# Pre-Lab Information

Purpose Plan an investigation to explore the variables involved in an electric circuit and how they are related by Ohm’s law.

Time Approximately 60 minutes

Question How do changes in voltage or resistance affect current in an electric circuit?

Hypotheses Write each hypothesis you developed during the laboratory lesson.

Hypothesis 1: how an increase in voltage affects current:

 Hypothesis 2: how an increase in resistance affects current:

**Summary** This lab about circuit design will allow you to test the two hypotheses generated above. You will first design a circuit to test how increases in voltage affect current. Then, you will alter the circuit to test how increases in resistance affect current. You will be provided with a variety of circuit components with which you can design and build your own functional circuits. In gathering data and testing your hypotheses, you will also want to satisfy other objectives in the lab, which include building a parallel circuit and calculating power usage of a circuit component.

 Recall that Ohm’s law predicts that the voltage, current, and resistance of a circuit are related. The total voltage of the circuit is equivalent to the product of the current and the resistance of that circuit. This relationship can be written in three ways, to solve each for a single variable:

*V* = *IR I* = *V*/*R R* = *V*/*I*

Remember that *V* is the voltage, *I* represents current, and *R* is resistance. The unit of current is the ampere. The unit of resistance is the ohm (Ω), which is equivalent to one volt per ampere. Every electric device offers resistance to the flow of current.

# Safety

* Always wear a lab coat and safety goggles when performing an experiment.
* Make sure you devise clear steps for building the circuits before actually building them. If you have any questions about connecting components properly, be sure to ask your instructor.
* **Make sure the circuit is off** while you are building the circuit and modifying connections, as well as at the end of your experiment.
* Use caution when connecting wires and devices within a circuit. Overloading, or short circuiting, an electric circuit could lead to electric shock.
* Behavior in the lab needs to be purposeful.
* Report all accidents—no matter how big or small—to your teacher.

# Introduction

It is time to get you thinking about circuit design and how you can demonstrate the relationships between the variables of Ohm’s law. Your goal is to gain usable data with which you can satisfy the objectives as well as address the hypotheses of the lab.

You have learned about the basic components in circuits. Now you will design your own, and devise variations on both series and parallel circuits from which you can verify Ohm’s law. As you might guess, there are many different circuits you could build that can be used to demonstrate the same concepts, or achieve the same results. A good circuit will be clearly laid out and concise, only containing the components necessary to test a hypothesis or demonstrate a concept.

As you proceed through the lab procedure to develop and run the lab, you will devise circuits to test Hypotheses 1 and 2. You will also want to keep in mind the following lesson objectives, and consider at which points you can demonstrate a parallel circuit and calculate power consumption of a component.

1. Construct functional series and parallel circuits.

2. Use Ohm’s law to calculate current, voltage, and resistance.

3. Calculate the power used by elements in a circuit.

# Lab Procedure

Here is an outline of the steps you should follow to plan your investigation for each part of this lab. Later in the guide, you will have writing space to develop your ideas, collect data, analyze and discuss results, and draw conclusions. Run through these steps twice, once for each hypothesis in the lab.

1. **Construct experimental circuits to examine how altering variables in Ohm’s law will affect current.**

How can you put together a circuit to investigate increasing either voltage or resistance and the effect on current? Identify your independent and dependent variables, and which variables might remain constant. Determine the exact components you will need for each circuit.

Develop the steps to build the circuit, and how you will run each experiment. Use simple drawings to create circuit diagrams, planning out each component and its connections. Develop a clear and organized protocol for circuit testing. Your teacher may guide you on selecting circuit components, but building circuits is up to you or your team. Room is provided in this lab guide to develop experimental circuits for each hypothesis.

For Hypothesis 1, you will focus on increasing voltage in the circuit. For Hypothesis 2, you will increase resistance in the circuit. While you can build a variety of circuits that can be used to investigate and gather relevant results, plan your circuits and check with both your lab partners and your instructor to verify that your design is feasible and safe.

Finally, there are two other objectives to incorporate in your circuits. One is to demonstrate a series versus a parallel circuit. You can do this by simply building a series circuit first, then building onto it, including parallel elements. Another objective is to calculate the power used by elements in a circuit. Your instructor may provide you with a small lightbulb, fan, or other component, which you can incorporate in a circuit to calculate power.

1. **Determine the types of data you will gather and what tools of measurement will be used to collect the data.**

How will you gather data for each part of your experiment? If gathering quantitative data, you may want to devise a table in which you can record your results in an organized manner. Also, consider how you will record any qualitative or descriptive data in addition to your numerical results. What tools will you use to measure the dependent variable?

1. **Gather materials and set up your experiment.**

Now that you know what you will do, gather the necessary items. Besides the electrical components you will experiment with, make sure you have the necessary equipment to take measurements. If you are working with lab partners, make sure each person knows his/her role in running the experiment. Check your setup and make sure you have adequate space and that everything is in order before you proceed.

1. **Run your experiment.**

As you proceed with your experiment, make sure you record all the necessary data and that each student is performing his/her role in running the experiment. Make sure all elements of your experiment are complete. Do not forget to clean up when you are done!

1. **Use the High School Lab Report Guide to write your lab report.**

Now that you have completed your experiments and have your data, use your results and complete your lab report.

# Hypothesis 1: Exploring How Voltage Affects Current

1. **Construct an experimental circuit to examine how an increase in voltage affects current.**

Write the steps of your experiment. Be sure to include steps for demonstrating a parallel circuit and for calculating the power usage of a component.

1. **Determine the types of data you will gather and which tools of measurement will be used to collect the data.**

Make a list of the data sections or tables. List the tools or devices used to make measurements.

1. **Gather materials and set up your experiment.**

Include a sketch of your experimental setup, including circuit diagrams.

1. **Run your experiment.**

Record your data and observations in the space below.

# Hypothesis 2: Exploring How Resistance Affects Current

1. **Construct an experimental circuit to examine how an increase in resistance affects current.**

Write the steps of your experiment. Be sure to include steps for demonstrating a parallel circuit and for calculating the power usage of a component.

1. **Determine the types of data you will gather and which tools of measurement will be used to collect the data.**

Make a list of the data sections or tables. List the tools or devices used to make measurements.

1. **Gather materials and set up your experiment.**

Include a sketch of your experimental setup, including circuit diagrams.

1. **Run your experiment.**

Record your data and observations in the space below.