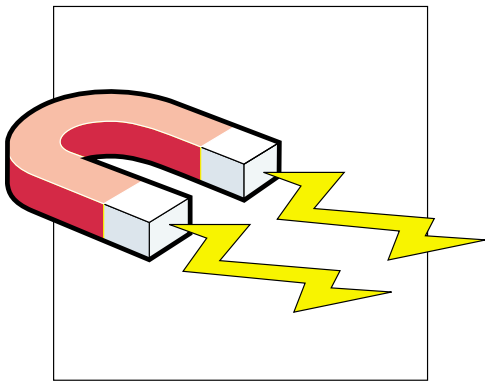
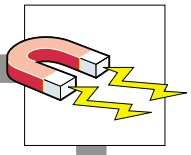
Unit 16: Magnetism





Vocabulary

Study the vocabulary words and definitions below.

attract ..... to draw or pull toward itself (e.g., a magnet attracts iron)

compass ..... an instrument with a magnetized needle that points to magnetic north; used to determine direction

demagnetize ..... to remove the magnetic properties from a magnet

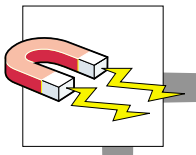
electromagnet ..... a device that creates a magnetic field made by connecting a coil of wire to an electric current

electromagnetic effect ..... the tendency of flowing electrons (electricity) to produce magnetic fields and the tendency of moving magnetic fields to cause electrons to flow

induced ..... caused, created, or produced

law of magnetic poles ..... like magnetic poles repel and unlike magnetic poles attract

like poles ..... the same poles; the poles of magnets that repel each other



lines of force ..... imaginary lines that show a magnetic field

magnet ..... a substance that attracts or pulls on other substances, especially those made of or including iron

magnetic ..... of or relating to a magnet or to magnetism

magnetic field ..... the space around a magnet where a force is noticeable

magnetic north ..... the magnetic pole located in the north about 800 miles from the North Pole; also known as the North Magnetic Pole

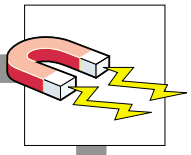
magnetic south ..... the magnetic pole located near the South Pole; also called the South Magnetic Pole

magnetic variation ..... for navigational purposes; the angle between the North Magnetic Pole and the actual geographic North Pole

magnetism ..... a property of matter that creates forces that attract or repel certain substances

magnetize ..... to become magnetic; to make into a magnet

nonmagnetic ..... anything that is not attracted to a magnet



North Pole ..... the northern end of Earth's axis

north pole ..... the end of the magnet that points to the north (if free to move)

northern lights ..... lights that are sometimes seen in the skies of the northern regions and are thought to be caused by the ejection of charged particles into the magnetic field of Earth

poles ..... the ends of a magnet where the magnetic field is strongest

repel ..... to push away

South Pole ..... the southern end of Earth's axis

south pole ..... the end of the magnet that points to the south (if free to move)

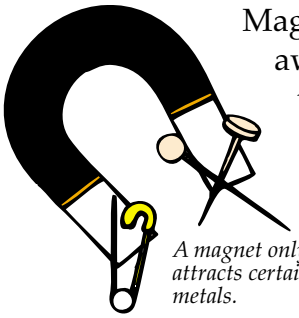
unlike poles ..... the opposite poles; the poles of magnets that attract each other

Introduction

Magnetism is a special type of force. Magnetism is a special property of matter. In this unit, you will learn how magnets are created. You will also discover how to make a **compass** and describe how it works. Magnetism is a force that affects many areas of everyday living.

What Is a Magnet?

A **magnet** is a substance that **attracts** or pulls on other substances. Iron, cobalt, and nickel are **magnetic** metals because they are attracted to a magnet. Anything that is not attracted to a magnet is **nonmagnetic**. Tin, copper, paper, and wood are nonmagnetic.



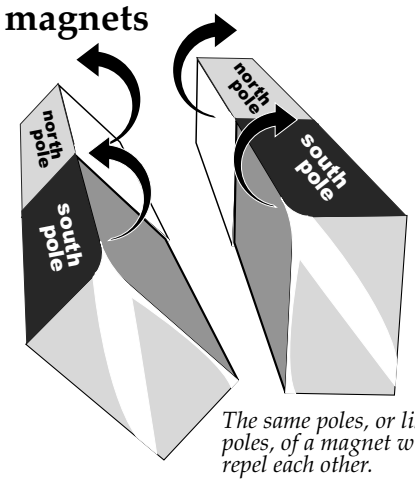
A magnet only attracts certain metals.

Magnetic force can also **repel**. Two magnets can push away from each other when their ends are put together. The ends of a magnet where the force is strongest are called **poles**. The poles of a magnet are found by determining which ends have the strongest force. Pass a bar magnet over a box of pins. Most of the pins will stick to the ends of the magnet.

One pole, or end of a magnet, is called the **north pole**. The other end is called the **south pole**. All magnets have a north and south pole.

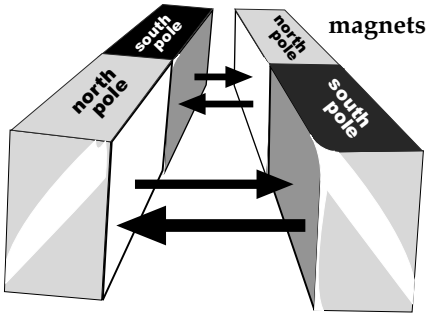
Pick up two magnets. Put the north pole of one next to the north pole of the other. What happens? They repel each other. Try placing a south pole next to a south pole. Again, the magnets will repel each other.

Now put a north pole next to a south pole. Do they repel each other? No, they



The same poles, or like poles, of a magnet will repel each other.

attract each other. This is called the **law of magnetic poles**. The same poles, or **like poles**, of a magnet will repel each other. The opposite poles, or **unlike poles**, of a magnet will attract each other.



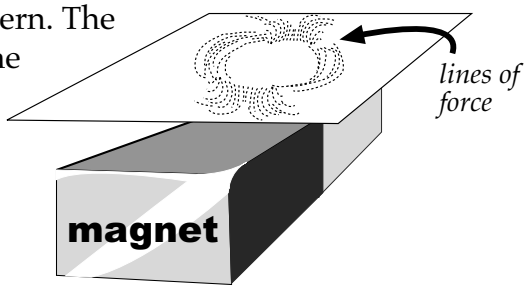
The opposite poles, or unlike poles, of magnets will attract each other.

Explaining Magnetism

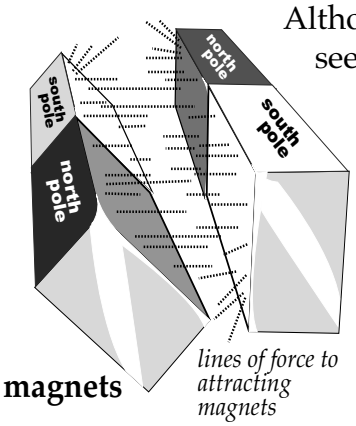
You know that atoms make up matter. Some atoms are like little magnets. In cobalt, iron, and nickel, the atoms may line up in a special way. When most of the atoms face the same way, the material will be magnetic. In nonmagnetic material, the poles cancel each other out. This is because they are not lined up in the same direction.

Magnetic Field

You already know that the force of a magnet is strongest at the poles. The rest of the magnet also has some force. Put a piece of paper over a bar magnet. Place some iron filings on top of the paper. Shake the paper slightly. The iron filings will make a pattern. The lines you see are called **lines of force**. The whole pattern is the **magnetic field**. A magnetic field is a space around a magnet where a force is noticeable.



When you get too far away from a magnet, the force will not be noticeable



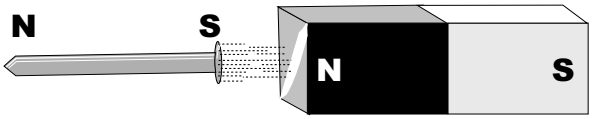
lines of force to attracting magnets

Although magnetism seems like a strong force, we see that it quickly gets weak with distance.

