PHYSICS IN MOTION
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Unit 5F
Ohm's Law
Ohm's Law Lab

Name:

Date:

Imagine you have time-traveled back to 1827, to the lab of the German physicist Georg Ohm. As one of Dr. Ohm's assistants, you want to show the great progress the lab has made in connecting voltage, current, and resistance. The trouble is, almost nobody believes your boss's claims. Desperate to confirm these great discoveries, you invite members of the press to the lab, to do an experiment you hope will settle the matter once and for all.

As your guests arrive, you get them into the spirit of the visit using a friendly competition: seeing who can light up a light bulb first (suppose you have brought the materials back in time with you)!

Part I: Connecting an Electrical Circuit

Materials:

- one wire
- one AA battery
- one small lightbulb

Procedure:

Once the materials are in hand, start a stopwatch and see how long it takes before you can get the bulb to light up.

1. **After the bulb is lit: What was the main difference between the setup that lights the bulb and ones that do not?**

_____

_____

_____

Part II: Demonstrating Ohm's Law

Now you turn to the main event: supporting the claims Dr. Ohm has made relating voltage, current, and resistance. Again suppose you've brought these materials with you:

Materials:

- 3 resistors: 50Ω, 100Ω, 1000Ω
- a variable power supply that can provide up to at least 10V
- an ammeter to measure current
- a voltmeter to measure voltage
- wire connections

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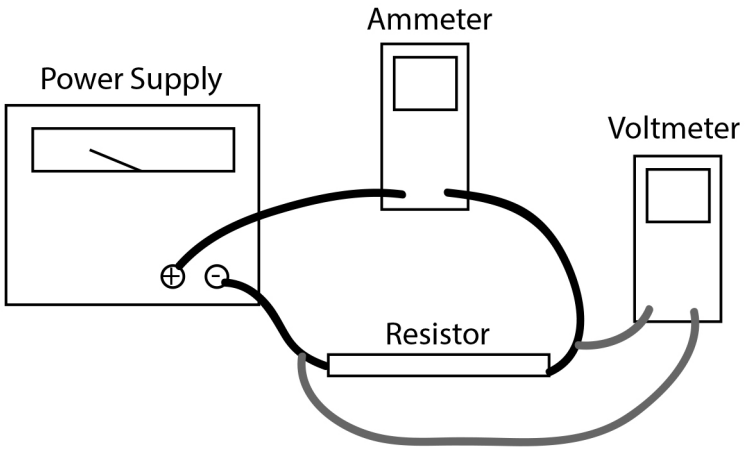
a. Choose one of the resistors and connect the circuit shown here. Make sure the power supply, voltmeter, and ammeter are powered off first.



b. Once things are wired up, have your lab teacher check the circuit before you turn on the power supply.

1. Why is the ammeter part of the main circuit loop but the voltmeter is not?

_____

_____

The voltmeter is set to have very high internal resistance. That way it can measure voltage without disrupting the original circuit by drawing lots of current.

c. Turn on the voltmeter and set it to read 20 V DC.
d. Turn on the ammeter and set it to read 10 A.
e. Turn on the power supply and adjust it until the voltmeter reads 0.5 V.
f. Look to see what current the ammeter displays and fill it in on this table:

Resistance = _____ Ω																		
V	0.5	1	1.5	2	2.5	3	3.5	4	4.5	5	5.5	6	6.5	7	7.5	8	9	10
I																		

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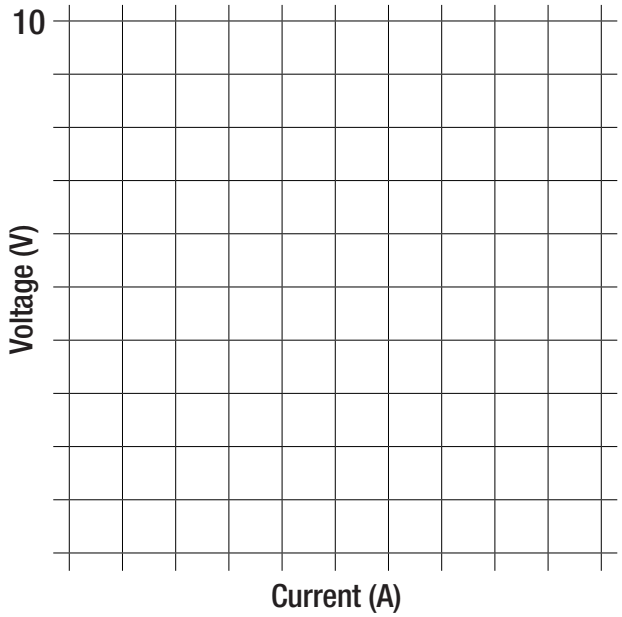
g. Fill out the rest of the table, adjusting the power supply until the voltmeter reads the prescribed voltage and writing in the ammeter reading.

h. It will be easier to show folks what's going on with a graph. Plot Voltage (on the vertical axis) versus Current (on the horizontal axis) below:



2. What functional shape is the plot - linear, quadratic, sine curve, logarithmic…?

3. Based on your answer, what general mathematical equation describes the curve? What values that have been measured go with each of the variables within the equation?

