Magnets and Magnetism

Strand Force, Motion, and Energy
Topic Magnetism
Primary SOL 2.2 The student will investigate and understand that natural and artificial magnets have certain characteristics and attract specific types of metals. Key concepts include
a) magnetism, iron, magnetic/nonmagnetic, poles, attract/repel;
b) important applications of magnetism.
Related SOL 2.1 The student will demonstrate an understanding of scientific reasoning, logic, and the nature of science by planning and conducting investigations in which
a) observations and predictions are made and questions are formed;
c) observations are repeated to ensure accuracy;
e) length, volume, mass, and temperature are measured in metric units and standard English units using the proper tools;
h) data are collected and recorded, and bar graphs are constructed using numbered axes;
i) data are analyzed, and unexpected or unusual quantitative data are recognized;
k) observations and data are communicated;
m) current applications are used to reinforce science concepts.

Background Information

Magnetism is a property of materials that respond to an applied magnetic field. If a magnet acts on another object that is magnetic, the object will either be attracted or repelled. A common misconception is that all metals are attracted to magnets; however, only ferrous metals such as nickel, iron, and cobalt are attracted to magnets.
All magnets have a north and south pole. If you put the poles of two magnets together, they will either pull together or push apart. They will pull (attract) each other if the poles are different. They will push (repel) each other if the poles are the same.

Materials

- Magnets (including bar magnets) and lodestones (magnetite)
- Compasses
- Common objects (e.g., cotton, nails, wood, cloth, aluminum foil, paperclips, paper and/or journals)
- Rulers
- Student sheets for centers:
    - Is it Attracted to a Magnet?
    - Are All Magnets the Same Strength?
    - Is a Magnet's Push or Pull Stronger?
    - Where Can We Find Magnets?

- Is it North or South?

Vocabulary

magnetism, iron, magnetic, nonmagnetic, poles, attraction, nonattraction, repel, compass, north, south

Student/Teacher Actions (what students and teachers should be doing to facilitate learning)

Introduction

This lesson plan should be used after students have been introduced to magnets, magnetism, and compasses. Set up the following five centers for students to further explore magnets, magnetism, and compasses. Students should rotate through the centers in small groups of two to three students.

Procedure

Center 1: Is it Attracted to a Magnet?

1) Center 1 Materials: *magnets, eight objects that students are familiar with that can be tested to see if they are attracted to a magnet (e.g., piece of wood, aluminum foil, paperclip, pencil, etc.), Is it Attracted to a Magnet? student sheet, ruler or straight edge for each student group to help stay on a line to fill in the chart*.
2) Instructions for the students are:
    a. Before getting out the magnet, use the Is it Attracted to a Magnet? student sheet to predict whether or not you think each object will be attracted by the magnet.
    b. Test each object three times to see if it is attracted by the magnet.
    c. Did you prove your predictions to be true or false? *(Remember: Proving a prediction false is not a wrong answer. Predictions are not right or wrong. They are either true or false.)*
    d. Complete the questions on the Is it Attracted to a Magnet? student sheet.

Center 2: Are all magnets the same strength?

1. Center 2 Materials: *box of paperclips, a man-made magnet, a lodestone, Are All Magnets the Same Strength? student sheet*
   NOTE: Since the paperclips may become temporarily magnetized, provide fresh paperclips as needed.
2. Instructions for the students are:
    a. Before getting out the two magnets, use the Are All Magnets the Same Strength? student sheet to record your prediction for how many paperclips you think each magnet can pick up.
    b. Test each magnet to see how many paperclips that are placed end to end the magnet can hold? (Students will be making a paperclip chain.)

c. Did you prove your prediction to be true or false?
d. Complete the questions on the Are All Magnets the Same Strength? student sheet.

Center 3: Is a Magnet's Push or Pull Stronger?

