Static Electricity: Charging by Friction | Grade 9, Academic, Physics

Lesson Introduction

Have you ever felt a "ZAP" after shuffling across a carpet or getting out of a car but weren't quite sure who you should blame? Have you ever seen a lightning bolt during a storm? Have you ever walked past a television and all the hairs on your arms stood on their ends even though it wasn't cold? Have you ever tried to separate clothes that were clinging to each other after taking them out of the dryer? Well live in fear no longer, as chances are you were merely the innocent victim of static electricity!

In this experiment, we'll be using a balloon and can to demonstrate **Static electricity**. When you rub the balloon on your hair or a piece of fur you're moving around tiny little pieces of electricity called electric charges. There are two kinds of electric charges, **positive charges** and **negative charges**. By rubbing the balloon on your hair or the piece of fur you're taking negative charges from the hair/fur and transferring them to the balloon. The balloon ends up negatively charged and the hair/fur becomes positively charged. **Positive and negative charges are attracted** to each other, so the hair/fur tries to stick to the balloon. It's the same with the can. The can has both positive and negative charges and its positive charges are very attracted to the negative charges on the balloon, which causes the can to roll towards the balloon.

The ultimate source of static electricity comes from the interesting properties of atoms—the tiny pieces of matter that make up all of the materials in our universe, such as water, desks, pencils and even us. Atoms are often visualized as miniature solar systems with a **positively charged nucleus** (where the sun would be), made up of **neutrons** and **protons**, being orbited by **negatively charged electrons** arranged in 'shells'. Under normal circumstances, atoms are neutral. They have no charge because the positive charge of the nucleus is balanced out by the negative charge of the orbiting electrons.

However, electrons aren't necessarily stuck to any particular atom. Electrons can move around and it's this movement which creates the static charge. When two different materials come into close contact, for example, fur rubbing against a balloon or two air masses in a storm cloud, electrons may be transferred from one material to the other. This is called (warning: scientific jargon alert!) contact induced charge separation and results in one material (the material that loses electrons) becoming positively charged and the other material (the material that gains electrons) becoming negatively charged.

Problem:
What is the relationship between the time spent charging by friction and the electric force between two objects?

Create a mind-map on everything you know about the problem's topic.

Procedure:

1. Students will be broken into groups of 3 or 4
2. Each group will be given a balloon, an empty 355 ml pop can, a fur cloth, a timer, tape, a meter stick, a calculator, and the required handouts.
3. Students will measure out 1 meter and put tape on the floor to show the beginning of the race and the finish line. Make sure you pick a location that is flat and smooth.
4. Students will have to **predict** and **explain** what they believe will happen when they charge the balloon and test the force of attraction/repulsion to the pop can at numerous distances.
5. Students will blow up the balloon and tie a knot in the end. Be careful not to stretch the balloon past its capability or it will pop.

Repeat the following steps rubbing the balloon it the fur for 10 seconds, then 30 seconds, and finally 60 seconds

6. Students will rub the balloon quickly with the fur, for a certain amount of time (10, 30, and 60 seconds). Students can use the classroom clock.
7. Students will put the can on its side on the start line on the floor. Make sure the can is still.
8. Students will use a timer to **record** (refer to Table 1 located in *Pre-Lab Questions and Lab* handout) the time it takes the charged balloon to move the pop can 1 meter by attraction or repulsion.
9. Students will **observe** the pop can as they attempt to use the charged balloon to move the pop can 1 meter by attraction or repulsion. Students will then **record** and **explain** their observations in Table 1 (refer to *Pre-Lab Questions and Lab handout*).
10. Students will dissipate the charge on the balloon using the method of their choice located on Questions 7 in the *Pre-Lab Questions and Lab* handout.
11. Students will calculate the speed of the can by dividing "meters traveled by the time taken to travel". Example. It took the pop can 10 seconds to travel 1 meter. Therefore, the speed of the pop can was 0.1 meters/second