Electrostatic Forces in Microgravity

Introduction

Students will explore the electrostatic properties in space and its effect on different materials. Electrostatic properties are fundamental properties of matter that involve electric charges and how they interact with each other. These properties can be observed in everyday life, from the static electricity that causes hair to stand up to the shock we feel when touching a doorknob.

In space, the absence of gravity and the presence of different types of particles can have a significant impact on electrostatic properties. Students will conduct a simple experiment to observe the effects of static electricity on different materials, such as balloons, Styrofoam cups, and small pieces of paper. Students will learn about the properties of space and how they relate to the principles of science.
By exploring electrostatic properties and their effects on different materials, students will develop an understanding of the atomic composition of molecules and the factors that affect electric and magnetic forces. They will develop skills in constructing and presenting arguments to support their observations and evaluations of different materials. Students will also learn about energy transfer, which is critical to understanding the behavior of particles in space.
By the end of this lesson, students will have a better understanding of electrostatic properties and their importance in space exploration.

Note: Safety precautions should be taken while conducting this experiment. Students should wear safety goggles and lab coats (optional) to protect their eyes and clothes.

Target grade level 5th - 9th grade students
Suggested time frame 45 min.

NGSS Standards

MS-PS1-1: Develop models to describe the atomic composition of simple molecules and extended structures.

MS-PS2-3: Ask questions about data to determine the factors that affect the strength of electric and magnetic forces.

MS-PS3-5: Construct, use, and present arguments to support the claim that when the kinetic energy of an object changes, energy is transferred to or from the object.

MS-ETS1-2: Evaluate competing design solutions using a systematic process to determine how well they meet the criteria and constraints of the problem.

Objective

To learn about electrostatic properties and how they relate to the behavior of particles in space.

- Conduct a simple experiment to observe the effects of static electricity on different materials.
- Investigate the properties of space and how they relate to the electrostatic force.

Materials

- Balloons
- Styrofoam cups
- Small pieces of paper
- Wool fabric or polyester fabric
- Plastic rulers or combs
- Magnets
- Baking soda
- Vinegar
- Safety goggles
- Lab coats (optional)

Engage

1. Ask students if they have ever heard of electrostatic properties and what they think it means.
2. Define electrostatic properties and explain how they are affected by various factors such as friction, charge, and distance
3. Introduce the electrostatic properties in space. Explain we will be observing the effects of static electricity on different materials on board G-Force One.

Procedures

- Distribute materials to students in groups of 3-4.
- Inflate the balloons and then rub them against the wool fabric or polyester fabric.
- Observe and record any changes in the balloons, Styrofoam cups, and small pieces of paper when they are brought near each other.
- Charge plastic rulers or combs by rubbing them against hair or a wool fabric.
- Observe and record any changes in the materials when they are brought near each other.
- Sprinkle baking soda on a wool fabric or polyester fabric and mist with vinegar.
- Observe and record any changes.

Results

Charged item	Observation	Explanation
Balloons		
Plastic		
Baking soda and misted vinegar on fabric		

Assessment:

As class, discuss the effects of electrostatic properties on different materials.

1. Summarize the experiment and observations.
2. Define “electrostatic properties”?
3. How are electrostatic properties affected by friction? Charge? Distance?
4. Let’s think about lightning. What is the connection between this activity and how lightning forms?
5. In what other ways does electrostatic force affect your life?
6. Do you think these results would change in microgravity? Explain.
7. How are the principles of electrostatic force relevant to space exploration?

Extensions

1. Build an electrostatic generator to demonstrate the principles of electrostatic properties. Students can use materials such as balloons, aluminum foil, and plastic wrap to create a simple generator and observe the effects of static electricity on different materials.

2. Research the history of electrostatics and its practical applications. What are some examples of electrostatic technology that we use in our daily lives, such as photocopiers, air purifiers, and spray painting equipment?

3. Investigate the differences between conductors and insulators and their impact on electrostatic properties. How does the movement of electrons in conductors and insulators affect their behavior in the presence of static electricity?

4. Explore the impact of electrostatic properties on the environment. How does the buildup of static electricity during thunderstorms contribute to the formation of lightning and other electrical phenomena in the atmosphere?

Extensions

Research the impact of electrostatic properties of astronaut suits. What materials are used to minimize the effects of static electricity on equipment and personnel in space?

Design and conduct an experiment testing which material would be most suitable for a G-Force One flight suit!

Design an apparatus to Demonstrate Electrostatic Charge in Microgravity!

Resources

Astronaut Don Pettit's experiment on board the International Space Station (5 min. 23 sec) https://www.youtube.com/watch?v=9NbCzbDdd-g