PS 12b Lab 1a
Basic Electrostatics

Names:
1.) _____
2.) _____
3.) _____

Learning Goal: Familiarize students with the concepts of charge, charge interaction, charge transfer, and polarization. We will also illustrate a way to visualize the electric field between two charged shapes.

Warm Up: Take a look at the University of Colorado PHET site. We will be using many of these to illustrate ideas presented in class. The individual JAVA Applets take a minute to load. At some point make sure that you bookmark the page on your own computer and make sure you can run the applets.

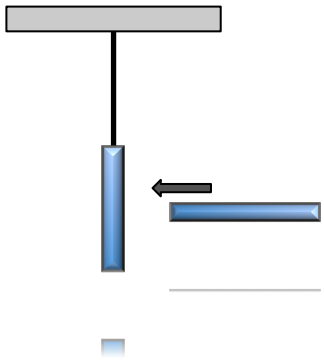
http://phet.colorado.edu/en/simulations/category/physics

For today try this PHET dealing with electric charges:

http://phet.colorado.edu/en/simulation/balloons

In the following scenarios discuss with your group and make predictions about what you think will happen. You are encouraged to draw diagrams that help clarify your predictions.

A.) Take a plastic rod has been undisturbed for a long period of time and is hung it from a thread. You pick up another undisturbed plastic rod and bring it close to, but do not touch, the hanging rod.



B.) Rub both plastic rods with wool. Approach the hanging plastic rod with the one in your hand.

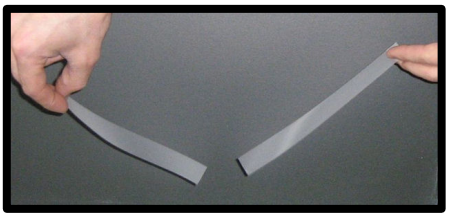
C.) Bring a glass rod that has been rubbed with silk close to a hanging plastic rod that has been rubbed with wool.

D.) Hold one of the plastic charged rods over some small pieces of Styrofoam puffs scattered on a tabletop. What do you expect to happen and why?

E.) Bring a plastic rod that has been rubbed with wool close to a hanging plastic rod that is neutral, i.e. it has not been rubbed and has been hanging for a long time.

Activity 1: Sticky Electrostatics

Procedure:



A.) Place two 20 cm of Scotch™ tape on a tabletop a foot or so apart. Give each one a little "tab" at the end so you can lift them off the table. Label each of these with a "B" for bottom.

B.) Now lay a third and forth piece of tape of the same size on top of these. Include a tab and label these "T" for top. You should now have two identical stacks of tapes.

C.) A cross bar has been provided for you to stick your pieces of tape for when they are needed. This will help you keeps things organized and separated.

D.) Lift one set of "T" and "B" taped off the table <u>together</u> by the tabs. While holding the pair, run your fingers down the sides to remove any excess charge.

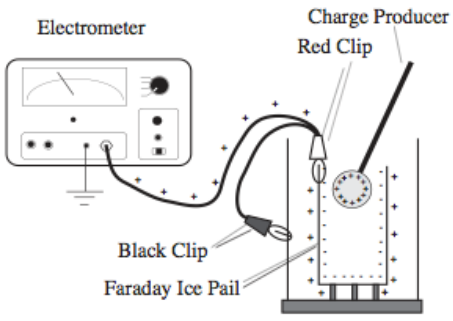
E.) Now pull the two strips of tape apart by the tabs so that you are holding a "T" tape in one hand and a "B" tape in the other. Slowly bring the tapes together but do not let them touch.

F.) Describe your results for the following interactions (Repel, attract, or no interaction)

- T tape is brought near a B tape: _____
- T tape is brought near a T tape: _____
- B tape is brought near a B tape: _____
- T tape is brought near a 20 cm strip of neutral paper: _____
- B tape is brought near a 20 cm strip of neutral paper: _____

Activity 2: Defining the charge on the sticky tapes.

