INVESTIGATIONS

WITH

STATIC ELECTRICITY

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INTRODUCTION

In these investigations, you will be using the laboratory to learn what makes things behave the way they do. Specifically you are to try to learn how nature's laws of electrification work and to seek some pleasure in speculating on the how's and why's. The essential element of laboratory work is honest, perceptive, and accurate observations. Any preconceptions that you may possess should be ignored when making observations.

Record observations when you see them. At the same time, you should write down any questions and/or ideas for further investigation. In addition you should write some conclusions based on investigations to date. But first and foremost, you must set down your observations in a manner in which you could expect to understand two months later. It is a good plan to keep your lab record in the form of a diary with the date on each page. In this way, it should be clear to you what observations are made and recorded in the lab and won't be confused with inferences and conclusions made subsequently on the basis of additional lab work and/or other work. The apparatus used is quite simple. However, don't be fooled. The phenomena are not necessarily simple, and certainly not trivial.

There is an old saying in science that the easiest things to observe are the hardest to understand. Care, patience, and persistence are often required to determine which is reproductible from that which is accidential. Investigations rarely prove anything, but should teach you something. (The complaint that the "experiment doesn't work" or the "apparatus doesn't work" is usually as apt as complaining that the pencil doesn't work when it is out of lead.) Keen eyes, skilled hands, open minds, and judicious, accurate observations are the hallmarks of good investigations.

Now begin your investigation and see if you can reach the same conclusions as others including your teacher.

ELECTROSTATIC ACTIVITIES

SECTION 1 ELECTROSTATIC INTERACTIONS

1.1 Tear part of a piece of paper into small bits. Take a plastic drinking straw and bring it close to the bits of paper. Can you lift the bits of paper by touching them with the straw?

1.2 Now rub the straw briskly with fur or wool or against your hair and try to lift the bits of paper from the table.

1.3 Can the scraps of paper be lifted even if you do not allow the rubbed straw to touch them first? Repeat this using the styrofoam coffee cup, trying to lift the paper bits before and after rubbing the cup on wool, fur or your hair.

1.4 Apparently, after the straw has been rubbed there is an interaction between the straw and paper which is capable of lifting the scraps of paper. What can you say about the size of this interaction compared to that of the earth's gravitational interaction with the scraps of paper?

1.5 The force involved in this interaction is called an electrical force, and was first observed by the Greeks, who found that pieces of amber (in Greek, elektron) attracted other things after being rubbed with fur. The materials which are capable of attracting the bits of paper are said to be electrically charged.

1.6 Can you conclude at this time that the bits of paper are charged? Why do you think what you do? Are they charged according to the definition in section 1.5? How could you test for this? Record your findings.

SECTION 2 CHARGED STATES OF MATTER

A. Interaction between charged and uncharged objects

2.1 Take a piece of 15-cm piece of scotch magic tape and make tabs by folding the first few centimeters of tape on each end, sticky side together. Stick the tape to a block of wood and press and rub it down well with your finger. Now peel the tape carefully but briskly from the wood.

2.2 Will either or both sides of the tape attract the scraps of paper?

2.3 Does the tape meet the definition of being charged?

2.4 Roll a piece of paper into a tube and bring it near the tape. Is there an interaction between the paper tube and the tape?

2.5 Does the paper tube meet your definition of being charged? Why or why not? Record all answers.

B. Interaction between two charged objects.

2.6 Make a second tape strip like the first one. Press them both down on the piece of wood separately, and then peel them loose from the wood. Try bringing the tapes near each other. How does one affect the other? Does the sticky or non-sticky side make a difference?

2.7 Make a third strip of tape, press it to the wood and remove. Bring it close to the other two. What do you observe?

2.8 What is your present definition of an electrically charged object based on observations to date? Record all findings.

2.9 Make a stand by taping the long end of a flexible straw to an upside down styrofoam cup with masking tape. Bend the top of the straw horizontally and stick one of the pieces of charged tape to the straw so that it hangs down. (This will be called the test tape.)

2.10 Make two new pieces of tape as before. Label one 'A' and press it to the block of wood. Label the second one 'B' and press it firmly down on top of 'A'. Peel the two pieces of tape from the wood making sure that they remain stuck together. Bring them near the test tape. What do you observe? Bring the combination near some paper bits. What do you observe? Is the combination tape charged? Record your findings.

2.11 Now run the non-sticky side of the tape combination across your lips or across a water pipe or gas jet. Again bring the combination tape near the test tape and bits of paper. Record your findings.

2.12 Carefully peel apart the two tapes. Hold one in each hand and bring them slowly toward each other. Record your findings.

2.13 Bring each tape separately towards the test tape. Record your findings.

2.14 Can you tell with certainty from this experiment that both tape 'A' and 'B' are charged. Record your findings.

2.15 Can you devise any additional experiments that will show convincingly that both 'A' and 'B' are charged. Try any that you devise. Results?

2.16 Now, write your definition of a charged object based on all investigation to date?

2.17 You have been using attractive and repulsive interactions to test for charged objects. How reliable do you feel the tests are? Would either test alone be sufficient? If so, which one? Again record your findings.

2.18 Make another test stand with a cup and straw and hang tape 'A' from one stand and tape 'B' from the other. Try rubbing various objects including your straw and a foam cup against various materials and test them by bringing them near 'A' and 'B'.

2.19 Which objects affect 'A' and 'B' differently? Which object(s) affect 'A' and 'B' similarly? Keep track of all findings.

2.20 Which objects are charged? Record your findings.

C. Charges and charged states.

2.21 If two charged objects behave the same in their interactions with all other objects, we will describe them as being in the same charged condition. We will suppose that a charged object is charged because of the presence of something called charge. With this hypothesis, we need to account for the charged states of tapes 'A', 'B', and the bits of paper in terms of the kind(s) of charge present.

2.22 How does one tape 'A' react with another tape 'A'? One tape 'B' with another tape 'B'?

2.23 Based on one's experience to date, would you say that the two 'A' tapes have the same or different charge? What about the two 'B' tapes? What about a tape 'A' compared to a tape 'B'? Record your findings.

2.24 Now consider the paper. How does one piece of paper react to another bit?

2.25 Considering how the paper interacted with the tape, could one assume the paper has a third type of charge? Why or why not?

2.26 Based on these observations, can you conclusively say that the paper bits have absolutely no kind of charge?

2.27 If we assume that there are only two kind of charges, one associated with tape 'A' and the other with tape 'B', how would one explain the charged state of each tape and the interactions of the tapes and paper bits? Record your findings.

2.28 Prepare another set of 'A' and 'B' test tapes. Briskly rub a foam pad or foam paper plate with the wool or fur. Bring the foam pad or plate and then the wool or fur near the test tapes. Is either charged? If so, which tape has the same charge as the charged objects?

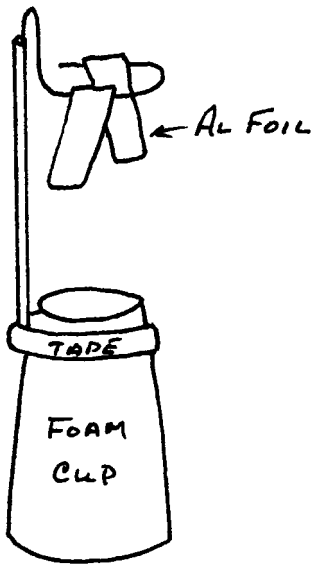
SECTION 3 BUILDING ELECTROSCOPES

3.1 Take a small piece of aluminized paper straw and fasten a 10-cm piece of polyester sewing thread to the straw. (We will refer to the piece of aluminized straw as the "pith ball" in the remainder of this packet.)

3.2 Make a stand to hold the pith ball by taping a flexible drinking straw to an upside down foam coffee cup with masking tape. (You may modify one of the stands you made earlier to hold tape 'A' or 'B'.) Bend the top of the straw horizontal and cut a vertical slit (with a razor blade) in the end of the horizontal segment. Slip the string of one or more "pith balls" into the slit and adjust their lengths to suit your needs.

3.3 Set up your stand with a pith ball hanging from it on about 10-cm of thread. Rub a plastic drinking straw with wool or fur and bring it near some paper bits. Is the straw charged? Now bring the straw near the pith ball. What happened? How can you use the pith ball to test for a charged object?

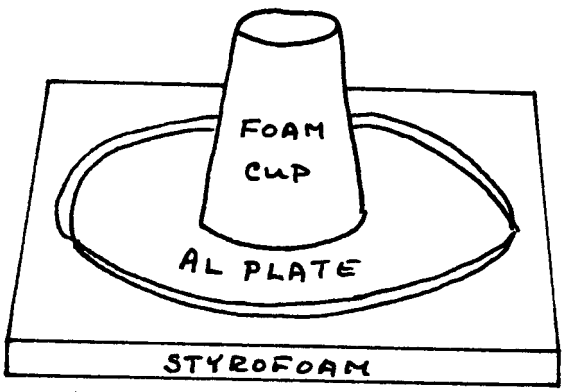
3.4 Now you will build a more sensitive electroscope. This is a very inexpensive version of the gold leaf electroscope. Modify the other stand you made for your test tapes by fastening the shorter end of the straw to the cup with masking tape and bending the straw so the long end is vertical. Bend the paper clip so the two U-shaped sections lie in perpendicular planes as in the diagram. Tape the paper clip to the top of the straw so that the longer U-shaped leg is now sticking out horizontally from the straw. Cut two strips of aluminum foil about a centimeter wide by five centimeters long and smooth them with your fingernail. Bend the top of each strip loosely around one of the horizontal bars of the paper clip, so that the strips swing freely from the bars.



3.5 Take a plastic drinking straw and rub it with wool or fur. Touch the pith ball with the straw. Is the straw charged? Touch the straw to the top of the paper clip on the electroscope. What happens to the foil leaves? How can you tell if an object is charged using the foil leaf electroscope?

SECTION 4 THE ELECTROPHORUS: A DEVICE FOR GENERATING STATIC ELECTRICITY

4.1 To make an electrophorus, take a styrofoam pad or disposable styrofoam picnic plate for the base. Take a disposable aluminum pie plate (8" or 9") and fasten an insulating handle to it by taping a styrofoam cup upside down in the center of the pie plate. You will also need to make a second pie plate with a foam cup handle for some of the experiments.



4.2 Rub the top surface of the foam with fur or wool to charge it. Slowly lower the electrophorus pie plate (henceforth called the electrophorus plate) to a height of a few millimeters above the foam while holding it by the cup handle. Be careful not to touch the pie plate with your hand or arm unless instructed to do so.

4.3 Still holding the electrophorus plate by the cup, raise it away from the foam. Touch the electrophorus plate to your leaf electroscope. Is the electrophorus plate charged?

4.4 Again lower the electrophorus plate to a point just above the foam, and this time touch the electrophorus plate briefly with your finger while it is on or just above the foam. What happens?

4.5 Slowly lift the electrophorus plate by the handle removing it from the foam. Do you feel any interaction between the electrophorus plate and the foam as you lift? Is it attractive or repulsive?

4.6 Touch the electrophorus plate to your leaf electroscope. Is the electrophorus plate charged?

4.7 Touch the electrophorus plate to your pith ball. What does the pith ball do? What can you say about the charge on the pith ball and the charge on the electrophorus plate?

4.8 Now bring the foam near the pith ball. What can you say about the charges on the pith ball and the foam pad?

4.9 Design an investigation that would determine the sign of the pith ball relative to the styrofoam? Do so and record the results.

4.10 Clearly the electrophorus is an effective, interesting and slightly puzzling charging device. Temporarily you will use it to supply charges for other experiments before trying to develop a better understanding of how it works.

4.11 Tape both a plastic straw covered with aluminum foil and a second regular straw with masking tape to the rim of the electrophorus plate so that both stick out horizontally. Set up the pith ball electroscope and briefly touch the pith ball with your finger. Rub the foam pad or foam plate with the wool or fur. Pick up the electrophorus plate by its handle, set it on the foam and touch it with your finger. Lift the electroscope plate by its handle, being careful not to touch the plate or the straws. Move the plate so that first the outer end of the plain straw touches the pith ball. Next touch the pith ball with the outer end of the foil covered straw. Record what happens.

4.12 Repeat the investigation but this time use the foil leaf electroscope. Again record the results.

4.13 Record how you feel the foil covered straw and the pith ball received the charge. Offer evidence that this is similar or different from the way that the tapes 'A' and 'B' received their charge.

4.14 Rub the foam with the fur or wool again. Pick up the electrophorus plate by its handle, set it on the foam and touch it with your finger. Lift the electrophorus plate from the foam, being careful not to touch

the plate or the straws. Touch the end of the plastic straw briefly with your finger. Now bring the electrophorus plate near the hanging pith ball. Is the plate still charged?

4.14 Now touch briefly the end of the foil covered straw with your finger. Bring the electrophorus plate near the pith ball. Is the plate still charged? Explain in writing why things behaved as they did.

4.15 Objects that behave like the plastic straw, the foam and the tape are called insulators. Objects that behave like the foil covered straw and the pith balls are called conductors. We will continue to look at the differences in their behavior and try to account for it while developing a model of electric charge. In a conductor we may imagine that one or both types of charge are free to move (in reality it is only one of the charges most of the time), whereas in an insulator neither type of charge can move very much or very readily.

4.16 Now use the electroscope and electrophorus to investigate a variety of materials of your choice to see if they behave like conductors or insulators. Record your findings.

4.17 Using the model described in the next to last paragraph above, can you explain the findings of your investigation in 4.1 through 4.3. You might consider using cartoon strips and/or other creative ways to record your results.

SECTION 5 THE BEHAVIOR OF THE ELECTROPHORUS

5.1 Rub the top surface of the foam with fur or wool to charge it. Touch the electrophorus plate (with both straws now removed) with your finger while it is in the air. What happens? Slowly lower the electrophorus plate to a height of a few millimeters above the foam while holding it by the cup handle. Be careful not to touch the aluminum plate with your hand or arm unless instructed to do so.

5.2 Still holding the electrophorus plate by the cup, raise it away from the foam. Touch the electrophorus plate to your leaf electroscope. Is the electrophorus plate charged?

5.3 Again lower the electrophorus plate to a point just above the foam, and this time touch the electrophorus plate with your finger while the electrophorus plate is on or just above the foam. What happens?

5.4 Take your finger away and lift the electrophorus plate by the handle. Do you feel any interaction between the electrophorus plate and the foam pad as you raise the plate?

5.5 Touch the electrophorus plate to your leaf electroscope. Is the electrophorus plate charged? What is the charge on the electrophorus plate? Is it like the charge on the foam? How can you tell?

5.6 Touch the electrophorus plate briefly with your finger while it is in the air. What happens when you do this? Is the plate still charged? Again lower the electrophorus plate this time letting it rest on the foam, and touch the electrophorus plate with your finger while it is on the foam. What happens?

5.7 Take your finger away and lift the electrophorus plate by the handle. Is the interaction between the electrophorus plate and the foam pad as you lift it the same as before?

5.8 Touch the electrophorus plate to your leaf electroscope. Is the electrophorus plate charged? Is the charge like that on the foam? Did it matter if the electrophorus plate was in contact with the foam?

SECTION 6 FORCE AND DISTANCE

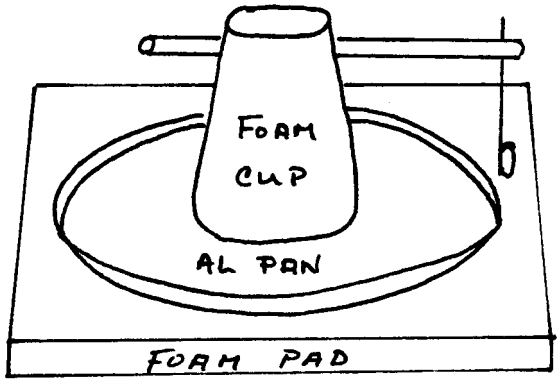
6.1 Let's now investigate how the electrical interaction or force between charged objects depends on distance. To estimate the reaction, you will "feel" the interaction. First place the electrophorus on the foam. Take the electrophorus plate by the handle, touch it briefly with your finger and then raise the electrophorus plate from the foam. You may have to hold the foam to the table. Can you sense any difference in the force as the plate is moved further away?

6.2 Repeat the above but this time not holding the foam to the table.

6.3 Take your stand with one pith ball hanging from it. Touch the pith ball briefly with your finger. Take the electrophorus plate by the handle, touch the electrophorus plate briefly with your finger, set the electrophorus plate down on the foam, touch it briefly with your finger, then lift the plate from the foam and touch it to the hanging pith ball. What happens to the pith ball as you vary the distance the electrophorus plate is from it? Record how your findings. Anything new?

SECTION 7 THE INDICATING ELECTROPHORUS

7.1 Take a plastic straw and using masking tape, fasten it horizontally to the top of the cup that serves as the handle of the electrophorus plate so that it extends over the edge of the pie plate. (Or you could take a pencil and poke holes in the cup near the top and slide the end of the straw into the holes.) Cut slits in one end of the straw and suspend a pith ball so that it is just touching the rim of the electrophorus plate as shown at the right.



7.2 Touch the electrophorus plate briefly with your finger to discharge it. Then lower it onto the foam. Record what happens to the pith ball. Next move the electrophorus plate up and down above the foam. Record what happens to the pith ball. Also record what you think happens to the charges on the rim of the electrophorus plate and the pith ball as you move the plate closer to the foam.

7.3 Again discharge the electrophorus plate with your finger while it is in the air. Lower the plate onto the foam and bring a second aluminum plate with cup handle near the pith ball. What happens?

7.4 Move the aluminum plate closer to the electrophorus plate until nothing more happens. Based on your observations, record what you feel is happening.

7.5 Once again, discharge the electrophorus plate with your finger while it is in the air and lower it onto the foam. Discharge the aluminum plate and once again bring it closer to the electrophorus plate until nothing happens. Move the aluminum plate away. Now raise the electrophorus plate from the foam and observe the position of the pith ball as you move the electrophorus plate above the foam. Record how (if any) the behavior of the pith ball relates to the force that you feel.

7.6 What can you conclude about the amount of charge on the rim of the electrophorus plate as you move it away from the foam? Account for the change(s). Is the charge on the electrophorus plate the same type as the charge on the pith ball?

7.7 Now bring the aluminum plate near the pith ball being careful not to let them touch. What happens? Is the aluminum plate charged? Test this by touching it to the leaf electroscope.

7.8 Is the charge on the aluminum plate the same as that on the electrophorus plate or the same as that on the foam pad? Test this by touching the aluminum plate to your pith ball electroscope and then bringing the foam near the pith ball electroscope. Make any other investigations that you wish. When completed, record your findings regarding the charged states of the foam, the electrophorus plate and the aluminum plate.

7.9 Rub the foam with the wool or fur to "refresh" the charge. Hold the electrophorus plate by its handle and discharge it by briefly touching it. Carefully lower the electrophorus plate onto the foam while watching the behavior of the pith ball. Bring the discharged aluminum plate near the pith ball as the electrophorus plate sits on the foam. Observe the pith ball as you do this. Was there a movement of charge?

7.10 When electric charges move from one place to another, we say that there is an electric current. Was there an electric current between the plates? Does the behavior of the pith ball tell you anything about how fast the charge is transferred? Or, about the size of the current that is flowing? Record your findings.

7.11 Once again take both plates away from the foam and discharge them with your finger. Lower the electrophorus plate onto the foam. Watch the behavior of the pith ball. Bring the aluminum plate near the pith ball as before while the electrophorus plate is sitting on the foam. Move it closer until the pith ball ceases to move. Remove the aluminum plate but do not set it down or touch it. Next lift the electrophorus while watching the behavior of the pith ball. What happens? Does a current flow? Record your findings.

7.12 When nothing more is happening, test the plates for charge by touching each of them in turn to the leaf electroscope. Also test the foam for charge. Record your findings.

7.13 Also record how you explain the behavior of the electrophorus.

SECTION 8 THE NEON BULB AND A CONVENTION FOR CHARGE

8.1 A NE-2 neon bulb has been fastened to a piece of plexiglas with two leads extending from the plexiglas. To use the neon bulb, touch the second lead with your hand while touching the other lead to a charged object while watching the electrodes.

8.2 Refresh the charge on the foam pad. Hold the electrophorus plate by its handle and discharge it. Lower it onto the foam and touch the electrophorus plate with a lead from the neon bulb while holding onto the other. Do you see a flash? Did it flash from the electrode coming from the plate or your hand? Repeat the experiment until you are sure. Now turn bulb around and repeat the experiment holding the bulb by the other lead. Does the flash occur at the plate or hand electrode? Record your findings.

8.3 Now try the following sequence. Refresh the charge on the foam. Discharge the electrophorus plate. Lower the plate onto the foam and touch the plate with one lead of the neon bulb while holding the other lead. Watch for the flash. Remove the bulb, and then lift the electrophorus plate from the pad. Now touch the electrophorus plate again with the lead from the neon bulb. Did the same electrode flash as before? Repeat the experiment until you are sure of your results. Record your findings.

8.4 When one lead of the neon bulb is held in the hand and the other end touches a charged object, it is the cathode (more-negative) terminal that glows. Thus the lead associated with the glowing terminal identifies the more NEGATIVE surface. This glowing terminal will also identify the direction of electron flow (from the glowing to the non-glowing terminal) as electrons always move away from the more negative and toward the more positive object. Of course, if positive charges move, they will move in the opposite direction. This definition turns out to be in complete agreement with Benjamin Franklin's arbitrary decision to call the charge on a glass rod rubbed with silk - POSITIVE charge. We can now use the neon bulb to determine the charge on any object.

8.5 Refresh the charge on the foam and see if you can determine its charge. Whether you will be able to see a flash depends on how highly charged the foam surface is. Record your findings.

8.6 Next lower an uncharged electrophorus plate onto the foam. Touch it briefly with your finger and then remove the electrophorus plate. Determine the charge of the plate. Is it the same as that of the foam? You have now seen how one can use the neon bulb to indicate the type of charge and the direction that charges move.

8.7 You are now ready to make a final investigation of the behavior of the electrophorus. To do this, take a bit of masking tape and tape one electrode of the neon bulb to the rim of the second pie plate so that the bulb and the other lead stick out horizontally perpendicular to the rim. You may now use this bulb to investigate the direction of charge transfer in the charging and discharging of the pie plates.

8.8 Refresh the charge on the foam pad, and once again discharge the pie plates. Lower the electrophorus plate onto the foam. Watch carefully while you bring the second pie plate near the first so that the untaped lead of the neon bulb touches the electrophorus plate while the electrophorus plate is sitting on the foam. Observe which electrode flashes. Move the second plate away, lift the electrophorus plate, and while they are in the air, bring the plates together so that the untaped lead of the neon bulb again touches the electrophorus plate. Observe which electrode flashes. When did currents flow? In which direction did they flow? What was the state of charge of the electrophorus plate at each stage of the experiment? Of the second plate at each stage?

8.9 At this point you have investigated the effect of distance on the electrical interaction, the difference between the behavior of charged conductors and insulators, and accounted for three charged states of objects with two kinds of charge. Use the features of this model to account for the behavior of the electrophorus plate and the second plate. Consider especially the type of charge you found on each plate, the direction of the charge flows and the changes that occur in the charged state of the plates as you carried out the procedure of charging and discharging the electrophorus. Make a diagram that shows the sequence of charging and discharging and the charge state of the foam, the electrophorus plate and the second plate at each stage. Record your findings and share with your instructor.

8.10 At the beginning of these activities, we used the attraction between neutral bits of paper and a charged object as part of our initial test for an object being charged. Bring a charged plastic straw near bits of paper. Also bring it near some foil bits. Bring it near the uncharged pith ball electroscope. Bring it near the leaf electroscope. Record you findings and specific explanation for each investigation.

Static Electricity Questions -1-

1.1 Does regular plastic straw (not rubbed) attract bits of paper?

1.2 Does plastic straw rubbed with fur or wool attract bits of paper?

1.3 What if plastic straw is near but not touching?

1.4 What will a foam cup rubbed with wool do to bits of paper?

1.6 Based on this information, are the bits of paper charged?

2.2 Does either side of scotch magic tape attract bits of paper?

2.3 Does the tape meet the definition of being charged?

2.4 Is there an interaction between the rolled paper and the tape?

2.5 Does the paper tube meet the definition of being charged?

2.6 How does one piece of tape affect the other?
Does the sticky or non-sticky side make a difference?

2.7 What does a 3rd piece of tape do when brought near the other two?

2.8. What is your present definition of electric charge?

2.10 How do the 2 pieces of tape stuck together affect tape electroscope?
How does it affect bits of paper?
Is the combination tape charged?

2.11 How does touching the non-sticky side affect the results in 2.10?

2.12 How does one of the pieces affect the other after being pulled apart?

2.13 How does each affect the tape electroscope?

2.14 Are you "positive" that both tape 'A' and 'B' are charged?

2.15 What experiment can you devise to give convincing evidence?

2.16 What is your definition of charge to date?

2.17 How reliable do you feel the tests you have done are?
Would either test be sufficient?

2.18 What objects did you test against tapes 'A' and 'B' electroscopes?
Results?

2.22 How do two tape "A"'s react with another? Two tape "B"'s?

2.23 What can you say about the charges on each tape 'A'? each tape 'B'?
What can you say about tape 'A' compared to tape 'B'?

2.24 How does one bit of paper react with another?

2.25 Could the paper have a third kind of charge?

2.26 Are you sure that the paper has no charge?

2.27 If only 2 kinds of charge, how can you explain behavior of tape? paper?

2.28 Does the foam and the fur or wool have a charge like tape 'A'? 'B'?

3.3 How does the rubbed straw affect the pith ball electroscope? How can you use the pith ball to test for charged objects?

3.5. How does a rubbed straw affect the foil electroscope?

4.3 Does bringing the electrophorus plate near the foam give it a charge?

4.4 What happens when you touch the aluminum plate when it is on the foam?

4.5 What interaction (if any) exists when you lift the aluminum plate?

4.6 Was the electrophorus plate charged? How do you know?

4.7 How does the electrophorus plate affect the pith ball electroscope? How does the charge on the ball compare to that on the plate?