What would the lines of force look like in attracting magnets? What would happen to the lines of force if two like magnets were placed together? Remember, opposite forces attract and like forces repel.

Making a Magnet

Magnetism can be **induced**, or created, in some materials. There are three ways to make a magnet. Place an iron nail against the north pole of a magnet. The force in the magnet will begin to pull at the atoms in the nail. They will line up in straight lines. This will make the nail temporarily magnetic. The end of the nail closest to the magnet's north pole will become the south pole. The other tip of the nail will be the north pole.

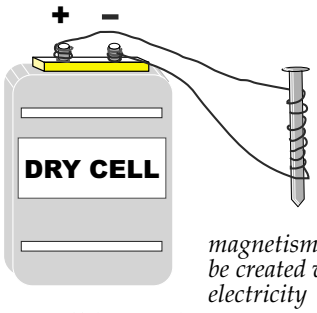


magnet

You can also **magnetize** some materials by rubbing them with a magnet. Run a magnet along the side of a needle. Keep rubbing in the same direction. The atoms in the needle will begin to line up. This will make the needle into a magnet. The longer you rub, the stronger the magnetism will become. Both induced magnets will lose their magnetic force after awhile.

Magnetism can also be created with electricity. Connect a wire to the (+) side of a dry cell or battery. Coil the wire around a nail. Attach it to the (-) side of the dry cell.

This will create an **electromagnet**. The nail will act like a magnet. This kind of magnet has many advantages over ordinary magnets. Electromagnets can be turned on and off. Their strength can be controlled. This kind of magnet is used in doorbells, electric motors, and telephones.



dry cell (battery)

magnetism can be created with electricity

The Electromagnetic Effect

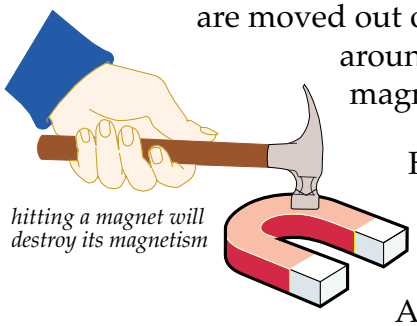
You saw that in the first two examples, a magnet was used to create a new magnet. In this last example, we did not use a magnet. Instead, we used electricity. Electricity is electrons that are flowing in a particular direction. Because these particles are charged, when they flow past the nail it causes a magnetic field to be created. It is this field that makes the nail act as a magnet. When you unplugged the wires, the electrons stopped. This also shut off the magnet.

This effect was first described by Michael Faraday. He called it the **electromagnetic effect**. This means that, as we've seen, electricity can create magnets. Magnets, however, can also be used to create electricity, the flow of electrons. Electrons move from areas of negative charge to areas of positive charge. By moving magnets past a length of metal, electrons are made to move. This is how electricity is generated. Electricity and magnetism are closely related and are usually found together. In many ways, they cannot be separated and are just two versions of the same force.

Demagnetizing a Magnet

When the physical appearance of a magnet is changed, the property of magnetism may or may not change. If a magnet is cut in half, it will not destroy the magnet. There will just be two smaller magnets. Each one will have a north and a south pole.

However, magnetism can be destroyed. A magnet can be **demagnetized** by removing properties from a magnet. Remember that the atoms in a magnet are lined up in a row. Magnetism will be destroyed if the atoms are moved out of line. Heating will cause atoms to move around. If a magnet is held over a flame, its magnetism will be lost.



hitting a magnet will destroy its magnetism

Hitting a magnet with a hammer will also destroy its magnetism. The force of the hammer will move the atoms out of line.

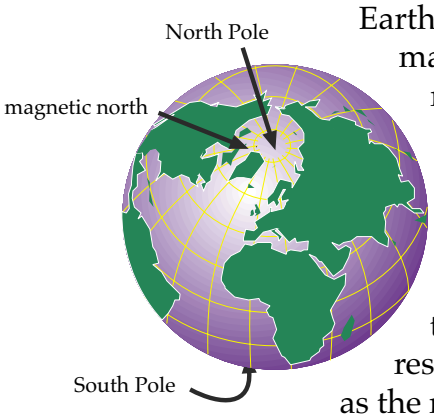
A magnet that is dropped over and over again will also lose its magnetism. Each time the magnet is dropped, more atoms will move out of line.

