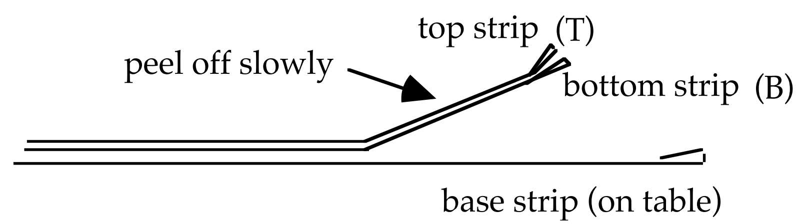
Electric Charge

If you have ever been shocked after walking across a carpeted room and touching a doorknob or if you have used transparent tape, you have experienced the effects of electric charge. You may have been told that there are two kinds of electric charge. In today's experiment you will determine this for yourself.

Getting Started

When you pull a long strip of transparent tape off a roll, it curls up. You can use this property to investigate electric charge and electric forces. To make the tape strips easy to handle, fold over the last 1/2 inch or so to make a non-sticky tab that you can use as a handle.

Place an approximately 10 inch long tab strip on the table surface sticky side down and smooth it out flat. This will be the base on which to make a pair of tab strips. Place two more tab strips on top of this base, both sticky side down. Label one tab T for top and the other B for bottom. Now *very slowly* (to minimize charging either strip) peel off **both** strips as one unit.



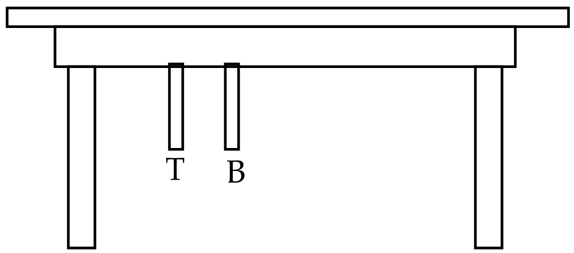
1. Outline and briefly describe this procedure in your Lab Notebook and include a sketch.

You will probably find that the pair of strips is mildly attracted to your hand or any nearby surface. If so, lightly and *slowly* drag the strips across the metal parts of your chair several times. This should eliminate the attraction (mostly).

Note: Record your observations. Number each question in your Lab Notebook and answer.

Q1. Why might bringing the tape in contact with metal make the tape become less attractive?

2. Now take the two tabs and *quickly* (to charge both strips) rip the two strips apart. With a minimum of handling, hang the two strips about a foot apart off the edge of the table as shown.



Repeat the entire process just described to get two more tab strips labeled T and B. Hang them from the table for a total of four strips. Note, if at any time your strips seemed to have "lost" or "changed" their charge, please make new T and B strips.

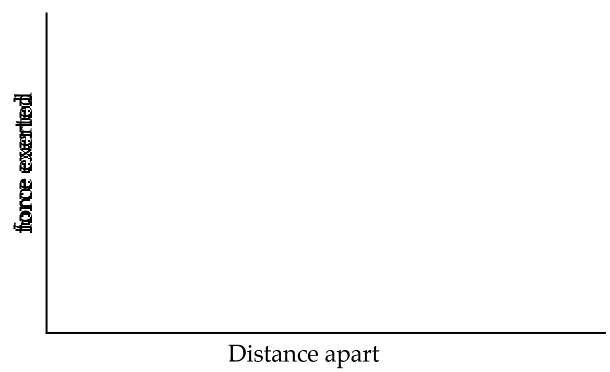
Q2. How do you think the two T strips will interact if you bring one close to the other; will they attract or repulse each other or do nothing? Record your prediction with explanation.

3. Bring two T strips close to each other and record your observation.

Q3. How do you think the two B strips will interact if you bring one close to the other? Record your prediction with explanation.

4. Bring two B strips close to each other and record your observation.

5. Using the two B strips, sketch a rough graph of the force the strips exert on each other as a function of how far apart they are. You should be able to judge how big the force is by how much the hanging strip is deflected.



Q4. Does this graph roughly follow Coulomb's law relating force and distance? Explain how it does or does not.

Q5. How do you think a B and a T strip will interact if you bring one close to the other? Record your prediction with explanation.

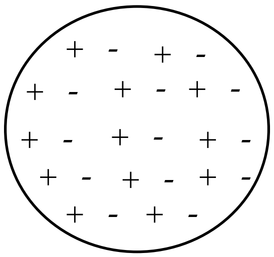
6. Bring a B and a T strip close to each other and record your observation.

