LEARN ABOUT

Magnets

FIND OUT

- about magnetic poles
- how magnetic fields cause magnetic forces
- how to use Earth's magnetic field to find directions

VOCABULARY

magnet
magnetic pole
magnetic field

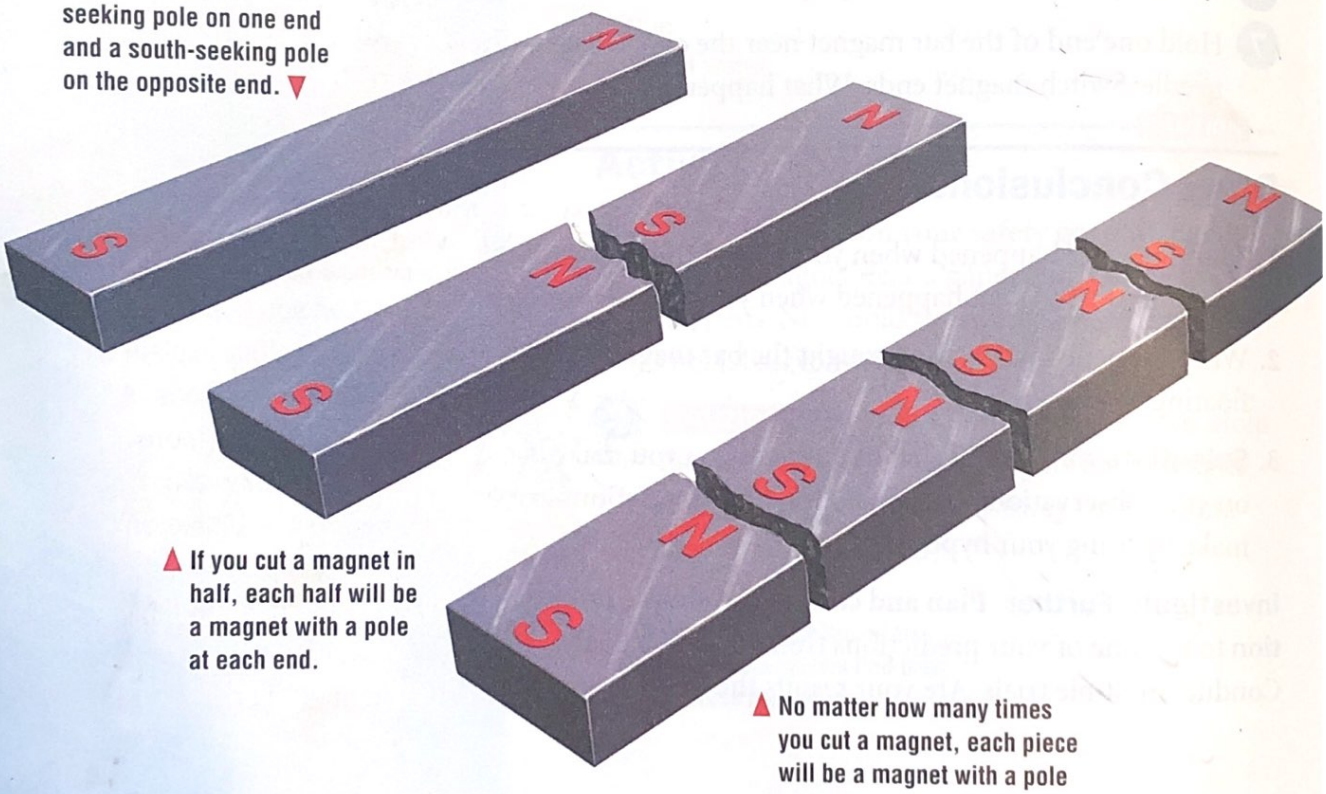
Two Poles

In the investigation you made a needle into a magnet. You could tell it was a magnet because it attracted metal paper clips, just as other magnets do. A **magnet** is an object that attracts certain materials, usually objects made of iron or steel. A needle isn't a natural magnet. You changed it into a magnet by dragging it along the bar magnet.

A magnet has two ends called **magnetic poles**, or just *poles* for short. A magnet's pull is strongest at the poles. If a bar magnet can swing freely, one end, called the *north-seeking pole*, will always point north. The opposite end, called the *south-seeking pole*, will always point south. A magnet's north-seeking pole is usually marked *N*. Its south-seeking pole is marked *S*.