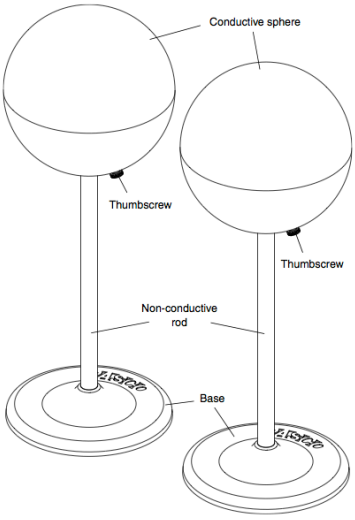
Now, we are going to investigate the sign of the charge we placed on the various objects. The TF will explain the following setup using the "traditional" Faraday Ice Pail. It's interesting that Faraday himself used this setup to determine charge back in1843, except he used an electroscope instead of the more modern electrometer.



A.) What is the sign of the charge on the "B" tape? The "T" tape?

B.) Now identify the charge on the plastic rod rubbed with wool, and the glass rod rubbed with silk.

Activity 3: Transfer of Charge



Caution: The sphere is being held at a high voltage and may give you a very small shock –it's barely enough to feel. The voltage supply we are using will limit how much charge is supplied to you. This is a safety feature to make it safe to touch the sphere. **Most** high voltage supplies **do not** do this and therefore should be treated with extreme caution.

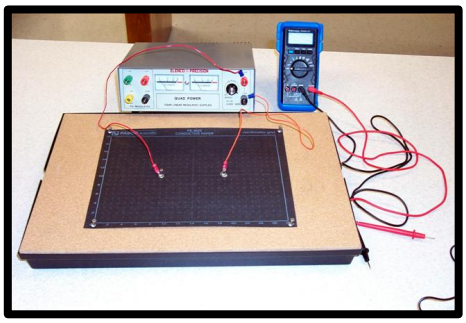
Procedure: Charge one of the spheres using the electrostatic voltage source, and then disconnect it. The sphere should hold some charge for a little while, but will the charge will eventually leak out due to the moisture in the air. Try to transfer charge to a second metal sphere with the first a metal wire and then plastic tubing. Test that you've successfully transferred charge from one sphere to another. Draw diagrams to illustrate your findings.

Results:

Challenge 1: Given a positively charged sphere and an uncharged sphere, figure out a way to make the uncharged sphere negatively charged. Draw and describe your method, and talk to a TF about your solution.

Challenge 2: You are give three spheres. Using the equipment on the bench, figure out a way to make one sphere positively charged and another one negatively charged, such that their charges are exactly equal in **magnitude**. Draw and describe your method, and talk to a TF about your solution.

Activity 4: Electrostatic Field Mapping



Procedure: On each of your tables is a set up for mapping out electrostatic fields. Each set up is a piece of carbon-impregnated paper that can conduct a small amount of charge. Each metal terminal is connected to +2.5 volt and -2.5 volt terminal of a power supply. Connecting the ground of the voltmeter as the midpoint between the terminals measure the voltage at different points on the paper. Our goal is to find locals of similar voltage, mark these, and then connect them to map an "equipotential contour". This is a location where the voltage is always the same. Try mapping out 10 such contours all over the entire paper.

A.) Map out equipotential surfaces very close around each metal terminal using the voltmeter. The "common" terminal of the voltmeter should be connected to the top center of the paper. The other probe will be lightly pressed into the paper at different point to give you the voltage relative to the "common". Find locations around the terminal that have the same voltage or "equipotentials". Call over a TF to help once you have explored a little bit.

B.) Once you have mapped out all the way around a terminal connect these points with a WHITE crayon.

C.) Move 1 cm away and repeat. Again connect these points in white. Equipotential contours are closed loops that will never cross. Keep this in mind when performing the mapping exercise. Map out about 10 contours.

D.) Electric field lines run perpendicular to the equipotential lines. Draw about 10 of these in using the red crayon.

E.) Make sure you trace out your terminals using the blue crayon.

F.) Call a TF over to discuss your results.