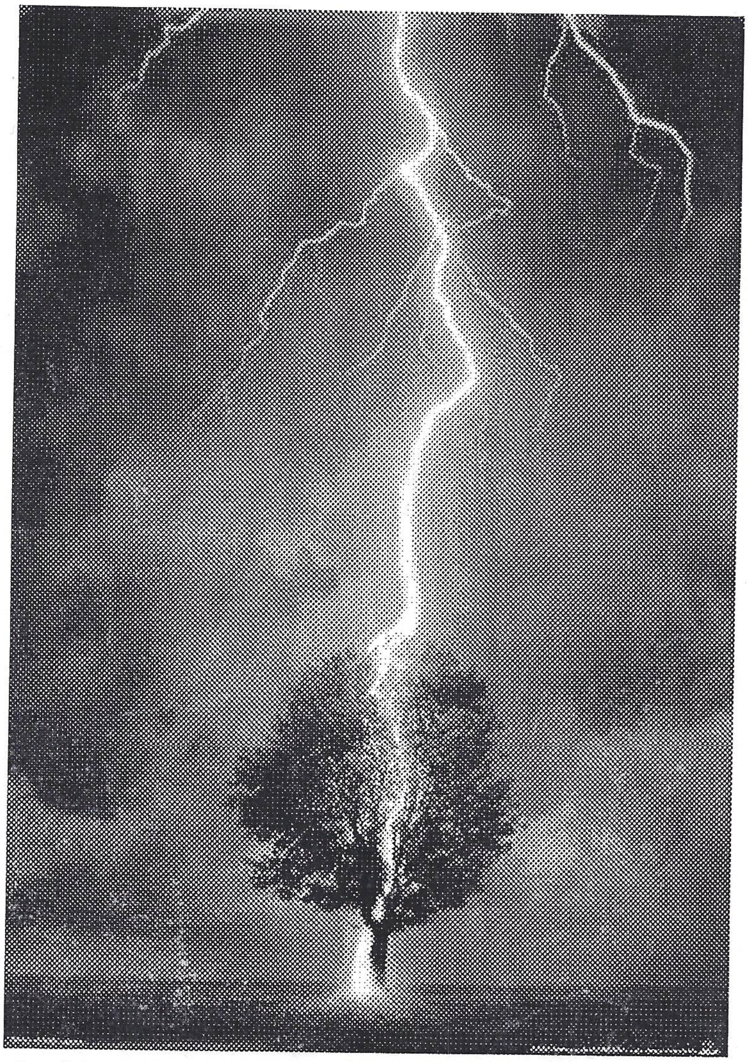
Zap!



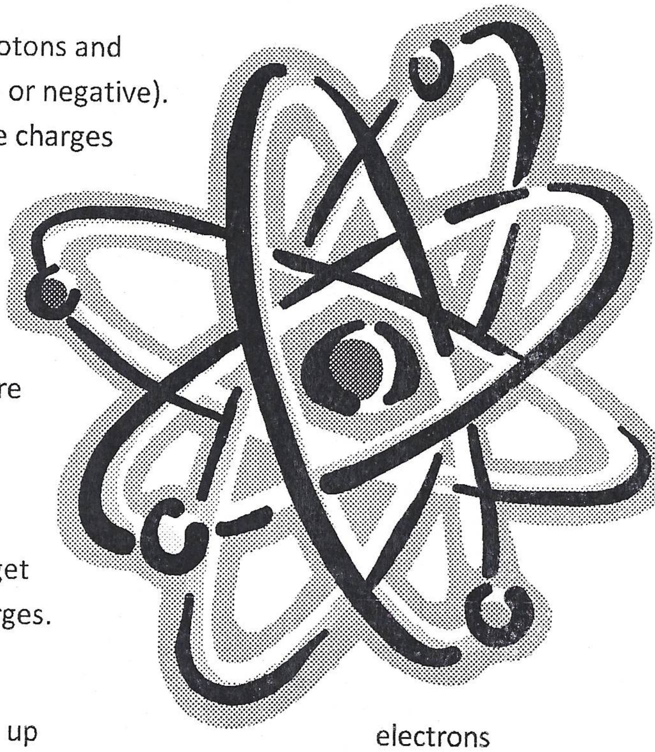
Have you ever been "shocked" when you touched a doorknob, a car-door handle, or a water fountain? Ouch! Well, then you already know something about the effects of **static electricity**.