Q6. Rub the glass rod **vigorously** with a piece of fur. How can you tell if the glass rod now has a "B-type" charge or a "T-type" charge? Explain your reasoning, what you observe and what you conclude.

Q7. Now rub the plastic rod with the fur. Repeat the procedure from (Q6) and state your observations and conclusions.

Charge and Conductors

A conductor is a material in which charges are free to move. In metal conductors such as aluminum, electrons are relatively free to move but protons are not. In the following observations, assume the metal ball starts out neutral.



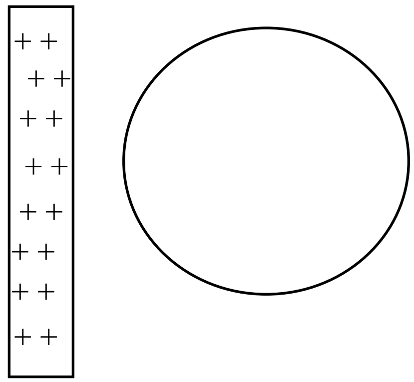
Q8. Suspend a metal ball from a string (insulator). Bring the neutral metal ball close to a T strip (without touching it). What do you observe?

Q9. Bring the neutral metal ball close to a B strip. What do you observe?

Q10. How is the interaction of the metal ball with the tab strips different than the interaction of the glass or plastic rods with the tab strips?

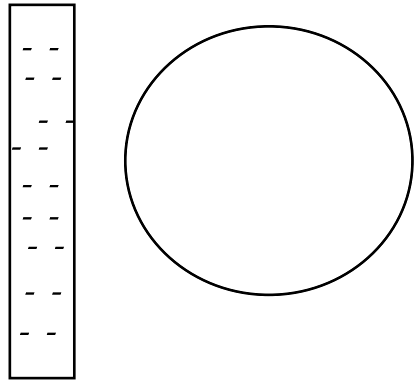
Explain (Q10) by considering the following words and pictures. Assume that the metal ball starts out neutral.

Q11. What will the distribution of charges in the disk look like if you bring the ball close to a positively charged tape? Sketch the following figure in your Laboratory Notebook and indicate the charge distribution in the sphere.



Q12. Would the interaction between the tape and ball result in an attractive force, a repulsive force, or no force at all? Carefully explain.

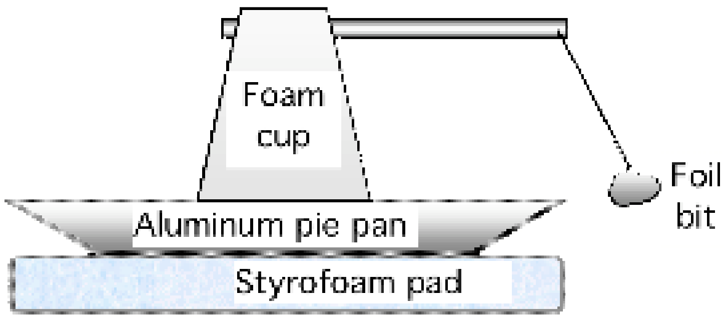
Q13. How about if instead you bring the ball close to a negatively charged tape? Sketch the following figure in your Laboratory Notebook and indicate the charge distribution in the sphere.



Q14. Does a force exist between the tape and ball? Again, carefully explain.

The Electrophorus

An electrophorus is shown. The foam cup is taped to the bottom of the aluminum pie pan. Your task is to explain what is happening during the experiment described next.



7. Using the foam cup as a handle, remove the aluminum pie pan from the styrofoam insulation pad that lies on the lab table. Now rub the styrofoam pad with fur or a soft cloth. Using the foam cup as a handle, slowly lower the aluminum pie plate onto the styrofoam pad. Observe what happens to the tiny aluminum foil bit as the pie plate gets close to the foam.

8. With the pie plate now sitting on the styrofoam pad, bring your finger near the foil bit and keep it near the bit (you may have to move your finger closer as time progresses). Alternatively, you can move an aluminum soft drink can near the foil bit (if the pie pan is at the edge of the styrofoam board).

Q15. Discuss carefully and in detail all aspects of the foil bit's motion with your team. Record your basic observation. Be prepared to explain in a class discussion.

List of Materials

Transparent Tape
Fur
Plastic Rod
Glass Rod
Metal Ball on a String
Electrophorus