Investigation Six – Finding Magnetic Fields of Earth

Standard III
Students will understand that magnetism can be observed when there is an interaction between the magnetic field of magnets or between a magnet and materials made of iron.

Objective 2
Describe how the magnetic field of Earth and a magnet are similar.

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.

Standard III
Objective 2

Background Information

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 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 the Earth.

These magnetic poles and Earth's geographic poles (axis of rotation) 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.

Pre-Assessment/Invitation to Learn

Materials
- Cow magnet
- Compass

1. Divide the class up into groups of three or four.
2. Have enough cow magnets for each group.
3. Lay the cow magnets on a flat surface, with "N" pointing away from them.
4. Have the children get a compass and put it in front of the north end of the cow magnet. Place the compass where there is an attraction yet doesn't pull it toward the magnet.
5. Have the students slowly slide the compass around the bar magnet as if they were orbiting it.
6. Ask them what they observed.
7. Discuss with them why this happened.
8. Tell them 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.
9. Tell them they can actually demonstrate this by making a small world with a cow magnet in it representing the North and South poles.
10.

Instructional Procedure

Materials
For each group
- Cow magnet
- 3" Styrofoam ball
- 1 roll of 2" masking tape
- Compass

1. The Styrofoam will represent Earth. Push a cow magnet into the center of "Earth."
2. Wrap the sphere with t wo-inch wide masking tape.
3. With one student holding a compass in one hand and the other student holding the sphere use the compass to find the North pole. It will be the area on the sphere where the north point of the compass is pointing directly at the sphere. Mark that spot with an "N".
4. Now use the compass to find the South pole. It will be the area on the sphere where the south point of the compass is pointing directly at the sphere. Mark that spot with an "S".
5. Draw a line around the sphere that connects the North pole with the South pole. This represents any longitude line on Earth.
6. As one students holds "Earth" take the compass and go around the world following the drawn longitude line. Ask the students what they noticed. (The compass will do the same thing it did in the Invitation to Learn)
7. Ask the students what comparisons they can make between the cow magnet by itself and the model of the world with the cow magnet in it.

Curriculum Extensions

Fine Arts –

- With the world already made have the students draw in the equator and have the longitude line represent the Prime Meridian. Draw and color in the continents. Hang them around the room. (Standard III, Objective 2)

Assessment Suggestions

Response Questions:

1. When sliding a compass around a bar magnet, explain what the compass needle does, and why it does it?
2. 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.
3. How are bar magnets and the poles of Earth the same?

Reference to the Assessment Section

	Multiple Choice	Constructed Response	Performance Test
Unit Test	6, 7, 8, 9, 10	1, 4	

Resources

Books:

- Gibson, Gary. Playing with Magnets. Copper Beech Books
- Woodruff, John. Magnetism. Raintree Steck-Vaughn
- Parker, Steve. Magnets. Lorez Books
- Levine, Shar, and Leslie Johnstone. The Magnet Book. Sterling Publishing Co., Inc.
- Riley, Peter. Magnetism. Franklin Watts

Web sites:

- www.windows.ucar,edu
- www.harcourtschool.com