A Shocking Atom

What you might *not* know is how static electricity happens. It all starts with a tiny thing called an **atom** (say: **ah**-tum). Everything in the world is made up of atoms - from your pencil to your nose. An atom is so small you can't see it with your eyes - you'd need a special microscope. Imagine a pure gold ring. Divide it in half and give one of the halves away. Keep dividing and dividing and dividing. Soon you will have a piece so small you will not be able to see it without a microscope. It may be extremely small, but it is still a piece of gold. Now, ff you could keep going, dividing it into smaller and smaller pieces, you would finally get to the smallest piece of gold possible. The smallest possible piece you can get down to of something is called an atom. Think of atoms as the building blocks of all the stuff in the world.

Now take that tiny atom of gold, if you divided it into smaller pieces, it would no longer be gold. It would be broke down into its parts because each tiny atom is made up of even tinier things, the building blocks of atoms:

1. **protons** (say: **pro**-tahnz), which have a positive charge
2. **electrons** (say: ih-**lek**-trahnz), which have a negative charge
3. **neutrons** (say: **noo**-trahns), which have no charge



Most of the time, atoms have the same number of protons and electrons and the atom charge is neutral (not positive or negative). Static electricity is created when positive and negative charges aren't balanced. Protons and neutrons don't like to move around much, but electrons love to jump all over the place!

When an object (or person) has extra electrons, it has a negative charge. Things with opposite charges are always attracted to each other; they like to find each other. It's like a crazy invisible game of tag. Positive charges seek negative ones and negative ones seek positives. Whew! Got it? Don't worry; we're going to get lots of practice playing with positive and negative charges. You've probably even done it before.

When you rub a balloon on your hair the balloon picks up electrons from your hair, remember they're negatively charged, and that makes the balloon negatively charged. And since all those electrons left your hair, your hair is now positively charged because mostly protons are left. Opposite charges attract, so bringing the negatively charged balloon near the hair causes the positively charged hair to stand up to try and get closer to all those electrons.

So, why is it called static?

When something is static that means it doesn't move. There are two types of electricity: static electricity and electrical currents. Static electricity stays in one place, like the charge on a doorknob that can zap your hand in the wintertime. Electrical current moves and flows, like the current in the wires in a lamp. So, static electricity is called static because the charges do not move from where they were made, unlike the electricity used to power electronic devices that flows back and forth from one pole of a battery or power source to the other. Most of the time static electricity is made when two objects come in contact or are rubbed together.

For a static charge to stay in an object, it has to have to be able to resist the flow of electricity. That is why plastic balloons and hair are great for static electricity and can stay charged, but they don't make very good conductors for electricity. Other materials, like aluminum, can get a static charge, but they don't stay charged for a long because they can't resist the flow of electrons. The electrons can move through very quickly.

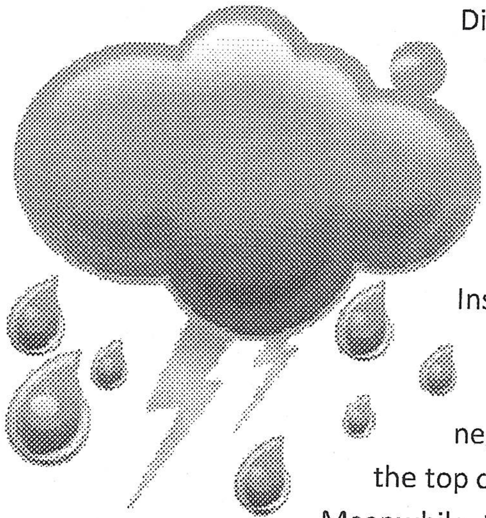
Beware of Conductors!