1. Center 3 Materials: *two bar magnets of the same size, 12 inch ruler,* Is a Magnet's Push or Pull Stronger? *student sheet*
2. Instructions for the students are:
    a. Before testing the two magnets, make a prediction as to whether the magnets' push (repel) or pull (attraction) is stronger.
    b. Test the two magnets as follows:
        i. Hold the north ends of two magnets toward each other. What happens?
        ii. Hold the south ends of the two magnets toward each other. What happens?
        iii. Hold the north end of one magnet and the south end of the other magnet toward each other on the table. What happens?
    c. Lay the ruler on the table. Put the north end of one magnet at the zero end of the ruler. Put the north end of the other magnet at the other end of the ruler.
        i. Push the magnet at the zero end of the ruler one inch toward the other magnet. Record your observations.
        ii. Continue pushing the one magnet one inch at a time toward the other magnet and record what happens at each additional inch.
        iii. Record the measurement on the ruler when you can no longer push the magnet any closer to the other magnet.
    d. Lay the ruler on the table. Put the north end of one magnet at the zero end of the ruler. Put the south end of the other magnet at the other end of the ruler.
        i. Push the magnet at the zero end of the ruler one inch toward the other magnet. Record what happens.
        ii. Continue pushing the one magnet one inch at a time toward the other magnet and record what happens at each additional inch.
        iii. Record the measurement on the ruler when the two magnets are magnetically attracted to each other.
    e. Complete the questions on the Is a Magnet's Push or Pull Stronger? student sheet.

Center 4: Where Can We Find Magnets?

1. Center 4 Materials: *access to all areas of the classroom for the team,* Where Can We Find Magnets? student sheet

2. Instructions for the students are:
    a. List magnets that you know about that are in the classroom.
    b. Take a tour of the room with your partner. Find as many magnets as you can in the classroom. List each magnet that you find and draw a picture of it.
    c. Make a list of magnets that you might find at your home.

Center 5: Is it North or South?

1. Center 5 Materials: *access to all areas of the classroom for the team, bar magnet compass,* Is it North or South? student sheet
2. Instructions for the students are:
    a. Look at the compass? What labels are on the compass? What happens to the needle on the compass when you turn? What happens to the needle of a compass when you bring a magnet near it?
    b. Hold the compass flat on the table so that the needle points north. Describe what object(s) the compass is pointing to in the room when the needle is on north.
    c. Describe what object(s) are south.
    d. What direction is the door of your classroom from where you are sitting/standing? Why does the compass point that direction?

Assessment

- **Questions**
    - Name three objects that are attracted to a magnet.
    - What is alike about objects that are attracted to magnets?
    - What are the two poles on a magnet?
    - Is a magnet's push or pull stronger?
- **Journal/writing prompts**
    - What do you observe about the materials that are attracted to a magnet?
    - Explain how you would tell someone to determine which way is North using a compass.

Extensions and Connections (for all students)

1. Create a new application for using a magnet.
2. Label classroom items that should not be near magnets (computers, televisions, projectors, etc.).

Strategies for Differentiation

1. Provide pictures for push (repel) and pull (attraction).

2. Play out “repel” and “attract” by giving students necklace cards with the terms “repel” and “attract” on them (1/2 the class gets each term). Those students labeled “repel” must move away from other students. Those students labeled “attract” must touch and remain shoulder to shoulder with fellow “attract” students. (You can color code cards to match classroom magnet pole colors).
3. To assist with journal writing, preteach interactive/shared writing. Students can work in pairs using this strategy.
4. Have students brainstorm uses of magnets in everyday life.
5. Give students an activity sheet or a collection of materials that students identify from prior knowledge of magnetic versus nonmagnetic items on a chart. After completion, allow students to test the actual materials with a magnet.

Center 1: Is It Attracted to a Magnet?

