



Level A Investigations

A-1 What is a Circuit?

What is an electric circuit?

Students learn the basics of how a circuit works by building a simple circuit out of a battery, a bulb, and a wire. In addition, they learn how to draw circuit diagrams using standard symbols. Finally, they build a circuit with a switch and observe how a switch works.

A-2 Types of Circuits

What kinds of circuits can you build?

Students learn that there are two types of circuits: series and parallel. They build both types of circuits and observe the differences between them. They apply their understanding of series and parallel circuits to understanding how circuits are designed for different purposes such as a bell in cars that warns the driver that the door is open.

A-3 Current and Voltage

How are current and voltage measured in a circuit?

Students learn how to use an electrical meter to measure current and voltage in a circuit. Through their measurements, they learn that voltage drops in a circuit as work is done (lighting a bulb) while current does not change in the same circuit.

Level B Investigations

B-1 Voltage

Why do charges move through a circuit?

In this Investigation, students explore how a battery works and what the term “volt” means. They measure voltage across a battery alone, and then while it is in a circuit lighting a bulb. They also discover that the charges in a circuit with more than one battery can only flow when opposite ends of the batteries are lined up (positive to negative, or negative to positive).

B-2 Current

How does current move through a circuit?

Students learn that you can increase the amount of energy in a circuit in two ways. The higher the current value, the more energy that can be carried. The higher the voltage, the more energy that can be carried by the same amount of current.

B-3 Ohm’s Law

How are voltage, current, and resistance related?

In this Investigation, students discover one of the fundamental relationships in electricity: Ohm’s law. They discover this relationship by measuring current, resistance, and voltage in a circuit. They graph voltage vs. current and find out that the slope of the graph is equal to the resistance.

Level C Investigations

C-1 Series Circuits

How do you use Ohm's law in series circuits?

In this Investigation, students learn how to calculate total resistance in a series circuit. They also use Ohm's law to determine the resistance of a bulb at different levels of current using a potentiometer. They discover that the resistance of the bulb increases as current increases.

C-2 Parallel Circuits

How do parallel circuits work?

Students build parallel circuits and measure their electrical quantities. They determine how total current and branch currents are related in parallel circuits. Finally, they build a test voltage circuit like the ones used in portable medical devices. These circuits alert you when battery voltage has dropped.

C-3 Compound Circuits

How do you analyze compound circuits?

In this Investigation, students build and analyze compound circuits. They determine the current at different points in a compound circuit. They also calculate the total resistance in the circuit.



Question: How does current move through a circuit?

In this Investigation, you will:

1. Measure and compare current at different points in a circuit.
2. Compare current in circuits with one and two bulbs.

Why does a bulb light? When you put a battery in a circuit, electric current flows through the wires and makes things happen. The current carries energy from the battery to a bulb or motor. You can increase the amount of energy in two ways. The higher the value of the current, the more energy that can be carried. The higher the voltage, the more energy that can be carried by the same amount of current.

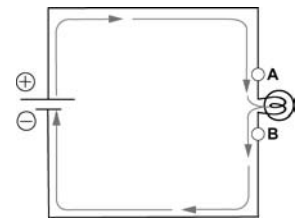
 **Safety Tips: Be careful working with batteries. If they are damaged or broken, return them immediately to your teacher.**

If a battery or wire gets hot, disconnect the circuit and ask your teacher for help.

1

Building test circuit #1

1. Gather the following materials: electrical meter and its two test leads, a battery and battery holder, a bulb and bulb holder, and two connectors.
2. Build test circuit 1 with one battery and battery holder, one bulb and bulb holder, and two connectors, as shown in the schematic at right. There are two points marked on the schematic, A and B, which is where the connectors are attached to the bulb holder. Make sure that you can easily identify these points in your circuit.

