Ecstatic for Static

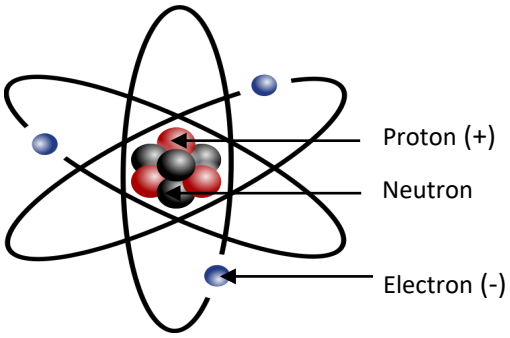
Grades 3 - 6

Test the ability of different materials to generate static charge using your own homemade electroscope.

Background Information

This activity focuses on electrostatics, the study of electric charges or electrical fields at rest. We'll test the ability of different materials to generate static charges using an electroscope.

Charges come from atoms, the tiny building blocks of all the matter around us (solids, liquid, and gases). Atoms have positively (+) charged particles called protons, negatively (-) charged particles called electrons, and particles with no charge, called neutrons.



Electrons are the smallest of these particles, spinning around the outer part of the atom. Protons and neutrons are packed tightly in the centre of the atom, or nucleus, and are difficult to break apart. However, atoms can easily lose or gain the smaller, negatively charged electrons from other nearby atoms.

When two charged particles are brought together they will attract or repel each other, depending on whether their charges are positive or negative.

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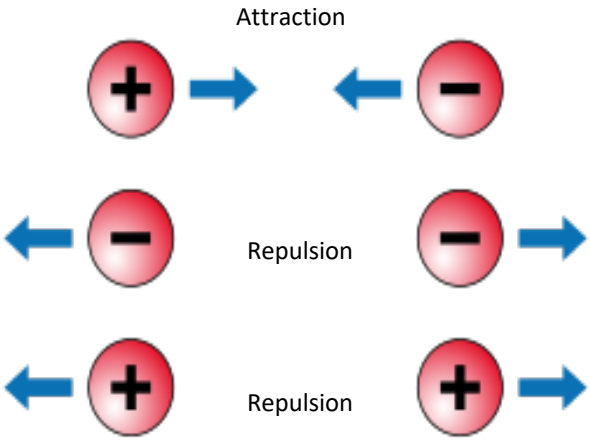
Background Information Cont.

Attraction is an invisible force that pulls opposite charges together. For example, a positive and a negative charge will attract each other, being pulled together.

Repulsion, is an invisible force that pushes like charges away from each other. For example, two positive charges will repel, pushing each other away. The same will happen for two negative charges.



Static electricity is the build up of electric charges on the surface of an object. Static electricity is not constantly moving in the same direction, like we see with current electricity moving through wires. But that doesn't mean the charges don't move at all. With static, they remain on the surface until that surface touches or approaches another object.

Charges are transferred when different materials touch each other, for example, when materials are rubbed or pressed together or when materials are pulled apart. Some materials tend to give up their negative electrons to other materials and become positive, while others are better at attracting electrons, becoming negative. The amount of charge transferred depends on a material's ability to give up or accept charges. Not all materials build up static charge as well as others, but we can increase the charge transfer with friction (by rubbing the materials together).

A classic example is dragging your sock feet across carpet. The friction from dragging your feet helps transfer the charges faster between your socks and the carpet than if the two materials were only touching, and you can give someone a noticeable zap!

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Background Information Cont.

This zap may be slightly uncomfortable but it's safe. Even though there may be a big difference in charge (or high voltage) between objects like your body and the person or thing you zap, only a few electrons are actually being transferred. When we talk about safety with electricity, we are most concerned about limiting the number of electrons flowing or being transferred known as *current.* Most day to day static shocks are safe for humans, except for the largest static charge, lightning!

Let's use the science of electrostatics to make an electroscope. Electroscopes are instruments that detect electrostatic activity or static charge. We'll create an experiment using this device, to determine *which of our chosen materials are the best at building up static charge?*

Materials

For the electroscope:

- Aluminum soda or juice can with pull tab still attached
- Paper or Styrofoam cup
- Aluminum foil
- Electrical tape (or masking tape if not available)
- Scissors

For the experiment:

- Materials you would like to try out like your hair, a balloon, clothing, hard plastic, metal surface
- Completed electroscope
- Table for recording observations and results (page 7)

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Instructions

1. Keep your testable question in mind: Which available materials build up the most static electricity?
2. Make a prediction about which materials or combinations of materials will build up the most charge (e.g. my fluffy slippers will build up the most charge)
3. Decide which part(s) (variables) of your experiments you will keep the same for each trial and which part(s) of the experiment will you change each time. Try to only change one variable at a time so you can make accurate observations about your data.
4. Start by developing your electroscope – you will need this to get information about how much charge you are making!
5. Turn the paper or Styrofoam cup upside down and tape your soda/juice can to the bottom of the cup
6. Cut two strips of aluminum foil about 4 cm by 0.5 cm
7. Shape the end of each foil strip into a thin hook
8. Hang the strips by their hooks on the can's tab - your electroscope is complete!
9. Gather several materials you want to try out with the electroscope – choose items that are non-breakable.
10. Decide how you will build up a charge in these materials and how you will gather results using the electroscope
11. Bring each charged object close to the aluminum foil strips on the electroscope and observe what happens
12. Record the results you want to capture in the table on page 7

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Things to Consider

- What happens inside the electroscope when charged materials are brought near it?
- Which material(s) built up the most charge? Do they have anything in common? Why would those materials be better at holding a charge? Can you tell if the charge is negative or positive?
- Explain your results to someone else or share it with your teacher or Discovery Centre.
- If you did this experiment again with different materials can you predict what would happen?
- Besides the material chosen, what else can affect static electricity/what you observed? Consider why the experiments might not have worked out as well as you would've liked.
- How would you change your experiment if you had to do it again? What materials or tools would you have liked to use that you may not have had available?
- Think about the variables that you were not able to control; how did they affect your experiment?
- Do you think that this is the same type of electricity that powers your lights or computers? Why or why not?

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Questions for Reflection & Activity Extensions

Experiment virtually with static

- https://phet.colorado.edu/en/simulation/balloons-and-static-electricity

Experiment virtually with current electricity

- https://phet.colorado.edu/sims/html/circuit-construction-kit-dc-virtual-lab/latest/circuit-construction-kit-dc-virtual-lab_en.html

Bending Water Trick:

- Using a plastic comb, rub it quickly against a soft or fuzzy surface for a few seconds
- Turn on the tap/faucet
- Bring the teeth of the comb near the water – what happens and why?

Static with Balloons:

- Blow up a balloon and securely tie it
- Rub it against your hair to see what happens? Can you get the balloon to attract or repel other materials? Can it defy gravity and stick to the wall?

Sparks in the Dark:

- Put on a pair of soft or fuzzy pajamas and socks and turn out the lights
- Climb in bed and get under the blankets or sheets
- Quickly rub your feet or knees against your blankets or bedsheets and see if you notice any sparks. These sparks are safe. Why do you think you can see them?

Variable Material *What you'll change each time	Controlled Variables * The things you'll keep the same each time	Observations *What did you notice?
Example: your hair, a balloon, or clothing	Example: the item you rub your material against, the number of times you rub the material, etc.	
Which material built up the most charge? _____		