Not train conductors, we're talking about when you scuff your feet on your living room rug, you pick up extra electrons and have a negative charge. Electrons move more easily through certain materials like metal, which scientists call **conductors**. Things through which electricity flows very easily are called "conductors," and things that block the flow of electricity are called "insulators." *(Can students think of any materials which block electrical flows? Rubber, etc)* When you touch a doorknob (or something else made of metal), which has a positive charge with few electrons, the extra electrons want to jump from you to the knob.

That tiny shock you feel is a result of the quick movement of these electrons. You can think of a shock as a river of millions of electrons flying through the air. Pretty cool, huh? Static electricity happens more often during the colder seasons because the air is usually drier, and it's easier to build up electrons on the skin's surface.

So, the next time you get a little shock from touching a doorknob, you'll know that it's just electrons jumping around. Think of it as putting a little spark in your life!

What other kinds of big sparks do we see? Lightning!



Did you know that lightning is a giant form of static electricity? It's formed when air rubs against rain clouds.

The sky is filled with electric charge. In a calm sky, the positive and negative charges are evenly interspersed throughout the atmosphere. So, a calm sky has a neutral charge.

Inside a thunderstorm, electric charge is spread out differently. A thunderstorm consists of ice crystals and hailstones. The ice crystals have a positive charge, while the hailstones have a negative charge. The positively charged ice crystals are pushed to the top of the thunderstorm cloud by upward pushing wind (updraft). Meanwhile, the heavy negatively charged hailstones are pushed to the bottom of the thunderstorm clouds by its downdraft (downward pushing wind) and gravity. Thus, the thunderstorm's positive and negative charges are separated into two levels: the positive charge at the top and the negative charge at the bottom of the cloud.

During a thunderstorm, the Earth's surface has an overall positive charge. Because opposites attract, the negative charges at the bottom of the thunder cloud want to link up with the positive charges of the Earth's surface.

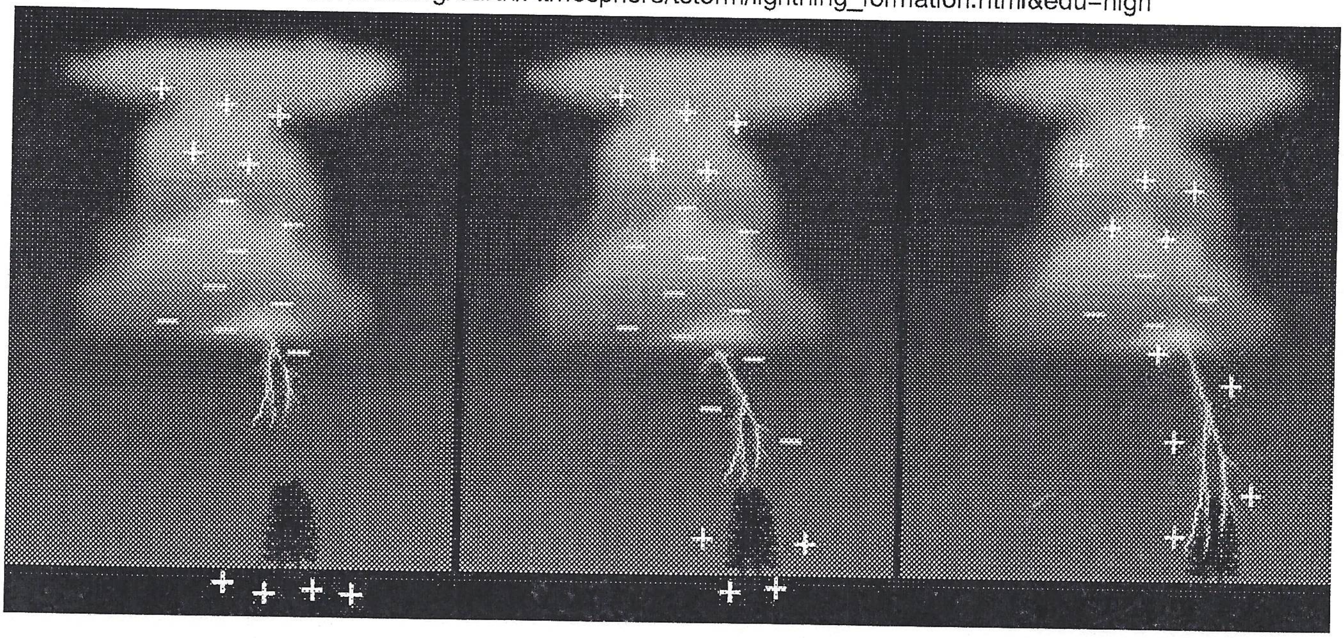
Once the negative charge at the bottom of the cloud gets big enough, a flow of negative charge rushes toward the earth. This river of electrons is called a stepped leader. The positive charges of the Earth are attracted to this stepped leader, so a flow of protons moves up through some high point, such as a tree or a telephone pole, and into the air, trying to meet the electrons flowing down from the cloud. (Sometimes it even happens through people!) When the stepped leader and the positive charge from the earth meet, a strong electric current carries the earth's positive charge up into the cloud. This electric current is known as the return stroke of lightning and that is what we see when we see lightning during a storm. The back and forth of charges happens three or four times, all within a few seconds, but normally the human eye cannot distinguish between all of the return strokes.