Earth as a Magnet

What makes one pole of a magnet point north? It must be attracted to something. Earth can be thought of as a large magnet. Look at a globe of Earth. The very top is called the **North Pole**. The opposite side is called the **South Pole**. These spots are not the magnetic poles. **Magnetic north** is located almost 800 miles from the North Pole. **Magnetic south** is located near the South Pole.

Why is magnetic north important? Scientists discovered the magnetic force of Earth could be used to determine direction. Sailors began using

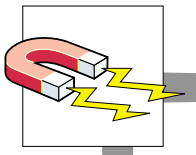
compasses to find their way. A compass has a magnetized needle that points to magnetic north. Any direction can be located if you know which way is north. For advanced navigation, it is important to know that there is a slight shift in north as you approach the North Pole. This shift is called **magnetic variation**.



Earth acts as a huge magnet. It also has a magnetic field. Earth's magnetic field is responsible for the phenomenon called the **northern lights**. Remember that magnets are closely related to electricity. Because of this, they have effects on charged particles. When charged particles come into Earth's atmosphere near the poles, they interact with the magnetic pole. The result is a release of energy. We see this energy as the northern lights or bright-colored areas in the sky.

Summary

Magnetism is a force that attracts or repels substances. Magnets have north and south poles. Poles that are the same repel each other. Unlike poles attract. Lines of force surround a magnet. Magnets can be created when atoms line up. The electromagnetic force can be used to create magnets or electricity. Applying heat, hitting, or dropping a magnet will destroy its magnetism. Earth acts as a magnet. A compass helps locate direction by pointing to the magnetic north.



Practice

Answer the following using complete sentences.

1. What are three ways to make a magnet? _____

   _____

   _____

   _____

2. What are three ways to demagnetize a magnet? _____

   _____

   _____

   _____

3. How does an electromagnet work? _____

   _____

   _____

4. Earth has two magnetic poles. What are they called? _____

   _____

   _____

5. Are the magnetic poles mentioned above the same as the North and South geographic poles of Earth? Explain.

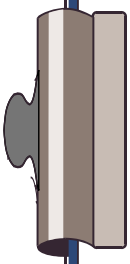
   _____

   _____

   _____

   _____

Lab Activity 1: Part 1



Facts:

- The magnetic field is the space around a magnet where a force is noticeable.
- The lines of force are lines that show the magnetic field.

Investigate:

- You will make a map of a magnetic field and diagram the lines of force for attracting and repelling magnets.

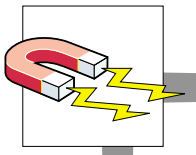
Materials:

- 2 bar magnets
- iron filings
- a sheet of paper

1. Place one bar magnet on your desk.
2. Cover the magnet with a sheet of paper.
3. Sprinkle iron filings on the entire paper.
4. Observe what happens.
5. In the space below, draw a diagram of what you observed.

Answer the following about the Lab Activity 1: Part 1. Use the term **poles** *or* **middle** *to correctly complete the statements.*

6. At the end of the experiment, most of the iron filings were at the _____ .



7. At the end of the experiment, there were fewer iron filings in the

   _____ .

8. From this experiment, you can see that a magnet is strongest at the

   _____ .

9. You can also see that a magnet is weakest in the

   _____ .

Lab Activity 1: Part 2

Continuing with Lab Activity 1, answer the following.

1. Remove the bar magnet from beneath the sheet of paper.

2. Shift the sheet of paper until the iron filings are in one pile in the middle of the paper. Move the paper to the side of your desk. We will use it in a moment.

3. Pick up two bar magnets. Hold one in each hand. Move the north pole of one of the magnets toward the north pole of the second magnet. Observe what happens.

   a. Did the poles attract or repel? _____

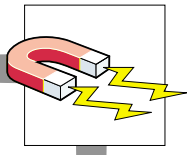
   b. Do like poles attract or repel? _____

4. Reverse one of the magnets so that the south pole of one is pointing toward the north pole of the other magnet. Move the magnets together. Observe what happens.

   a. Did the north pole attract or repel the south pole? _____

   b. Do opposite poles attract or repel? _____

5. Put the magnets on your desk so that the north poles of each are about one hand's width away pointing toward each other. Place the sheet of paper with the iron filings on top of the two north poles. Observe what happens.