✓ **What is each end of a magnet called?**

A magnet has a north-seeking pole on one end and a south-seeking pole on the opposite end. ▼



▲ If you cut a magnet in half, each half will be a magnet with a pole at each end.

▲ No matter how many times you cut a magnet, each piece will be a magnet with a pole at each end.

Magnetic Forces

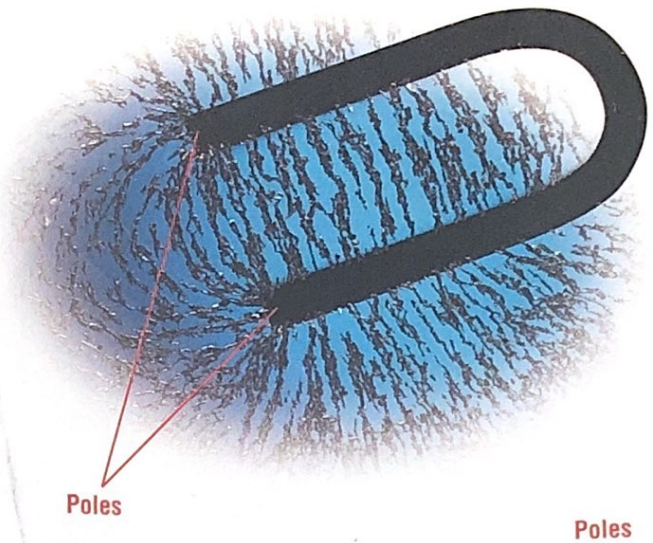
If you've ever played with magnets, you've probably felt them pull toward each other. At other times they seem to push away from each other. The forces you felt are magnetic forces caused by magnetic fields.

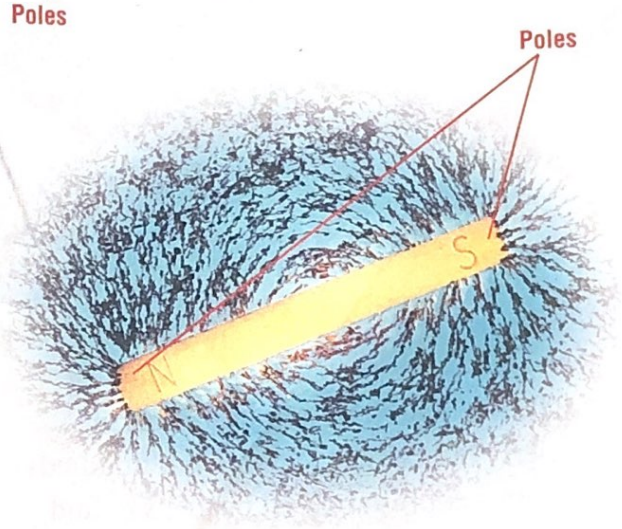
A **magnetic field** is the space all around a magnet where the force of the magnet can act. You can't see the field. However, a magnet can move iron filings into lines. The pattern made by the iron filings shows the shape of the magnet's field.

Forces between magnetic poles are like forces between electric charges. Opposite magnetic poles attract, and like poles repel. If the N pole of one magnet is held toward the S pole of another magnet, their fields form a closed pattern. This closed pattern of lines shows a force that pulls the magnets together.

If two magnets are held with their N poles near each other, their magnetic fields form an open pattern of lines. Just as with electric charges, this pattern shows a force that pushes the magnets away from each other.

✓ Where is the pull of a magnet strongest?

