# Experiments with Static Electric Charges
**Spring 2024**

## Introduction

This series of experiments are designed to give you an understanding of how electric charges behave on insulators and conductors. We will perform several experiments described in Unit E of Moore's text, *Electric and Magnetic Fields are Unified*. Each experiment should include the following in your journal:

- A description of what you are doing
- A sketch (or sequence of sketches) that represent your observations and show the movement of charges (as applicable)
- A brief explanation about the cause of what you observe

## Experiments

1. *Fun with an oscilloscope:* You will use a bright spot on an oscilloscope to determine the net charge on rubber and glass rods. The spot is caused by electrons (negatively charged) striking a phosphor coating on the back of the oscilloscope face.
    a. Charge the rubber rod by rubbing it vigorously with a piece of fur. Holding the rod *parallel* to the oscilloscope, bring it close to the bright spot and then move the rod up and down. Don't touch the glass face with the rod. Describe the motion of the spot with respect to the rod.
    b. Now charge the glass rod with the paper towel, and again bring it near the spot on the oscilloscope. Again, describe what happens to the spot when the glass rod moves up and down.
    c. Based on your observations, which rod (rubber or glass) ends up with a net negative charge, and which with a net positive charge (Figure 1)?


**Figure 1**: Rods showing a net charge.

2. *Charging foil by charge transfer*:
    a. A piece of foil is suspended by a silk thread. Ground the foil by touching it with your fingers; this will remove any excess charge that is on the foil (**Figure 2**). Note that there are an equal number of positive and negative charges.
    b. Charge the rubber rod with a piece of fur, then *slowly* bring it near the foil – don't let the rod and foil touch just yet! Describe what happens, and explain why. Your sketch should show how the charges move on the foil – keep in mind that *only the negative charges are free to move!*
    c. Now let the charged rubber rod touch the foil, and then hold the rod near the foil. Again describe what happens, and explain why.
    d. Charge the glass rod with a piece of paper towel, and carefully move it toward the charged foil (*don't let the rod touch the foil just yet!*). Describe the reaction of the foil.
    e. Note that you have created a device that will detect the presence of a charged object; if you know the charge on the foil, you can then determine the sign of the charge on the object by observing the behavior of the foil. Do your results for the charge on each rod agree with your results using the oscilloscope?

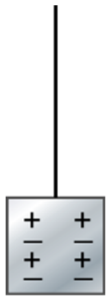

**Figure 2:** Neutral foil

3. *Fun with water:*
    a. Turn on the sink faucet to produce a smoothly flowing stream of water. You want a flow rate just fast enough not to produce drops but slow enough not to give turbulence.
    b. Charge the rubber rod with fur and hold the rod next to the water stream (*don't get the rod or the fur wet!*). Describe what happens.
    c. Predict what will happen to the stream when the glass rod charged with the paper towel is held close. Try it, describe the results, and explain why it happens.

4. *Separation of charges*:
    a. You are provided with two metal spheres on insulating stands (**Figure 3A**, in their neutral state). Using these spheres, the rubber rod, and the fur, figure out a way to give the metal spheres equal but opposite charges *without* touching either sphere with the rod or fur (the spheres *can* touch each other), as shown below in **Figure 3B**. The goal is to have each sphere retain its net charge when you are finished. Listen carefully while performing this experiment; if you hear a "click", then there has been a transfer of charge, and the experiment won't work.
    b. Test the charge on each sphere by using the foil "charge detector" you created in step 2. Include a sketch showing how the charges move between the spheres; remember that negative charges are free to move in a conductor and will seek to disperse themselves as widely as possible; positive charges are fixed in place.
    c. Describe your solution using words and diagrams.

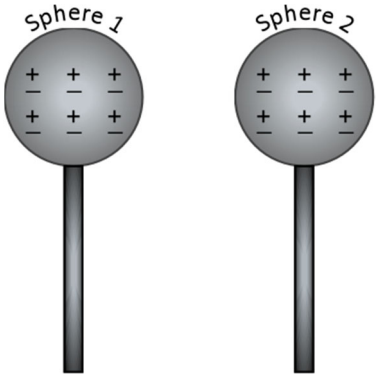


**Figure 3A**: *Before* contact, both spheres are neutral

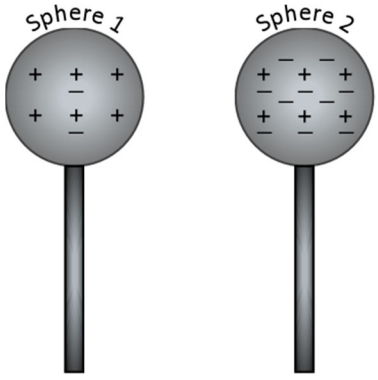


**Figure 3B**: *After* contact, each sphere has a net charge

## Discussion

- Your journal today will consist of your sketches, observations, and conclusions for the experiments you performed. Be sure that you explained your results as you performed each experiment.