Science Unit: ***Electricity with Applications***

Lesson 2: ***Series and Parallel Circuits***

School Year:	2010/2011
Developed for:	Pierre Eliot Trudeau Elementary School, Vancouver School District
Developed by:	Scott Morgan (scientist), Alison Diesvelt and Paula Jeram (teachers)
Grade level:	Presented to grades 5 and 6; appropriate for grades 5 - 7 with age appropriate modifications
Duration of lesson:	1 hour and 30 minutes (revise as needed)
Notes:	**It is highly recommended that power adapters be used instead of batteries.** Batteries are not recommended because they can explode when shorted, are expensive and have a short life. Power adapters, on the other hand, are safer, last for years, contain circuits that protect them when shorted and cost much less per year of use. The typical 6-V battery used in schools costs $10 and lasts 1-2 years. A power adapter costs $20 - $30 but lasts for many years. **Safety precaution**: If using batteries, be careful not to short the terminals of the battery as it will damage the battery and there is a danger of explosion. In other words, do not connect the terminals of the battery directly with a low resistance element such as a wire or any piece of metal. Note that voltages less that 24 V are considered safe. Power supplies should be used that have outputs less than 24 V and have current limiting to prevent blowing fuses in the event that outputs are shorted.

Objectives

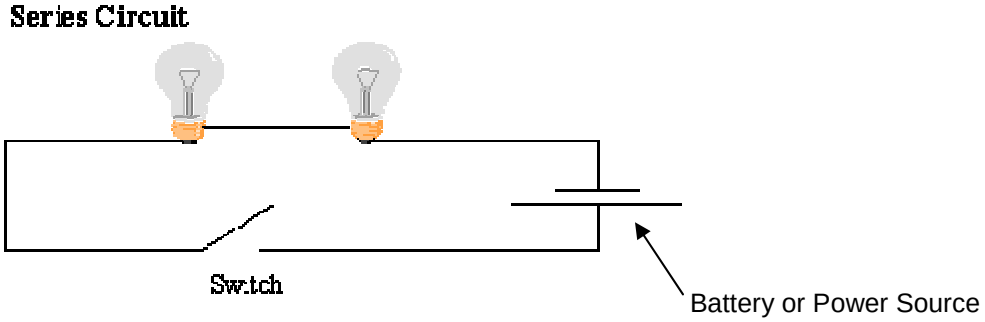
1. To learn how electricity is used in circuits to do work.
2. To be able to distinguish series and parallel circuits.
3. To create a series circuit that lights a lamp.
4. To demonstrate the conversion of electricity into heat.
5. To determine the conductivity of various common materials (some metals and insulators (glass, cloth, bodies))
6. To learn about electrical safety.

Background Information

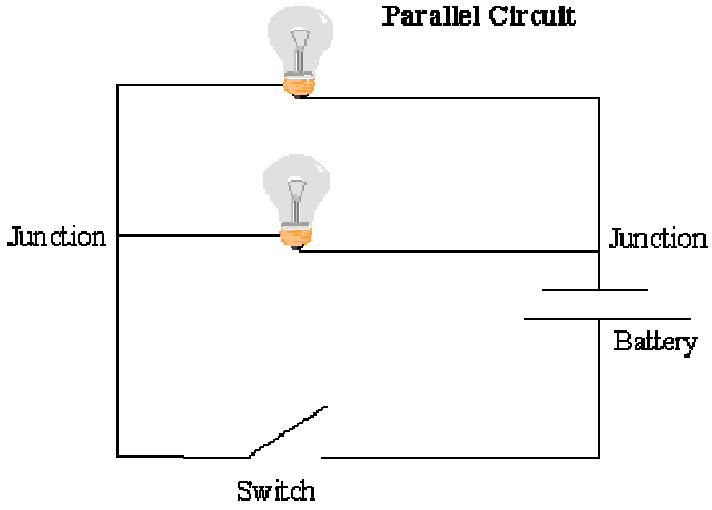
Electrical current, which concerns the movement of charge, in the context of this lab and general usage, means that electrons are made to travel through conductive elements. The protons and neutrons that make up the structure of the conductive elements do not move.

Electrical current flows in a closed circuitous route from a power source such as a battery (chemical energy) or generator (electromechanical energy) through conductive elements and back to its source. For example, in a toaster, current flows from one conductor in the plug in the wall socket through the electrical cord, through a heating element in the toaster and back to the wall socket through the other conductor on the plug.

There are two possible arrangements of closed circuits, series and parallel. A series circuit consists of a power source and one or more conductive elements arranged in a closed loop. The following diagram shows and example of a series circuit.



A parallel circuit contains an arbitrary number of interconnections of conductive elements such that there are at least two distinct paths for current to flow from the power source, through the conductive elements and back to the power source. The following diagram shows an example of a parallel circuit.



Vocabulary

Current	The movement of electrical charge.
Insulator	A material that does not conduct electricity well.
Conductor	A material that conducts electricity well.
Charge	A property of some atomic particles (such as electrons and protons) that cause them to attract or repel.
Power supply	A device that supplies electrical current.
electron	The negatively-charged parts of an atom.
Circuit	An electrical power source (such as a battery) interconnected with other electrical components using conducting devices such as wires.

Series circuit	A circuit in which the components are connected one after the other in a loop.
Parallel circuit	A circuit in which the components are connected in parallel (across each other).

Materials per group of three to four

- 5 or 6-VDC, 3-A Power supply or batteries (see safety concerns)
- 4 test leads with alligator clips (mini-sized are easier for children to operate).
- 3 6 VDC lamps

In the Classroom

Introductory Discussion

What is a circuit?

- Electrical current powered by an electrical power source such as a battery or power supply travels from one of the two terminals of the source, through one or more circuit elements and back to the power source through a second terminal. The circuit elements could be wires, lamps, heating elements or any number of elements that conduct electricity. The simplest circuit would form a single continuous loop (called a series circuit) from one source terminal to the other, but more complex arrangements are possible.

Can you think of any circuits in this classroom?

- Lights, computers, PA system, projectors, cell phones, DVD players, TV.

Science Activity/Experiment

Safety Guidelines

If using batteries: Be careful not to short the battery terminals as it will damage the battery and there is a danger of explosion. In other words, do not connect the terminals of the battery directly with a low resistance element such as a wire or any piece of metal.

1. Students will work in groups of 3-4. They will need a power supply, 4 test leads with alligator clips, 2 bulbs and various classroom items (eg. Coins, pencils, paper, eraser).

2. Using the test leads, connect the power supply and one bulb in series (see diagram above). Record your results and sketch your circuit.

3. Predict what the outcome will be when you connect two bulbs in series. Connect the power supply and 2 bulbs in series. Record your results and sketch your circuit.

4. Connect the power supply, one bulb and one classroom item of your choice (eg. Pencil, eraser, coins, paper) in series. Did the bulb light up? Repeat using 4 different items and record your results. Which items are the best conductors? And which are the best insulators?

5. Connect the power supply and 2 bulbs in parallel (see diagram above). Record your results and sketch your circuit. How does the brightness of bulbs compare with just one bulb in series?

Closure Discussion

1. Did the circuit behave as you predicted?
2. What happened when you added a second bulb in series? Did the bulbs get brighter, dimmer or stay the same? Why?
3. What happened when you connected a bulb in parallel with the series bulb? Did the bulbs get brighter, dimmer or stay the same? Why?

References

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Name_____ Date_____

Series and Parallel Circuits

Series Circuits

Materials: power supply, 4 test leads with alligator clips, 2 bulbs, various classroom items.

What will happen if we connect the power supply and one bulb in series?

_____

_____

Using the test leads, connect the power supply and done bulb in series. What happened and why?

_____

_____

Sketch your circuit (using the symbols on page 111 of your science book).

What result do you expect if you connect two bulbs in series?

_____

Connect the power supply and two bulbs in series. What was the result and what do you think is happening?

_____

_____

Sketch your circuit.

Connect the power supply, one bulb and one other item of your choice (eg. Coins, pencils, paper, eraser) in series. Did the bulb light up? Repeat for a number of items and fill in the table below.

Item	**Bulb brightness (off, dim, bright)**

Which items are the best conductors?

_____

Which are the best insulators?

_____

Parallel Circuits

What will happen if we connect two bulbs in parallel?

_____

_____

How does the brightness of bulbs compare with just one bulb in series?

_____

_____

Sketch your circuit.