Team Member Names: _____

Date: _____

1. Before you test each object with the magnet, predict if you think each will be attracted to a magnet. Record your predictions in the table below. *(Use your ruler or straight edge to help you mark the line on the chart.)*
2. Test each object three times using the magnet to see if it is attracted to the magnet. Record your results in the table below.
3. Were your predictions supported by your tests?
4. After you have tested each of the objects, answer the questions.

Name of the Object	**PREDICTION** **Will it be attracted to a magnet?**		**TESTING** **Is the object attracted to a magnet?**						**Was your prediction proved true or false?**	
			Test 1		**Test 2**		**Test 3**			
	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No
	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No
	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No
	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No
	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No
	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No
	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No
	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No

Questions:

1. Do the objects that were attracted to the magnet have anything alike about them? If yes, tell about what that is. _____

2. Do the objects that were not attracted to the magnet have anything alike about them? If yes, tell about what that is. _____

3. Did any of your findings surprise you? _____

4. Why was it important to test each object three times? _____

Center 2: Are All Magnets the Same Strength?

Team Member Names: _____

Date: _____

1. Before you test the strength of the two magnets, predict the number of paperclips you think that can be held in a chain by each magnet. Record your predictions in the table below.
2. Test each magnet three times to see how many paperclips hung in a chain can be held by each magnet. Record your results in the table below.
3. Were your predictions true or false?
4. After you have tested each of the magnets, answer the questions.

<table>
<tr><th colspan="2">Lodestone</th><th colspan="2">Manmade Magnet</th></tr>
<tr><td>Predict how many paperclips a lodestone will hold in a chain.</td><td></td><td>Predict how many paperclips a manmade magnet will hold in a chain.</td><td></td></tr>
<tr><td rowspan="3">Number of Paperclips Held</td><td>Test 1</td><td rowspan="3">Number of Paperclips Held</td><td>Test 1</td></tr>
<tr><td>Test 2</td><td>Test 2</td></tr>
<tr><td>Test 3</td><td>Test 3</td></tr>
</table>

Questions:

1. Which kind of magnet did you find to be stronger? _____

2. Did any of your findings surprise you? _____

3. Why was it important to complete three tests? _____

4. Do you think the size of a magnet will determine how many paperclips it can hold in a chain? Explain your answer. _____

Center 3: Is a Magnet's Push or Pull Stronger?

Team Member Names: _____

Date: _____

1. Before testing the two magnets, make a prediction as to whether the magnet's push (repel) or its pull (attraction) is stronger.

   _____

   _____

   _____

2. Test the two magnets as follows:
   a. Hold the north ends of two magnets toward each other. What happens?

      _____

      _____

      _____

   b. Hold the south ends of the two magnets toward each other. What happens?

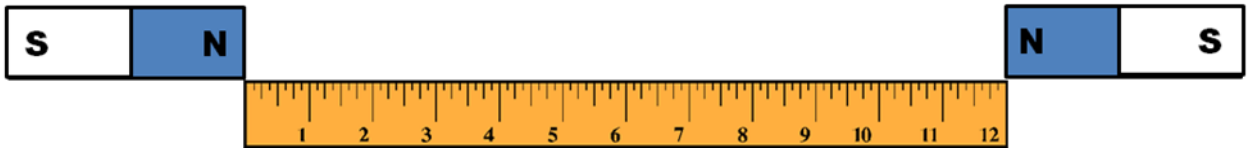
      _____

      _____

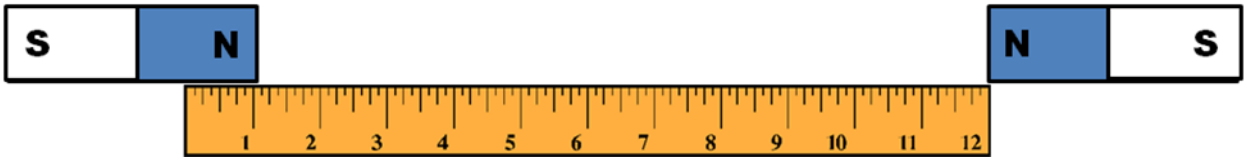
      _____

   c. Hold the north end of one magnet and the south end of the other magnet toward each other on the table. What happens?