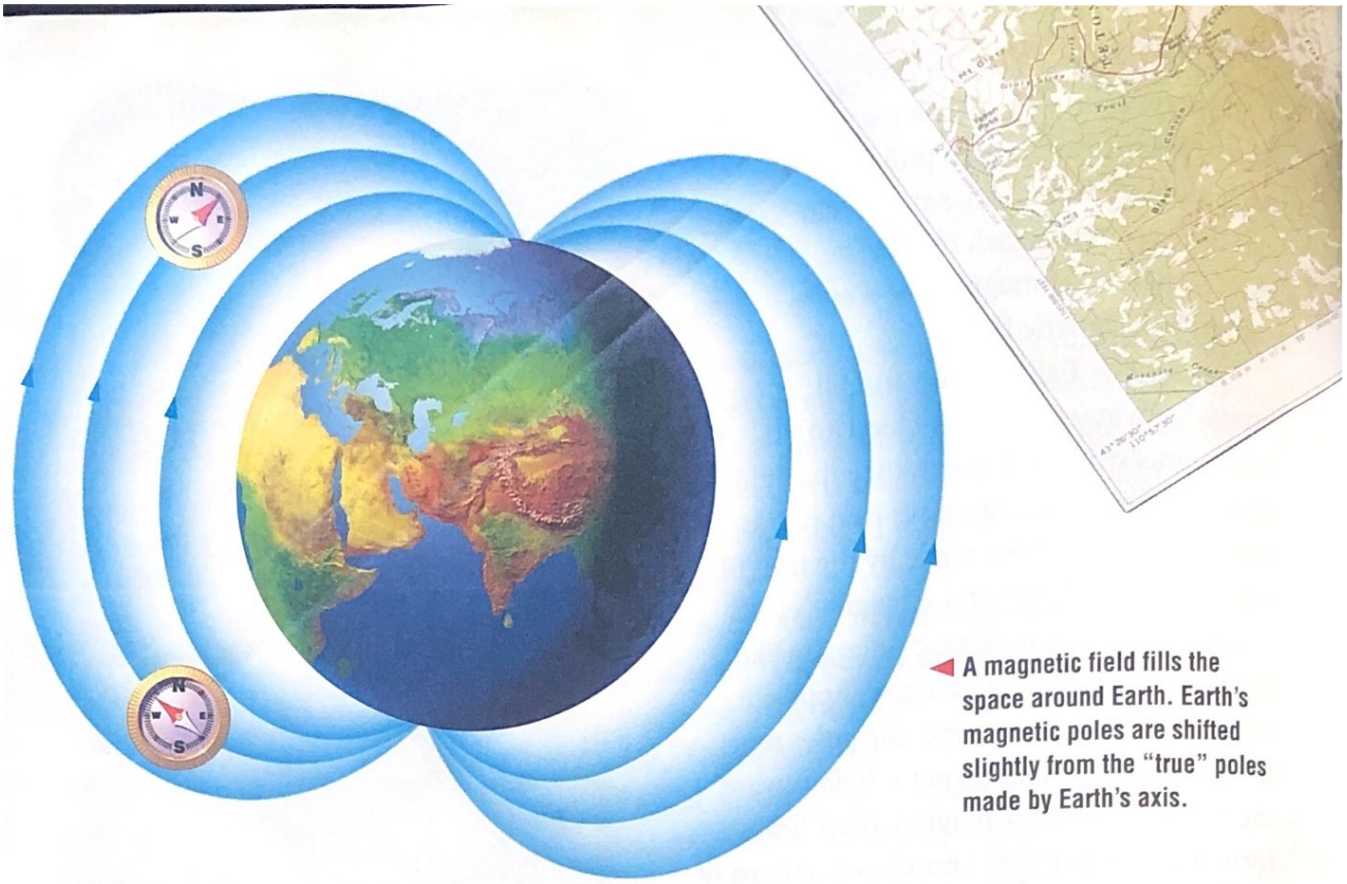




▲ The shape of a magnetic field depends on the shape of the magnet. The bunching of iron filings on the end of a magnet shows that the magnetic force is strongest at a magnet's poles.

▲ Opposite poles of two magnets attract. The pattern of iron filings is closed. This shows a magnetic force that attracts, or pulls, the magnets together.

▲ Like poles of two magnets repel. The field lines are open, showing lines of force that push the magnets apart.



