Static Electricity in the Atmosphere is a collection of a few educational resources that students and the general public have enjoyed while visiting the National Center for Atmospheric Research (NCAR), our Outreach Booth at festivals and conferences, and/or online through our educational Web sites.

These resources are just a few from our resources that introduce the concept of static electricity in our atmosphere, which manifests itself most often as lightning. It is far from a comprehensive review of the topic, but rather offers a few engaging activities to serve as an enhancement to the study of weather and/or the atmosphere.

We welcome your comments, corrections, and input.

A young static electricity enthusiasts learns about lightning at the UCAR Center for Science Education’s booth at the AMS Weatherfest public outreach event.
Static Electricity

Engaging Hands-on Activities for Students

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scied.ucar.edu

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Static Electricity Tubes

Students learn properties of electricity by creating static electric tubes. Note: Dry weather conditions are best for the activity’s success.

Related Web Pages for Students
- scied.ucar.edu/activities
- scied.ucar.edu/webweather/thunderstorms/how-lightning-forms
- www.ucar.edu/learn

Directions
1. As a group, break styrofoam packaging material into small crumbs or purchase istyrofoam in small pellet form to avoid this step. (Static electricity will be plentiful!)
2. Duct tape one end of the 15” plastic tube shut.
3. Place two cups of styrofoam crumbs/pellets into each clear tube.
4. Duct tape the remaining end of the tub shut, and secure.
5. Once styrofoam is securely in the tube with taped ends, rub the tube vigorously using the wool cloth for approximately one minute.
6. Next rub your hand along the tube and notice what happens.

Ask students these questions:
1. What happens when you rub the styrofoam-filled tube with the wool? Why? What other substances might work to create static electricity? Try various fabrics and substances to find out.
2. Why does the styrofoam move away from one’s hand near the tube? Is there a way to prevent the styrofoam from moving?
3. How is the static electricity produced different from an electric current? (Electric current can be generated at a power station and delivered via a wire as a power source to homes and other locations.)

Background Information
To understand static electricity, you have to think about atoms. Atoms make up everything we can see and everything with mass. Atoms have a nucleus consisting of neutrons and protons and a surrounding “shell” that is made up of electrons. Electrons are somewhat free to jump from one object to the next. Normally, the number of electrons and protons are the same in an atom. But when an atom has an excess of electrons, it is negatively charged, and when it has an excess of protons (from losing its electrons), it is positively charged. Some materials are more apt to give up electrons when near another object (i.e. wool, fur), and some objects are apt to pick up extra electrons that they are in contact with (styrofoam, teflon). When a student rubs the plastic tube with the wool, he or she is generating static electricity. Watch the styrofoam attract and repel different substances such as the plastic of the tube and one’s hand.

Extension: Rub the tube with different items other than wool: paper, fur, foil.... Is static electricity still generated? Why or why not?
Electrifying Demonstrations

Static electricity can be illustrated by showing students the plasma ball. Plasma is stripped electrons, and atoms without electrons or with a build-up of electrons is what causes static electricity. In many plasma balls, the plasma gives off a light different than most static electricity we are used to seeing. The light looks like lightning. Demonstrate the different ways you can control some of the electrons by putting your hand to the ball. The charged plasma will move toward your hand and the current will travel to you to the ground. If you put a florescent light up to the plasma in a darkened room, it will light. If you hold the plasma tube, and someone tickles the back of your hand, you’ll get a small shock! Then again, if you are holding on to the static tube, you can also be the shocker. Tickle the back of a friend’s hand with your free hand, and you’ll shock him or her!

A Van de Graaff generator is a tool used to generate static electricity. When the Van de Graaff generator is turned on, the lower roller (charger) begins turning a thick rubber belt. Since the belt is made of rubber and the lower roller is covered in silicon tape, the lower roller begins to build a negative charge and the belt builds a positive charge. Silicon is more negative than rubber; therefore, the lower roller is capturing electrons from the belt. The strong negative charge on the roller next repels electrons near the tips of the brush at the top of the unit. The brush underneath the metal head next rubs the belt and begins to stripe nearby air molecules of its electrons. As long as there is air between the lower roller and brush assembly, the Van de Graaff generator will continue to charge the belt.

