# ALL CHARGED UP!

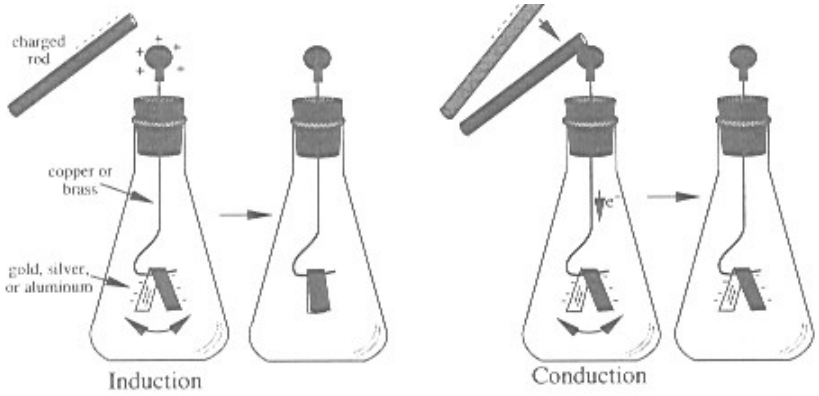
NAME_____

Electricity is invisible, so to study it we must develop instruments that allow us to observe its effects. One such instrument, called an **electroscope**, will be used by you to observe charges in action. The metal vanes should hang straight down because they are uncharged and affected only by gravity.

**ELECTROSCOPES**

Rub a plastic strip or hard-rubber rod with fur or a wool cloth. As you rub, the rod removes electrons from the rod or fabric and develops a net negative charge. As you move the rod toward the ball on top of the electroscope, electrons in the metal are repelled and move toward the bottom of the electroscope. The leaves are now both negatively charged, and thus, they experience electrostatic repulsion and move apart. The higher the induced charge, the farther apart the leaves will move. Move the rod away and the leaves will collapse. Again move the rod toward the ball, but this time touch it. Electrons will flow from the rod to the leaves, and the leaves will move apart and remain even further apart after the rod has been removed. You have **charged** the electroscope **by conduction**.

Rub the glass rod vigorously with a silk garment and repeat the activity. In this case, the silk obtains a negative charge, leaving the rod with a positive charge. Approach the tip of the electroscope with the positively charged glass rod. Do the leaves move in a different way? Why or why not? What happens if you touch the electroscope with the charged rod and then remove it?




**Questions**

1. Do the leaves separate any further if you rub harder? Explain.

2. Why do the leaves collapse after the charged rod is pulled back without touching the electroscope?

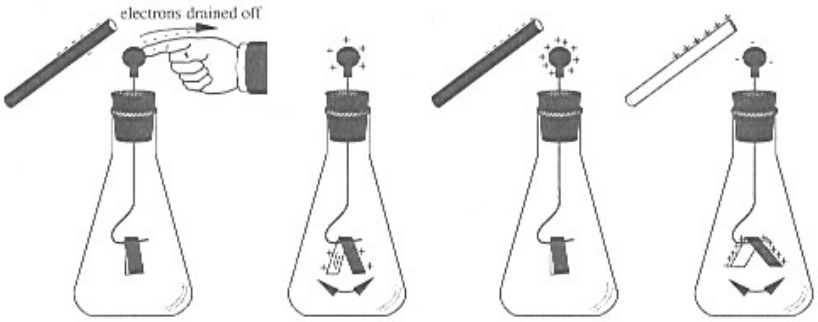
3. Plastic has a net negative charge after being rubbed with wool, while glass has a net positive charge after being rubbed with silk. Do they produce the same or different effect when brought close to the tip of the electroscope? Explain.

