

Hands On!



Magnetic Fields

NGSS Standards

MS-PS2-3, MS-PS2-5, MS-ETS1-1

Cross Cutting Concepts

- Patterns
- Cause and Effect
- Energy and Matter

Science & Engineering Practices

- Developing and Using Models
- Planning and Carrying Out Investigations
- Analyzing and Interpreting Data
- Constructing Explanations and Designing Solutions

Objective

Students will utilize a visual magnetic field using iron filings and apply it to the fundamental principles of magnetism and the earth's magnetic fields.

Terms

Magnet, Magnetic Field, Magnetic Force Magnetic Pole, Field Lines, Attract, Repel

Materials for Each Group

- Compass
- Bar magnets
- Iron Filings
- White Paper
- Clear Plastic Sheet Protectors
- Tape
- Dry erase marker



Lesson Overview

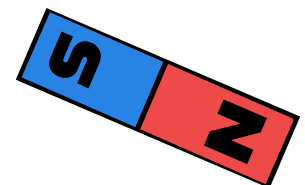
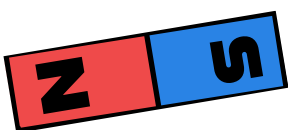
TIP: View [this helpful introductory video](#) and have students complete this [Magnetic Fields Interactive](#) before starting the activity.

1. Provide students with a compass. Allow them to observe the compass needle. Ask them to determine which way is north, south, east and west.
 2. Remind students to keep the compass level for accurate readings.
 3. Next, allow students to experiment with magnets near (but not touching) the compass to observe the effect on the needle.
- Caution: Avoid direct contact between the magnet and compass to altering the magnetic field of the compass magnet.

Explore A Magnetic Field Model

Before Class Setup: Place approximately 1 teaspoon of iron filings into sheet protectors (one setup per group), ensuring they're placed on one side of the paper. Seal the open end of the sheet protector with tape, ensuring no iron filings can escape.

1. **Explain** that tiny pieces of iron can be strongly attracted to a magnet and can each become a magnet themselves when exposed to a magnetic field. Magnetic field lines are invisible lines that represent the force and direction of a magnetic field. They exit from the magnet's north pole and enter its south pole.
2. **Observing Magnetic Fields:** Using the filings in the sheet protector, encourage students to position a magnet near, but not directly on top of, the iron filings. A gentle tap on the sheet protector can help. They should observe the curved patterns the filings form, representing the magnetic field lines.
3. **Experimenting with Magnet Placement:** Prompt students to experiment by relocating the magnet to different areas, aiming to find positions that make the field lines most distinct.
4. **Tracing and Sketching:** Instruct students to use a dry erase marker to trace the patterns made by the iron filings. Emphasize the concept that magnetic field lines are three-dimensional, enveloping the magnet in every direction.
 - o Have students answer corresponding questions provided on their worksheet, and fill out the chart in “*Explain: Analysis of Magnetic Fields*” to illustrate the various field lines based on the orientation of their magnets.
 - o Optional: Have students try various orientation of magnets to see what other magnetic field patterns they create.



Created by: Donna Falk

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Your Mission:

You will demonstrate a visual magnetic field model using iron filings and apply it to the fundamental principles of magnetism and the earth's magnetic fields.

Method: Magnetic Field Model

1. Setting Up:

- You will be provided with a sheet protector that contains iron filings. Gently shake the sheet protector to distribute the iron filings.

2. Observing Magnetic Fields:

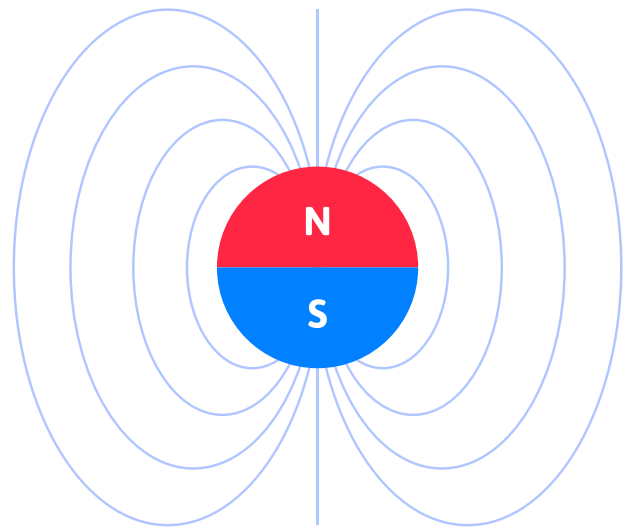
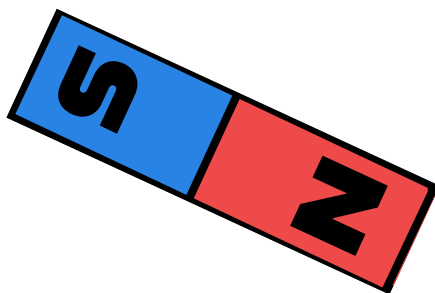
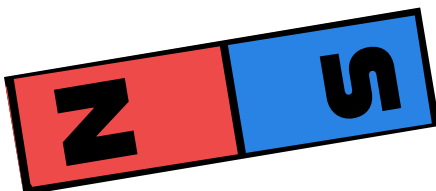
- Position a magnet on different areas of the paper, near the iron filings. Gently tap on the sheet protector. Observe the patterns formed by the iron filings around the magnet. What do you notice?

