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DISCOVERY MUSEUM

Static Electricity

Teacher Resource Guide

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Static Electricity

There are two different kinds of electricity, **current** and **static**. Current electricity is the familiar kind of electricity that turns on our appliances. Any kind of appliance that has a cord that has to be plugged into the wall or needs batteries uses current electricity. The electricity flows through the metal wires in the cords like water through a channel. Static electricity occurs when objects are rubbed together and results in the objects becoming charged with static electricity. This form of electricity can fly through the air (like lightning) as opposed to simply flowing through wires.

All objects are made up of atoms, and all atoms are made of smaller particles called electrons and protons. Protons form the center of every atom, around which electrons circle, like planets around the sun, held together by the force of the opposing charges in each. Protons have a positive charge and electrons have a negative charge. The opposite charges of protons and electrons attract, like opposite poles of a magnet. Two protons, however, or two electrons, will repel one another, because they have similar charges, just as two magnets will push apart if they are placed with the same poles together.

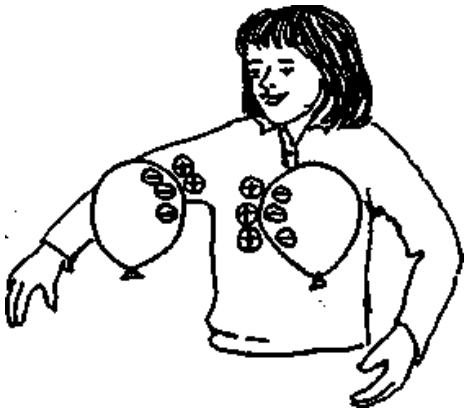
Usually, objects are made of an equal number of protons and electrons. However, sometimes when an object rubs against another object, electrons can be rubbed onto or off of the object, leaving an imbalance of protons and electrons. This imbalance gives the object a charge. Oppositely charged objects attract one another, while similarly charged objects repel.

Sometimes when oppositely charged objects come close to one another, electrons can fly through the air from the negatively charged object to the positively charged one. A large example of this is a lightning bolt, which occurs when clouds rub electrons off onto other clouds. The electron heavy clouds then discharge their excess electrons to the earth or to another cloud in the form of a lightning bolt. A smaller example of the same event can occur when you shuffle across a carpet with socks on, then put your finger close to a metal object. The spark that you see is made of discharged electrons, just like a miniature lightning bolt.

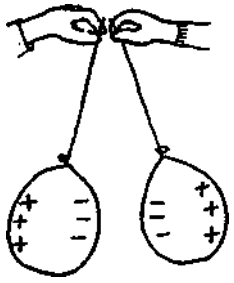
Other familiar situations that cause static electricity are: clothes rubbing together in the dryer, sliding down a playground slide, combing your hair, petting a cat, and rubbing your hair against your pillow while you sleep.

Balloon Experiments

Take a balloon and rub it on your hair or a wool sweater. Put the balloon against a wall and it will stick. This is because you rubbed some electrons onto the balloon from your hair or from the sweater. This charges the balloon. The wall has not been charged, so some of the extra electrons on the balloon are attracted to the protons on the wall. Eventually, the extra electrons drain away into the wall and the balloon will fall. Try to find other objects that balloons will stick to, and other materials besides wool and hair that you can rub balloons against to make them stick.



Take two balloons with about two feet of string tied to each. Rub them both on your hair or a wool sweater. Have two people each hold a balloon by the end of the string as far away from their body as possible (or the balloon will stick to them). Have the two people approach one another to try to get the balloons to touch. The balloons should repel because both have an excess of electrons (negative charge) from the wool or hair.

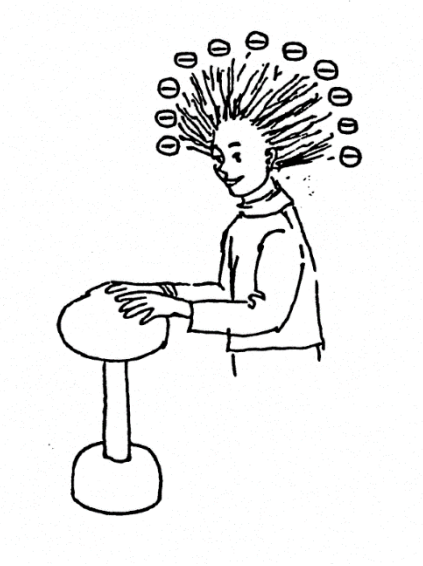


The Van de Graaff Generator

The Van de Graaff generator consists of a ball-shaped piece of metal on a stem. Inside the stem is a motor that spins a rubber belt which rubs on some wires. The rubbing builds up static charge on the wires which will transfer the charge to the metal ball. The charge is stored in the ball and can build up to fairly high levels. When an object gets near the charged ball, the built up static charge jumps from the ball to the object like a miniature lightning bolt. Although this may feel "shocking", it is not dangerous. If you hold your hand on the generator and then turn it on, the static charge goes into your body without causing a shock because the charge does not have to jumps through the air.