3. Lay the ruler on the table. Put the north end of one magnet at the zero end of the ruler. Put the north end of the other magnet at the other end of the ruler.



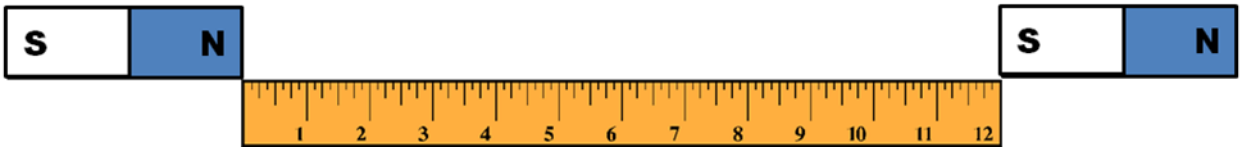
   a. Push the magnet at the zero end of the ruler one inch toward the other magnet. Record what happens.



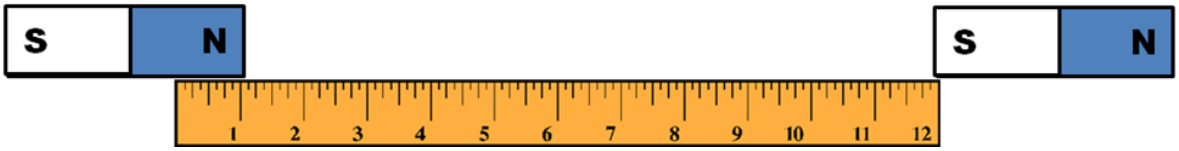
   b. Continue pushing the one magnet one inch at a time toward the other magnet and record what happens at each additional inch.

c. Record the measurement on the ruler when you can no longer push the magnet any closer to the other magnet.

4. Lay the ruler on the table. Put the north end of one magnet at the zero end of the ruler. Put the south end of the other magnet at the other end of the ruler.



a. Push the magnet at the zero end of the ruler one inch toward the other magnet. Record what happens.



b. Continue pushing one magnet one inch at a time toward the other magnet and record what happens at each additional inch.

c. Record the measurement on the ruler when the two magnets are magnetically attracted to each other.

5. Was the distance when the two magnets were pulled (attracted) to each other larger or smaller than the distance when the two magnets pushed away from (repelled) from each other? _____

6. Was your prediction true or false? _____

Center 4: Where Can We Find Magnets?

