Entertaining Experiments in Electrostatics

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Abstract. *While articulating the idea of utilizing materials from our everyday life to demonstrate various science concepts, the author also outlined several different hands-on activities to dramatically and playfully demonstrate the effect of static electricity.*

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1. Introduction

There is often a misconception that experiments in teaching physics need to involve sophisticated and expensive equipments. The efforts to access to these equipments lead people to identify physics as something that is far away from our everyday life. The fact is that physics is truly omnipresent. Physics and our everyday life are so tightly intertwined that they are one and the same. Therefore, many materials for scientific explorations can be readily found in our surrounding environment effortlessly. We could use these ordinary materials to demonstrate many fascinating ideas behind physics and to humanize science at the same time. There are many advantages behind this initiative of bringing science into our everyday life. First, the experience of these activities can be leveraged to intensify the students' motivation and interest in the realm of science. Second, the materials required for hands-on experiments can be obtained cheaply and easily. Finally, the restrictions on both the locations and time for performing these types of experiments are greatly decreased and thus we could perform them almost everywhere at anytime.

This combination of science exploration and our everyday life has become the new direction of science education in the recent years. Much efforts and research in the science education community has been directed toward designing experiments that are interesting, individualistic and encourage students in the direction of hands-on sense of discovery and accomplishment.

On the topic of static electricity, traditional textbook often calls for advanced equipments such as the Van de Graff electrostatic generator, gold leaf electrometer, amber rod, etc. Instead, we are going to construct various contraptions to show off the concept of static electricity in an interesting and animated fashion through series of different demonstration in this presentation.

2. Purpose

A series of hands-on activities are presented. These experiments utilize some readily available objects and can be used to encourage the involvement of all the students in classroom to create a very memorable learning experience and that is exactly what we are striving for.

3. Hands-on experiments

The static electric charges are most easily obtained by rubbing two different objects. After having tried several objects such as plastic ruler, plastic comb, glass rod, hard rubber rod, amber rod, etc., we end up with a truncated PVC pipe used in the plumbing since it is easily accessible and at the same time chargeable by rubbing with a piece of wool cloth. An incredible amount of electric charges can be produced and temporarily stayed on the pipe. The charged pipe can readily pick up a whole sheet of tissue paper. With this charged pipe we may conduct the following series of fascinating experiments in electrostatics.

A. The effect of the charged pipe on a conductor

Lay an aluminum can on the table and bring

the charged pipe close to it. It can be seen that the can is attracted to the pipe and rolls immediately. In addition, if you wave the pipe above the can, the can imitates the movement of the pipe from side to side.

B. The effect of the charged pipe on a stream of tap water

As you bring the charged pipe close to a small stream of tap water, the stream magically bends towards the pipe. The effect could be more dramatic as the flow of water is decreased.

C. The effect of the charged pipe on a plastic "jellyfish"

We first construct a "jellyfish" by using a piece of plastic wrapping rope. We then rub the wool cloth against the tentacles of the plastic "jellyfish". The tentacles will be charged up and repel one another. Now, with all tentacles stretched out, the piece of the plastic rope looks like a jellyfish. Then we toss up the charged plastic jellyfish in the air and then move the charged pipe under it to prevent it from descending. With careful and sometimes acrobatic maneuvering, a student could use the idea of repulsion force to keep the plastic jellyfish in the air for quite a while.

D. Charging a Leyden cup

Here we describe a simplified version of the Leyden jar. It is a plastic cup lined both the interior and exterior with aluminum foil. We can transfer the static charges from the charged pipe onto the cup. Now have a student hold onto the charged cup with one of his/her hands, and start forming a chain of hands in a circle with every student in the class. The last student then would touch the protruded aluminum strip with his/her free hand. At the instant when the student gleefully makes the touch, a closed circuit is formed and the Leyden cup discharges through every student in the circular chain. All students should experience a slight electric shock at the same time. The shock delivered is harmless and similar in magnitude as an electrostatic jolt received when one takes a piece of synthetic fabric out of the dryer. However, it can be a lot of fun when all students are jolted simultaneously. From this impressive experience, the students will learn how electric charges can be stored, how static charges stored in the Leyden cup could produce shock through a circuit, and that human is a conductor of electricity, etc.

E. Constructing and operating an electrostatic motor

A very primitive electrostatic motor can be constructed by using very easy materials. Operating this motor is similar in principle to the machine invented by Benjamin Franklin in 1748.

4 Conclusion

These hands-on activities has been used in class to encourage the involvement of all the students in classroom to create a very memorable learning experience and that is exactly what we are striving for.

References

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