Detecting the Electric Field

Overview: You are actually fairly familiar with electric fields, too, but you may not know it. Have you ever rubbed your feet against the floor and then shocked your brother or sister? Have you ever zipped down a plastic slide and noticed that your hair is sticking straight up when you get to the bottom? Both of these phenomena are caused by electric fields and they are everywhere!

What to Learn: The way to change how something is moving is to give it a push or a pull. The size of the change is related to the strength, or the amount of "force," of the push or pull.

Materials

- head of hair
- balloon
- yardstick or meterstick
- spoon, large

Lab Time

1. Blow up a balloon and tie it off.
2. Put the spoon on the table and balance the yardstick on top of it, overhanging the edge of the table.
3. Charge the balloon by rubbing it on your hair.
4. Bring the charged balloon next to the ruler and use it to guide the stick around on the table. If the effect weakens, recharge the balloon on your hair.
5. This works really when you add more people and more balloons!

Detecting the Electrical Field Data Table

Item/Object	Did It Stick?	How Long Did It Stick? *(measure in seconds)*

Reading

Electric fields are extremely common. If you comb your hair with a plastic comb, you cause that comb to have a small electric field. When you take off a fleece jacket or a polyester sweat shirt, you create an electric field that may be thousands of volts! Don't worry, you can't get hurt. There may be lots of voltage but there will be very little amperage. It's the amperage that actually hurts you.

Different parts of the atom have different electrical charges. The proton has a positive charge, the neutron has no charge (neutron, neutral get it?) and the electron has a negative charge.

These charges repel and attract one another kind of like magnets repel or attract. Like charges repel (push away) one another and unlike charges attract one another.

So if two items that are both negatively charged get close to one another, the two items will try to get away from one another. If two items are both positively charged, they will try to get away from one another. If one item is

positive and the other negative, they will try to come together.

How do things get charged? Generally things are neutrally charged. They aren't very positive or negative. However, occasionally (or on purpose as we'll see later) things can gain a charge.

Things get charged when electrons move. Electrons are negatively charged particles. So if an object has more electrons than it usually does, that object would have a negative charge.

If an object has less electrons than protons (positive charges), it would have a positive charge. How do electrons move? It turns out that electrons can be kind of loosey-goosey.

Depending on the type of atom they are a part of, they are quite willing to jump ship and go somewhere else. The way to get them to jump ship is to rub things together. Let's play with this a bit and see if we can make it more clear.

Remember, in static electricity, electrons are negatively charged and they can move from one object to another. This movement of electrons can create a positive charge (if something has too few electrons) or a negative charge (if something has too many electrons). It turns out that electrons will also move around inside an object without necessarily leaving the object. When this happens, the object is said to have a temporary charge.

Try this: Blow up a balloon. When you rub the balloon on your head, the balloon is filled up with extra electrons, and now has a negative charge. Now stick it to a wall— to create a temporary charge on the wall.

Opposite charges attract, right? So, is the entire wall now an opposite charge from the balloon? No. In fact, the wall is not charged at all. It is neutral. So why did the balloon stick to it?

The balloon is negatively charged. It created a temporary positive charge when it got close to the wall. As the balloon gets closer to the wall, it repels the electrons in the wall. The negatively charged electrons in the wall are repelled from the negatively charged electrons in the balloon.

Since the electrons are repelled, what is left behind? Positive charges. The section of wall that has had its electrons repelled is now left positively charged. The negatively charged balloon will now "stick" to the positively charged wall. The wall is temporarily charged because once you move the balloon away, the electrons will go back to where they were and there will no longer be a charge on that part of the wall.

This is why plastic wrap, Styrofoam packing popcorn, and socks right out of the dryer stick to things. All those things have charges and can create temporary charges on things they get close to.

Exercises Answer the questions below:

1. What happens if you rub the balloon on other things, like a wool sweater?

2. If you position other people with charged balloons around the table, can you keep the yardstick going?

3. Can we see electrons?

4. How do you get rid of extra electrons?

5. Does the shape of the balloon matter?

6. Does hair color matter?

7. Rub a balloon on your head, and then lift it up about 6". Why is the hair attracted to the balloon?

8. Why does the hair continue to stand on end after the balloon is taken away?

9. What other things does the balloon stick to besides the wall?

10. Why do you think the yardstick moved?

11. What other things are attracted or repelled the same way by the balloon? (Hint: try a ping pong ball.)

Answers to Exercses: Detecting the Electric Field

1. What happens if you rub the balloon on other things, like a wool sweater? (You'll charge the balloon with a positive charge instead of a negative charge.)
2. If you position other people with charged balloons around the table, can you keep the yardstick going? (Yes!)
3. Can we see electrons? (Nope!)
4. How do you get rid of extra electrons? (Touch something that's grounded, like a metal pipe that's partly buried in the ground.)
5. Does the shape of the balloon matter? (Not really.)
6. Does hair color matter? (I've found that color and texture do!)
7. Rub a balloon on your head, and then lift it up about 6". Why is the hair attracted to the balloon? (The negative charge on the balloon is attracted to the positive charge on the hair.)
8. Why does the hair continue to stand on end after the balloon is taken away? (The balloon brought the positive charges to the surface, so now each hair has little positive charges all over the surface, making each hair strand repel each other.)
9. What other things does the balloon stick to besides the wall? (You, the wood desk, anything that is a good insulator.)
10. Why do you think the yardstick moved? (The negative charge on the balloon attracted the positive charge on the yardstick.)
11. What other things are attracted or repelled the same way by the balloon? (Hint: try a ping pong ball.)