

Basic Electrical Circuits

Teacher's Guide

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Lesson Overview: This lesson discusses the basics of electricity as it pertains to basic circuits.	Subject area(s): Electronics, Physics
National Science Education Standards Addressed: 1.	Topic: Electrical Circuits
	Audience: 3 rd – 6 th grade
Resources: 1. Water/Electricity analogy: http://hyperphysics.phy-astr.gsu.edu/hbase/electric/watcir.html 2. Any electrical circuits book will provide background on the subject	Suggested time: approx 50 min
	Materials: <ul style="list-style-type: none">▪ Batteries (e.g. C cell), with holder▪ Wire w/ alligator clips▪ Low Voltage light bulbs▪ Light bulb bases▪ Paper and pencil

Learning Objectives:

Students will:

1. Draw an electrical schematic
2. Learn how to build the following basic electrical circuits: simple, series, and parallel.

Background:

1. Electricity is all around us. A basic understanding of how electricity works allows us to build simple circuits and how to be safe using it.

Assessment Strategy:

1. Students will need to build and demonstrate the operation of a simple, series, and parallel circuit.

Teaching Tips:

Obtaining Materials and Experiment prep - All materials can be found at a store like RadioShack or through catalogs. There should be at minimum one C- cell battery, one battery holder, two low voltage light bulbs with bases, and three or four wires terminated with alligator clips for each group. Students should not work in groups of more than two.

Engage - Discuss electronics and how circuits are the basis of the video games, etc. Can talk about electrical systems in their house, i.e. light switches, why there are two and three prongs on a power cord, etc.

Explore – Through out the lesson many questions can be asked about the circuits. Good questions are for asking about similarities between the water analogy and the electrical circuit. For example, “In the electrical circuit what is acting like the pump?”

References:

Knight, R. (2004) Physics for scientists and engineers. San Francisco: Pearson Addison Wesley

Nave, R. (2006). Hyper physics, <http://hyperphysics.phy-astr.gsu.edu/hbase/hph.html>

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Basic Electrical Circuits

Procedure:

1. Discuss what a circuit is, i.e. something that is circular. Relate circuits to circles.
2. Water analogy

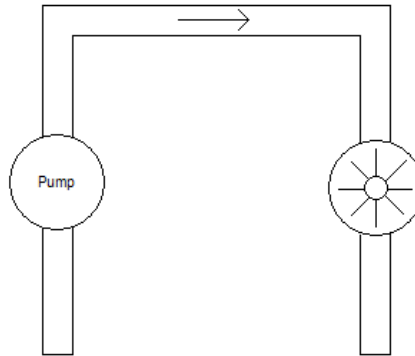


Figure 1. Open Water Circuit

- a. This is an example of an open circuit. The water will flow through the pump and spin the turbine. However, the water has nowhere to go and the circuit is inoperable.
- b. Question: How could I make this circuit work?

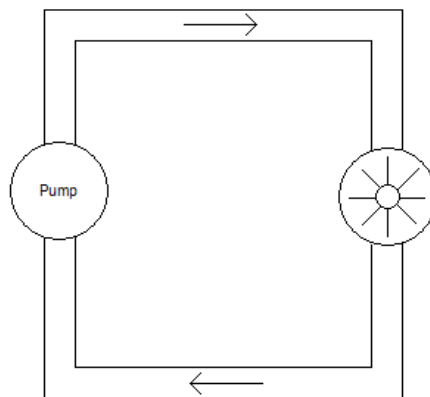


Figure 2. Closed Water Circuit

- c. This is an example of a closed circuit. The water will flow continuously and recycle itself.
 - d. Could extend this by asking students how to turn the circuit on and off. For example, a valve could be inserted on one of the pipes.
3. Electrical Circuits
 - a. A battery acts like a pump, but instead of pumping water it pumps charge.

