Magnetic Forces

An Educator's Reference Desk Lesson Plan

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Grade Level: 3, 4

Subject(s):

- Science/Physical Sciences

Duration: 2 hours

Description: Introduction to magnetic attraction, strength of force, and the magnetic forces of the earth.

Goals: Science as Inquiry; Physical Science: Magnetism

Objectives:

1. Students will gain an understanding that certain materials, depending on their composition, are either attracted or repelled by magnets.
2. Students will discover properties of a magnet and be able to visualize a magnet's force field using iron filings.
3. Students will be introduced to the earth's magnetic force.
4. Students will learn that compasses are made to point to the magnetic north pole on the earth.

Materials:

- paper clip
- magnet
- thread
- numerous objects (magnetic and non-magnetic)
- iron filings
- assorted magnets
- compass
- ruler
- small cardboard box
- two dowels

- Episode # 21, Bill Nye the Science Guy: Magnetism

Procedure:

Scientific Explanation:

All magnets attract and repel certain objects. The ability to attract and repel is produced by the arrangement of atoms within the magnetic material. The objects that are attracted or repelled are composed of specific elements such as iron, cobalt, nickel, or alloy metals made with these elements. Although third grade students may not be able to identify these particular elements, they will be able to recognize that there are specific materials that are attracted or are repelled. They will also be able to recognize that materials such as aluminum cans, paper, plastic, wood, and corks are not attracted or repelled by magnets. (Discuss that certain metals are attracted to magnets and that they are found naturally in the ground.) The magnet's attracting and repelling forces can be visualized with the use of iron filings sprinkled around the magnet. Finally, the magnetic force strength of different magnets can be demonstrated by hanging paper clips on a magnet, until their weight exceeds the strength of the magnetic attraction.

Is the earth a magnet? The earth is a magnet. The magnetic north pole is the direction in which all compasses point. The earth's force field can be observed by the needle deflection of the compass. A compass is an example of a free-floating magnet.

Focus Phase:

Tie a paper clip to one end of a piece of thread about 1 foot long. Tape the other end of the thread securely to a stable surface. Place the magnet about ½ inch away from the paper clip. Slowly lift the magnet, so that it remains consistently ½ inch away from the paper clip at all times. The magnet should be strong enough so that the paper clip appears to float in air. Carefully slip a piece of paper between the paper clip and magnet and observe what happens. Through whole class discussion, allow students to offer their ideas about what they observed. Using the KWL model, further discussion of magnets could be expanded to include what the children know.

Challenge Phase:

Divide the class into small groups. Have the groups perform the following activities and record their results. (Groups will share magnets as well as objects if there are not enough magnets for each student to have his/her own.) However, each student may record his/her predictions and results on individual sheets provided. (*Note: It may be best to predict each object from the bag as a whole group and record class predictions on the board. Pass out the magnets after the predictions are made.)

1. Open the bag of objects and look at each one. Each student will predict and record on the sheet provided which items he/she thinks will be attracted or repelled by a magnet. Next, hold the bar magnet near each object. Observe what happens. On the sheet provided, record "A" for attracted, "R" for repelled, or "N" for neither. The last column on the sheet is used to record what the group thinks each object is made of.
Students could also further explore their predictions and findings to include articles of jewelry, clothing, etc. Results should be recorded on the back of their prediction page.
2. A separate station is set up for the next activity. Call each group individually to the station. A bar magnet is placed on the table. A plastic sheet and a white piece of paper are placed over the bar magnet. Iron filings are sprinkled across the white sheet of paper. Students will describe and journal as a group what they observe and what they think caused the patterns that they see. (Note to the students that the closer the iron filings get to the ends of the magnet, the greater is the magnetic force, which creates the patterns that are seen.)
3. For the next station, stick two dowels through a small cardboard box and rest a magnet on the dowels. As a class or in groups predict and record how many paper clips the magnet will hold. Unwind a paper clip so that one side is attracted and held by the magnet, and the other end can hold the paper clips. Begin to hang paper clips one at a time onto the clip attached to the magnet, and count the number of paper clips it can hold until the clips are released from the magnet. Record the results and discuss the findings. Repeat the procedure with another type of magnet. Compare and discuss the results.
4. A free exploration table may be set up with a variety of magnets for students to explore if they complete the other activities early. They should journal any discoveries that they made while exploring at the table.
Extension Activity:
Place a compass on the table so that the needle is pointing to N (north). Tie one end of a length of string around the middle of a bar magnet. Tie the other end to a ruler. Place a book on the ruler so that the ruler edge with the string and magnet are hanging freely over the end of the table. Ask the students to predict in their journal what direction they believe the magnet will point to if the ruler is

moved to face a different direction. Record the direction the N side of the bar magnet is pointing. Adjust the position of the ruler two more times so it is pointing in different directions. Record the direction the bar magnet N side is pointing. Discuss with the class what they observed and predicted. Show Episode # 21, Bill Nye the Science Guy: Magnetism.

Concept Review:

Ask groups to share their findings for each activity above. Record their findings in columns on the board or overhead projector.

Various objects either reacted or didn't react with the magnet. From the material column, have the students determine what types of material don't react with magnets and what types of material do react with magnets. (Objects that can be attracted or repelled by magnets are made of iron, cobalt, nickel, or alloy metals made with these elements.)

The attracting and repelling forces of a magnet were visualized by the use of iron filings. The students should describe the patterns that they see and relate it to the magnet's force. (To reinforce this concept, have the groups take two bar magnets and move one around the other to observe what will happen. One magnet can make the other magnet move without touching it, either attracting it to the first magnet or repelling it away.) The strength of the magnetic force of each magnet can be measured and observed by hanging paper clips from each.

The north end of the magnet will always face north when compared to the compass no matter what direction the ruler was facing. The north end of the bar magnet is north seeking. The earth is a magnet that has a magnetic North and South Pole.

Closure:

Show the students several objects that were not included in their original bag of objects. Have them record in their journal whether or not they believe the objects will react with a magnet. Students should provide reasons for their answers.

Place a ring magnet or a horseshoe magnet on the table; cover it with a plastic sheet and piece of white paper. Shake iron filings around the magnet. Ask the students to journal what they observe and describe an explanation for what they see.

Assessment: The students will demonstrate science understandings by:

1. correctly choosing which objects will react and which objects will not react due to the material that they are made from.
2. correctly describing the pattern created by the iron filings as the magnet's force of attracting and repelling.