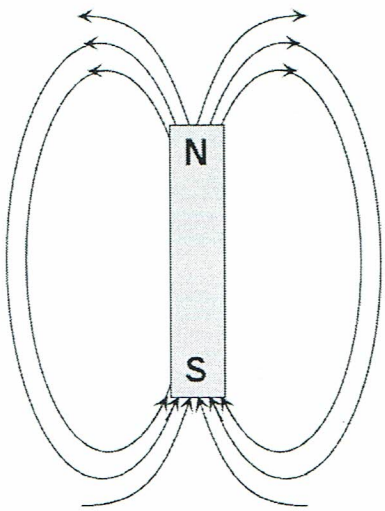
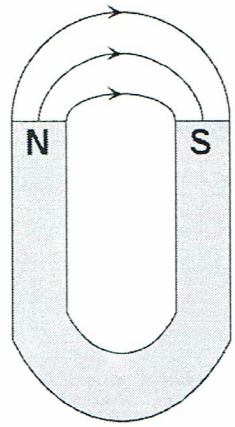
Magnetic Field

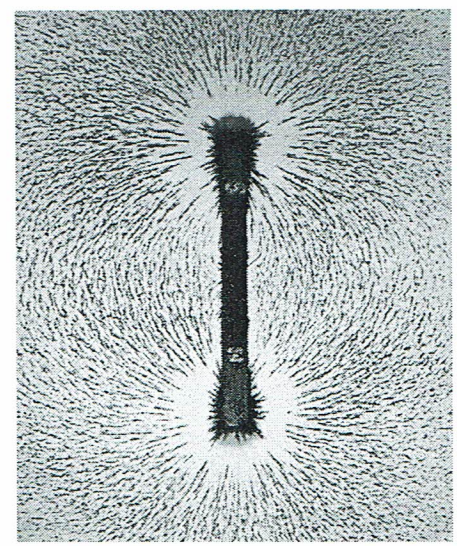
The area around a magnet where the magnetic force acts is called the **magnetic field**. The magnetic field cannot be seen. It makes no noise. It has no odor or taste. You cannot touch it.

You can feel the effects of a magnetic field. You can feel the push or pull when you bring tow magnets together. You can feel the magnetic field when you bring an object, such as a paper clip, close to a magnet. As you move the paper clip closer to the magnet, you reach a point where you can feel the magnet pulling the clip.

Although you cannot see a magnetic field, you can see its effect. When iron filings are placed near a magnet, they form a pattern. This pattern shows the shape of the magnetic field. The pattern seems to end at the surface of the magnet. You cannot see it, but the magnetic field goes through the magnet also. The size of the magnetic field depends upon the strength and size of the magnet.







Location of a Magnetic Field Demonstration

Facts to Know

Unlike poles attract each other. Like poles repel each other. A magnetic field is formed by the magnetism that radiates from a magnet.

Procedure

1. You will need two pieces of string and two magnets. Tie a piece of strong to the center of each magnet. Hold the string with the magnets next to each other. Twirl the magnets.

Observation

Do the magnets always stop with the same sides touching each other?

_____

Can you get the north pole of one magnet to dangle right next to the north pole of the other magnet?

_____

2. Place a bar magnet under a sheet of paper and sprinkle with iron filings.
    - Do not slide the paper away from the magnet. Iron filings will attach to the magnet and be very difficult to remove.
    - Do not touch the iron filings with your fingers!

Observation:

Draw your observations below and label

Conclusions

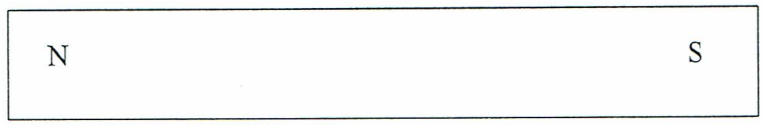
1. What do you discover when we dropped the iron filings on the magnet over the paper?

_____

2. The iron filings show the greatest force _____.

Directions: Below are drawings of bar magnets. On each, draw the lines of magnetic force that show the location of the magnetic field.

