

The Electric Circuit

Standard #3240-03	Students will relate forces and energy to motion	<i>Topic:</i> Changes in Force, Motion, and Energy <i>Course:</i> #3240
Objective #3240-0303	Analyze energy movement and transformations.	
ILO's:	2a. Identify variables and describe relationships between them. 4d. Recognize the personal relevance of science in daily life. 5a. Know science terminology appropriate to grade level. 7e. Recognize the vital need for creative thinking and imagination in designing and conducting scientific inquiries.	

Description of Activity:

Title: The Electric Circuit

Overview: The students will design an electrical circuit capable of running 3 lights in different rooms in a home. In the process they will discover series and parallel circuits.

Duration: 3-4 45 minute class periods

Materials: per group-wire, 3 mini-lights (Christmas lights work well) 3 C batteries (1.5 volts each-battery not to exceed 9 volts), scissors, tape (cellophane or electricians) switches, battery pack (if using C cells)

Background Information:

An easy and safe way to learn about electric energy is to use batteries, bulbs and wire. An electric charge can be made to move in a current. An electric circuit allows the flow of electrons from a power source to make a round trip back to the power source. In a series electric circuit, only one path is available for the electrons to flow through. When any part of a series circuit is disconnected, no current can flow through the circuit. This is called an "open" circuit. The electrons require a closed path or they won't move at all. In a parallel electric circuit, two or more paths are available for the electron flow. Parallel circuits contain separate branches for the current to move through. More current flows through the paths of lowest resistance. Because all branches connect the same two points of the circuit, the potential difference is the same in each branch. Parallel circuits have the advantage that when one branch of the circuit is opened, such as when you turn off a light, the current continues to flow through the other branches. In this experiment, students will construct series and parallel circuits.

Teaching and Learning Strategies:

This experiment works best in groups of 2-3. However, for larger class sizes, 4 students will work as well. In order to insure inquiry, the students need to be allowed to try different things and experiment with their materials. Do not inform students about the nature of parallel and series circuits. This is to be discovered.

Development of Laboratory Skills and Tools:

Students should complete the skill building laboratory "Lights Out". This activity will provide background in electric circuits as well as what types of materials will conduct electricity. Students will also learn basic symbols to use in diagramming electric circuits.

Invitation to Learn:

A discussion of the "Lights Out" activity should emphasize the need for a circuit to be closed in order to turn a light on, and that different materials make better electrical conductors than others. Expand this discussion to the electrical wiring in the students' homes. Electricity comes into their homes from the power company in just one wire. Ask the question: **How does electricity travel through our homes? What would be the best types of circuits for 3 light fixtures in different rooms?**

The students need to work in groups to find their answers. Hand out the student designed experiment worksheet and have them plan a circuit that they think would work best in a house. Have materials available for them to test their design. Remind them that if a design doesn't work, that they can try another one. They should consider such things as, if one light doesn't work or is turned off, will the whole system not work (series circuit) and will the bulbs be bright enough?

Safe operating procedures include being careful of hot wires and bulbs.

Summary of Learning:

Multiple Choice:

1. What happens when one light goes out, or is removed in a series circuit?

- a. all the lights go out
- b. only that light goes out
- c. half of the lights go out
- d. nothing happens

answer: a

2. What happens when one light goes out, or is removed in a parallel circuit?

- a. all the lights go out
- b. only that light goes out
- c. half of the lights go out
- d. nothing happens

answer: b

3. What arrangement would make the brightest light?

- a. 2 bulbs connected in parallel to a 1 battery
- b. 2 bulbs connected in series to 1 battery
- c. 2 batteries connected in series to 1 bulb
- d. 2 batteries connected in parallel with 1 bulb

answer: d

Strategies to share learning:

Students could look at blueprints to see how commercial circuits are diagramed and then make their own using their data. They could draw their homes on poster board and share them with the class.

Student Designed Experiment Format

TITLE: The Electric Circuit

PURPOSE: What is the best circuit design for a house with 3 light fixtures?

PREDICTION: (What is a possible answer?)