3. Experimenting with Magnet Placement:

- Next, experiment by moving the magnet to various spots to identify the location where the filings display the most distinct field lines.

4. Tracing and Sketching:

- Use a dry erase marker to trace the alignment of iron filings. Sketch your lines onto "Analysis of Magnetic Fields" worksheet.



Questions for Analysis:

Magnetic Fields

Pattern Observation:

- Describe the pattern formed by the filings around the magnet.

Magnet Movement:

- What changes occur when you move the magnet?

Understanding the Phenomenon:

- Why do the filings align in specific patterns?

Magnetic Force Exploration:

- How does the magnetic force influence the iron filings without direct contact?




Extend Your Thinking:

- How can you use the concept of magnetism in everyday life? Give some examples of how magnets are used in different technologies.



Analysis of Magnetic Fields

Within the table below, sketch the 2 dimensional magnetic field lines that surround the magnet. Explain the patterns observed for each of the orientations, making sure to explain where the field lines are the most concentrated (where the magnetic field is the strongest).

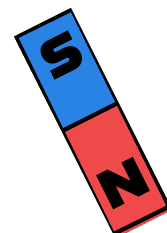
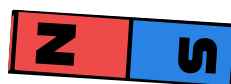
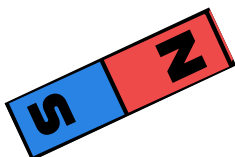
Draw the magnetic field lines for each magnet orientation	Explain the patterns observed (include where the magnetic field is the strongest)
	
	
	



Analysis (continued)

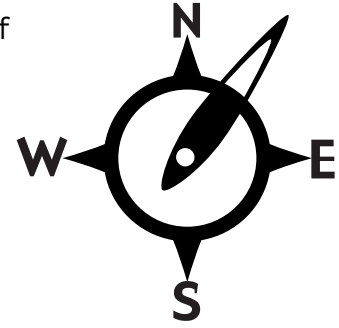
Using the empty boxes below to explore your own magnet orientations or try different shaped magnets if provided.

Draw the magnetic field lines for each magnet orientation	Explain the patterns observed (include where the magnetic field is the strongest)



Evaluation

- Creating the visual magnetic field model in a neat and accurate manner.
- Student’s depth of understanding of magnetic fields and completion of follow up discussions and questions.
- Student’s ability to work well with group members.



Suggested Grading Rubric

Criteria	3 Points	2 Points	1 Point
Procedure	Student follows procedure accurately and effectively. They correctly utilize the materials to create an accurate model of a visual magnetic field. The model is neat and clean up is complete.	Student follows most of the procedure accurately. They may have minor errors in their model, model is somewhat neat and cleanup is not complete.	Student does not follow the procedure accurately. They made significant errors in the model, the model is not created neatly and cleanup was not performed.
Knowledge and Understanding	Student demonstrates clear understanding of magnetism and earth's magnetic fields. They explain iron filings alignment and compass behavior.	Student demonstrates some understanding of magnetism and earth's magnetic fields. They partially explain iron filings alignment and compass behavior.	Student demonstrates limited understanding of magnetism and earth's magnetic fields. Their explanation of iron filings alignment and compass behavior is unclear or incorrect.
Collaboration	Student works cooperatively and effectively with all group members, actively contributing ideas, listening to others, and resolving conflicts constructively.	Student generally works well with group members, but may occasionally display a lack of teamwork, active contribution, or conflict resolution skills.	Student has difficulty working with group members, displays a lack of teamwork, rarely contributes ideas, or does not effectively resolve conflicts.

