Introduction to Static Electricity

PHY407: A Physical Science Activity

Universiti Teknologi MARA
Fakulti Sains Gunaan

Name:_____ Lab #:_____

Outcomes

Upon completion of the activity, students will be able to:

- Describe the difference between electrically charged and uncharged objects and how they interact.
- Describe and explain the interaction between electrically like charges and opposite charges;
- Describe and explain the two ways to electrically charge an uncharged objects.

Background Information

Phenomenon such as hair raising, pieces of paper being attracted, balloons stuck to a wall and water running down from a tap being bent when a comb rubbed onto a sweater is brought near it, are common daily events that are observed. These phenomena are just some of the events that require investigations as to how and why they happen, what are the quantities involved and how intense the push or pull will be. The discovery of an electron with a mass of 9.1×10^{-31} kg (a mass that is far too small for us to encounter on a daily basis), and a proton with a mass 1,000 times bigger than the mass of an electron, led the scienctific community to better understand many of the interactions that occurred between objects especially in the phenomena described earlier. Scientists are able to associate these charges to chemical and physical interactions at the micro and macro level and one of the investigations at the macro level pertains to how objects acquire and exchange electrical charge. Normally, objects around us such wood, brick wall, balloons, and sweaters are electrically neutral which means that the number of positive charges and negative charges are equal (the object is electrically balanced) in the object. Often times the object will gain or lose electrons and hence making it negatively charged or positively charged. The area of physics that study the charge transfer and its interaction is known as electrostatics. The simplest way to charge an object is by rubbing it. Today, we will be charging balloons by rubbing them with a piece of cloth such as wool. We will put a dot on the balloon so we remember where it was rubbed. We can rub it with a lot of things to make it charged, for example hair is good at charging objects. But it messes up your hair if you rub things on your head. This is why we use a piece of wool such as socks and sweaters. The question (problem statement) we are trying is answer is “How are balloons which are rubbed by different material going to behave when brought near other balloons or other materials.” You will be making a number of observations and read about physical properties of matter before you form your hypothesis or make predictions about the behaviour of balloons.

Pre-lab activity (Do these before coming to lab. You will be quizzed at the beginning of the lab)

Visit the Physics Education Technology (PhET) at Boulder Colorado (http://phet.colorado.edu/new/get_phet/simlauncher.php) and download the "Ballons and Static Electricity" simulation. Alternatively, you may download it from my website (http://drjj.uitm.edu.my/DRJJ/itmclass/phy407.html). Experiment with the balloons by rubbing it on the brick wall or the sweater and observe and record what happens to the charges on the balloon, the sweater and the wall. In addition, observe and record what happens to the charges on the wall if the charged balloon is brought near it and when the balloon is released. Charge up the balloon even more and repeat the above procedure.

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Student Activity

Student Activity #1: Can objects which are not rubbed with other materials (neutral or uncharged objects) pull (attract) or push (repel) objects that are rubbed (non-neutral or charged) with other materials?

Materials

- 1 balloon
- Thread
- Small pieces of paper
- Water faucet
- Wall: concrete, metal, plastic
- Wool cloth or a piece of silk

Investigation 1

Activity 1.1

- Blow up the balloon as big as possible and tie off the end. Using a marker pen put a dot on one side of the balloon. This dot lets you know which area you rubbed. Record your predictions first before you perform the activity and record your observations in Table 1.1.

Prediction 1.1: What happened to the balloon in the following instances?

Table 1.1

Actions	Write your predictions here	Write your observations here
Near the pieces of paper?		
Near running water from a faucet?		

Actions	Write your predictions here	Write your observations here
Near the wall?		
Near any wall (wood, concrete, plastic…)?		
Near your hair?		

Activity 1.2

- Rub the balloon with the wool at the dot that you had initially marked.

Prediction 1.2: What happened when you put the charged part of the balloon (the dot);

[Record your predictions first before recording your observations in Table 1.2]

Table 1.2

Actions	Write your predictions here	Write your observation here
Near the pieces of paper?		
Near running water from a faucet?		
Near the wall?		
Near any wall (wood, concrete, plastic…)?		
Near your hair?		

Questions

1. What happened when you place the unmarked side of the balloon near the paper? Was it any different for the side of the balloon with the dot?
2. Could you get the balloon to stick on all of the different types of walls? How about the part of the balloon with the dot?
3. Did the part of the balloon with the dot attract the water? Away from the dot?
4. From these experiments, what can you say about how charged objects affect regular neutral (uncharged) objects like paper, walls, and water?

5. Why did we pick less heavy things like paper in our test rather than something heavy like a pen or a pencil?
6. After all of your observations, do you know now whether charged objects can attract neutral objects?

Student Activity #2 - The Balloon Electroscope

Materials

1. 2 identical balloons
2. Thread
3. Wool cloth, silk cloth, or piece of fake fur
4. Water sprayer per 2 groups

Activity 2.1

1. Blow-up the balloons as big as possible, tie the ends in a knot, and tie thread to the ends of each balloon.
2. Tie the balloons together using the thread so the balloons are about 80 cm apart.
3. Have one person hold the uncharged balloons by the thread and move the balloons together. Record observation.

Prediction 2.1: What happened when the uncharged balloons, hold by the thread, are moved closer together. Record your predictions first before you perform the activity and record your observations in Table 2.1.

Table 2.1

Actions	Write your prediction here	Write your observation here
Hold the uncharged balloons by the thread and move them closer		

Activity 2.2

- Rub each balloon all over with the wool as best as possible. Move one balloon near the other but do not allow them to touch. How do they react with each other?

Prediction 2.2: What happened when the charged balloons, hold by the thread, are moved closer together?

While the balloons are repelling each other, gently mist the balloons with water.

Record your predictions first before you perform the activity and record your observations in Table 2.2.

Table 2.2

Actions	Write your predictions here	Write your observation here
Hold the charged balloons by the thread and move them closer		
While the balloons are repelling each other, have the students gently mist the balloons with water.		

Questions

1. Why did the balloons repel each other after they were rubbed all over with the wool?
2. What would have happened if we rubbed one side of the balloons instead of all over?
3. Why did the balloons fall back towards each other after they were sprayed with water?
4. What effect does damp weather have on electrical charges?
5. During which time of the year would it be best to do experiments using static electricity?