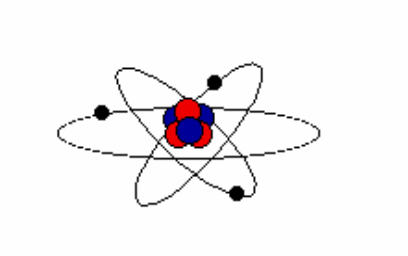
Experiment 5-Electric Charges Lab

So what are atoms made of? In the middle of each atom is a "nucleus." The nucleus contains two kinds of tiny particles, called protons and neutrons. Orbiting around the nucleus are even smaller particles called electrons. The 115 kinds of atoms are different from each other because they have different numbers of protons, neutrons and electrons.



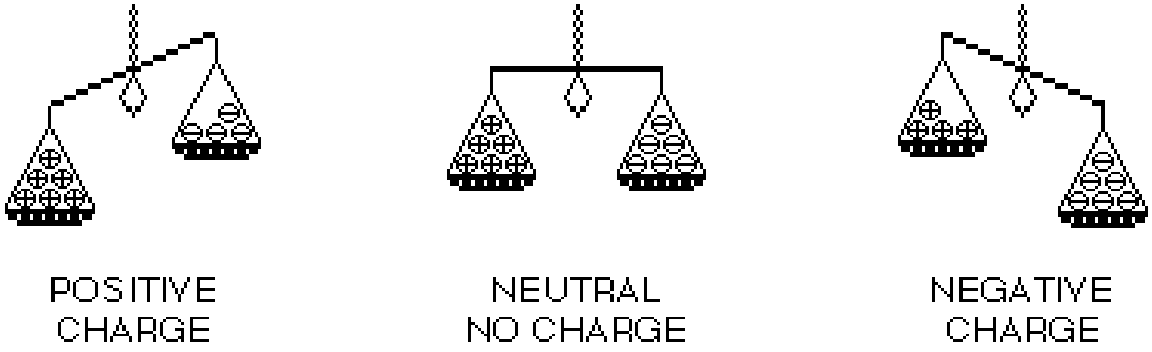
Protons, neutrons and electrons are very different from each other. They have their own properties, or characteristics. One of these properties is called an electrical charge. Protons have what we call a "positive" (+) charge. Electrons have a "negative" (-) charge. Neutrons have no charge, they are neutral. The charge of one proton is equal in strength to the charge of one electron. When the number of protons in an atom equals the number of electrons, the atom itself has no overall charge, it is neutral.

The protons and neutrons in the nucleus are held together very tightly. Normally the nucleus does not change. But some of the outer electrons are held very loosely. They can move from one atom to another. An atom that looses electrons has more positive charges (protons) than negative charges (electrons). It is positively charged. An atom that gains electrons has more negative than positive particles. It has a negative charge. A charged atom is called an "ion."

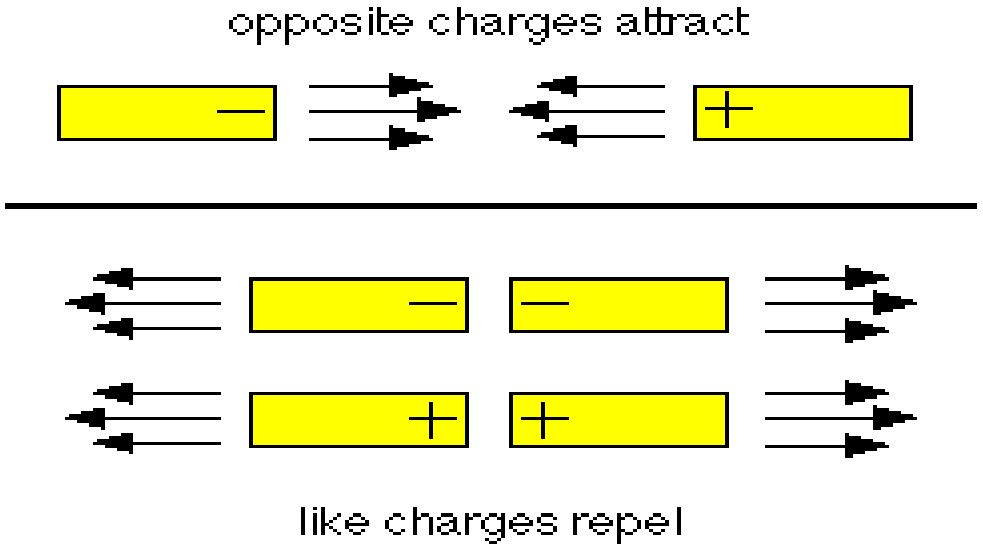
Some materials hold their electrons very tightly. Electrons do not move through them very well. These things are called insulators. Plastic, cloth, glass and dry air are good insulators. Other materials have some loosely held electrons, which move through them very easily. These are called conductors. Most metals are good conductors.

How can we move electrons from one place to another? One very common way is to rub two objects together. If they are made of different materials, and are both insulators, electrons may be transferred (or moved) from one to the other. The more rubbing, the more electrons move, and the larger the charges built up. (Scientists believe that it is not the rubbing or friction that causes electrons to move. It is simply the contact between two different materials. Rubbing just increases the contact area between them.)

Static electricity is the imbalance of positive and negative charges.



Now, positive and negative charges behave in interesting ways. Did you ever hear the saying that opposites attract? Well, it's true. Two things with opposite, or different charges (a positive and a negative) will attract, or pull towards each other. Things with the same charge (two positives or two negatives) will repel, or push away from each other.



