

Electro Lab



Learning Objectives

- Electricity is made by creating an electric circuit, or closed path, that electrons can move on.
- Conductivity refers to how easily electric charge can pass through a material.

21st Century Skills

- Critical Thinking and Problem Solving
- Creativity and Innovation

Colorado Academic Standards Addressed

| Grade level | Colorado State Standard(s) addressed | Activity and description |
|-------------|--|---|
| 3 | Physical Science Prepared Graduate Competency: Apply an understanding that energy exists in various forms, and its transformation and conservation occur in processes that are predictable and measurable. | Circuit Activities: Students will observe energy flow through a circuit and deduce that energy cannot flow when a circuit is not complete. Students will measure energy output using a voltmeter. |
| 4 | Physical Science Standard #1: Energy comes in many forms such as light, heat, sound, magnetic, chemical, and electrical. | Plasma Ball: Students will experience how electrical energy can produce light and heat |
| 5 | Physical Science Prepared Graduate Competency: Apply an understanding of atomic and molecular structure to explain the properties of matter, and predict outcomes of chemical and nuclear reactions. Physical Science Prepared Graduate Competency: Apply an understanding that energy exists in various forms, and its transformation and conservation occur in processes that are predictable and measurable. | Circuit Activities: Students will discuss the properties of electrons and their significance in the atomic structure Circuit Activities: Students will observe energy flow through a circuit and deduce that energy cannot flow when a circuit is not complete. Students will measure energy output using a voltmeter. |
| 6 | Physical Science Standard #1: All matter is made of atoms, which are far too small to see directly through a light microscope. | Circuit Activities: Students will discuss the properties of electrons and their significance in the atomic structure |

Important Electricity Facts and Vocabulary

Circuit: A complete, closed path through which electrons, or electric current, flows.

Conductor: Materials through which electric charges flow easily, like copper wire or salt water, and unlike plastic.

Current: The flow or movement of electrons through a wire or any conductor. A current tells you how fast electrons are moving.

Electricity: A flow of electrons, which makes an electrical current.

Electrons: All matter is made up of tiny atoms, which are made of protons, neutrons and electrons. Electrons have a negative charge, and as they move around they can create electricity.

Insulator: Materials that resist the flow of electric charges through them. Air, plastic, glass, and rubber are NOT good conductors.

Voltage: The source of energy that makes electrons move.

Optional (and Highly-Recommended) Pre- and Post-Lab Activities

Bad Hair Day: Different materials have different amounts of attraction for electrons. When two objects rub against each other, it is likely that one will steal electrons from the other. If you rub a balloon against your hair, the balloon will steal electrons from your hair. This leaves your hair positively charged and the balloon negatively charged. Since opposite charges attract, your hair will be pulled toward the surface of the balloon. You will also notice that your hair stands up even if the balloon is not near you. This is because each hair is positively charged and wants to stay away from all the other positively charged hairs. You should also notice that after rubbing the balloon on your hair, you can get the side of your balloon that touched your hair to stick to other things like a wall or ceiling. Because the negative charge on the balloon will force some of the electrons in the wall to move to the other side of their atoms, the negatively charged balloon will be attracted to the positively charged surface of the wall. If the air is very dry, the balloon should stick for many hours, possibly even days! Remember that the moisture in the air can steal charges from the balloon, so on humid days this may not work as well, or at all.

Electro Lab



Electricity on the Web: There are some great resources online where kids can try different electricity games and activities. Some to check out are <http://resources.woodlands-junior.kent.sch.uk/revision/science/electricity.htm> or <http://www.sciencekids.co.nz/electricity.html>

The Human Circuit: This demonstration involves the entire class. Students stand in a circle to show how a circuit works to form a "human circuit."

1. At one side of the circle, identify one student as the battery by giving him/her a piece of paper with the word "battery" on it.
2. At the other side of the circle, identify another student as the "switch." Give this person two papers (switch on and switch off). Have this person begin by holding up the "switch on" paper.
3. At another side of the circle, identify a student as the "light bulb."
4. The rest of the students in the circle are conductors (wire). They each have a piece of paper with a big **e-** marked on it, representing an electron.
5. Students start passing the **e-** pieces of paper around the circle to the student next to him/her as if they were playing hot potato. All the students, even the students being the "battery" and the "light bulb," help to move the electrons. Once the exercise is in process, point out how the current of electrons flows around and around the circuit as long as the switch is on (and there is a closed circuit).
6. Next, have the student who is the switch occasionally switch their paper to the "switch off" or open circuit. This action makes a circuit break and the electron papers must freeze, or stop moving around the circle.
7. When the switch goes off, the flow of electrons stops, so the current stops, and the electricity stops. When this happens, the "light bulb" person stops glowing by lowering to the floor.
8. When the student "switch" changes his/her paper to "switch on," the flow begins again and the electrons start moving like hot potato around the circle. Because it is turned "on," the student "light bulb" can jump up from the floor and "glow" again.
9. Keep playing the game for a few minutes or until all the students understand how the current (or flow of electrons) moves through a closed circuit (closed circle when the switch is on). Once they understand, students should know to stop the flow of electrons when the switch is turned off, or the circuit is open. Here are some questions you could ask while the electrons are flowing:

Electro Lab



Which part of our circuit was _____?

- The voltage? (Answer: Battery, because it stored the amount of electrical energy that was able to flow.)
- The current? (Answer: The electron papers formed the current moving through the circuit.)
- The electrons? (Answer: The e- papers were electrons because they were flowing along the circuit to carry a charge and create electricity.)
- The conductor? (Answer: The electron-passers were conductors.)
- The insulator? (Answer: No one was an insulator if the electrons continued to flow through the circuit. You could be an insulator if the electron-passers turned into an insulator, like a plastic ring instead of a wire ring, which means that you wouldn't be able to move the electrons along as quickly, or even at all.)
- Open circuit? (Answer: The circuit was open when the switch was "off," the circle was broken, and the electrons stopped flowing.)
- Closed circuit? (Answer: The circuit was closed when the switch was "on," the circle was complete, and the electrons were flowing around the circuit.)

10. Actively engage all students by re-assigning the roles of the switch, battery, and light bulb several times during the activity. See if the students have ideas of other items that could use the flow of energy just like the light bulb.

Dancing Rice Krispies: Some materials pick up electrons really well, like a balloon or a piece of plexiglass. Other materials are really good at giving electrons away, like the wool that charges the balloon or plexiglass. This is static electricity. When we rub a balloon or a sheet of plexiglass with a piece of wool, electrons jump from the wool to the balloon or plexiglass to give that surface a negative charge. Rice Krispies on the table are positively charged, and when they get close enough to a negative charge, they will be attracted to that opposite charge. As a result, the Rice Krispies defy gravity and jump up to the negative charge.

Place a sheet of Plexiglas on two blocks so that it rests several inches above the surface of a table. Scatter some Rice Krispies on the table below the Plexiglas. Rub a piece of wool or fleece across the top side of the Plexiglas and observe the behavior of the Rice Krispies below it. The Rice Krispies should jump from the table and stick to the bottom of the Plexiglas. Others might just stand up at attention on one end. Eventually, you should observe some of the Rice Krispies drop back down to the table.

If you don't have any plexiglass, a balloon will have a similar effect. Spread some Rice Krispies on the tabletop. Blow up the balloon and tie it off, and then charge the balloon with static electricity by rubbing the wool or someone's hair against it. Place the balloon about 1 inch over the top of the Rice Krispies, and watch as the static electricity in the balloon attracts the Rice Krispies.