4.8 How does the foam affect the charged pith ball?

4.10 What investigation can you perform to show the sign of charge on the pith ball and foam?

4.11 How does the plastic straw affect the pith ball? aluminumized straw?

4.12 How does replacing the pith ball with the foil electroscope affect the results?

4.13 Does touching the plastic straw affect the electrophorus plate?

4.14 Does touching the aluminumized straw affect the electrophorus plate?

4.16 How can you check if other objects are insulators or conductors?

4.17 How do you think the electrophorus work?

5.8 Explain how the electroscope becomes charged. What charge is on it? On the foam plate?

6.3 What happens to the electrostatic force as the distance between charged objects increases?

7.13 What conclusions can you write after completing section 7?

8.2 When touching the foam, which electrode flashed?

8.3 When touching the electrophorus, which electrode flashed?

8.5 What is the charge on the foam?

8.6 What is the charge on the electrophorus?

	Paper	Straw	FNoorl or	CUP	Stcoptech	Wood	TSacpope	FPolaamte	PBialthl	PSictohpe	RBalzaodre	FSocilpe	EPllectero phorus	ASltraw	APllate	NBeul2b	
1.1	x	x															Tape Electroscope
1.2	x	x	x														Foam cup
1.3	x	x		x													Flex straw
2.1					x	x											Masking Tape
2.2	x				x												Scotch Masking Tape
2.4	x				xxx												
2.6					x	x											Pith Ball Electroscope
2.7					x	x											Foam Cup
2.9							x										Flex Straw
2.10					x	x	x										Masking Tape
2.11					x		x										Thread
2.13							x										Al straw
2.16							xx										
2.28			x		xxxxx			x									Leaf Electroscope
3.1									x		x	x					Foam Cup
3.2										x							Flex Straw
3.3	x	x	x							x							Masking Tape
3.4												x					Paper Clip
3.5		x	x							x		x					Aluminum Strips
4.1								x					x				
4.2			x					x					x				
4.3								x				x	x				Electrophorus Plate
4.4								x					x				Al Pie Pan
4.5								x					x				Foam Cup
4.6												x	x				Tape
4.7										x			x				
4.8								x		x							
4.11			x					x					x	x	x		
4.12												x					Pieces of Paper
4.13			x					x		x			x				Regular Plastic Straws (4)
4.16										x		x	x				Flexible Plastic Straws (2)
5.2								x				x	x				Fur or Wool
5.3								x					x				Foam Coffee Cups (4)
5.4													x				Scotch Magic Tape
5.5								x				x	x				Block of Wood
5.6								x					x				Sheet of Paper
5.7													x				Styrofoam Picnic Plate
5.8												x	x				Aluminum Covered Straw
6.1								x					x				Masking Tape
6.3								x		x			x				Large Paper Clip
7.1		x							x		x		x				Aluminum Foil Strip (2)
7.2								x					x				Aluminum Pie Pans (2)
7.3													x		x		Polyester Thread
7.4													x		x		
7.5								x					x		x		
7.7												x			x		
7.8								x		x			x		x		
7.9			x					x					x		x		
7.11								x					x		x		
7.12												x					
8.1																x	
8.2								x					x			x	
8.3													x			x	
8.5								x									
8.6													x		x	x	
8.7															x	x	
8.8							x						x		x	x	
8.10	x	x								x		x				x	

Materials for Electrostatic Interactions

1. Pieces of paper
2. Plastic Drinking Straw - Regular (4)
3. Plastic Drinking Straw - Flexible (2)
4. Fur
5. Wool
6. Styrofoam Coffee Cup (4)
7. Scotch Magic Tape
8. Block of Wood
9. Sheet of paper
10. Styrofoam Pad
11. Styrofoam Picnic Plate (2)
12. Aluminum Covered Straw (2)
13. Duct Tape
14. Large Paper Clip (1)
15. Aluminum Foil
16. Aluminum Pie Pan (2)
17.

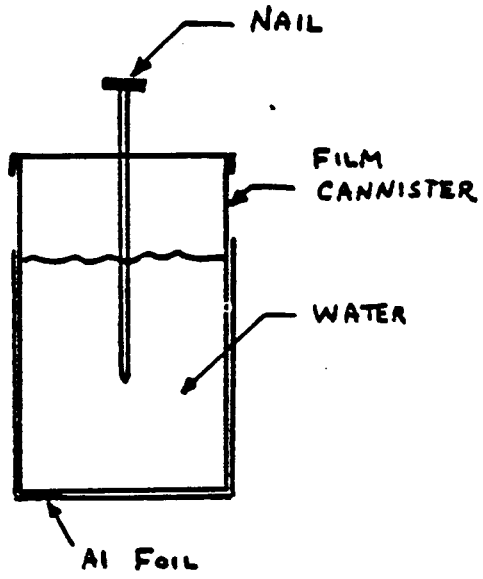
UNIT 26: THE LEYDEN JAR

Construct a Leyden jar by using a plastic film canister:

Step i. Push a nail through the plastic top.

