dangerous because so much current will heat up the wire and could even start a fire!



4. Apply: Short circuits can be avoided using **fuses**, devices that melt if too hot. Set up the circuit shown to the right, and turn the switch **ON**.

   A. What happens? _____

   B. Create a short circuit. What happens now? _____

   C. How does a fuse make the circuit safer? _____

   _____