Activity 5: Invisible Magnetic Fields

Time: 1 class period (1 class period = 45 min)

Materials:
- Computers or tablets with Internet access
- Magnetic Earth multimedia activity—available online at culturalconnections.gi.alaska.edu or on the Cultural Connections USB flash drive provided with the activity kit
- Magnetic Field Pattern Windows
- Clear sealed iron filing cases
- Bar magnets
- Iron filings, paper clips and/or staples (use closed staples)
- Assorted Magnets (optional)
- Paper
- Pencils
- Invisible Magnetic Fields worksheet

Standards Addressed:
- NGSS: MS-PS2: Motion and Stability: Forces and Interactions MS-PS2-5, DCI: Motion and Stability: Forces and Interactions: PS2.B: Types of Interactions
- Alaska Cultural Standards: E.4
- Inupiaq Learning Framework: [B]E.e.3.2
- Inupiaq Cultural Values: Sharing, Cooperation
- Alaska Science Content Standards: A.1

Background Information:

Earth is surrounded by a powerful magnetic field that extends far into space. The organized movement of the molten iron and nickel within Earth's outer core generates this field. If there were no solar wind, Earth's magnetic field would be shaped like the field around a bar magnet. The constant pressure of the solar wind distorts Earth's magnetic field, compressing it on the side that faces the sun and stretching it into a long magnetotail on the side that faces away from the sun. In this activity, students will use bar magnets to model Earth's magnetic field.

Assessments:
- Invisible Magnetic Fields worksheet will provide a means of assessing student ability to:
  - conduct an investigation and evaluate the experimental design to provide evidence that fields exist between objects exerting forces on each other even though the objects are not in contact;
  - understand that magnetic forces that act at a distance and can be explained by fields that extend through space and can be mapped by their effect on a test object.
• Observation of student participation in the inquiry activity and class discussions will provide a means of assessing student ability to:
  ◦ understand the processes of science used to design and conduct repeatable scientific investigations and defend scientific arguments;
  ◦ share resources with a group of peers;
  ◦ cooperate with a group of peers to complete the activity;
  ◦ observe environmental conditions such as Earth’s magnetic field.

Activity Instructions:
1. Ask students to partner-read or group-read pages 8-9 of the KiuguyatNS / KiugiyaqNS Middle School Guide. Discuss the content and check for comprehension. Ask students if they have used a compass, and if so to share their observations. Discuss why a compass works. Explain that a compass makes use of the Earth’s magnetic field, or nipitchanja nunaqpaumNS.

2. Ask students to visit culturalconnections.gi.alaska.edu and try the magnetic earth multimedia activity to learn more about Earth’s magnetic field. Review the Earth’s magnetic field portion of the Kiuguyat video as needed.

3. Divide the class into small groups and distribute the Invisible Magnetic Fields worksheet. Explain that students will conduct an experiment to find the magnetic field around a bar magnet. Ask students to use what they already know about magnetic fields to write a hypothesis on their worksheet.

4. Distribute materials to each group. Allow students 5 minutes to freely explore the materials, then ask them to work through the worksheet to conduct their experiment. Provide guidance throughout the lab as needed.

5. Allow students time to work with the materials and record their observations.

6. Discuss as a class: What were your conclusions? Where was the magnetic field the strongest? What evidence supports this? How does the magnetic field around a bar magnet compare to that around Earth? What were the strengths and weaknesses of this experiment? How could it be improved (i.e. with different supplies, more time, stronger magnets etc)?

Connections and Extensions:
• Watch a video! Find the Bill Nye video on magnetism online and share it with students.

• Write about it! Record observations in a science journal, notebook or loose sheet of paper while experimenting with the magnets.

• Draw it! Draw what each magnetic field looks like, making sure to use appropriate scale. Write about any differences or similarities between different magnets.

• Extend your discussion! Why do the materials in the window work to show the magnetic field of magnets? What would happen if you left a magnet on the window for a longer period of time? What happens to increase the effect of the magnetic field? Is the magnet stronger now? How have iron shavings farther from the magnet become affected?
Activity 5: Invisible Magnetic Fields

Invisible Magnetic Fields (1 of 4)

Name: _____________________ Date: ______________

Discover the magnetic field around a bar magnet.

Materials:
- Magnetic field observation window
- Iron filings
- Bar Magnets
- Paper clips or staples (use closed staples for safety)
- Experiment Recording Sheet
- Pencil
- Sheet of white paper

Hypothesis:
Use what you know about magnets to make a hypothesis. What shape is the magnetic field around a bar magnet? Sketch the shape that you predict around the bar magnet below, and explain your hypothesis in the space provided. Where is the magnetic field strongest? Where is it weakest?

[Image of a bar magnet with north and south poles marked]

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_________________________________________________________________________________
_________________________________________________________________________________
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Activity 5: Invisible Magnetic Fields

Invisible Magnetic Fields (2 of 4)

Experiment:

Work with a partner to test your hypothesis. Here are two ways to find the magnetic field around a bar magnet using the materials provided. **Put a check** next to the method you use.

- **Method 1:** Use a magnetic field observation window to view the magnetic field around a bar magnet. The observation window is full of iron filings and mineral oil. Iron is attracted to magnets.
  1. Tip the iron filings to the bottom of the window.
  2. Hold a magnet against the window.
  3. Flip the window so that the iron filings move toward the magnet.
  4. Sketch your observations.
  5. Repeat the trial at least three times, recording your observations each time.

- **Method 2:** Use iron filings, staples or paper clips to reveal the magnetic field around a bar magnet.
  1. Place a bar magnet flat on a desk or table, on top of or underneath a sheet of white paper.
  2. Sprinkle iron filings, paper clips or closed staples around the magnet. Watch as the objects are pulled toward the magnet before they actually touch it.
  3. Sketch your observations.
  4. Repeat the trial at least three times, recording your observations each time.

Describe your observations. Where was the field strongest? Where was it weakest?

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TRIAL 1

Sketch your observations.

Describe your observations. Where was the field strongest? Where was it weakest?
Activity 5: Invisible Magnetic Fields

Invisible Magnetic Fields (3 of 4) Name: ______________________

Sketch your observations.

TRIAL 2

Describe your observations. Where was the field strongest? Where was it weakest?

________________________________________________________________________

________________________________________________________________________

Sketch your observations.

TRIAL 3

Describe your observations. Where was the field strongest? Where was it weakest?

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________________________________________________________________________
Activity 5: Invisible Magnetic Fields

Conclusion:

What did you find out? **Draw and describe** the magnetic field around a bar magnet. What shape is it? Where is the field strongest? Where is it weakest?

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What evidence supports this conclusion?

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Think about what you learned about Earth’s magnetic field. How is the magnetic field around a bar magnet similar to the magnetic field around Earth? How is it different?

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Evaluate your experiment: How well did it test your hypothesis? How could you improve the experiment?

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Which statement is correct? Circle one.

a. Magnetic fields extend into the space around the magnet.

b. Magnetic fields do not extend beyond the surface of the magnet.