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Digital Video Lesson Plan

Electrostatics

Purpose/Rationale:

The purpose of this lesson is to use discrepant events that will demonstrate how positive and negative charges are attracted and repelled.

SOLs:

PS.11 The student will investigate and understand basic principles of electricity
and magnetism. Key concepts include
 a) static, current, circuits;
 b) magnetic fields and electromagnets; and
 c) motors and generators.

National Science Education Standards:

CONTENT STANDARD B: As a result of their activities in grades 9-12, all students should develop an understanding of

- Structure of atoms
- Structure and properties of matter
- Chemical reactions
- Motions and forces
- Conservation of energy and increase in disorder
- Interactions of energy and matter

Materials:

Balloons
Ring stand
pith balls
string
comb
wool fabric
activity sheet
water faucet

Resources:

Teaching Science to Children; an Integrated Approach, Alfred E. Friedl, McGraw-Hill, Inc. copyright 1991

Safety:

No safety precautions need be taken in order to perform this demonstration.

Time Frame:

Two 45 minute class periods

Procedure for Teaching:

In this demonstration students will learn about the attraction and repulsion of molecules through demonstration with objects. It is important to remember in Electrostatics particles or molecules have an inherent charge. When demonstrating Electrostatics, we simulate charged particles artificially by rubbing objects together.

1st event: Balloon on an Invisible Shelf:

Fill a balloon and tie it. Then rub the balloon with wool and touch it to a wall. It should stay. The balloon gets charged with electrons by the rubbing of the wool. The wall has a neutral charge. Opposite charges attract and so the balloon sticks to the wall, eventually the charges on the balloon will transfer to the wall and the balloon will fall.

2nd event: Pith Ball and Plastic Comb, Attraction and Repulsion:

Rub a plastic comb with wool. Ask students what will happen when the comb is brought near the pith ball. Bring the comb near the ball to show that there is an attraction. After the comb and ball touch for a moment, the ball jumps away. Initially, the comb is charged and attracts the uncharged ball. The charges then move from the comb to the ball and both objects have the same charge and are no longer attracted to each other

Next, hold your hand near the ball, but do not touch it. The ball will then move towards your hand. Your hand is neutral; the pith ball contains charges and is therefore attracted to each other. After the ball has touched your hand, the charges are once again neutralized and the ball will no longer be attracted to your hand. This demonstrates a series of charge transfers and also that like charges repel and opposite charges attract.

3rd event: Comb and Stream of Water:

In this exercise, the students will need to explain the phenomena behind the demonstration. Once again, charge the plastic comb using the wool. Have one of the students hold the charged comb near a slow stream of water from the faucet. Ask for possible explanations from the class. Ask the students to relate this exercise to the previous demonstration.

4th event: Hairy Balloon:

This exercise is best demonstrated with a willing student with fine, naturally straight hair. Use different balloons for different students to prevent transfer of anything. Before the balloon and hair are rubbed together, both have no charge, neutral. Have a student rub a balloon vigorously on a section of hair. The hair and balloon will become charged quickly. Have the student demonstrate their charged hair by pulling the balloon gently away from the head. The hair should cling to the balloon. The hair will also repel itself, as it is the same charge all over. The balloon and hair become charged, the hair with one charge and the balloon with another.

Evaluation:

The student should be able to demonstrate a developing knowledge of Electrostatics. The initial questions on the Activity sheet are meant to help the student develop reasoning skills and learn about Electrostatics. The later questions on the Activity Sheet are meant for the student to demonstrate proficiency of his/her knowledge of Electrostatics that s/he accumulated during the demonstration exercise.

For questions 1-4, 20 points total- 5 points each

For questions 5-7, 15 points total- 5 points each

For questions 8-9, 20 points total- 10 points each

For questions 10-13, 40 points total- 10 points each

Challenge 5 points for attempts, extra for well thought out answers

Activity Sheet for Electrostatics

Name _____

Date _____ Period _____

Event 1: The Invisible Shelf

1. If you were to take a balloon and put it against the wall, what would happen when you let go?
2. How might we make the balloon stay on a wall or ceiling?
3. What **phenomenon** is involved in making a balloon stay on a wall in the demonstration?
4. Will the balloon stay on the wall indefinitely?

Normally we cannot place an object on a wall without some kind of adhesive such as tape or glue, but with the "magic" of static electricity, we can make objects stick to walls, and water move as if pulled by a "magic" force. Electrostatics is not magic, but rather they are a phenomenon of science. In nature, we can observe static electricity. Sometimes we get shocked when we touch another person. Or we might see a woman's dress clinging to her pantyhose. Or maybe our hair flies away from our heads and won't stay in place. We can observe these things in nature and we can artificially replicate them in our classroom, so that we can study and observe them.

Event 2: Do you love Pith Balls?

A pith ball is a small ball made from Styrofoam. They can be purchased or made at home from just a simple plastic packing peanut.

5. Does the comb have a charge before it is rubbed with the wool?
Does the pith ball have a charge?

6. What happened when the comb was rubbed with wool and then placed near the pith ball?

7. After the comb is held near the pith ball for a while, what happens?

Why might this happen?

When we artificially charge particles, like rubbing the comb with wool, the charges eventually decrease. Likewise, as a charged object is held near an uncharged object, the charges are transferred from the charged object to the uncharged object until the charges are equal and neutralized.

Event 3: Bending Water

8. What do you see happening when the comb is placed near the stream of water?

9. Why does this happen? (Explain the process of charges and charge transfer.)

Event 4: A Bad Hair Day

The Electrostatics in this demonstration are a bit more complicated than in the past examples. A balloon rubbed in hair generates a charge on the balloon and on the hair.

10. Describe what happens to the hair as it is rubbed with the balloon.

11. The balloon and the hair also demonstrate some Electrostatics, describe what happens between the balloon and the hair.

12. Are the charges of the balloon and the hair in the demonstration the same or are the charges opposite?

13. What happens to objects with like charges?

What happens to objects with opposite charges?

Challenge:

Explain what happens to the objects and charges in each of the scenarios presented at the end of Event 1.