# Lesson 1: Closed Circuits vs. Parallel Circuits

## Objective:

Students will understand the movement of electrons.

Students will act like an electric circuit to understand the transfer of electrons happening within the circuit. Next, they will create an electrical circuit using materials provided by the teacher.

## NGSS:

4PS3. Energy can also be transferred from place to place by electric currents, which can then be used locally to produce motion, sound, heat, or light. The currents may have been produced to begin with by transforming the energy of motion into electrical energy.

## Essential Questions:

1. What is an electrical current?
2. What is the difference between a closed circuit and a parallel circuit?

## Materials:

* Boat rope
* 10-gauge wire
* 2 batteries
* 2 small fan motors or speaker/buzzer that can be attached to the wires
* Small items, such as small balls or erasers, for each student

## Lesson Sequence:

*Closed Circuit*

1. Begin by asking students the essential questions above. Answers will vary depending on the experience they have had with the subject matter.
2. Tell students that we cannot see electricity because the charged particles whose movement creates electricity is too small to see, even with a microscope. However, we can infer their existence in the form of an electrical current that provides energy to our light bulbs, computers, and many other devices we use every day.
3. Show students the setup of a battery with wires attached to it to make a closed circuit.
4. Let them explore the circuit so that they can better understand the next steps. You can use a light bulb for exploration and replace it with a fan or a speaker. Discuss what they hear or feel as the wires are opened and closed in the circuit.

Left: An illustration shows an open circuit in which one end of an electric wire is connected to the positive terminal of the battery, which has a connection to a light bulb. The other end of the electric wire lies disabled near the negative terminal of the battery. 

Right: An illustration shows a closed circuit in which one end of an electric wire is connected to the positive terminal of the battery, which has a connection to a light bulb. The other end of the electric wire is connected to the negative terminal of the battery. 


1. Place a large boat rope in a circle on the floor. Ask students to place themselves around the rope to form a circle. (The size of the rope circle will vary depending on the size of the classroom.) Tell students that they are a battery and they will represent a wire conductor. The circle represents the circuit. Give each member of the circle the same object, such as a small ball or eraser. Tell students that the objects represent electrons inside a wire conductor. A wire conductor is full of electrons.
2. Tell the students that they are all a battery in the circuit. Explain that all batteries have a positive and a negative end. Tell them that you, as the teacher, are the start of those charged ends. On the left is the negative charge. On the right is the positive charge. Tell students to pass their “electron” [the objects you gave them] to the student on their right. Tell them to keep passing on electrons to the person on their right. Remind students that electrons share the same negative charge and repel one another so they move in the same direction. Tell them that the flow of electrons through a conductor is called the electrical current.
3. Now, have one student step away from the circle as all other students remain. Ask students beside the student that left whether they can continue passing their “electrons” as they had in the past. [NO, the gap is too wide.] What happens? The current will stop and is now an open circuit.

*Parallel Circuits*

1. Show students a setup of a parallel circuit.

Left: An illustration shows a parallel circuit in which two light bulbs are connected to a switch and a battery in such a way that the same terminals of two light bulbs are connected together making multiple paths for current flow. 

Right: An illustration shows a series circuit in which two light bulbs are connected to a switch and a battery in such a way that the end of one light bulb is connected to the beginning of the other light bulb making a single path for current flow. 

1. Place a large boat rope in a circle on the ground. Twist the rope to make a smaller circle at the top. The rope should resemble the shapes in the diagram photos above.
2. Like the movement of electrons in the closed circuit described above, move the “electrons” (the item chosen to represent the electron) around the rope.
3. Ask students whether there is anything different in the movement of electrons around the circuit.

*Building a Closed and a Parallel Circuit*

1. Now, it is time to work with students to build the closed and parallel circuit. For this activity you will need a battery, wire, and two fans or small speakers that emit sound. Place all items in front of the students on a tray for better equipment management. On the battery, be sure to make a tactile symbol noting the positive charge. Tell the students the symbol used and ask them where the positive and negative charges are on the battery. Be sure they can identify both charges.
2. Beginning with the closed circuit, remind students about the way the electrons moved. Ask students whether they can build a closed circuit based upon the experience of moving electrons around the circuit and creating a current. Talk to the students about the role of the wires, battery, and fan/speaker. Tell them that the goal is to get the fan/speaker to work. Monitor the work of the students. Give guiding questions only to have them build the simple closed circuit on their own.
3. Once the fans/speakers are working, ask the students whether this is a closed or open circuit. [Closed.] Now, ask students how to make the circuit open [remove one of the wires from the battery or from the fan/ speaker]. Ask students what happened. [The fan/speaker quit working.] Ask students to tell you what happened to the electrons. [They quit flowing through the circuit.] Now, ask students to describe the flow of the electrons in the circuit, referring to the flow that occurred on the boat rope earlier. [Positive to negative.]
4. Now, tell students you are going to challenge them. Now, you will give them an additional fan/speaker and wire on their trays. Tell students the location of placement on the tray. Explain to students that now they are to make a parallel circuit. Remind them to think of the boat rope activity completed prior. Tell students the goal is to get BOTH speakers/fans working. Again, give guiding questions only.
5. As an additional challenge, ask students about the conditions under which only one speaker/fan is working but the other one is not. How can that be possible? Now, ask the students to make the working speaker/fan stop working and the non-working one begin to work. How can they make it possible?
6. Once students have completed the task, ask the students to describe how they were able to make both speakers/fans to work. [Answers vary.] Ask students to describe the flow of electrons. [Again, positive to negative.]
7. Ask students to write down the similarities and differences between a parallel and simple closed circuit as exit tickets to inform any misconceptions or review that must take place the next day.

Source: Adapted from “Electric Circuits” <https://wosu.pbslearningmedia.org/resource/phy03.sci.phys.mfe.lp_electric/electric-circuits>.