Some objects transfer charge more easily than others. These objects are called conductors. Metal is a good conductor. Water is a good conductor. So are you, because you are full of water. Objects that are poor conductors are called insulators. If you are touching the generator, charge flows through your body and into the ground where the excess charge is dissipated.

If, however, you are insulated from the ground (by standing on a plastic stool), the charge builds up on the outside of your body. Negative charge builds up on your skin and hair. As your individual hairs become charged, they repel one another because they are each negatively charged. The way that each hair can repel other hairs evenly is to stand straight up so that each hair is as far from every other hair as possible. This works best for people with fine, straight hair with no gel or hairspray. When the generator is turned off, you are still charged, so your hair remains standing up for a short while. Only when you step off the stool to the ground does the excess charge in your body flow into the ground, making your hair go back to normal.



Static Experiments with Electrical “Fleas”

Cut a large square out of the back of a cereal box. Either cover the hole with a piece of plexiglass or stretch plastic wrap over the cereal box and secure it with a rubber band. Cut some styrofoam packing peanuts into small pieces or cut up small pieces of paper and put them into the box. Rub the plastic vigorously with a piece of wool to watch the "fleas" dance.

Both the plastic and the "fleas” start out electrically neutral. They have the same amount of negative as positive charge. When you rub the plastic, the wool transfers some negative charge into the plastic. This negative charge causes the tops of the fleas to become more positive, and the bottoms of the fleas to become more negative. The attraction between the negative plastic and the positive tops of the fleas cause the fleas to jump to the plastic. Once a flea touches the plastic, some of the plastic’s negative charge flows into the flea, making the top of the flea electrically neutral. But since the bottom of the flea is still negative, the flea now has an excess of negative charge and is repelled from the plastic. Once the flea touches the ground again, its excess negative charge drains into the box, and it starts to build up charge and jumps again.

Try this experiment with small pieces of different materials, such as puffed rice cereal, small balls of tin foil, and small pieces of string.

Resources

Lower Elementary (K-3) Print Resources

- *The Magic School Bus and the Electric Field Trip*, Joanna Cole with Bruce Degen, illustrator, Scholastic Press, New York, 1999
- *Where Does Electricity Come From?* (The Clever Calvin Series), C. Vance Cast, Barron's Educational Series, New York, 1992 (illustrated text explaining electricity for early elementary age students)
- *Oscar and the Bird, a Book About Electricity*, Geoff Waring, Candlewick Press, 2011
- *Explore Electricity! With 25 Great Projects*, Carmella Van Vleet, Nomad Press, 2013

Upper Elementary (4-6) Print Resources

- *Experiments with Electricity* (True Books: Science Experiments series), Salvatore Tocci, Children's Press, Connecticut, 2002
- *Eyewitness Books: Electricity*, Steve Parker, DK Publishing, New York, 2005
- *Your Guide to Electricity and Magnetism,* Gill Arbuthnott, Crabtree Publishing, 2017

Online Resources

- Static explained at several levels for elementary students
  - http://www.sciencemadesimple.com/static.html
- All about static electricity from DK FindOut!
  - https://www.dkfindout.com/us/science/electricity/static-electricity/
- Science Snacks, small experiments about static via the Exploratorium
  - Holding Charge: https://www.exploratorium.edu/snacks/holding-charge
  - Electrical Fleas: https://www.exploratorium.edu/snacks/electrical-fleas
- Static Electricity: Snap, Crackle, Jump, video via Zoom! on PBS
  - https://mass.pbslearningmedia.org/resource/phy03.sci.phys.mfe.zsnap/static-electricity-snap-crackle-jump/
- A historical perspective on static, complete with pictures and objects from the archives, via the Library of Congress
  - https://www.loc.gov/everyday-mysteries/item/how-does-static-electricity-work/