

Magnetism:



Push Me a Grape

Primary Audience: Kindergarten – 5th Grade

Description: Witness the attractive and repulsive power of magnets.

Keywords: Diamagnetic

Concepts:

- Both the north and south poles of a strong rare-earth magnet repel a grape. The grape is repelled because it contains water, which is diamagnetic. Diamagnetic materials are repelled by magnetic poles.

Materials:

- Per Group:
 - Two Large Grapes
 - Drinking Straw
 - Film Canister w/ Lid
 - Pushpin
 - Small Knife or Razor Blade
 - Neodymium Magnet

Instructions:

Device Assembly:

1. Insert the pushpin through the underside of the film canister lid and put the lid on the canister so that the point of the pin is sticking out.
2. Find the center of the drinking straw and use the knife to cut a small hole, approximately 0.5 cm x 1 cm. (You can also use the hot tip of a soldering gun to melt a hole.)
3. Push one grape onto each end of the straw. Balance the straw with the grapes on the point of the pushpin; the point of the pin goes through the small hole on the straw.

QuickTime™ and a
TIFF (Uncompressed) decompressor
are needed to see this picture.

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Observations:

- Bring one pole of the magnet near the grape. Do not touch the grape with the magnet.

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- The grape will be repelled by the magnet and begin to move slowly away from the magnet.
- Pull the magnet away and let the grape stop its motion.
- Turn the magnet over and bring the other pole near the grape. The other pole will also repel the grape; both poles of the magnet repel the grape.

Possible Interactive Questions:

- What happens when you bring the magnet closer to the grape? Why do the grape move further away from the magnet?
- Can you make the device spin? How fast can you make it go?

What's Going On?

Ferromagnetic materials, such as iron, are strongly attracted to both poles of a magnet.

Paramagnetic materials, such as aluminum, are weakly attracted to both poles of a magnet.

Both poles of a magnet, however, repel diamagnetic materials. The diamagnetic force of repulsion is very weak (a hundred thousand times weaker than the ferromagnetic force of attraction). Water, the main component of grapes, is diamagnetic.

When an electric charge moves, a magnetic field is created. Every electron is therefore a very tiny magnet, because electrons carry charge and they spin. Additionally, the motion of an orbital electron is an electric current, with an accompanying magnetic field.

In atoms of iron, cobalt, and nickel, electrons in one atom will align with electrons in neighboring atoms, making regions called domains, with very strong magnetization. These materials are ferromagnetic, and are strongly attracted to magnetic poles.

Atoms and molecules that have single, unpaired electrons are paramagnetic. Electrons in these materials orient in a magnetic field so that they will be weakly attracted to magnetic poles. Hydrogen, lithium, and liquid oxygen are examples of paramagnetic substances.

Atoms and molecules in which all of the electrons are paired with electrons of opposite spin, and in which the orbital currents are zero, are diamagnetic. Helium, bismuth, and water are examples of diamagnetic substances.

If a magnet is brought toward a diamagnetic material, it will generate orbital electric currents in the atoms and molecules of the material. The magnetic fields associated with these orbital currents will be oriented such that they repelled by

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the approaching magnet.

A law of physics known as Lenz's Law predicts this behavior. This law states that when a current is induced by a change in magnetic field (the orbital currents in the grape created by the magnet approaching the grape), the magnetic field produced by the induced current will oppose the change.

Further Exploration:

1. Try fruits other than grapes; a fruit such as watermelon, which has high water content, works well. Cut the fruit into grape-sized chunks.

Relevant Ohio Science Content Standards:

- Physical Sciences K-2 B: Recognize that light, sound and objects move in different ways.
 - 1.5: Explore the effects some objects have on others even when the two objects might not touch (e.g., magnets).
- Physical Sciences 3-5 C: Describe the forces that directly affect objects and their motion.
 - 3.3: Identify contact/noncontact forces that affect motion of an object (e.g., gravity, magnetism and collision).