Step ii. Wrap the outside in aluminum foil about 2/3 the way up.

Step iii. Fill the plastic canister 2/3 full of water.



LEYDEN JAR

1. Use your electrophorus to attempt to transfer one unit of charge into the water. (Touch the aluminum pie tin to the nail sticking out of the top of the Leyden jar while someone else holds the Leyden jar.) Touch the top of the nail with your finger to see if it is charged.

   OBSERVATION:_____

2. Transfer five units of charge to your Leyden jar. Check to see if any charge has accumulated by touching with your free hand.

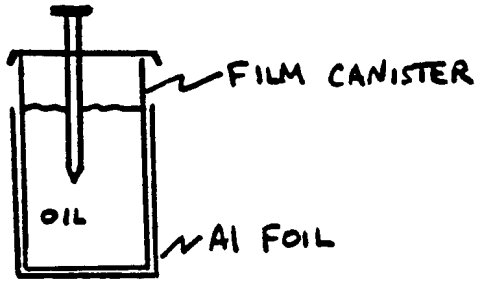
   OBSERVATION:_____

3. Transfer ten units of charge. Check to see if any charge has accumulated.

   OBSERVATION:_____

D. <u>The Plastic Cup with Various Substances Inside and Outside</u>

Construct the following "Leyden Jar" and observe how well they work.



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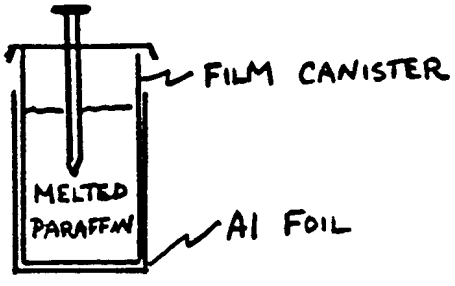

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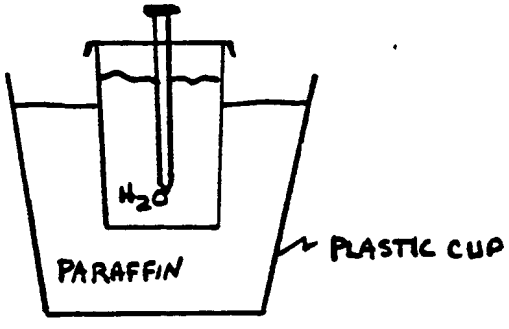

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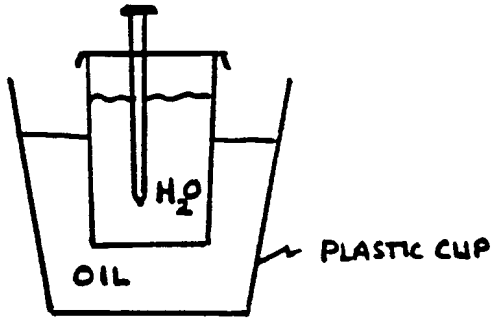

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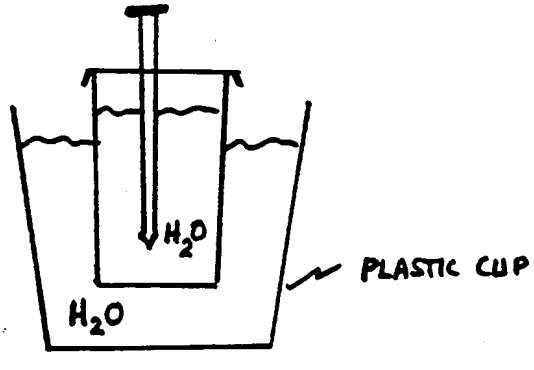
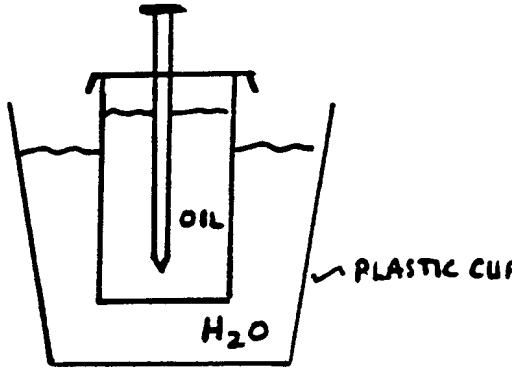


OBSERVATION: _____



OBSERVATION: _____

From your results of parts B, C and D, summarize the conditions necessary for the construction of a good Leyden Jar.