1.



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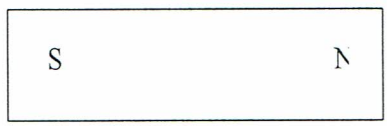

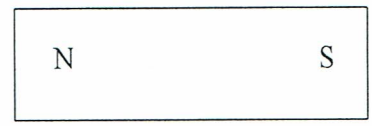

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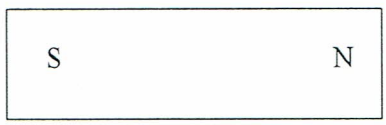
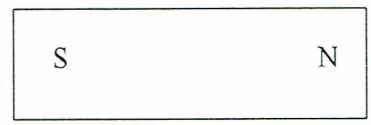




4. What do the letters "N" and "S" stand for on the magnets?

_____

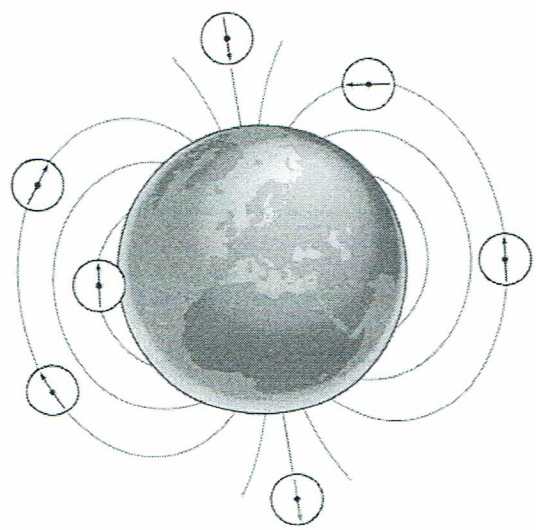
_____

5. How could you test each of the predictions you have made?

_____

_____

_____



How Are Magnets Made?

There are three different kinds of magnets: natural, temporary, and permanent. Each kind is made in a different way.

Natural magnets are rocks with a lot of iron in them. Magnetite is an example of rock that is naturally magnetic. Natural magnets are magnetic when they are found in the ground. No one has to do anything to them, because they are already magnets.

Temporary magnets are called that because they are weak and last only a short time. They are made from pure (soft) iron. One way to make a temporary magnet is to stroke a soft iron object (like a nail) with a magnet.

Permanent magnets are made from "hard" iron, which is iron plus some other special materials. Steel is a hard iron, so it makes good permanent magnets. If we strong steel scissors they will be magnetized. There are called permanent magnets because they are strong and because they hold their magnetism for a long time.

A ceramic magnet is a special kind of permanent magnet. The ring magnets we use in school are ceramic magnets. They are made from a form of iron called strontium ferrite. This powder is pressed into molds. Then it is put into a very hot oven where it is heated to 2,250 degrees Fahrenheit. As these future magnets cool, they shrink slightly. The flat sides of ring magnets become their poles.

Uses of Magnets

There may be a number of ways magnets are used in your home. Perhaps a magnet holds the refrigerator door shut. Some cabinet doors are held shut with magnets also. You may use magnets to attach notes, lists, or drawings to refrigerator doors or magnetic bulletin boards.

Bar magnets are used in compasses. A compass is an object used by travelers to determine direction. The needle in a compass is positioned so it can turn freely. The needle is usually a magnet. The needle always points north. The north pole of a magnet seeks the North Pole of the Earth. By knowing where north is, a traveler is able to find other directions.

Bar magnets can be bent into a horseshoe shape. Horseshoe magnets are used where a strong magnetic field is needed in a small space. These magnets are used in the motors of some toy cars.