- b. The battery like an escalator for charge. As the charges are moved up they achieve a higher potential energy. This can be easily be linked with gravitational potential energy. Electrical potential energy is known as voltage and has units of volts (e.g. C-cell battery is 1.5 volts). Something that has potential energy will always try to move to a region of lower potential energy. In the case of an electrical circuit. The positive charges coming from the positive terminal (high potential) of the battery will want to go to the negative (lower potential) terminal.

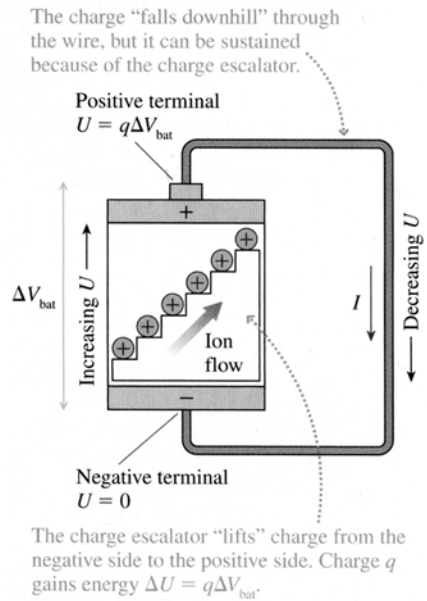


FIGURE 30.17 The charge escalator model of a battery.

Figure 3. Charge Escalator Example

Source: Knight, R. Physics for scientists and engineers, pg 942

- c. Current is the flow of charge per second. Current has units of amperes. Link to water analogy, water has a flow rate through the pipes.

4. Understanding schematics

a. Symbols

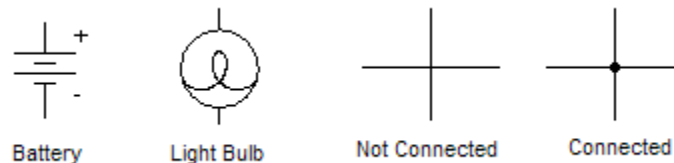


Figure 4. Schematic Symbols

- b. When two wires intersect on a schematic they are only connected if there is a dot at the intersection.

5. Simple circuit

- a. Have students draw the schematic, discuss it, and then build it.

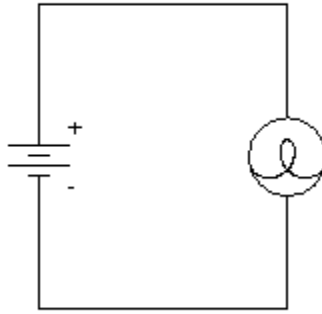


Figure 5. Simple Circuit Schematic

6. Series Circuit

- a. Have students draw the schematic, discuss it, and then build it.
b. What happens to the intensity of the bulbs? Why?

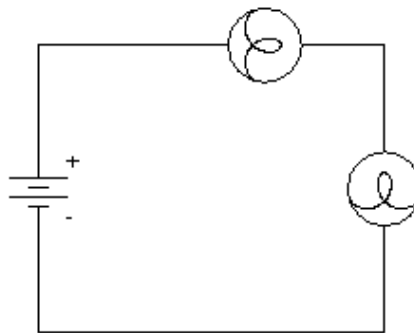


Figure 6. Series Circuit

7. Parallel Circuit

- a. Have students draw the schematic, discuss it, and then build it.
b. Do the two light bulbs have the same voltage?
c. What happens to the intensity of the bulbs? Why?

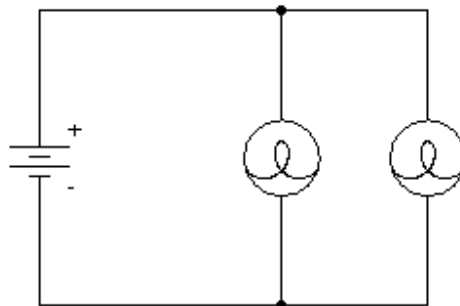


Figure 7. Parallel Circuit

8. Have students demonstrate they built all the circuits. Then they experiment with additional batteries and light bulbs for the remainder of the time.