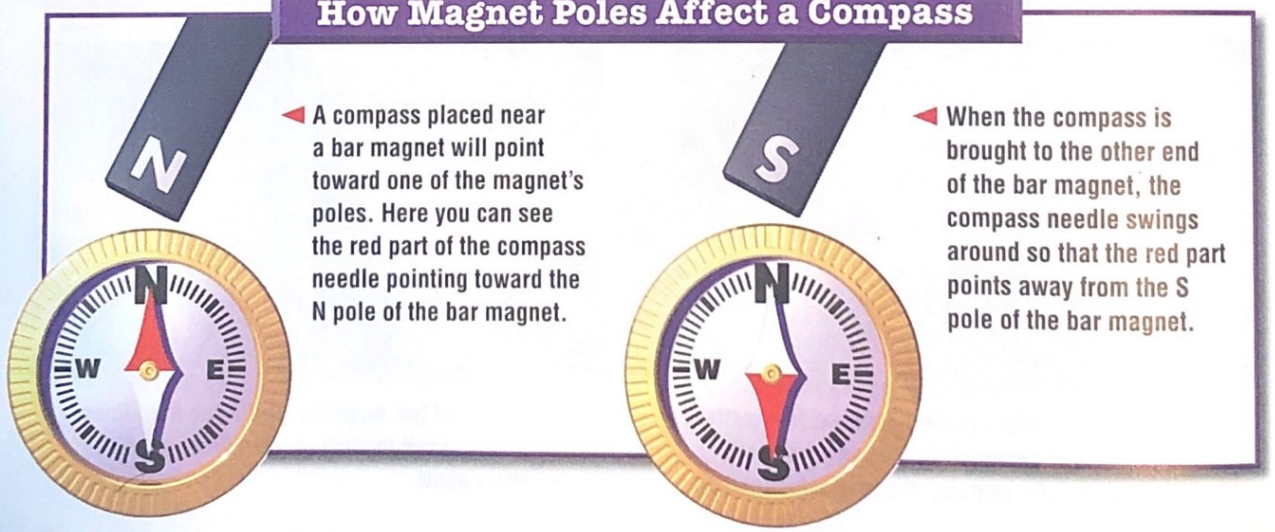
A magnetic field fills the space around Earth. Earth's magnetic poles are shifted slightly from the "true" poles made by Earth's axis.

Compasses

The north-seeking and south-seeking property of magnets is useful. For hundreds of years, people have used magnets to find direction. The first magnets used were made of a heavy natural material called *lodestone.* Today geologists know this material as the mineral magnetite.

A compass today uses a lightweight magnetic needle that is free to turn. This is much like the needle you made into a magnet in the investigation. A compass needle points along an imaginary line connecting the North and South Poles. This is because Earth is like a giant magnet.

How Magnet Poles Affect a Compass



A compass placed near a bar magnet will point toward one of the magnet's poles. Here you can see the red part of the compass needle pointing toward the N pole of the bar magnet.

When the compass is brought to the other end of the bar magnet, the compass needle swings around so that the red part points away from the S pole of the bar magnet.

When there are no landmarks you know, a map and a compass can help you find your way.

The field lines of Earth's magnetic field come together close to the planet's North and South Poles. This pattern is like the one shown by the iron filings around the bar magnet on page C47. Indeed, Earth's magnetic field is like the field of a giant bar magnet.

✓ **How does a compass work?**

Summary

Magnets are objects that attract materials such as iron. Every magnet has two magnetic poles. Magnetic forces are caused by the interaction of magnetic fields. Earth's magnetic field is like the field of a bar magnet. A compass needle interacts with Earth's magnetic field.

Review

1. How can you find the poles of a magnet?
2. What is a magnetic field?
3. Which type of magnet has a field that is about the same shape as Earth's magnetic field?
4. **Critical Thinking** Describe the field lines formed if the south poles of two magnets are brought close together.
5. **Test Prep** How many poles does a magnet have?

   A none
   B one
   C two
   D four

LINKS

MATH LINK

Magnet Strengths Decide on a way to measure the strength of different bar magnets. Test some magnets. Then use a computer program such as *Graph Links* to make a bar graph to show what you measured. Which magnet is strongest?

WRITING LINK

Informative Writing—How-To Write a paragraph telling a classmate how to use a compass to find the direction in which he or she is traveling.

SOCIAL STUDIES LINK

Earth's Moving Magnetic Poles Earth's north magnetic pole is constantly moving. Find out how the pole's location is shown on topographical (tahp•uh•GRAF•ih•kuhl) maps, which show the land's surface features, and on navigational charts. Find the current location of the north magnetic pole on a globe. Measure the distance between the true North Pole and the magnetic north pole.

TECHNOLOGY LINK

Learn more about Earth's magnetic field by visiting the National Air and Space Museum Internet site.
www.si.edu/harcourt/science