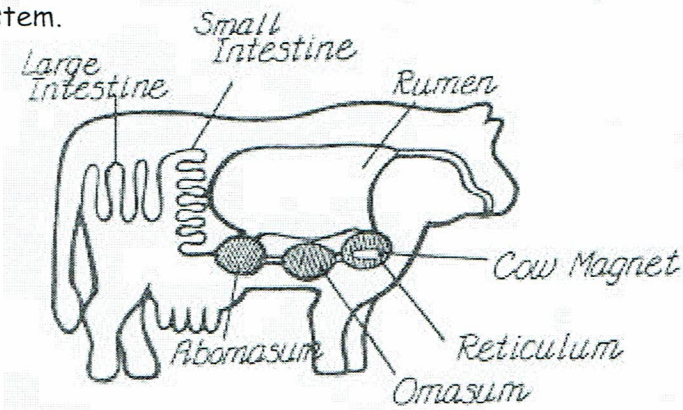
Large industries use magnets. Magnets can be used to separate valuable metals from other matter. In other industries, magnets are used to pick up small pieces of metal that rub off machinery. This helps keep the machinery clean. Clean machinery breaks down less often. In the food and chemical industries, magnets keep metal particles from mixing with the products. Magnets have been used from searching for underwater treasure to removing a steel splinter from an injured person's eye.

What on Earth is a cow magnet?

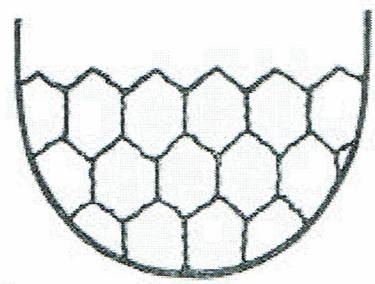
Magnets come in many shapes and sizes, but the cow magnet was invented to solve a very serious problem of dairy farmers. To understand how cow magnets help, it is necessary to know how a cow's stomach works.

As you might guess, a cow has a very large stomach. In an adult cow it can hold about 280 liters (over 60 gallons) of food. The stomach is divided into four compartments: the rumen, the reticulum, the omasum, and the abomasums.

The muscles in the walls of the rumen and reticulum mix and moisten the food. Then it is passed back up into the mouth, where the cow chews it thoroughly. We say the cow is "chewing her cud." Then the food is swallowed a second time. This time it passes through all four sections of the stomach and on to the rest of the digestive system.



Highly schematic drawing of a cow's digestive system


Close-up of honeycomb cells of reticulum

When we start to eat food with a seed or a piece of bone in it, we usually feel it in our mouths before we swallow it. Cows, on the other hand, swallow their food so quickly the first time that they do not sort out the small bits of hay wire and other scrap that gets into their food. As a result, they swallow many of these bits of wire.

If the wire stays with the food, there is no problem, but unfortunately, the wire often becomes lodged in the honeycomb-like hexagonal cells of the mucous membrane in the cow's reticulum or second stomach. The motion of the cow causes some of the wires to go through the walls of the cow's digestive tract and sometimes even into its heart.

Veterinarians use a special tube to put a cow magnet in the back of the cow's mouth. The cow swallows the magnet easily because it is long, narrow, and round, something like a thick, smooth, heavy crayon. Since the magnet is heavy, it sinks to the bottom of the rumen. As wire bits go into the rumen, they stick to the magnet instead of the stomach lining. One small cow magnet can help a cow for her whole life.

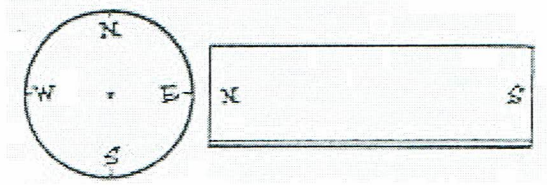
Magnets and Compasses

Materials

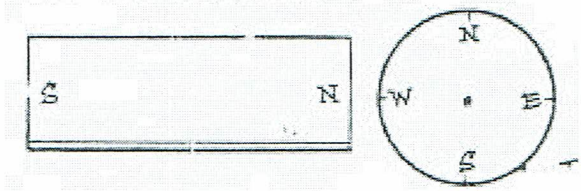
compass, bar magnet

Procedure

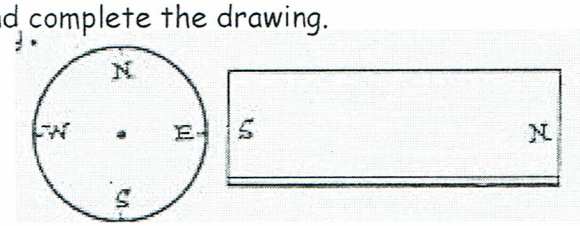
1. Place a compass on your desk and bring a bar magnet next to the compass as shown. Complete the drawing how the needle is positioned.



2. Now place the bar magnet as shown. Complete the drawing.



3. Move the magnet and complete the drawing.



4. Is the pointer of the compass a north seeking pole or a south seeking pole?

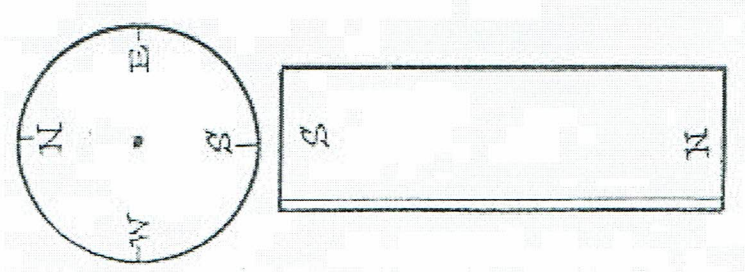
_____

_____

_____

5. Predict what will happen in the drawing below. _____

Check your answer with a magnet and compass and complete the drawing.



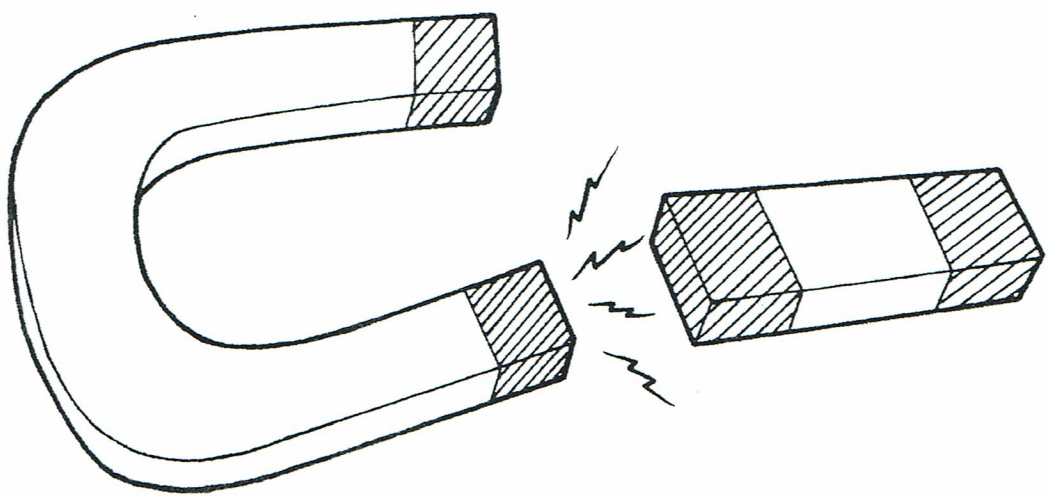
We Live On a Giant Magnet

Our Earth is a big magnet. The North Pole and the South Pole have the strongest magnetic fields. For over 2,000 years, people have used this to aid them in their travels. They have used a compass to find their way. A compass needle is really a thin magnet. It always points to the Earth's North Pole. But a compass can stop working right if a strong magnet is put next to it.

If a magnet is hung on a string, it will turn until one end points toward the Earth's North Pole. That is the south pole of the magnet. The other end is its north pole. North and south poles pull towards each other. So the north pole of Magnet A pulls the south pole of Magnet B closer. If they get near enough, they will snap together. But two north poles will always **repel**. They will push away from each other. And the same is true of two south poles.

Some metals are magnetic. These metals are iron, nickel, and steel. Aluminum, copper, gold, and silver are not magnets. Magnets have no effect on them. Magnetic force passes right through them without changing the force or the metal.