Stack foil muffin tins on the Van de Graaff generator’s metal “head” and they will go flying one by one. Put a wig on the head and it will definitely look like a bad hair day. Blow bubbles toward the generator to see if they repel or attract. Why do you think this happens?

And remember -- Always read up on safety before using a Van de Graaff generator in any capacity!
In this activity students figure out how far they are from a storm by watching lightning and listening for thunder. You’ll need a stormy day, a video of a thunderstorm, or a simulated storm.

**Related Web Pages for Students**
Web Weather For Kids: scied.ucar.edu/webweather
scied.ucar.edu/webweather/thunderstorms

**Directions**
1. Divide students into small groups. Have each read the student version of this activity (URL listed above) for instructions.
2. Discuss the reading as a class including how light and sound travel at different speeds. Review the activity in detail.
3. Assign each group stopwatches, paper and pencil and a safe space near a window from which to witness lightning if a thunderstorm happens to be occurring. If not, which is likely, make an imaginary storm with a flashlight or switch-controlled light to represent lightning and clashing symbols to represent thunder.
4. Instruct students to time the number of seconds between the flash of lighting and the rumble of thunder, and to write down the number. Ask them to also write down the actual time. If the weather allows, have groups take several measurements over 15 minutes or more, noting the time of each measurement. (This will allow students to assess whether the storm is moving towards their location or away.) Simulate the movement of the storm by consistently increasing or consistently decreasing the time between lightning and thunder over a given time period of various lightning strikes.
5. Have student groups calculate the distance of the storm from the measurements using these instructions: Every 5 seconds counted equates to a distance of one mile. Divide the number of seconds you count by 5 to get the number of miles. If student groups made several measurements, have them perform the calculation for each measurement to try to answer the following: Was the storm moving towards school, away from school, or not moving either direction?

**Assessment:** Have student groups create a poster from a sheet of craft paper that displays their data both in a table and visually (with a graph or map) to present their analysis to the class. Hang posters around the room and discuss all results.

**Background Information**
A bolt of lightning heats the air along its path causing it to expand rapidly. Thunder is the sound caused by the rapidly expanding atmosphere. The light and sound actually happen at the same time, but the light of the lightning flash travels faster than the grumbling sound of the thunder. The time between the flash of light and thunder will tell you how far you are from where the lightning struck.

**Extensions**
Make Your Own Lightning!

In this activity, students observe lightning formation.

Related Kids’ Crossing Web Pages for Students
What Gives Lightning its Zap?  
scied.ucar.edu/webweather/thunderstorms/how-lightning-forms  
Web Weather For Kids:  
scied.ucar.edu/webweather

Directions
1. Divide students into groups of four. Have groups read the article What Gives Lightning its Zap? and the Student Version (URLs listed above).
2. Discuss the reading and directions as a class. Make sure students understand the concept of negative and positive charges.
3. Distribute supplies and directions to each group. If possible, show students a completed version so they know what it should look like.
4. Instruct students to push the thumbtack through the center of the pie pan from the bottom and then push the eraser end of the pencil into the thumbtack. Students should only hold the pie plate by the pencil.
5. Following the directions in the students handout, complete the set-up by putting the Styrofoam plate upside-down on a table, rubbing the bottom of the plate vigorously with the wool for one minute, picking up the pie pan with its pencil handle and placing it on top of the styrofoam plate.
6. Instruct a student from each group to touch the edge of the pie plate with a finger. Ask if they felt a shock. Have groups repeat the process of rubbing the plate with the cloth and allow another member of the group to touch the pie plate. Students may be able to actually see the sparks if the classroom lights are turned off. (This experiment works best in low humidity.)
7. For extra excitement, get a Neon Gas Spectrum Tube (about $20 from Edmund Scientific, among other places). Tell students that on the count of three you will turn off the room lights. That is when students should touch the end of the tube to the pie plate. When the tube touches the plate, they will see a spark - lightning!

Background Information
When negative charges (electrons) in the bottom of a cloud are attracted to positive charges (protons) in the ground, and the protons rush up to meet the electrons, we see lightning. In this experiment, the finger is the cloud and the pie pan is the ground. Rubbing the Styrofoam plate with the wool cloth generates the positive charge as electrons are rubbed off of the plate. Students will likely be able to provide other examples of static electricity and attraction from daily life (e.g., shuffling across carpet, clothing stuck together, rubbing balloons against clothing).

Extensions