Investigation Five – Discovering Magnetic Fields

Standard III Students will understand that magnetism can be observed when there is an interaction between the magnetic fields of magnets or between a magnet and material made of iron.
Objective 2 Describe how the magnetic field of Earth and a magnet are similar.
Intended Learning Outcomes 1. Use science process and thinking skills 2. Manifest science attitudes and interests 3. Understand science concepts and principles 4. Communicate effectively using science language and reasoning

Standard III

Objective 2

Background Information

There are unseen magnetic fields around single magnets, between two magnets attracting each other, and between two magnets repelling each other. With the use of iron filings we can see these magnetic fields. By sprinkling metal filings over a single bar magnet, we can see its magnetic field pattern. You will see a different magnetic field pattern when iron filings are sprinkled between two attracting bar magnets. A different magnetic field will be observed when iron filings are sprinkled on two repelling bar magnets. But it doesn't stop there. By getting all types of magnets and sprinkling iron filings on them, you will see all different kinds of magnetic field patterns.

The lines that form these magnetic field patterns are called magnetic field lines. These lines show the direction of the magnetic forces. When iron filings are sprinkled on a bar magnet, you see that these magnetic field lines start at the magnet's north end and will end at the magnet's south end. The field lines that curve toward each other show attraction. You will even see these curved lines if you sprinkle iron filings on two attracting bar magnets.

However, if iron filings are sprinkled between two bar magnets repelling each other, the magnetic field line will curve away from each other and even stand on edge. The magnetic field forces are pushing each other away and this causes the curving and standing on edge.

Pre-Assessment/Invitation to Learn

1. Give the students a piece of art paper and have them fold it into eighths.
2. Have them write their names and the title *magnetic Fields* in the upper left hand square.
3. Leaving the art paper at their desks, have them gather around you so they can see the first magnet experiment.
4. Place a bar magnet into a plastic locking bag.
5. Put the bag into a tote tray and cover it with a piece of copy paper.

Materials

- Zip-lock bag
- Bar magnet
- Iron filing
- Tote tray
- 12 X 18 Art Paper
- Pencil
- Paper cup

6. Sprinkle some iron filings on top of the white paper.
7. Ask them what is happening to the filings.
8. Encourage them to try to explain why the filings are in the pattern they see.
9. After your demonstration and discussion, explain what has happened.
10. Have the students go back to their desks and have them label the first box "bar".
11. Have them draw a picture of a bar magnet in that same box.
12. Have them draw the magnetic field pattern they saw on the bar magnet. You may need to help them by drawing it on the board. Emphasize the magnetic field lines that show attraction and the iron filings standing on end that show repulsion.

Instructional Procedure

Materials
- Six different types of magnets such as, domino, horseshoe, disc, donut, cow, and ball magnets
- 1 pound of iron filings
- 6 paper cups
- 6 tote trays
- 6 pint-sized plastic locking bags
- Small stack of copy paper

1. Divide the students into six groups.
2. Have the six remaining magnets in plastic locking bags in the six tote trays.
3. Have a piece of copy paper by the side of each tote tray.
4. Have a small paper cup with a small amount of iron filings by each tote tray.
5. Have each group stand by a different tote tray with their art paper and pencils in hand.
6. Have the students name the magnet they will be observing and write it in any box on their paper.
7. Have the students draw a picture of that magnet in the box they labeled.
8. Have the students put the white copy paper on top of the bag.
9. Have one student in each group, sprinkle the iron filings on top of the copy paper.
10. Have the students observe the pattern created by the iron filings. Then have them draw that pattern on the magnet figure they drew. Make sure they draw accurately showing all the magnetic field lines and any iron filings that are standing on end.
11. Everyone should finish about the same time. Have them clean up their iron filings and put them back into the paper cup.
12. Have student groups rotate to the next station.
13. The children will repeat steps 6 through 12 after each rotation until everyone has been to each station. (If there is time, each of the students at each station can sprinkle iron filings on top of the bag so they all have a chance to experience each one.
14. When groups have been to all the stations, have them clean their last station and go to their seats.
15. Discuss how the iron filings reacted to each kind of magnet. This can be done a number of ways. 1) The teacher can draw the patterns on the board (or on an overhead) while the children compare what they drew with what is on the board (or overhead).

2) The teacher can choose six children to go to the board an draw what they have on their papers. Each of them should tell what they think is happening. 3) Do the same as number 2 but have the students lead the discussions instead of the teacher.

Curriculum Extensions

Science –

- Experiment by putting two magnets of the same kind in a bag with "N" and "N" (north ends) facing each other. Sprinkle iron filings on them to examine the pattern. (ILO 1)
- Experiment by putting two magnets of the same kind in a bag with "N" and "S" facing each other. Sprinkle iron filings on them to examine the pattern (ILO 1)
- Experiment by putting a nail or paper clip, or any other article that would stick to a magnet and put them into a bag. Sprinkle iron filings on them to examine the pattern. (ILO 1)
- Magnetize a paper clip, a small nail, a pin, or any other article you think could be magnetized. Put it into a bag and sprinkle iron filings on top to see what patterns they may have. (ILO 1)
- Put a horseshoe magnet or any other odd-shaped magnet in the bottom of a bowl with about two inches of water covering it. Magnetize some small nails and stick them through some small square pieces of cork. Put them in the water to let them float. Ask what shape the magnetized nails are taking. (ILO 1)
- Put both pieces of a broken magnet in a plastic bag. Put a piece of copy paper on top. Now put metal filings on top. Ask how this is different from a whole magnet of the same kind. (ILO 1)

Fine Arts –

- When the metal filings are on top of the paper, spray paint the metal filings. Before the paint dries, shake off the metal filings and the magnetic field design will be left. (Standard 2, Objective 2)
- If there are enough iron filings, spray them with spray glue. It will keep the iron filings in place to show the actual pattern. (Standard 2, Objective2)

Assessment Suggestions

- Response questions:
  1. Draw a picture of the metal filings on a bar magnet.
  2. Draw a picture of metal filings on a horseshoe magnet.
  3. Draw a picture of the metal filings on a donut magnet.
  4. Draw a picture of the metal filings on a domino magnet.
  5. Draw a picture of what magnetic fields look like when iron filings show attraction.

- Observational descriptions:
  Have pictures of different kinds of magnets that have iron filings on them. Have the students describe on paper what is happening by using the vocabulary words magnetic field, repel, and attract. Have them label where the attractions and the repulsions are on the magnets.

Reference to Assessment Section

	Multiple Choice	Constructed Response	Performance Test
Unit Test	5, 6, 7, 8, 9, 10	1	Which is Stronger?

Resources

Books:

- Levine, Shar, and Leslie Johnstone. The Magnet Book. Sterling Publishing Co.
- Parker, Steve. Learn About Magnets. Lorenz Books
- Riley, Peter. Magnetism. New York: Grolier Publishing. ISBN 0-531-14506-9
- Bocknek, Johathan. Science of Magnets. Milwaukee, Wisconsin: Garth Stevens Publishing
- Turner, John Hudson. Magnetism. North Mankato, Minnesota: Smart Apple Media.

Websites:

- www.windows,ucar,edu
- www.si.edu.harcourt.scienct
- www.harcourtschool.com

Videos:

(See Resources in Investigation 1)