



LESSON PLAN: *National Geographic Magazine Archive 1888-1994*

Title: Magnetic Field Lines: How the Earth's Magnetic Field Causes the Northern Lights

Grade Level(s): 9-12 (High School)

Subject/Content: Physics

Overview & Purpose: This lesson serves as a supplement to teaching high school students about magnetic fields, magnetic field lines, and the magnetic fields used on Earth. The article, "Unlocking Secrets of the Northern Lights," serves to give students a visible application of magnetic fields.

Focus Question: What is a magnetic field and how does the Earth's magnetic field work?

Materials and Resources Needed:

- Database: National Geographic Virtual Library, National Geographic Magazine Archive 1888-1994.
[Gartlein, Carl W., and William Crowder. "Unlocking Secrets of the Northern Lights." *National Geographic Nov. 1947: 673+*. National Geographic Virtual Library. Web. 12 May 2013.](#)
- Bar magnet
- Iron fillings
- Paper
- Student questions regarding lab and article

Procedures:

Steps/Activities by the teacher:

- Guided notes on magnetic fields. A magnetic field is the area around a magnetic object with which the force of magnetism acts. Also define a magnetic force. A magnetic force is the force between magnetic poles.
- Magnetism Lab – It is your choice if you do this as a demonstration or put students into groups and allow them to do it as a lab. Conduct magnetism lab which involves putting iron fillings around a magnet in order to teach students about the magnetic field. The procedure is as follows: Place a bar magnet under a white sheet of paper. Sprinkle iron fillings on top of the white sheet of paper. The iron fillings act to show where the magnetic field lines around a bar magnet lie. Students should sketch the magnet and the magnetic field lines. In order to teach students about field strength and direction, place a compass in various locations around the magnet. The compass should always point towards the north side of the magnet. Have students record the direction on their diagram using arrows. Go through questions on the student handout after the lab and have students answer the questions in detail.
- Read article entitled, "Unlocking Secrets of the Northern Lights," using popcorn style reading. Stop along the way to discuss and have students answer the questions on the student worksheet.

Steps/Activities by Student(s):

- Take notes on magnetic fields and magnetic force.
- Watch demonstration on the magnetic field of a bar graph or perform lab on the magnetic field of a bar graph. Draw the bar graph as well as the magnetic field and the direction of the magnetic field. Answer the questions that follow.
- Read article entitled, "Unlocking Secrets of the Northern Lights," as a class and answer the questions that follow.

Learning Objectives:

- Students will have an understanding of what magnetic field lines are and their presence in the world.
- Students will have an understanding of what an Aurora is as well as how they are caused by magnetic fields.

Related Activities: The related activities are shown in the lesson plan above. Use the article on the Northern Lights in order to enhance a lesson on magnetic field lines and forces.

Physics

- Discuss the definitions of magnetic fields and magnetic forces.
- Use the article on Northern Lights as one of the applications of magnetic fields.

Skills Used: Students will use their information locating skills in order to locate important information on magnetic fields.

Homework/Assessment: Homework is to finish the reading assignment if not finished in class. The assessment will be based on the student's answers to the lab questions. This will show their level of understanding of magnetic fields and magnetic field lines.

Differentiation:

- **Advanced-** Have your most advanced students research different theories on the Earth's fading magnetic field. Instruct them to find at least 2 additional theories and then to pick the one that they agree with the most. They can then write a one page essay discussing why they believe it is the best theory. Their grade on that essay can replace the grades for the day.
- **Struggling-** Shorten the reading assignment to only a few pages of reading and answering questions.

Standards Alignment

Next Generation Science Standards:

HS-PS2-5: Plan and conduct an investigation to provide evidence that an electric current can produce a magnetic field and that a changing magnetic field can produce an electric current.

HS-PS2-4: Forces at a distance are explained by fields (gravitational, electric, and magnetic) permeating space that can transfer energy through space. Magnets or electric currents cause magnetic fields; electric charges or changing magnetic fields cause electric fields.

HS-PS3-5: Develop and use a model of two objects interacting through electric or magnetic fields to illustrate the forces between objects and the changes in energy of the objects due to the interaction.

National Curriculum Standards for Social Studies, Science, Language Arts:

Physical Science (9-12)
Magnetism

Standard Source: NSES 1996 from National Academies Press

ISTE NETS for Students:

High School

- Students use critical thinking skills to plan and conduct research, manage projects, solve problems, and make informed decisions using appropriate digital tools and resources. Students:
 - a. Identify and define authentic problems and significant questions for investigation.
- Students demonstrate creative thinking, construct knowledge, and develop innovative products and processes using technology. Students:
 - a. Apply existing knowledge to generate new ideas, products, or processes.
 - c. Use models and simulations to explore complex systems and issues.

Standard Source: ISTE NETS for Students, 2007

Name: _____
Date: _____
Period: _____

Magnetism Notes

1. What is a magnetic field?
2. What is magnetic force?

Magnetism Lab

Procedure:

1. Place a bar magnet under a white sheet of paper.
2. Sprinkle iron fillings on top of the white sheet of paper. The iron fillings act to show where the magnetic field lines around a bar magnet lie. Sketch the magnet and these lines below.
3. In order to determine the direction of these lines, hold a compass to the magnets and record the direction that the compass points. Add arrows to your drawing above.

Questions:

1. Draw the magnet and the magnetic field according to the iron fillings. Add the direction of the magnetic field lines as well.
2. Where are most of the magnetic field lines?
3. When we moved the compass away from the magnet, what happened? What does this tell you about the magnetic field strength?
4. How is Earth like a magnet?
5. The magnetic field of Earth is drawn below. How can a compass be used on Earth in order to figure out which direction you are traveling?
6. Why does this make sense with the Earth's magnetic field?

“Unlocking Secrets of the Northern Lights”

Instructions: As you are reading the article, answer the questions that follow.

1. What are the main causes of an aurora?
2. According to G.P. Putnam’s Sons, what does aurora look like?
3. What is a magnetic storm, and how might it affect your morning newspaper?
4. What scientific discoveries did the aurora help with in the 1940’s?
5. According to the images on page 678, what happens to the sun spots over time? How does this create the northern lights?
6. According to the image on page 680, why are the aurora only present near the North Pole and the South Pole?
7. How are aurora and magnetic storms related?
8. How did sunspots help in World War II?
9. Does the aurora affect the weather? If yes, how so?
10. How far is the aurora from us and how tall is it?

11. What are the two important findings of the aurora on pages 699 and 700?

12. What are the three types of aurora and how are they formed?