Static Electricity Electrified Objects

<http://somup.com/cY1QFtQlBS> Components of Static Electricity (5:31)

What are some properties of Electric Objects?

# **Introduction**

# **Purpose** To investigate properties of electric objects.

**Discussion**

In the first part of static electricity and magnetism, you thought about some of the similarities and differences between magnetic and electric objects by experimenting with many different materials. In the previous activities you explored some of the properties of magnetic objects by investigating effects on and by unrubbed nails and magnet-rubbed nails.

# **Materials** Coffee Stirrer Wool Cloth or Rabbit’s Fur

#  Styrofoam (Plate or Square) 1 ft2 Piece of Acrylic

#  Static Electricity “TORSION” Apparatus Pie Tin Apparatus

**Procedures**

1. Previously you found that a wool rubbed stirrer attracted an unrubbed test stirrer. Copy and complete the prediction table below by predicting what you think would happen to as an uncharged/unrubbed coffee stirrer and then a charged/rubbed coffee stirrer in the Static Electricity Torsion Apparatus as the various listed objects are brought nearby. Place an (**A**) in the box if you think the stirrer will be attracted towards the object; place an (**R**) in the box if you think the stirrer will be repelled away from the object; and place an (**O**) in the box if you think there will be NO noticeable response between the object and the stirrer.

**PREDICTION TABLE**

|  |  |  |
| --- | --- | --- |
|  | Effect on “unrubbed” coffee stirrer | Effect on wool “rubbed” coffee stirrer |
| Wool/fur rubbed coffee stirrer |  |  |
| STYROFOAM rubbed on a piece of acrylic |  |  |
| ACRYLIC rubbed on a piece of Styrofoam |  |  |

2. Remove all static from the objects **BEFORE** you use them as shown by the teacher. This procedure we will call “Unrubbing.”

3. Place an “unrubbed” coffee stirrer in the Static Electricity Torsion Apparatus.

1. Complete the observation table below according to what actually happens to the coffee stirrer in the Static Electricity Torsion Apparatus as you bring the various objects near it. Use the same symbols as in the prediction table.
2. Take the coffee stirrer out of the apparatus and rub it vigorously on one end with a wool cloth. Place it in the apparatus and retest all the objects, filling out the chart.

**OBSERVATION TABLE**:

|  |  |  |
| --- | --- | --- |
|  | Effect on “unrubbed” coffee stirrer | Effect on wool “rubbed” coffee stirrer |
| Wool/fur rubbed coffee stirrer |  |  |
| STYROFOAM rubbed on a piece of acrylic |  |  |
| ACRYLIC rubbed on a piece of Styrofoam |  |  |

 Did your results match your predictions? List any discrepancies and possible reasons.

6. Re-rub the Styrofoam square against the piece of acrylic. First bring the Styrofoam near your bare arm and describe the feeling. Then, bring the rubbed acrylic piece near your arm. What happens? Describe the feeling on your arm.

**7. PREDICT** what would happen if you rubbed the Styrofoam piece vigorously against the acrylic piece, separated them, and then brought them close to each other again. Would they attract, repel or have no effect on each other?

 How did you decide?

**8. TEST** your prediction in #7 and record your findings.

**9. PREDICT** what would happen if you rubbed TWO pieces of Styrofoam against a clean piece of acrylic and then brought the two rubbed Styrofoam pieces near each other *(the rubbed sides*). Would they attract, repel or have no effect on each other?

 How did you decide?

**10. TEST** your prediction in #9 and record your findings.

11. Wool rubbed coffee stirrers repelled each other as seen earlier in this activity. **PREDICT** what would happen if you take a wool rubbed coffee stirrer and dip it in water BEFORE bringing it near a wool rubbed stirrer in the Torsion Apparatus.

**12. TEST** your prediction in #11 and record your findings. Give an explanation for your observations.

13. Obtain a Pie Tin apparatus which you will use with the Torsion apparatus and one coffee stirrer. You will also need a wool cloth.

14. Clear off the table so that there is plenty of room for these next procedures. You will perform a similar experiment with the Pie Tin apparatus and Torsion apparatus that you did with the floating magnet around the bar magnet.

15. Use a piece of wool to vigorously rub the Styrofoam cup of the Pie Tin apparatus. Lay the Pie Tin apparatus in the center of a large open area on your lab counter or desk.