4. Why do the leaves remain separated after the rod has touched the ball and been removed?

**DETERMINING CHARGE WITH AN ELECTROSCOPE**

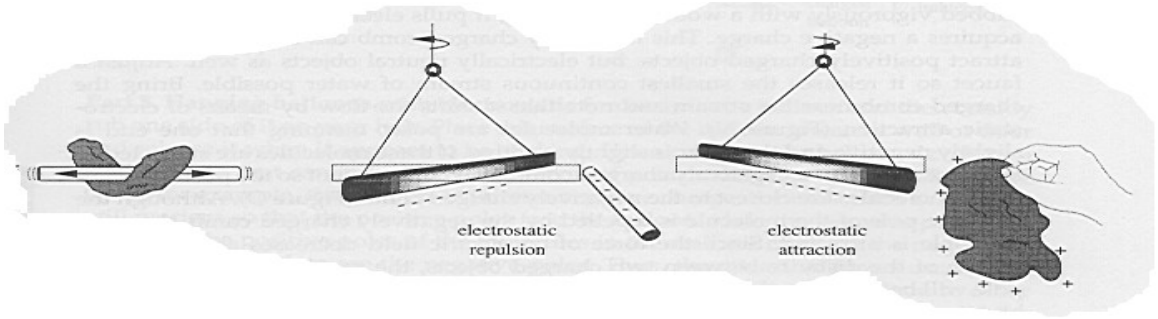
Rub a hard-rubber rod or plastic strip with wool or fur. The rod or strip still acquires a net negative charge by removing some electrons from the fabric or wool. While touching the ball of the electroscope with one hand, position the charged rod near (but not touching) with the other. The negative charge of the rod will repel electrons away from the electroscope and they will flow into your body. When you remove your hand and the charged rod, the leaves spread apart, indicating a positive charge has been achieved due to the loss of electrons. Bring the charged rod close to the scope once again and note that the leaves collapse as negative charges are repelled from the top of the scope and move into the leaves where they neutralize the positive charge. When the rod is removed, the leaves once again separate.

Knowing that the scope is now positively charged, we can determine the charge on other objects. If, for example, an object with a positive charge is brought near to the end of the scope, electrons will move from the leaves to the object. This will leave a larger positive charge on the leaves, thus causing them to separate even further. By contrast, if a negatively charged object is brought near the end of the scope, electrons will move toward the leaves from the object. The positive charge in the leaves is then neutralized, and the leaves collapse. Charge glass and plastic strips with a variety of fabrics (wool, silk, plastic wrap, animal fur) and determine their resulting charge using the electroscope.




**DETERMINING CHARGE USING A SUSPENDED ROD**

Tie and tape both ends of a thread around the ends of a hard-rubber rod or plastic strip. Charge the rod by rubbing it with wool or animal fur and suspend it as shown. Charge another rod or plastic strip in the same fashion. This second rod can now be used



to “chase” the first rod since both have the same charge and like charges repel. Now approach the suspended rod with the portion of the wool or fur on which the rod was rubbed. Does it repel or attract the suspended rod? Explain.

**Questions**

1. Will the leaves of the electroscope collapse or separate if both have the same charge? Explain.

2. To establish a lasting charge on an electroscope by the process of induction, it is necessary to place your finger on the electroscope when charging it. Explain.

3. Under what conditions did you obtain maximum separation of the leaves? Explain.

4. How can you place a negative charge on the electroscope by the process of induction? Try it.

5. Why does the cloth attract the suspended rod while the rod that was rubbed with the cloth repels it?

**ELECTROPHOROUS**

**Preparing the Electrophorous**

1. Invert the styrofoam cup in the center of the aluminum plate and tape it in place. This forms an insulating handle for moving the plate from place to place. Always use this handle.
2. Slide the plastic straw through the two holes, with the slit end outermost.
3. Hang the coated pith ball from the straw by passing it through the slit in the straw.
4. Adjust the position of the ball so that it is even with the edge of the plate and about an inch away.
5. Set the styrofoam pad in a convenient location, and rub the top of it briskly with the wool cloth for a full minute.
6. Using the handle, set the plate on the pad and notice what happens to the ball.
7. Briefly touch the plate with your finger. You should feel a shock or hear a snap.
   **Why did this shock occur?**

8. Remove the plate using only the styrofoam handle.
9. When the plate is first charged, it should induce the opposite charge in the hanging ball, which should attract the ball.
10. If the ball can touch the plate, charge will be shared by conduction, and now the same charge on the ball will cause it to be repelled from the plate.
11. If one carefully touches the ball with the tip of the finger that is held steadily in place, the ball will discharge, swing back, touch the plate, and then swing out ot again to touch the finger.
    **Why does this motion repeat itself?**