



Electricity and Circuits

Reference Guide

Equipment Setup

Electric Circuits	1
-------------------------	---

Investigation Guides

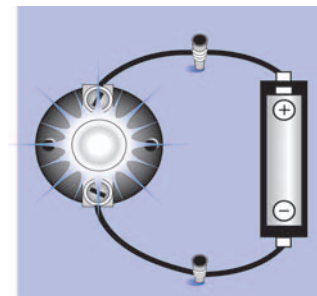
A-1	What is a Circuit?	3
A-2	Types of Circuits	7
A-3	Current and Voltage	11
B-1	Voltage	15
B-2	Current	19
B-3	Ohm's Law	23
C-1	Series Circuits	27
C-2	Parallel Circuits	31
C-3	Compound Circuits	35



B-2 Current

Key Question: How does current move through a circuit?

In this Investigation, students learn about current and how to measure current in a circuit. Students measure current at several different points in a circuit and find out that current is the same. This finding presents an opportunity to reinforce the idea that charges transfer energy — not mass — to a bulb. Students also describe the relationship between current and bulb brightness by comparing circuits of one bulb and two bulbs. They discuss their ideas about why current is lessened when a second bulb is added.



Preparation

Before this Investigation, students should be able to build a complete circuit, explain how electrical charges flow through a circuit, and explain the meaning of voltage. They should also know how to use an electrical meter.

A reading or class discussion on current and amps will help students better understand the Investigation. Students should know that current is the flow of electrical charges. They should also know that current is measured in amperes, or amps for short. One ampere is a flow of one coulomb of charge per second.

Setup and Materials

Students work in groups of two to three at tables.

Each group should have:

- Electric circuits set
- Two D alkaline batteries
- Electrical meter

The Investigation

Time  One class period

Leading Questions

- How do charges move through a circuit?
- How is the flow of charge measured?

Learning Goals In this Investigation, students will:

- Explain current.
- Measure amps with an electrical meter.

Key Vocabulary current, amperes, amps

1

No student responses are required in part 1.

2

Current at point A: 0.101

Predicted current at point B: 0

Actual current at point B: 0.101

B-2

Current



B-2

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.

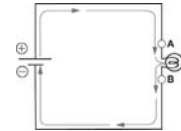
Safety Tips: Be careful working with batteries. If they are damaged or broken, return them immediately to your teacher.

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.

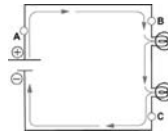


8. Predict what the current at point B will be. Record your prediction.
9. Following the same procedure you did for point A, use your meter to measure current at point B. The positive lead of the meter should be closest to the positive battery terminal, and the negative lead of the meter should be closest 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.

2

3

Student responses are not required in part 3.

4

Observations: The bulbs in test circuit #1 were a lot brighter than those in test circuit #2.

5

Current at point A: 0.072
 Predicted current at point B: 0.072
 Predicted current at point C: 0.072
 Actual current at point B: 0.072
 Actual current at point C: 0.072

6

- a. The current is the same at both points in the circuit.
- b. Again, the current is the same in the three places we measured.
- c. The current went down when a second bulb was added to the circuit.

	Current in circuit 1 (amps)		Current in circuit 2 (amps)
point A	0.101	point A	0.072
point B	0.101	point B	0.072
		point C	0.072

- d. Having two bulbs in the circuit slows down the charges moving through the wire. The lower current affects the brightness of the bulb. We don't know exactly why the charges are slowed down when there is a second bulb.

1. Current is the flow of electrical charges. It carries the energy needed to do work. Voltage supplies the energy that makes the charges flow.
2. Amperes, or amps for short, are the units of current. One amp is a flow of one coulomb of charge per second.
3. To measure current you have to make the electrical charges flow through the meter. Since current is a measure of how many charges per second, the charges must flow through the meter in order to be counted.
4. The circuit with three bulbs will have a slower current.
5. The current at point B will be 0.5 amps, or slightly lower.

Curriculum Resource Guide: Electric Circuits

Credits

CPO Science Curriculum Development Team

Author and President: *Thomas Hsu, Ph.D*

Vice Presidents: *Thomas Narro and Lynda Pennell*

Writers: *Scott Eddleman, Mary Beth Abel, Lainie Ives, Erik Benton and Patsy DeCoster*

Graphic Artists: *Bruce Holloway and Polly Crisman*

Curriculum Contributors

David Bliss and David Lamp

Technical Consultants

Tracy Morrow and Julie Dalton

Curriculum Resource Guide: Electric Circuits

Copyright © 2002 Cambridge Physics Outlet

ISBN 1-58892-043-7

2 3 4 5 6 7 8 9 - QWE - 05 04 03

All rights reserved. No part of this work may be reproduced or transmitted in any form or by any means, electronic or mechanical, including photocopying and recording, or by any information store or retrieval system, without permission in writing. For permission and other rights under this copyright, please contact:

Cambridge Physics Outlet

26 Howley Street,

Peabody, MA 01960

(800) 932-5227

<http://www.cpo.com>

Printed and Bound in the United States of America