MATERIALS: (What will I use to find out?)

PROCEDURES: (What circuit designs will I use to find out?)

DATA: (What happened?)

ANALYZE RESULTS: (What does my data mean? Is there more than one way to view the data? Could I have done something differently?)

CONCLUSIONS: (What did I learn?)

Student Designed Experiment Scoring Rubric

RESPONSE	CRITERIA	RATING
Exemplary	Completes all steps. Experiment is logical and clear. Data is recorded and thoroughly analyzed. Diagrams are present. Prediction made. Conclusions thorough and thoughtful.	6
Competent	Completes all steps. Experimental procedures lack thoroughness. Data is recorded, analysis not complete. Conclusions too brief.	5
Satisfactory	Completes nearly all steps. Some procedures lacking or illogical. Data recorded but poorly analyzed. Conclusion does not accurately sum up experiment.	4
Nearly Satisfactory	Completes most steps. Procedures missing. Data recorded but not analyzed. Conclusion inadequate.	3
Fails to Complete	Most steps missing. Data recorded but procedures do not indicate it's origin. Conclusion missing.	2
Fails to Begin Effectively	Directions not followed. Nearly all steps missing. Doesn't show understanding of how to develop experiment.	1
No Attempt Made	Does not begin experiment.	0

Teacher Page

Skill building activity for "The Electric Circuit"

Title: Lights Out

Description: This activity will provide students with an opportunity to make a simple electric circuit and see what materials will conduct an electric current.

Materials: small light bulbs (Christmas mini-lights with wires cut leaving a 2-3 cm length) light sockets (if not using Christmas lights) wire, various materials to test (ex. plastic rods, metal chains, pencils, glass rods, wood, rubber tubing, etc) switch, 3 1.5 V batteries and battery pack or electricians tape to hold them together. Battery should not exceed 9 V.

Background Information: Electricity is the flow of electrons through a substance. Not all substances will allow electrons to flow, they are insulators. Metals are generally good conductors of electricity and are used in nearly all wires. A circuit is the path formed by electric conductors. A closed circuit returns electrons to their source, an open one does not. In order to draw electric circuits the following symbols need to be taught to the students:

Drawing Under Construction

Safety Suggestions: Lights, wires and batteries can become hot during this lab and should not be touched. Wires should never be inserted directly into a wall outlet.

Student Page

Name _____

Title: Lights Out

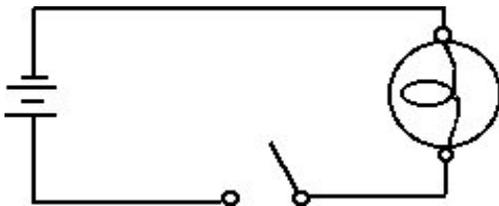
Purpose: To learn how to make a simple circuit and what substances carry electricity best.

Materials: light bulb, batteries, wire, switch, conducting substances

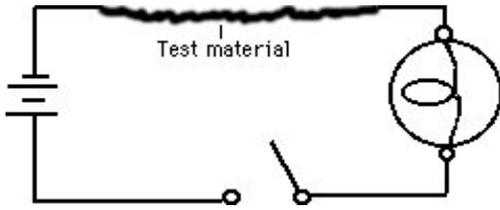
Prediction: (which substances will not conduct electricity?)

Procedure:

1. Make a simple circuit by attaching the bare ends of wires to the light, the battery and the switch. Use this diagram to help. If you do not know what the symbols mean, ask your teacher.



2. Test your circuit. If it does not work, make adjustments until it does. Record the brightness of the light on your paper.



3. Add a test material to the circuit. Place it in the area marked in this diagram:

4. Test 4 more materials this way and record results.

Data:

Test Material:	Brightness of light
none	

Analysis:

Answer in Complete Sentences

1. What does circuit mean in electricity?
2. When did you know you had a closed circuit?
3. In general, which substances conducted electricity the best?
4. In general, which substances did not conduct electricity the best?
5. If you were in a lightning storm outdoors, which type of fence would be safer to touch, wood or wire? Why?

Conclusion: