Name _____ Section _____

Period 12 Activity Sheet: Electric Circuits

Activity 12.1: How are Voltage, Current, and Resistance Related?

a) **Data Collection** Connect the DC power supply to the **thin** 30 cm length of nichrome wire. Adjust the power supply setting to 0, 1, 2, 3, 4, and 5 volts. For **each** voltage setting, record in the table the voltage shown on the **analog voltmeter**. Measure and record the amount of current at each voltage setting with a **digital multimeter**.

Voltage (in volts)	**Current (in amps)**	**Resistance (in ohms) (calculate using V = IR)**

b) **Data Analysis** Graph your data with **voltage on the vertical axis and current on the horizontal axis.** Choose values for the grid lines so that your graph fills most of the grid. Label your graph axes.

c) Data Interpretation

1) Pick two points on the line you drew on your graph and find the slope using

$$\text{slope} = \frac{\text{voltage}_A - \text{voltage}_B}{\text{current}_A - \text{current}_B}$$

_____

2) Compare your answer for the slope of your graph in part 1) above to your calculated resistance of the nichrome wire in the third column of the data table on the previous page.

3) Explain the physical meaning of the slope of your graph.

4) How does your answer compare to the resistance you measured for the thin 30 cm nichrome wire in Activity 11.5.b?

Activity 12.2: What Is the Result of Adding Resistors in Series?

a) We will use single bulb trays to determine the effect of adding resistors in series.

1) Connect a single bulb tray to a 3-battery tray. Note the brightness of the bulb.

2) Now connect a second single bulb tray in series with the first bulb. What happens to the brightness of the bulb? _____

3) What will happen if you connect a third single bulb tray in series with the first two bulb trays? **Prediction:** _____ **Answer:** _____

4) How does the amount of current flowing through the circuit change as more bulbs are added in series? Why?

b) Next we examine the total resistance of the circuit when resistors are added in series. Disconnect the batteries from the circuit. Use a **digital multimeter** to measure the resistances and record the values in the table.

Load Device	**Resistance (in ohms)**
All 3 bulbs connected together	
First single bulb tray	
Second single bulb tray	
Third single bulb tray	

How does the total resistance of the circuit compare to the resistances of the single bulb trays?

c) Group Discussion Question: If the sum of the resistances of the 3 single bulb trays does not equal the resistance of the circuit when all three bulb trays are connected together, why is this so?

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Activity 12.3: What is the Result of Adding Resistors in Parallel?

a) Bulb trays

1) Connect a 4-bulb tray to a 3-battery tray with connecting wires. Are the bulbs in the tray wired together in series or in parallel? _____ Explain how to tell whether bulbs are connected in series or parallel by examining the circuit and by turning individual bulbs off and on.

2) Disconnect the battery tray from the 4-bulb tray. Unscrew all but one of the bulbs. Measure the resistance across the entire bulb tray with a digital multimeter. _____

3) Screw in a second bulb and measure the resistance across the tray. _____

4) Predict what will happen when the third bulb is screwed in. _____

   Check your prediction by measuring the resistance. _____

5) What happens to the total resistance of a circuit when resistors are added in parallel? Explain why resistors in parallel have this effect.

6) A circuit consists of one 4 ohm resistor connected in parallel to a 6 ohm resistor. Calculate the total resistance of the circuit, assuming that these resistors are the only sources of resistance in the circuit.

_____

b) Human resistance

1) Use an **analog multimeter** to measure the resistance between your hands. (Before taking the measurement, reset the meter by connecting the two meter leads together and setting the meter scale to zero.) _____

2) Using 4 hollow metal rods, connect 3 people into a series circuit. (Each person holds a rod in one hand and grasps the end of the rod held by the next person.) Measure the resistance of your series circuit with the analog multimeter. _____

3) How does the resistance of the circuit compare to the sum of the resistances of the 3 people? Series circuit resistance: _____ Sum of individual resistances: _____

4) Using two rods, connect 3 people into a parallel circuit. (Each person puts one hand on each of the rods.) Measure the resistance of this parallel circuit. _____

5) Would you expect that adding more people (resistors) in parallel would increase or decrease the total resistance of the circuit? _____

6) Is the total resistance of the parallel circuit less than, equal to, or greater than the resistance of an individual person's resistance? _____

Activity 12.4: What Voltage Drops Occur Across Combination Circuits?

a) Close the switch on the circuit board and unscrew bulb #3, leaving bulb #1 and bulb #2 connected in a series circuit. Close the switch and observe the brightness of the bulbs.