Team Member Names: _____

Date: _____

1. List magnets that you find in the classroom. _____

   _____

   _____

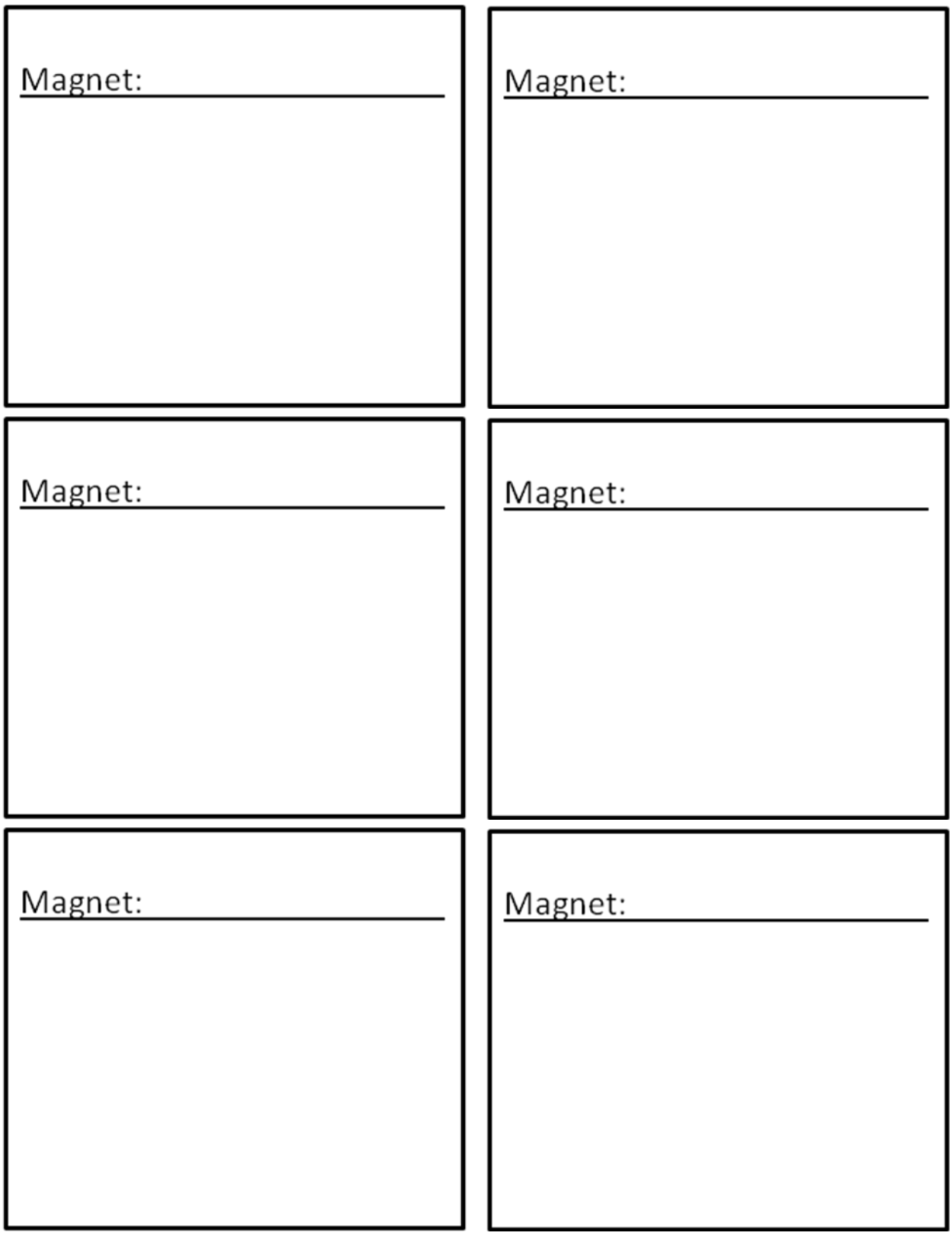
   _____

   _____

   _____

2. Take a tour of the room with your partner. Find as many magnets as you can in the classroom. Try to find magnets that are not on your list for #1. List each magnet that you find and draw a picture of it. (Draw any additional magnets on the back of your pages.)

Magnet:	Magnet:



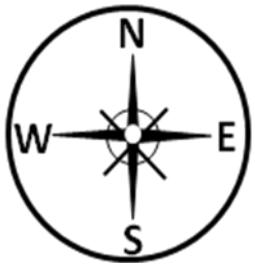
3. Make a list on the back of your page of magnets that you can find at home.

Center 5: Is it North or South?

Team Member Names: _____

Date: _____

1. Look at the compass. What labels are on the compass?



_____

_____

_____

2. What happens to the needle on the compass when you turn the compass?

   What happens to the compass needle when you bring a bar magnet near it?

_____

_____

_____

3. Hold the compass so that the needle points north. Describe what objects the compass is pointing to in the room when the needle is on north.

_____

_____

_____

4. Describe what object(s) in the room are south.

_____

_____

_____

5. What direction is the door of your classroom is from where you are standing? _____

_____

_____

_____