People find magnets very useful. You may stick notes and pictures on your refrigerator with magnets. Videotapes have tiny magnets that record pictures and sounds. Big magnets lift scrap iron and steel into train cars.



We Live On a Giant Magnet

Comprehension Questions

Fill in the bubble next to the best answer. You may look back at the story.

1. **A magnet would not affect**

   (a) nickel. (b) steel. (c) aluminum. (d) iron.

2. **What happened last?**

   (a) The compass starts to work correctly again.
   (b) Bob moves his compass away from Jill's magnet.
   (c) Bob's compass no longer correctly points north.
   (d) Jill put a magnet next to Bob's compass.

3. **Pat puts the south pole of Magnet 1 right near the south pole of Magnet 2. What happens?**

   (a) The magnets will pull together.
   (b) The magnets will move away from each other.
   (c) The magnets will not move at all.
   (d) The magnets will stand up straight.

4. **The word *repel* means**

   (a) dislike. (b) attract. (c) resist. (d) burn.

5. **Which of the following is not a way a magnet can be used?**

   (a) to heat a stove
   (b) to hang things on a refrigerator
   (c) to pick up heavy metal things
   (d) to record sounds on a cassette tape

6. **Picture putting a small, flat magnet next to each item below. Which would it cling to?**

   (a) a can of soda pop
   (b) a bar of gold
   (c) a sterling silver necklace
   (d) a steel drum

7. **Would you like it if all coins were made of magnetic metals? Explain.**

_____

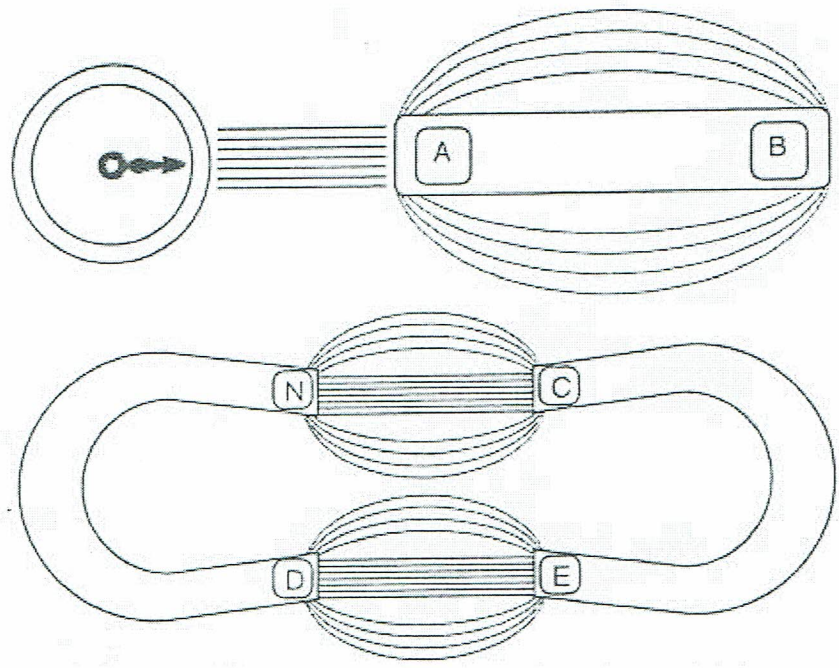
_____

_____

Making Inferences

Look at the illustrations below. Use what you observe to help you answer the questions.

Three magnets and a compass were placed under a piece of glass. Iron filings were gently sprinkled on the glass, revealing the magnetic fields below.



1. What is around the magnets? _____

2. Where on the magnets is the magnetic force the strongest? _____

3. The arrow end of the compass is its north pole. Is the box labeled **A** a north or south pole? Explain how you found your answer.

_____

_____

4. Identify the poles labeled B, C, D, and E as either north or south poles.

B _____ C _____ D _____ E _____

5. Explain how you identified the poles.

_____

_____

_____