TRB 5:3 - Activity 7: Finding Magnetic Fields of Earth

Summary

Students will investigate the effects of magnets on the needle of a compass and compare this to the effects of Earth's magnetic field on the needle of a compass.

Main Core Tie

Science - 5th Grade

Standard 3 Objective 2

Materials

- paper grocery bags for each student
- 1 /2" conduit pipe cut 2 1/2 inches in length for each student (PVC pipe or wood dowels can be used too. Dead batteries work well, too, with donut magnets instead of disc magnets.)
- 2 disc magnets, 1/2 inch in diameter for each student
- 5 rolls of 2-inch wide masking tape for the class
- sharp black permanent markers to distribute throughout the class
- two rubber bands for each student
- 5 rolls of 1/2 inch masking tape for the class

Additional Resources:
Books:
Harcourt Science, Grade 4,2002
Harcourt Science, Grade 5,2002
Electricity and Magnetism, Glencoe, McGraw-Hill
Electricity and Magnetism, Prentice Hall
Playing with Magnets, Gary Gibson, Copper Beech Books
Magnetism, John Woodruff, Raintree Steck-Vaughn
Magnets, Steve Parker, Lorenz Books
The Magnet Book, Shar Levine and Leslie Johnstone, Sterling Publishing Co., Inc.
Magnetism, Peter Riley, Franklin Watts

Background for Teachers

Earth has two magnetic poles. One is called the Magnetic North Pole and the other is called the Magnetic South Pole. These magnetic poles are where compasses point. These poles cause a huge magnetic field from pole to pole like the magnetic field of a bar magnet. If we were able to sprinkle iron filings on Earth like we can a bar magnet, the iron filings would line up just as the iron filings do on the bar magnet with many lines curving from the North Pole to the South Pole. The theory is that the molten iron in Earth's outer core generates a substantial magnetic field that penetrates through to Earth's surface. It is like there is a huge bar magnet that goes through Earth from the North Pole to the South Pole.
Because Earth is like a huge bar magnet, a compass acts the same on Earth as it does around a bar magnet. If you were to move a compass clockwise around a bar magnet, keeping the compass in the same direction the whole time, the needle would rotate once as you went from the north end to the south end, and then rotate back to the north end. The same would happen on Earth. If you could travel by air from the North Pole to the South Pole and back to the North Pole, keeping the compass in the same direction the whole time, the needle would rotate once as you went around Earth.
These magnetic poles and Earth's geographic poles are not identical. The geographic poles are where Earth spins causing night and day. The magnetic poles are close to the geographic poles, but

the magnetic poles are slightly tilted a few degrees away from Earth's geographic poles.

Intended Learning Outcomes

1-Use science process and thinking skills.
2-Manifest scientific attitudes and interests.
4-Communicate effectively using science language and reasoning.
5-Demonstrate awareness of social and historical aspects of science.

Instructional Procedures

Invitation to Learn:

Divide the class up into groups of three.
Have enough bar magnets for each group.
Lay the bar magnets on a flat surface, with “N” pointing away from them.
Have the children get the compasses they made earlier out of pins, tape, and string.
Tell the students to take their “compasses ” and hang them in front of the north end of the bar magnet. Place the compass where there is an attraction yet doesn't pull it toward the magnet.
Have the students slowly circle the compass around the bar magnet as if they were orbiting it.
Ask them what they observed.
Discuss with them why this happened.
Tell them that this is what would happen if they flew around the world from the North Pole to the South Pole and back to the North Pole with a compass always facing the same direction.
Tell them they can actually demonstrate this by making a small world with magnets in it representing the North and South poles.

Instructional Procedures:

Take two disc magnets and place them on top of each other so they attract each other.
Without flipping either magnet over, place one disc magnet on top of a 2 1/2 inch long conduit pipe, wooden dowel, or PVC pipe.
Place the other disc magnet on the bottom of the pipe. (This creates the magnetic field.)
Tape the disc magnets onto the pipe.
Turn your grocery bag inside out so the writing is on the inside.
Wrinkle the bag with your hands so it can be easily worked.
Push the bottom of the bag about halfway up to form a cradle.
Place the pipe on the cradle that is inside the bag.
Without disturbing the magnets on the pipe, wrap the bag around the pipe.
Work the paper bag around the pipe to create a nice smooth sphere.
Stretch one of the rubber bands over the sphere, anywhere, to hold the bag in place.
Place the second rubber band around the sphere so that it meets the first rubber band at right angles to hold the bag securely in place.
Wrap the sphere with two-inch wide masking tape.
With the compass in one hand and the sphere in the other, use the compass to find the North Pole. It will be the point where the pins are pointing directly at the sphere. Mark that spot with an “N.”
Now use the compass to find the South Pole. Mark that spot with an “S.”
Draw a line around the sphere that connects the North Pole with the South Pole. This represents the Prime Meridian.
Draw another line that represents the equator. It should make right angles with the Prime Meridian.
Draw in the continents with markers.
Use different markers to color the continents, and color the oceans blue.

The world has been made determining where the North and South poles are located.
Take the compass and go around the world from pole to pole as they did with the bar magnet.
Ask the students what they noticed.
Ask the student what comparisons they can make between the bar magnet and the model of the world with the magnets in it.

Extensions

Instead of making Earth have the children make their own world of water, continents, and lines. Give it a name. Write about their new world.

Assessment Plan

Response Questions:

When walking a compass around a bar magnet, explain what the compass needle does, and why it does it.
If you were able to take a compass around the world, explain what the compass needle would do, and why the compass would do that.
How are bar magnets and the poles of Earth the same?

Bibliography

This lesson is part of the Fifth Grade Science Teacher Resource Book (TRB3) http://www.usoe.org/curr/science/core/5th/TRB5/. The TRB3 is designed to be your textbook in teaching science curriculum to your students. This book covers all the objectives of each standard and benchmark. If taught efficiently, a student should do well on the End-of-Level (CRT) tests. The TRB3 is designed for teachers who know very little about science, as well as for teachers who have a broad understanding of science.

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