6. In the space below, draw a diagram of what you observed.

You have just drawn the magnetic field between like magnets.

7. Carefully pick up the sheet of paper and iron filings. Change the direction of one of the magnets so that the north pole on one is facing the south pole of the other.

8. Place the paper and iron filings on the magnets. Observe what happens.

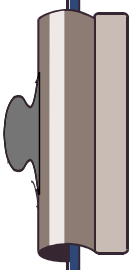
9. In the space below, draw a diagram of what you observed.

You have just drawn the magnetic field between unlike magnets.

10. The law of magnetic poles states that like poles

_____ and unlike poles _____ .

Lab Activity 2



Facts:
- Earth is a huge magnet.
- All magnets point to the magnetic north.

Investigate:
- You will magnetize a simple needle to create a simple compass.

Materials:
- bar magnet
- steel needle
- thin piece of cork
- bowl
- water
- a compass

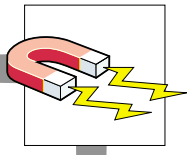
1. Fill a shallow bowl with water.
2. Rub a needle with a bar magnet. Be sure to rub in only one direction.
3. Lay the needle on the piece of cork.
4. Place the needle and cork in a bowl of water.
5. Observe what happens.

   You know that the needle is pointing north and south, but which end is pointing to the north?

   _____

   _____

6. Set a compass a few feet away. Check the needle for north.



7. What happened when you rubbed the needle with the magnet?

_____

_____

8. In which direction did the needle point when you placed it on the cork in the water? (north and south or east and west)

_____

9. Why does the needle of a compass point north?

_____

_____

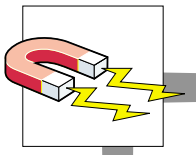
_____

10. If Earth did not have magnetic poles, would a compass work? Why or why not?

_____

_____

_____



Practice

Use the list above each section to complete the statements in that section.

attract	**magnetism**	**repel**
like	**nonmagnetic**	**south pole**
magnet	**north pole**	**unlike**
magnetic	**poles**	

1. A property of matter that creates forces that attract or repel certain substances is called _____ .

2. A _____ is a substance that attracts or pulls on other substances.

3. Anything that is attracted to a magnet is called _____ .

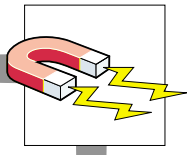
4. Anything that is not attracted to a magnet is called _____ .

5. The ends of a magnet are called _____ .

6. The end of the magnet that always points to the north (if free to move) is called the _____ .

7. The end of the magnet that always points to the south (if free to move) is called the _____ .

8. The law of magnetic poles states that like poles _____ and unlike poles _____ .



9. The north pole of one magnet and the north pole of another magnet would be considered _____ poles. (like or unlike)

10. The north pole of one magnet and the south pole of another magnet would be considered _____ poles. (like or unlike)

compass	**lines of force**	**magnetize**
demagnetize	**magnetic field**	**North Pole**
electromagnet	**magnetic north pole**	**South Pole**
induced		

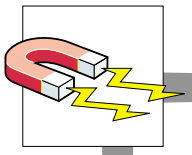
11. A _____ is the space around a magnet where a force is noticeable.

12. The _____ are the lines that show a magnetic field.

13. Magnetism that is caused by an object touching or being placed near a magnet is called _____ magnetism.

14. To make something into a magnet is to _____ it.

15. A device that creates a magnetic field made by connecting a coil of wire to an electric current is called an _____ .



16. To remove the magnetic properties from a magnet is to _____ .

17. The northern end of Earth's axis is called the _____ .

18. The southern end of Earth's axis is called the _____ .

19. The magnetic pole located in the north about 800 miles from the North Pole is called _____ .

20. A _____ is an instrument with a magnetized needle that points to the magnetic north.