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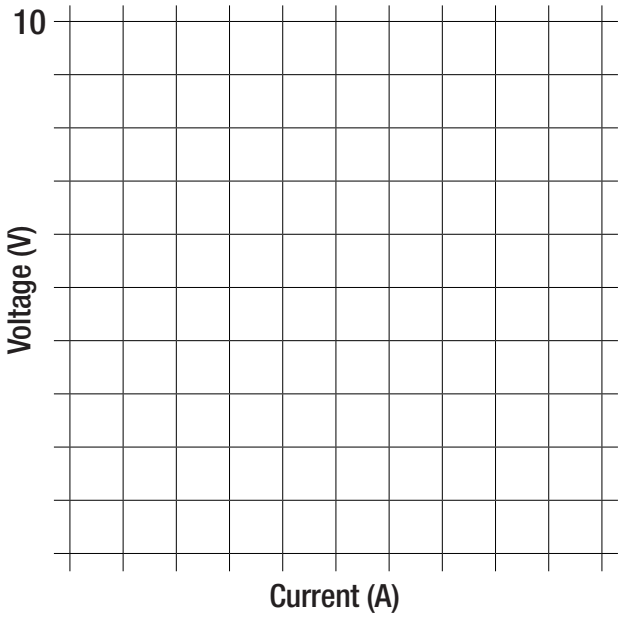
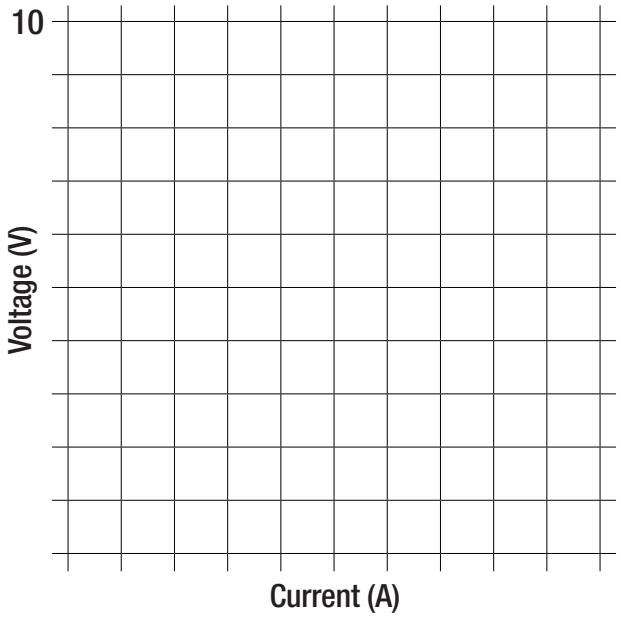
i. Keep all this in mind as you continue. Now, turn off the power supply, switch out the resistor and put one of the other two in its place, then turn the power supply back on. Repeat the same process as before for this, and then for the last, resistor. Fill in ammeter readings here:

Resistance = _____ Ω																		
V	0.5	1	1.5	2	2.5	3	3.5	4	4.5	5	5.5	6	6.5	7	7.5	8	9	10
I																		

Resistance = _____ Ω																		
V	0.5	1	1.5	2	2.5	3	3.5	4	4.5	5	5.5	6	6.5	7	7.5	8	9	10
I																		

j. Now plot V vs. I curves for these resistors. Be sure the label each plot with the resistor value used.





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The visitors to Ohm's lab are starting to get restless to see some results. Now it's time to show them what Ohm found.

4. **On each graph, write a formula that relates V (Voltage) to I (current). If they are connected by a constant, include the units of that constant.**

   For the first resistor, the constant, is _____.

   For the second resistor, the constant is _____.

   For the third resistor, the constant is _____.

5. **Compare the three constants to the resistors' values. What is the percent error for each resistor?**

6. **Write a general equation that relates V, I, and R:**

7. **And that concludes your demo to the press! To help them as they create tomorrow's news, write a brief 'news article' on your findings. Include the 5 W's (who, what, where, how, why), and be sure to explain the experimental process and the summary equation you derived.**