Electromagnetic Forces

Reflect

Have you ever played with refrigerator magnets? You put them near each other and they snap together. Turn one around and they seem to push each other away. There seems to be an invisible **force** acting on the magnets and it behaves in different ways, depending on which way you turn the magnets. Have you tried this with more than two magnets? Did the forces seem stronger with two?

What is electromagnetic force?

Force: A push or pull

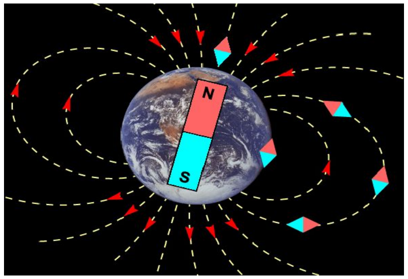
Electromagnetic forces usually occur around electrically charged particles. These forces can be detected as electric **fields**, magnetic fields, or as light. Forces that act across a distance are referred to as fields.

Fields: forces that act across a distance

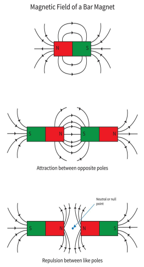
Magnetic force is caused by certain particles that make up an object. When these particles are all arranged in the same way, the object becomes a magnet..

The magnetic force of a magnet forms a pattern called a magnetic field. A magnetic field is made up of magnetic lines of force. The lines of force are invisible, but there is a way to see their shape. Put a magnet under a piece of paper and sprinkle small bits of iron on the paper. The iron bits will line up with the lines of force. What do you notice about the pattern in the lines?

Earth is a large magnet with a magnetic field. A compass has a needle that is a small magnet. The needle always points toward Earth's magnetic north pole.



Earth is actually a giant magnet and has its own magnetic field.



The lines of magnetic force, or the magnetic fields, are seen around these magnets.

Electric forces also act across distances, forming electric fields. In much the same way as magnets have north and south poles that can attract or repel each other, there are positive (+) and negative (-) electric charges that attract and repel. Opposite charges, (+) and (-), attract. Like charges, (+) and (+) or (-) and (-), repel.

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Reflect

Try rubbing an inflated balloon on your hair. Now bring the balloon close to your hair. Does your hair stand up toward the balloon when you bring it near? Try bringing the balloon close to a small stream of water from a water faucet or small bits of paper on a desktop. Does the water or paper move toward or away from the balloon? If so, you are observing the electric field.

What Do You Think?

What do you think causes lightning during a storm? If an electric field exists which is caused by positively or negatively charged areas in the clouds or on the ground attracting each other, the result could be a bolt of lightning. Lightning can be from cloud to cloud, cloud to ground, or ground to cloud, depending on the arrangement of the excess charges.

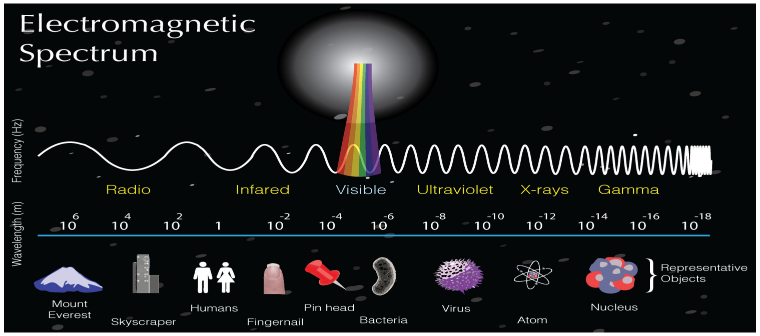
Now think about the balloon you just used. You charged it by rubbing your hair and it together. What produces this rubbing effect in the atmosphere during storms that causes the ground and clouds to become charged?

Lightning happens during a storm when opposite charges attract.

Look Out!

Light is another example of electromagnetic forces acting across a distance. The light we see on Earth comes from the sun and is a type of electromagnetic radiation. Electromagnetic radiation is energy made up of particles called photons. These photons travel by electromagnetic waves and they are faster than anything we know of in the universe.

The electromagnetic spectrum contains all forms of electromagnetic radiation, including visible light.



Try Now

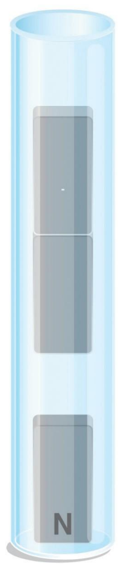
A compass needle always points north.

When a piece of iron is put into the field of a magnet, it will become a magnet, too. When the iron object is taken out of the field, it will still be a magnet. The new magnet may not be very strong. It helps to heat and tap on the iron object while it is in the field.

You can use Earth's magnetic field to make a magnet. You will need a compass, a hammer, and an iron rod. The iron rod should be about a foot long. (The vertical rod in a ring stand works well.) With an adult's help, use the compass to find the direction north. Point one end of the rod toward north. Hit one end of the rod with the hammer several times. This will help rearrange the iron atoms to create a magnetic field.

Now you can see if you made the rod into a magnet. With an adult's help, tie a string to the middle of the rod. The rod should spin freely while hanging from the string in a level position. Tie the string to something overhead. Give the rod a gentle spin. If one end is pointing north when it stops spinning, the rod has become a magnet.

What Do You Know?
Imagine dropping three magnets into a glass tube. The picture below shows how the magnets lined up in the tube.



The north pole of the bottom magnets is marked with an N. Mark the remaining poles of all three magnets. Write the letter N on each north pole. Write the letter S on each south pole. Remember, if poles are the same they push away from each other.

Electromagnetic Forces

Connecting With Your Child

Magnetism at Home
This activity will help you explore the forces of gravity and magnetism with your child. The only materials you will need are two bar magnets, duct tape, and a transparent tube. You may use any size tube; however, the longer the tube, the easier it will be to see the results. The magnets must fit lengthwise into the tube. Stronger magnets work better than weaker magnets. (Very strong bar magnets might be available from a veterinarian who treats large animals. Vets put strong magnets in cow's stomachs to prevent iron scraps from traveling farther down the digestive tract.) The tube could be large-diameter, clear plastic tubing available from a hardware store.

1. Attach one end of the tubing to the floor with tape, and support the other end so that the tube is vertical.
2. Drop, carefully, one bar magnet into the tube. Observe its acceleration as it falls. Note whether the north pole or the south pole is facing up.
3. Drop, carefully, the other magnet into the tube. Observe its acceleration as it falls. Note whether the north pole or the south pole is facing up.
4. Remove the second magnet, reverse it end-for-end, and drop it again. Observe its acceleration as it falls.

How did the alignment of each magnet's poles affect how the second magnet fell? (When the same pole of each magnet is facing each other, the upper magnet should hover above the lower magnet. When opposite poles are facing each other, the upper magnet should collide with the lower magnet.)

Here are some questions to discuss with your child:
- Which forces act on the falling magnets?
- Why did the top magnet hang in the air above the bottom magnet in one trial? Explain by comparing the forces acting on the magnet.
- You watched magnets fall in three different trials. Explain the differences in the motion of the magnets in terms of forces.
- Do you think magnetism requires energy? Why or why not?