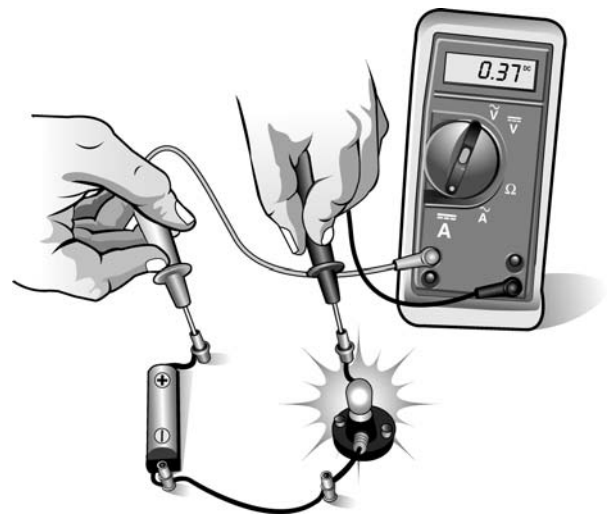


2

Measuring current through test circuit #1

To measure current, the meter must be placed *in* the circuit so that the current has to flow through it. Follow the instructions below carefully.

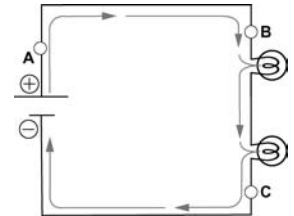
1. Connect the two meter leads to the meter as shown at right.
2. Set the meter to measure DC current at the highest range.
3. Remove the connector between the positive terminal of the battery and the bulb holder.
4. Place the red positive lead of the meter on the post attached to the positive terminal of the battery.
5. Place the black negative lead of the meter on the free post attached to the bulb holder. You should now have a complete circuit. The bulb should light and you should get a reading on the meter.
6. Record the current at point A.
7. Reconnect the circuit and then disconnect it at point B.



8. Predict what the current at point B will be. Record your prediction.
9. Following the same procedure you did for point A, use your meter to measure current at point B. The positive lead of the meter should be closest to the positive battery terminal, and the negative lead of the meter should be closest to the negative battery terminal.
10. Record the current at point B.
11. Remove the meter and reconnect the circuit. Leave it connected while you complete part 3.

3 Building test circuit #2

1. Gather the following additional materials: one battery and battery holder, two bulbs and bulb holders, and three connectors.
2. Build the circuit in the diagram at right. Make sure that you can easily identify points A, B, and C where the connectors are attached.



4 Comparing test circuits #1 and #2

Compare the brightness of the bulbs in test circuits 1 and 2. Record your observations.


5 Measuring current through test circuit #2

1. Using the same procedure you followed in part 2, measure and record current at point A.
2. Predict what the current will be at points B and C.
3. Using the same procedure you followed in part 2, measure and record current at points B and C.

6 What did you learn?

- a. Review the two current readings for circuit 1. What conclusions can you draw from these results?
- b. Review the three current readings for circuit 2. What conclusions can you draw from these results?
- c. Transfer all your results for circuit 1 and circuit 2 into the table below. Compare the current readings in the two circuits. What happened to current when you added a bulb to the circuit?

	Current in circuit 1 (amps)		Current in circuit 2 (amps)
point A		point A	
point B		point B	
		point C	

- d. You probably determined that adding a bulb to the circuit reduced the current. With the rest of your group propose an explanation. Be prepared to present and defend your explanation. 



Question: How does current move through a circuit?

 **Safety Tips: Be careful working with batteries. If they are damaged or broken, return them immediately to your teacher. If a battery or wire gets hot, disconnect the circuit and ask your teacher for help.**

1 Building test circuit #1

No responses are required in part 1.

2 Measuring current through test circuit #1

Record the current at point A.

Predict what the current at point B will be. Record your prediction.

Record the current at point B.

3 Building test circuit #2

No responses are required in part 3.

4 Comparing test circuits #1 and #2

Compare the brightness of the bulbs in test circuits 1 and 2. Record your observations here:

Questions

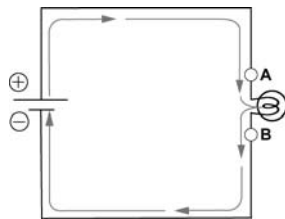
1. What is the difference between current and voltage?

2. What units are used to measure current? What do these units mean?

3. When you measure the current of a circuit with an electrical meter you insert the meter at one point into the circuit while the circuit is on. Explain why current must be measured in this way.

4. Will a circuit with three bulbs have a faster or slower current than a circuit with two bulbs?

5. In the circuit below, the current at point A is 0.5 amps. What is the current at point B?



Curriculum Resource Guide: Electric Circuits

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