16. Unrub a coffee stirrer. Then, use the piece of wool to rub ONE END of a coffee stirrer and set it in the Torsion apparatus. Place the Torsion apparatus about 15 cm from the Pie Tin apparatus. Observe what happens to the coffee stirrer. Be sure you can distinguish between the unrubbed end of the coffee stirrer and the rubbed end.

17. Move the test stand to position #2 and let the coffee stirrer settle in some orientation. Record your observations by copying the drawing below and showing the orientation of the coffee stirrer toward the Pie Tin Styrofoam cup apparatus.

1

2

3

4

5

6

7

8

18. Re-rub the coffee stirrer and the Styrofoam cup vigorously with the piece of wool after every TWO measurements.

19. Repeat the previous procedures until you have placed the Torsion apparatus at positions #1-8. Be sure to “re-rub” the coffee stirrer and Styrofoam cup every two measurements. Make a drawing to represent the coffee stirrers’ orientation at each of the eight positions.

20. In looking at the orientations of the coffee stirrer at different positions around the rubbed cup, what particular pattern of behavior (if any) can you describe?

21. Go back to the magnetic pattern that you observed when you moved the floating nail around the bar magnet …

a. What is similar between the electric pattern you observed and the magnetic pattern?

b. What is different between the electric pattern you observed and the magnetic pattern?

c. Can you make any inferences based on these patterns? If so, what?

**22. PREDICT** what would happen if you performed a similar experiment to the Pie Tin and Torsion apparatus, except you move the Torsion apparatus 30 cm from the Pie Tin apparatus.

**23. TEST** your prediction in #22 and record your findings. Make another drawing (be sure to label the drawing) or your results in all 8 positions. Describe any difference in terms of the strengths of the attractive or repulsive forces between the Styrofoam cup and the coffee stirrer.

**24. TEST** the apparatus one more time, but this time place the Torsion apparatus 45 cm from the Pie Tin apparatus. Describe your observations in terms of the strengths of the attractive or repulsive forces between the Styrofoam cup and the coffee stirrer.

**Conclusions and Questions**

1. How is an electric object produced?

2. How does a rubbed electric object interact with another rubbed electric object?

3. Do electric objects seem to retain their properties for a long time?

4. Why does dipping a rubbed electric object in water seem to effect it?

5. How does the influence of an electric object change with distance from it?

6. Update the “Big Ideas” list for Static Electricity and Magnetism.

**OBSERVATION TABLE**:

|  |  |  |
| --- | --- | --- |
|  | Effect on “unrubbed” coffee stirrer | Effect on wool “rubbed” coffee stirrer |
| Wool/fur rubbed coffee stirrer | A | R |
| STYROFOAM rubbed on a piece of acrylic | A | R |
| ACRYLIC rubbed on a piece of Styrofoam | A | A |

 Did your results match your predictions? List any discrepancies and possible reasons.

* ***Students should look at their prediction table and their actual results to compare. Then, give some reasons why their results may have differed from their predictions.***
* ***Evidence for Opposite Charges … charges were once designed as charge A and charge B. Benjamin Franklin coined the “+” and “-” designations for charges.***
* ***“Likes Repel” while “Opposites” attract***
* ***The “wool” has excess electrons. Therefore, the object rubbed by wool usually will take on a NEGATIVE charge (electrons transferred to the object).***
* ***Styrofoam and Wool rubbed coffee stirrer have the same charge (repel each other)***
* ***Acrylic is most likely POSTIVELY charged.***

6. Re-rub the Styrofoam square against the piece of acrylic. First bring the Styrofoam near your bare arm and describe the feeling. Then, bring the rubbed acrylic piece near your arm. What happens? Describe the feeling on your arm.

* ***Both rubbed items (Styrofoam & Acrylic) produce similar results on the arm (arm is neutral while the Styrofoam & Acrylic are charged). The hairs should have been attracted to the rubbed item.***
* ***One could sense an electric charge (electrostatics).***

**8. TEST** your prediction in #7 and record your findings.

* ***Since Styrofoam takes on a negative charge when rubbed with Acrylic and Acrylic takes on a positive charge when rubbed with Styrofoam, the pieces should have an attractive force between them.***
* ***Distinguish electrostatics and adhesion.***

**10. TEST** your prediction in #9 and record your findings.

* ***Since Styrofoam takes on a negative charge when rubbed with Acrylic, both Styrofoam pieces should have the same charge … repel each other.***
* ***Sometimes, one needs to be creative to observe the repulsion. E.g. use smaller pieces of Styrofoam. Place one piece on the table (rubbed side up) and drop the other piece (rubbed side down) on top of it from 6 inches.***

**12. TEST** your prediction in #11 and record your findings. Give an explanation for your observations.

* ***The water will take away the charge produced through rubbing the stirrer. Humidity (water) has a large effect on electrostatics.***
* ***Since the dipped stirrer is neutral, it will be attracted to the rubbed stirrer.***

13. Obtain a Pie Tin apparatus which you will use with the Torsion apparatus and one coffee stirrer. You will also need a wool cloth.

