Activity 3: Magnetism and the Earth

Introduction:

What is magnetism?

From your clothes to your desk, every bit of matter is made of tiny particles called atoms. Atoms have negatively charged electrons that spin around them. Most of the time, the electrons spin in random directions. When the electrons all spin in the same direction, though, they create an invisible force known as magnetism.

When something is magnetic, it can pull things with steel or iron in them to it. The two ends of a magnet are called the north and south poles. These are the parts where the magnets are strongest. Around these poles is an area known as a magnetic field. In the magnetic field, other objects can be drawn to the magnet. If you try to put two south pole ends of a magnet together they will repel each other, but if you a north pole and a south pole will attract each other.

The Earth is a very big magnet, with the North and South poles located on opposite ends of the planet. The Earth's magnetic force however, is not very strong. What about other stars and planets—do they have magnetism too? We know the Sun has a magnetic field several times stronger than Earth's, but the Moon has no little or no magnetism. The other planets have magnetic fields too. Saturn, Jupiter, Neptune, and Uranus have fields stronger than Earth's, while Mars, Mercury, and Venus have weaker fields. Stars that have collapsed, called neutron stars, have the strongest magnetic force of anything in the universe.

How does a compass work?

Compasses have a small magnet in them, usually a pointed needle. The magnet, or needle, always aligns itself with the Earth's magnetic field, pointing towards the North Pole. No matter where you are, your compass will point north making it a useful tool for navigation.

Objectives:

- Identify the poles of magnets and describe the interactions between the poles and magnetic objects
- Explain what magnetism is and where it occurs in nature
- Discuss and illustrate the various applications of magnets

Vocabulary:

- Magnets
- Matter
- Atoms
- Electrons
- Poles
- Magnetic Field
- Neutron Star
- Compass

Activity A: Iron Filings Demo

Materials:

- Iron Filings
- 2 Magnets

Procedure:

1. Use iron filings and small magnets to illustrate magnetic field lines and the concept of north and south poles.
2. Show the students how like poles repel and unlike poles attract.
3. If time allows, let the students, in small groups, interact with the magnets and iron filings. Make sure to have the filings in a container that will allow the students to see what is happening but prevents the filings from directly interacting with magnets as the filings are difficult to remove from the magnet once they are stuck to it.

Activity B: Making a Compass

Materials (per group):

- cork
- sewing needle (dulled if possible)
- plastic bottle cap
- small magnet
- small container of water

Procedure:

1. Have students form small groups and give each group a pre-cut piece of cork, a sewing needle, a plastic bottle cap, small magnet, and some water.
2. First, have the groups magnetize their needle by sliding the magnet along it in one direction. Have them repeat this 10-15 times, but always slide the magnet in the same direction (**don't slide it back and forth**).
3. Next, have the students pour water into their plastic caps and then place the piece of cork in the water.
4. Have the students carefully place the needle on top of the cork. The needle should be balanced on the cork so that it can move freely. Encourage the students to poke the cork with their finger to make it point in other directions, so that they observe it unerringly swing back to North on its own.
5. Place the new compass on a piece of paper, and have the students draw a compass rose around it (label N,E,S,W)
6. Finally have the students test that their compass really points north by comparing with a commercially made compass. Afterwards, encourage students to move their needle with the bar magnet and observe what happens.

Variations and Follow-up Activities:

- Ask students if they can they name local landmarks, or even states/countries immediately to the North, South, East, & West. Draw and/or label them on the paper to create a map!
- Younger kids will enjoy drawing representative depictions, older students can get into more detail and keep adding places and discussing how it all goes together.
- Ask students if they know where the North or South poles are? What is it like in those places?
- Ask if there is an East or West Pole?

- Use a Globe or Ball to show that the poles are the points (ends of the axis) the earth rotates around.
- Discuss the fact that stars directly above the poles appear motionless. Can they think of a way to locate the special "pole" star? If you have a map of the polar constellations put a pin in it and spin it around to illustrate what happens. A photograph of star trails could be nice to show.

Activity C: Electricity and Magnetism: Induction Motor

Materials (per group):

- AA battery
- Piece of thick copper wire (6 in.)
- Strong magnet (metal coated rare-earth disk magnet of 1/4 in. diameter)
- Paper Clips
- Pins

Procedure:

1. Begin by asking "So, apart from making a compass and sticking things together, what good are magnets?" This is a rhetorical question and can begin a lively discussion (or no one has any idea which is fine too!)
2. In small groups students will be given an "AA" (double A) battery, a piece of thick copper wire approximately 6 inches long, and a strong magnet (a metal coated rare-earth disk magnet of ¼ inch diameter works best with AA cells, since they have the same radius). Each student can have their own wire.
3. Begin by having the students verify that although the magnet attracts pins, paper-clips (etc.), it will not attract the copper wire. Nor will the copper wire attract pins etc.
4. Now short the battery with the copper wire (it must be a thick wire to avoid getting hot). Show that the wire attracts pins etc. – It has become a magnet!
5. Stick the magnet to the bottom (flat end) of the AA cell, and stand it up on the table or floor.
6. Challenge the students to shape the wire so that it will balance on the top, and hang down to touch the magnet at the bottom. The result is eye-popping, even for adults!
7. Once successful, ask the students what they think is happening.

Variations and Follow-Up Activities:

- Make the wire piece ahead of time, and merely challenge the students to balance it. (This in no way affects the educational value).
- Ask: What is pushing the wire?
    - Why does the wire rotate in that direction?
    - Can you think of something you could do to make it spin the other way? (and have them try)
    - Where is the energy coming from to make the wire spin?
    - Can you guess what this device is called?