So, we see lightning when a river of billions of moving electrons and protons race up or down between a cloud and the ground (or between two clouds).

Where does the thunder come from?

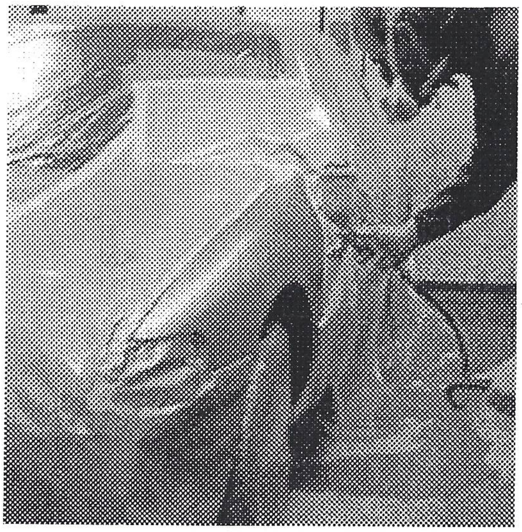
The speeding electrons bump into air molecules along the way, heating them to a temperature five times hotter than the surface of the sun. This hot air expands as a supersonic *(faster than the speed of sound, which is 340.29 meters per second or 761 miles per hour)* shock wave, which you hear as thunder.

Lightning can start fires and it is strong enough to hurt or kill people. Lightning also helps nature by putting nitrogen in the ground for plants to use.

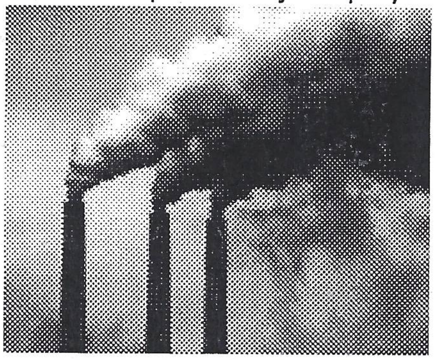


So, What Good Is It?

Static electricity can be annoying, shocking, interesting, and fun to play with, but is it useful? Does it do more than make clothes stick together, dirty TV screens, shoot sparks, make lightning bolts, and shock our hands? Can we actually **do** anything with it, or is it just a fun but useless phenomenon?