1) Measure the **voltage drop** across bulb #1 with a **digital multimeter**. Record the voltage in the box beside the bulb in the diagram. Repeat for bulb #2.

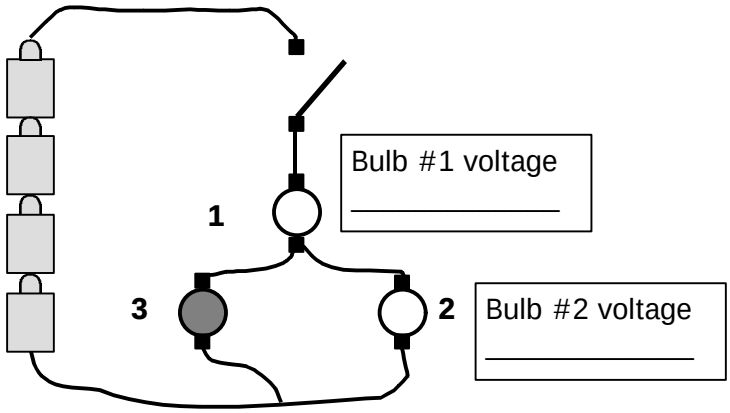
2) Change the setting and the lead connection on your multimeter and measure the **current** flowing through the circuit by opening the switch and attaching the multimeter leads to either side of the open switch. _____

   a) How much of this current do you think flows through bulb #1? _____

   b) How much flows through bulb #2? _____

3) Based on your measurements of voltage and current, how do the resistances of bulbs #1 and #2 compare? Are their resistances approximately equal? _____

   Explain how you decided that the resistances of bulbs #1 and #2 are or are not approximately equal.



b) Screw in bulb #3. Bulbs #2 and #3 are now connected in parallel. Bulb #1 is connected in series to the parallel network of bulbs #2 and #3. Close the switch.

1) Are the 3 bulbs equally bright? If not, which one is the brightest? _____

2) Measure the **voltage drop** across each bulb with a digital multimeter. Record your measurements in the box beside each bulb in the diagram.

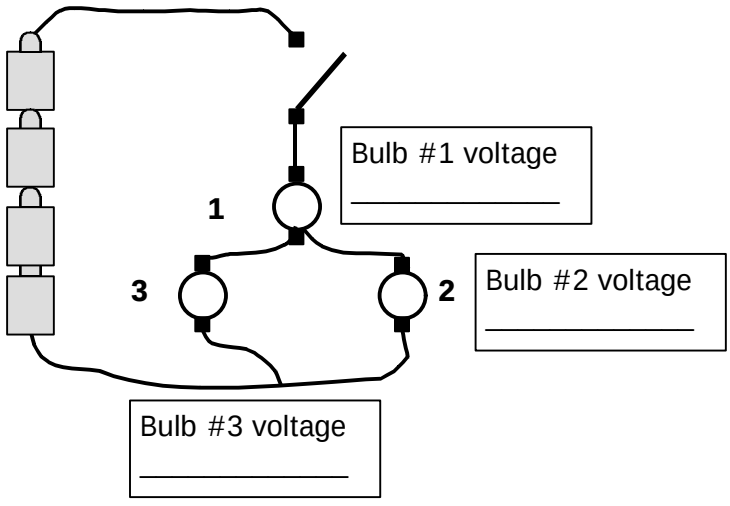
3) Measure the **current** flowing through the circuit by opening the switch and attaching the multimeter leads to either side of the open switch. _____

   a) How does this amount of current compare to the current you measured when only two bulbs were lit?
   _____

   b) How much of this current flows through bulb #1?
   _____

   c) If the bulbs are identical, how much current flows through bulb #2? _____

   d) How much current flows through bulb #3? _____



4) Why does more current flow through the circuit when bulb #3 is lit? Explain how adding resistors in parallel changes the resistance of a circuit.