MAGNETISM

Suggested Grades: 4th and 5th

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Magnets are useful things that we don't often think about, yet they are used daily. They serve as latches on cupboard doors, refrigerator hangers for school papers and artwork, and essential parts of every electric motor. Even the most technologically advanced electric vehicles need magnets in order to run.

Humans first start noticing and using magnets more than 5,000 years ago, when the Chinese discovered that some kinds of rocks were attracted to each other. They also noticed that these special rocks always pointed toward the North Star when they were suspended from a string. The ancient Greeks used magnetic rocks in compasses and navigating devices. It was they that began calling them *lodestones,* or leading stones, and who named the magnetic ore *magnetite*, after a Greek town where it was often found.

Magnetism is a force that happens when the magnetic regions of some types of matter line up to create a *magnetic field*. This magnetic field attracts only materials containing iron, nickel or cobalt; although most everyday magnetic materials are made of iron (or steel, which contains iron). The group of metals that are attracted to magnets are called *magnetic objects*.

The invisible magnetic field around a magnet can have considerable pulling/pushing power, although how the field forms or works is still a scientific mystery. We do know, though, that when a magnetic object comes into a magnetic field, its magnetic regions or *domains* are forced into to alignment. This alignment causes the magnetic object to turn into a temporary magnet, which is then attracted to the permanent magnet. When the temporary magnet is removed from the magnetic field, the magnetic regions move out of alignment, and the forces in the magnetic object returns to their pre-magnetic state.

A magnetic field is strongest close to the magnet and gets weaker as the distance from the magnet increases. The stronger the magnet, the further away its magnetic field can be felt. Magnetic fields can even pass through paper, plastic, or glass. The lines of magnetic force extend from the magnet's ends, or *poles*, in all directions– including side-to-side, upward and downward.

All magnets have two poles; a north pole that is attracted to the Earth's North Pole, and a south that is attracted to Earth's South Pole. Unlike magnetic poles (north + south) always attract each other, but pairs of like poles (north + north OR south + south) always repel or push each other away. Magnets always have two poles, even when broken into small pieces. No-one knows how this happens, but we do know that opposite magnetic poles attract and like poles repel.

The Earth acts like it has a gigantic bar magnet through its center with lines of magnetic force radiating from one pole to the other. Since the needle of a compass is a small magnet and always lines up with the Earth's magnetic field, it will always point to magnetic north and south. Earth's magnetic poles are slowly but continually shifting and do not align exactly with the geographic North and South Poles so navigators must correct for this discrepancy as they chart their courses.

Magnets occur naturally, but certain metals to be induced to become temporary magnets. The simplest way is to stroke an item containing iron in a single direction with a permanent magnet. This will cause its magnetic domains to line up facing the same direction, and the item will act like a magnet until those domains move around and are no longer lined up.

Another way to make a type of temporary magnet called an *electromagnet* is by using electricity. An electric current flowing through a wire produces a magnetic field. The strength of the magnetic force can be increased by wrapping the wire into a coil. The more turns of the wire in the coil, the stronger the magnetic field. The magnetic field can also be strengthened by increasing the amount of current flowing through the wire and adding an iron or steel rod in the middle of the coil. Electromagnets can be very powerful; they are routinely used to lift large piles of heavy scrap iron in junkyards and reclamation centers.

Sometimes permanent magnets can lose their magnetic power if not properly cared for. Don't drop magnets and keep them out of hot places. Store bar magnets side by side in pairs, with the north pole of one magnet next to the south pole of the other magnet. Horseshoe magnets should always be stored with the "keeper" metal bar across the ends.

How do magnets work?

Why are magnets important in our daily lives?

OBJECTIVES

- ✓ Predict which objects will be magnetic and test predictions with a magnet.
- ✓ Measure the strength of a magnet and graph how the strength changes as the distance from the magnet increases.
- ✓ Students will construct and use an electromagnet, and will be able to describe how and why it works

MATERIALS

Iron Chef Demonstration

One ceramic magnet
Masking tape
One pencil, blunted or unsharpened
One clear plastic cup, 10-oz. size
1/4 to ½ cup of Wheaties®, Total®, or other dry, whole bran flake cereal and its box
1 Tbsp water, about enough to turn the cereal to the consistency of cooked oatmeal
One copy of the nutritional content label from the cereal box for each activity group

Picturing Magnetism

1 piece of steel wool or an iron scouring pad for each activity group
1 pair scissors for each activity group
1 piece of white or light colored paper for each activity group
One or more differently shaped magnets for each activity group
Pen or pencil for each student
One copy of the Picturing Magnetism Data Sheet for each student (page 21)