Next Generation Science Standards

Students who demonstrate understanding can:

3-PS2-1. Plan and conduct an investigation to provide evidence of the effects of balanced and unbalanced forces on the motion of an object.

3-PS2-2. Make observations and/or measurements of an object's motion to provide evidence that a pattern can be used to predict future motion.

3-PS2-3. Ask questions to determine cause and effect relationships of electric or magnetic interactions between two objects not in contact with each other.

3-PS2-4. Define a simple design problem that can be solved by applying scientific ideas about magnets.

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

MS-PS2-4. Construct and present arguments using evidence to support the claim that gravitational interactions are attractive and depend on the masses of interacting objects.

MS-PS2-5. Conduct an investigation and evaluate the experimental design to provide evidence that fields exist between objects exerting forces on each other even though the objects are not in contact.

HS-PS2-4. Use mathematical representations of Newton's Law of Gravitation and Coulomb's Law to describe and predict the gravitational and electrostatic forces between objects.

HS-PS2-5. Plan and conduct an investigation to provide evidence that an electric current can produce a magnetic field and that a changing magnetic field can produce an electric current.

Standards Key

K = Kindergarten
3 = 3rd Grade
(numbered by grade)
MS = Middle School
HS = High School
PS = Physical Science
LS = Life Science
ES = Earth Science

TEACHERS GUIDE

LEVITATING GLOBE
ITEM # 3169-00

ENERGY - MAGNETISM

This Levitating Globe defies gravity and inspires wonder and amazement! Great for a classroom, office, or home, this will be an unforgettable conversation piece. Globe comes with base and power supply. Comes with a Teacher's Guide.

Materials

- ruler
- 3 rare earth magnets – 0.5 inches wide and 1/16th of an inch thick
- copper wire
- batteries
- alligator clips
- paperclips
- iron nails

Goals & Objectives

See Next Generation Sceince Standards on Page 4

How it works

The base has sensors and microprocessors that detect the distance between the magnet in the globe and the electromagnet in the base. The current is varied to adjust the height of the globe and maintain balanced magnetic forces of repulsion and gravitational forces of attraction.

Introduction

Electricity and magnetism are non-contact forces that can be attractive or repulsive. Electromagnetism, the use of a conductive material and electricity to produce a magnetic field or the use of a conductive material and a magnet to produce an electric field, is considered one of four basic forces (gravity, nuclear strong force, nuclear weak force are the other three), but it is the only force that can also be repulsive (the other three fundamental non-contact forces are attractive only).

Students have difficulty visualizing the empty space that exists between objects that are simultaneously attracting and repelling each other. The Levitating globe can be used as a demonstration tool to aid in understanding the rotational motion of planets and the atomic structure of an atom.

Activities

1. Levitate the globe and ask students to explain what they are seeing using scientific language. What forces are at work? How do they know? Lead them to discuss and consider how gravity, electricity and magnetism are affecting the motion of the globe. Older students should be introduced to coulombs law and compare it to the universal law of gravitation. How are they the same? Different? How are non-contact forces different from contact forces? How do they know when a non-contact force is acting on an object?

2. The direction of rotational motion can be changed using rare earth magnets at the 12, 4 and 8 o'clock positions on the base once the globe is already levitating. The magnets are 0.5 " wide and 1/16th of an inch thick. Ask older students to use their knowledge of scientific concepts to attempt to explain how this works.

3. Ask students to research what variables affect the strength of an electromagnet. Provide materials (copper wire, batteries, alligator clips, paperclips, iron nails) to design an experiment to test the electromagnetic force created.

Note

It is always best to DO an experiment ahead of time to be able to best present it to the class.

Discussion

Future applications of electromagnetic levitation:
Floating cities, floating transportation, rocket launching, 3-D cell cultures, wind turbines, study weightlessness, and frictionless mechanical parts.

Glossary

Vocabulary

- attraction
- Coulomb's law
- Electromagnetism
- Lenz's Law
- repulsion