14. Clear off the table so that there is plenty of room for these next procedures. You will perform a similar experiment with the Pie Tin apparatus and Torsion apparatus that you did with the floating magnet around the bar magnet.

15. Use a piece of wool to vigorously rub the Styrofoam cup of the Pie Tin apparatus. Lay the Pie Tin apparatus in the center of a large open area on your lab counter or desk.

16. Unrub a coffee stirrer. Then, use the piece of wool to rub ONE END of a coffee stirrer and set it in the Torsion apparatus. Place the Torsion apparatus about 15 cm from the Pie Tin apparatus. Observe what happens to the coffee stirrer. Be sure you can distinguish between the unrubbed end of the coffee stirrer and the rubbed end.

17. Move the test stand to position #2 and let the coffee stirrer settle in some orientation. Record your observations by copying the drawing below and showing the orientation of the coffee stirrer toward the Pie Tin Styrofoam cup apparatus.

R

U

1

2

3

4

5

6

7

8

R 🡪 rubbed

U 🡪 Unrubbed

R

* ***The electric FIELD produced shows the stirrer pattern going OUT from the charged Styrofoam cup (the unrubbed stirrer end is nearest the Styrofoam cup).***
* ***There is NOT a LOOP field as in magnetism.***

18 Re-rub the coffee stirrer and the Styrofoam cup vigorously with the piece of wool after every TWO measurements.

19 Repeat the previous procedures until you have placed the Torsion apparatus at positions #1-8. Be sure to “re-rub” the coffee stirrer and Styrofoam cup every two measurements. Make a drawing to represent the coffee stirrers’ orientation at each of the eight positions.

20 In looking at the orientations of the coffee stirrer at different positions around the rubbed cup, what particular pattern of behavior (if any) can you describe?

***All the objects pointed outward.***

21 Go back to the magnetic pattern that you observed when you moved the floating nail around the bar magnet …

a. What is similar between the electric pattern you observed and the magnetic pattern?

***All objects responded.***

b. What is different between the electric pattern you observed and the magnetic pattern?

***There is NO loop pattern with the static electricity.***

c. Can you make any inferences based on these patterns? If so, what?

***There are significant differences between static electricity and magnetism.***

**22 PREDICT** what would happen if you performed a similar experiment to the Pie Tin and Torsion apparatus, except you move the Torsion apparatus 30 cm from the Pie Tin apparatus.

**23 TEST** your prediction in #22 and record your findings. Make another drawing (be sure to label the drawing) or your results in all 8 positions. Describe any difference in terms of the strengths of the attractive or repulsive forces between the Styrofoam cup and the coffee stirrer.

 ***Force is inversely proportional to the square of the distance between the charged objects (F = 1/d2). The greater distance caused a smaller electrostatic force.***

**24 TEST** the apparatus one more time, but this time place the Torsion apparatus 45 cm from the Pie Tin apparatus. Describe your observations in terms of the strengths of the attractive or repulsive forces between the Styrofoam cup and the coffee stirrer.

 ***Force is inversely proportional to the square of the distance between the charged objects (F = 1/d2). The greater distance caused a smaller electrostatic force. The force will become too small to affect the objects.***

**Conclusions and Questions**

1. How is an electric object produced?

***Friction (rubbing)***

1. How does a rubbed electric object interact with another rubbed electric object?

***Attract or repel based on charged objects***

1. Do electric objects seem to retain their properties for a long time?

***No. Electrostatics is short lived especially compared to magnetism.***

1. Why does dipping a rubbed electric object in water seem to effect it?

***The water neutralizes or absorbs the charge.***

1. How does the influence of an electric object change with distance from it?

***Force is inversely proportional to the square of the distance between the charged objects as described by F = 1/d2.***

1. Update the “Big Ideas” list for Static Electricity and Magnetism.