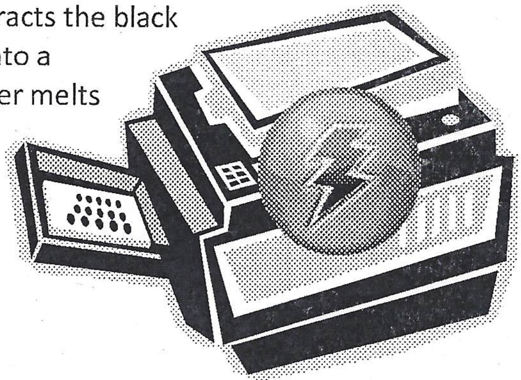


Static electricity isn't useless. In fact, static electricity is vital for painting the outside of your car or refrigerator. For example, when the factory is painting a car, the paint particles are given a negative charge, and the car frame is dipped in a substance that gives it a positive charge. Then, when the paint sprays out it sticks to the car, and is attracted to all the areas where it would be hard for a person to reach. This process ensures a perfectly even layer of paint, since when there is enough negative paint in the car the extra will be repelled (shoved away) by the paint already on the car. It also makes sure that the paint won't fall off easily, since the electrical attraction between the paint and the car is much stronger than if the paint was just sprayed on without being charged.



It also affects the quality of sandpaper, and, even more importantly, the cleaning of smoke from coal-fired power plants. In coal fired power station static electricity is used to stop the dust particles and pollution from reaching the atmosphere. Particles of ash pass through a charged grid, and become charged. They then stick to charged plates on either side of this grid, where they can be disposed of safely.

Without static electricity we wouldn't be able to make copies. Why not? A Xerox machine uses static electricity to make copies. Remember, when you rub a balloon on your head, the balloon is charged with electricity. Inside a Xerox machine is a plastic drum that is also charged. When you put a piece of paper on the glass, a copy of it goes onto the drum. Where there were dark places on the paper, the static charge on the drum attracts the black plastic toner powder. Then the powdered places go onto a blank piece of paper, and the paper is heated. The toner melts and makes black letters on the new piece of paper.



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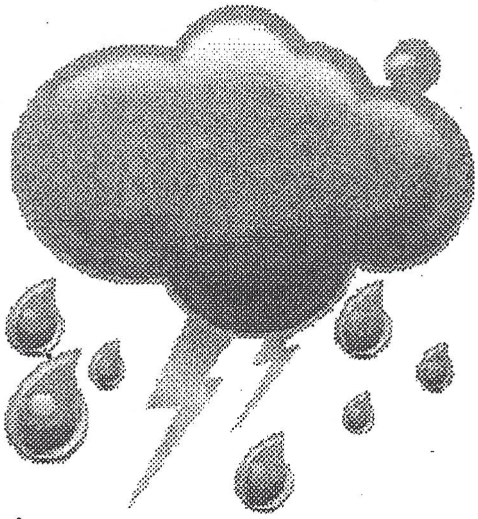

1. Protons have a ____________ charge.
2. Electrons have a ___________ charge
3. ____________ have no charge.
4. Everything in the world is made up of ____________.
5. Things through which electricity flows very easily are called "____________," and things that block the flow of electricity are called "____________."
6. Lightning is a giant form of ____________.
7. Static electricity _________________ and electrical current _________________.
8. Static electricity isn't ____________.
9. We see lightning when a river of billions of moving ____________ and __________ race up or down between a __________ and the ground (or between two clouds).
10. Thunder is a ____________ shockwave that moves faster than the speed of sound.
11. When you rub a ____________ on your head it picks up electrons.

Word Bank

Electrons	Positive	Stays in one place	
Supersonic	Useless	Protons	Balloon
Static electricity	Electrons	Conductors	
Insulators	Moves and flows	Atoms	
Negative	Neutrons	Cloud	