A charged object will also attract something that is neutral. Think about how you can make a balloon stick to the wall. If you charge a balloon by rubbing it on your hair, it picks up extra electrons and has a negative charge. Holding it near a neutral object will make the charges in that object move. If it is a conductor, many electrons move easily to the other side, as far from the balloon as possible. If it is an insulator, the electrons in the atoms and molecules can only move very slightly to one side, away from the balloon. In either case, there are more positive charges closer to the negative balloon. Opposites

attract. The balloon sticks. (At least until the electrons on the balloon slowly leak off.) It works the same way for neutral and positively charged objects.

So what does all this have to do with shocks? Or hair full of static? When you take off your wool hat, it rubs against your hair. Electrons move from your hair to the hat. Now each of the hairs has the same positive charge. Remember, things with the same charge repel each other. So the hairs try to get as far from each other as possible. The farthest they can get is by standing up and away from the others. Bad hair day!

As you walk across a carpet, electrons move from the rug to you. Now you have extra electrons. Touch a door knob and ZAP! The door knob is a conductor. The electrons move from you to the knob. You get a shock.

Usually we only notice static electricity in the winter when the air is very dry. During the summer, the air is more humid. The water in the air helps electrons move off you more quickly, so you can not build up as big a charge.

When we rub two different materials together, which becomes positively charged and which becomes negative? Scientists have ranked materials in order of their ability to hold or give up electrons. This ranking is called the triboelectric series. A list of some common materials is shown here. Under ideal conditions, if two materials are rubbed together, the one higher on the list should give up electrons and become positively charged. You can experiment with things on this list for yourself

TRIBOELECTRIC SERIES

your hand
glass
your hair
nylon
wool
fur
silk
paper
cotton
hard rubber
polyester

Part A - Swinging Cereal

Hypothesis: What can we learn about charges from the static electricity applied to objects like cereal?

Experiment:

Materials: hard rubber or plastic comb, or a balloon, thread, small pieces of dry cereal (O-shapes, or puffed rice of wheat)

Procedure:

1. Tie a piece of the cereal to one end of a 12 inch piece of thread. Find a place to attach the other end so that the cereal does not hang close to anything else. (You can tape the thread to the edge of a table but check with your parents first.)
2. Wash the comb to remove any oils and dry it well.
3. Charge the comb by running it through long, dry hair several times, or vigorously rub the comb on a wool sweater.
4. Slowly bring the comb near the cereal. It will swing to touch the comb. Hold it still until the cereal jumps away by itself.
5. Now try to touch the comb to the cereal again. It will move away as the comb approaches.
6. This project can also be done by substituting a balloon for the comb.

What Happened: Combing your hair moved electrons from your hair to the comb. The comb had a negative charge. The neutral cereal was attracted to it. When they touched, electrons slowly moved from the comb to the cereal. Now both objects had the same negative charge, and the cereal was repelled.

Part B - Bending water

Water is what we call a polar molecule. Even though it will not conduct electricity well in its pure form it's atoms are arranged so that it acts like a tiny weak magnet. This charged nature of water can be demonstrated and observed in this exercise.

Hypothesis: Does water have a charge?

Materials: a hard rubber or plastic comb, or a balloon, a sink and water faucet

Procedure:

1. Turn on the faucet so that the water runs out in a small, steady stream, about 1/8 inch thick.
2. Charge the comb by running it through long, dry hair several times or rub it vigorously on a sweater.
3. Slowly bring the comb near the water and watch the water "bend."
4. This project can also be done with a balloon.

Part C - Light a light bulb with a balloon

Fluorescent lights are filled with a gas that easily allows electrons to move around. When electricity is applied the electrons absorb the energy and then, a very short time later, give off the energy they absorbed in the form of light. Fluorescent lights use a lot less energy for the same amount of brightness compared to incandescent or regular light bulbs. Instead of using electricity from the electrical outlet we are going to use static electricity.

Hypothesis: Can Static electricity be used to light a fluorescent light bulb?

Materials: hard rubber comb or balloon, a dark room, fluorescent light bulb (not an incandescent bulb)

SAFETY NOTE: DO NOT USE ELECTRICITY FROM A WALL OUTLET FOR THIS EXPERIMENT. Handle the glass light bulb with care to avoid breakage. The bulb can be wrapped in sticky, transparent tape to reduce the chance of injury if it does break.

Procedure:

1. Take the light bulb and comb into the dark room.
2. Charge the comb on your hair or sweater. Make sure to build up a lot of charge for this experiment.
3. Touch the charged part of the comb to the light bulb and watch very carefully. You should be able to see small sparks. Experiment with touching different parts of the bulb.

Part D - Static in the Summer

Since water is polar and has an attraction for electrons, as seen in Part b, moisture inhibits the exchange of electrons between solids. A moist room will allow less static electricity to form than in a drier room. This experiment is best done at home.

Hypothesis: Can you generate more or less static electricity in a humid environment?

Materials: a balloon, and a watch or clock

Procedure:

1. Rub the balloon on your hair or sweater. Stick it to a wall and time how long it stays before falling down.
2. Repeat step (1) in the bathroom, just after someone has taken a hot, steamy shower.

What happened: In the bathroom, water in the air and on the walls helped move electrons away from the balloon more quickly. In the summer, the air is more humid, and static electricity does not build up as much as during the winter, when the air is very dry.

Experiment 5-Electric Charges Lab Data Page

Name: _____ Section: _____

Part A-Swinging Cereal

Describe in detail what you did and what you observed.

Conclusions:

Part B - Bending water

Describe what you did and what you observed.

Conclusions:

Part C-Light Bulb with Balloon

Describe what you did and what you observed.

Conclusions:

Part D - Static in the Summer

Describe what you did and what you observed.

Conclusions: