

What are Conductors, Insulators and Circuits?

Objective

Students will learn about electric current and energy transfer by experimenting with circuits.

Curriculum Focus

Science

Materials (Per Student Group)

- Several general purpose C-cell batteries
- A string of holiday lights, cut apart and stripped at the ends, OR small bulbs and sockets with wires
- Copies of "Student Sheet: A Bright Idea!"

Key Vocabulary

Battery
Circuit
Conductor
Electricity
Electric current
Electron
Insulator

Next Generation Science Correlations

3.ETS1-1
3.ETS1-2
4.PS3-2
4.PS3-4
4.ETS1-1
4.ETS1-2
5.ETS1-1
5.ETS1-2
MS.PS3-3
HS.PS3-3
HS.PS3-5



Introduction

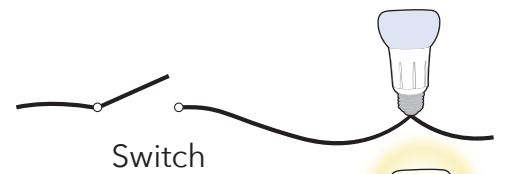
Electric current or electricity travels through wires from generation plants to places that use it, such as industrial and commercial buildings and our homes. Conductors, insulators and circuits are needed to make this happen. Conductors are materials that allow an electric current to pass through them. For example, most metals conduct an electric current. That is why wires are made of metals. Insulators, on the other hand, resist the flow of an electric current. Rubber, plastics and other insulators do not allow electricity to pass through them easily.

Electricity moves through a circuit, which is a pathway for an electric current to follow. Usually copper wire that is surrounded by insulation of different colors comprises the wiring in most homes and businesses. This will ensure that the electricity cannot escape. However, if for some reason a conductor that has electricity running through it does not have insulation around it or the insulation is damaged, it can pass the electricity to another conductor. This is called a short circuit.

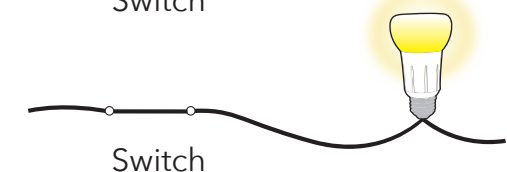
An open circuit is a pathway that has an opening, which does not allow an electric current to flow. A switch that is in the off position makes its circuit an open circuit. A closed circuit is where an electric current is allowed to flow. For example, when a switch is in the on position the pathway is complete and a current can flow through it.

Series and parallel circuits are types of circuits that are used to wire homes and businesses. In a series circuit, there is one pathway for an electric current to follow. Various devices are connected in such a way the electric current flows through each device. In a parallel circuit, there are multiple pathways for an electric current to flow through the devices on the circuit.

Open circuit:
no electricity
can flow.



Closed circuit:
electricity
can flow.





Procedure

Have students use the materials provided to experiment with simple circuits by following the guided inquiry activity on the student sheet. As the students do the activity, have them note the light and heat energy given off.

1. Divide students into small groups
2. Distribute string of lights or small bulbs and a battery to each group as well as a copy of "Student Sheet: A Bright Idea!"
3. Introduce students to their materials.
4. Have students experiment with the battery and lights to make the lights work.
5. Discuss the questions on the student sheet.



To Know and Do More

Ask students about different examples at home or school that are similar to open or closed circuits.

Closed circuit: turn the faucet handle or lever for water to flow; a green traffic light that allows traffic to flow; school crossing guard that allows students to cross the street

Open circuit: a bridge that is out or destroyed over a river so that no one can cross; computer mouse that is not connected to a computer; a red light at an intersection that does not allow traffic to flow

Student Sheet: A Bright Idea

Electric circuits conduct an electric current from the power source through wires to a load (a device that uses electric current). Power sources can be many different things from batteries to generators, solar panels to wind turbines.

Alessandro Volta, an Italian physicist, made the first battery in 1800. Volta placed two different metal electrodes in an electrolyte solution (a chemical mixture which will conduct an electric current). The chemical reaction caused an electromotive force. A common misconception is that batteries store electrical energy. This is not really true. Batteries convert chemical energy to electrical energy. They store chemical energy that can be released during a chemical reaction. By using metals or carbons that have different chemical properties and an acid or base that will allow the movement of electrical charges, an electric current can be produced.

Procedure

Electrons moving in a wire are called an electric current or electricity.

1. Make the bulb light up using one battery and one light. Congratulations, you have made an electrical circuit!
2. What did you have to do to get the light to come on and complete the circuit? How was it touching the battery?
3. What do you have to do to make the light bulb turn off, then back on?
4. What do you think the electrical terms open circuit and closed circuit mean?
5. How do you think a light switch works?
6. What type and form of energy is in the battery?
7. Into what forms of energy did you transform the battery's energy?
8. Using one battery, try to light up two lights.
9. Sketch how the wires are connected to the battery when you light two lights.
10. Are the lights the same brightness as when you did only one or are they dimmer?
11. Compare your methods and results for numbers 8 through 10 with other students. Is there more than one way to light multiple lights using only one battery?
12. A series circuit has only one path that electrons can follow as they are pushed from one side of the battery to the other. A parallel circuit has more than one path and the electrons can go more than one way to get from one end of the battery to the other. Which type of circuit did you make and draw in number nine?
13. Experiment with multiple batteries connected together, placing the positive end of one battery touching the negative end of another battery. What effect does the number of batteries have on the brightness of the bulbs?
14. If you leave the battery connected to a bulb long enough, you will feel the wire and the ends of the battery getting warm. What do you think is causing this?
15. Can that heat be useful? Can it be dangerous? Give an example to prove your point.

