

Lab 08: Electrostatics



Brushing a kitten on a dry day.
Snap! Crackle! Cute!

INTRODUCTION

Everyone has, at some point, experienced the electrostatic force. Whether you are peeling the socks off the sweatshirt that just came out of the dryer, or your hair stands up when you run a comb through it, you are seeing and feeling the effects of the force between charges. It's also a cliché that "opposites attract," but in the case of electric charges, it happens to be true (and it is also true that like repels like). Attraction and repulsion are both easy to demonstrate.

OBJECTIVES

- Use charge polarization to create electrostatic attraction
- Demonstrate electrostatic attraction and repulsion qualitatively
- Distinguish between charge conduction and induction
- Measure the amount of charge induced or transferred to an object

PROCEDURE

Complete each of the following demonstrations,

recording measurements, drawing sketches, and answering the questions in your lab notebook.

ACTIVITY 1: CHARGE POLARIZATION

- Blow up a balloon. Rub it vigorously across someone's head.
- Stick the balloon to the chalkboard, the wall, or the cork board. Observe which balloon remains stuck longer.

QUESTIONS

1. Does the balloon stick to one surface better/longer than the other? Which surface?
2. If the balloon has a net negative charge, does the wall have a net positive charge? Explain.
3. Use a sketch to show how the charges on the balloon affect the charges in the wall.



Try this in the lab!

4. On the left is a picture of a charged rod held near to (but not touching) a thin stream of water. Do this using a thin stream at the sink! Use the concept of charge polarization to explain this photo.

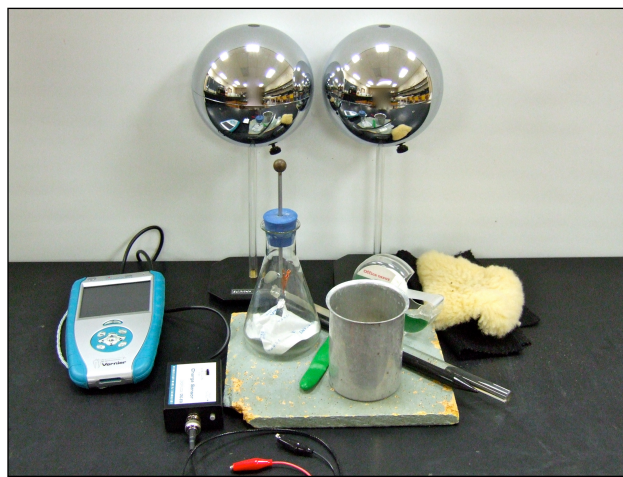
ACTIVITY 2: ELECTROSCOPE

- Charge the ebonite rod with the wool, and bring it close to the metal ball of the electroscope (without actually touching it). Observe what happens.
- Recharge the rod if necessary and repeat, this time actually touching the rod to the electroscope ball.
- Charge the glass rod with the wool, and bring it close to the metal ball of the electroscope. Recharge and repeat, touching the rod to the metal ball.
- Sprinkle a small amount of black pepper at one end of the green sheet, and a bit of salt at the other end. Observe what happens to the particles when you approach with a charged rod.

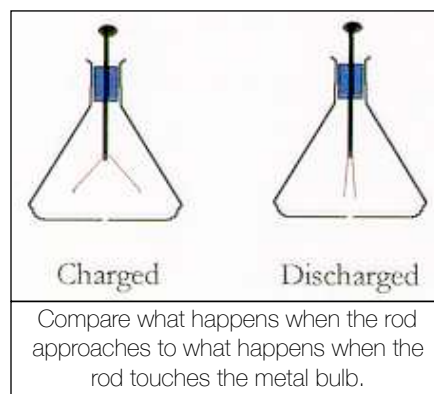
- Mix the salt and pepper together in the middle of the green sheet. Can you separate them electrostatically?

QUESTIONS

5. What happens to the charges in the metal ball when you bring the negatively charged rod close (without touching)? What is the net charge on the electroscope? How do you know?
6. Explain why this makes the leaves of the electroscope separate.



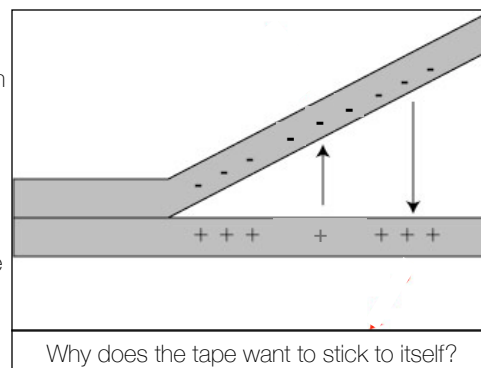
Electrostatics equipment for demonstrating electric charge.



7. What happens to the charges carried by the rod when you touch it to the electroscope ball? What happens to the net charge on the electroscope? Explain why the leaves of the electroscope separate when the rod touches the metal ball.
8. Is the glass rod as effective as the ebonite rod? Can you charge the glass rod as easily? Why do you suppose?
9. Does the salt or the pepper attract more easily to a charged rod? Is there a difference? Were you able to separate the pepper from the salt after you mixed them together?

ACTIVITY 4: STICKY TAPE

- Pull two approximately 3-inch strips of tape from the roll, being careful not to let them touch anything but the tip of your finger as you pull them off.
- As the strips dangle from your finger, observe what happens when you try to bring them together.
- Discharge each strip by passing it lightly between two fingers.
- Note: If you need to recharge the strips, press each strip lightly to the tabletop and pull it off; you do not need to use fresh strips each time.
- Stick the pieces of tape together, being careful to attach the sticky side of one piece to the flat side of the other (do not adhere sticky to sticky, and leave yourself a little overlap at the end). Peel them apart, and note what happens.



QUESTIONS

10. On a freshly pulled strip, is the distribution of charge uniform? How do you know? Which side of the strip of tape should be negatively charged, and why?
11. In each situation, explain why the strips either repel or attract each other.



Why is this girl smiling? Shouldn't she be shrieking?

ACTIVITY 5: VAN DE GRAEFF GENERATOR

- Stand on the insulating platform provided. Place one hand on the sphere of the van de Graeff while it is not plugged in, and have someone plug in the generator. Keep one hand on the sphere while it charges. Observe what happens.
- Switch the generator off and discharge the sphere.
- Stand on the insulating platform and hold the fluorescent tube vertically. Have someone switch the generator on, and watch the bulb as the sphere charges.
- Turn the bulb horizontally and watch what happens. Alternate the bulb between vertical and horizontal.

QUESTIONS

12. Why does your hair stand on end when you are touching the sphere?
13. If the day is especially humid, why is it much harder to make your hair stand up?
14. If the van de Graeff can generate literally thousands of volts, why don't you get electrocuted? Why, then, can the 110 volts of a household circuit injure or even kill you?
15. Would you still be safe if we replaced the insulating platform with a metal one? Explain.
16. Why won't the fluorescent tube light when the bulb is held vertically?