SECTION 1 (PP. 703-711): MAGNETISM IS A FORCE THAT ACTS AT A DISTANCE.

Georgia Standards: S8P5c – *Investigate and explain that electric currents and magnets can exert a force on each other*; S8CS2b – *Demonstrate appropriate techniques in all laboratory situations.*

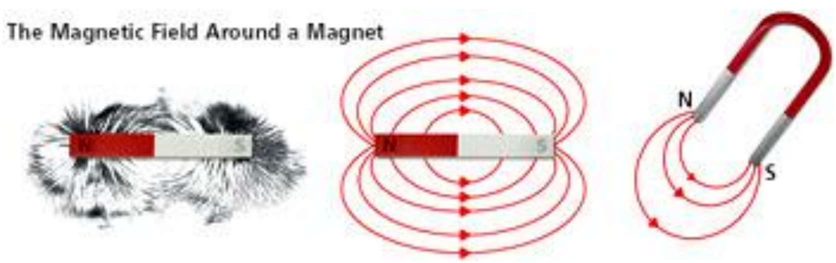
1. **Magnets attract and repel other magnets.**

   A ***magnet*** is an object that attracts certain other materials, particularly iron and steel. There may be quite a few magnets in your kitchen. Some are obvious, like the seal of the refrigerator and the magnets that hold notes to its door. Other magnets run the motor in a blender, provide energy in a microwave oven, operate the speakers in a radio on the counter, and make a doorbell ring.

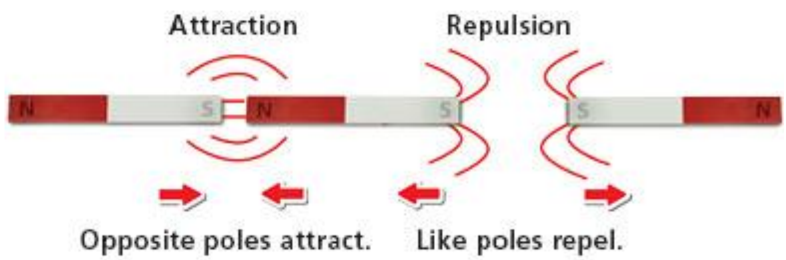
   The force exerted by a magnet is called ***magnetism***. The push or pull of magnetism can act at a distance, which means that the magnet does not have to touch an object to exert a force on it. When you close the refrigerator, you feel the pull before the magnet actually touches the metal frame.

   The force of magnetism is not evenly distributed throughout a magnet. Magnetic poles are the parts of a magnet where the magnetism is the strongest. Every magnet has two magnetic poles.

   A ***magnetic field*** is the region around a magnet in which the magnet exerts force. If a piece of iron is within the magnetic field of a magnet, it will be pulled toward the magnet. Many small pieces of iron, called iron filings, are used to show the magnetic field around a magnet. The iron filings form a pattern of lines called ***magnetic field lines***.



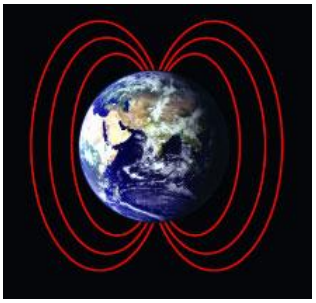
   If the magnets are held so that the north pole of one magnet is close to the south pole of the other, the magnetic field lines extend from one magnet to the other. The magnets pull together. On the other hand, if both north poles and both south poles of two magnets are brought near one another, the magnets repel. It is very difficult to push like poles of strong magnets together because magnetic repulsion pushes them apart.



2. **Some materials are magnetic.**
   Of all the common elements on the periodic table, only iron, nickel, cobalt, and a few others are magnetic. Other materials, such as steel, are magnetic because they contain one or more of these elements. Iron, nickel, and cobalt are next to each other in the periodic table. This location indicates that the properties of these elements are similar because their electron configurations are similar.

   Each of these elements contains unpaired electrons that produce a very small but strong magnetic field. Atoms in a magnetic material align so that these small magnetic fields form a ***magnetic domain***. When placed within a larger magnetic field, the magnetic domains align, and the material becomes a magnet.

3. **Earth is a magnet.**
   Because the north pole of a suspended magnet always points in a northerly direction on Earth, it can be inferred that Earth itself is a magnet. We commonly call the direction that the north pole of a magnet points to as ***magnetic north***. Because it attracts the north pole of a magnet, however, the magnetic north pole of Earth is actually the south pole of the magnet formed by Earth (remember, opposites attract).



   A constant stream of charged particles is released by reactions inside the Sun. These particles could be damaging to living cells if they reached the surface of Earth. One important effect of Earth's magnetic field is that it turns aside, or deflects, the flow of the charged particles.

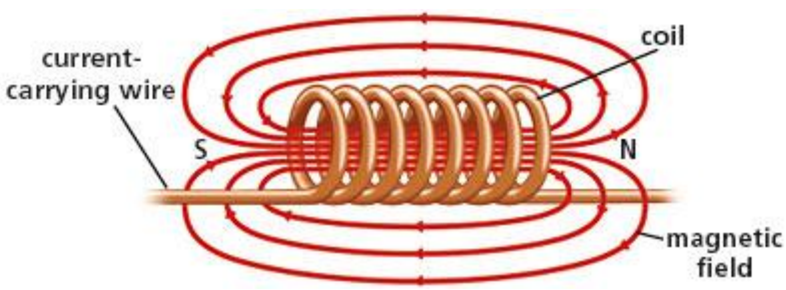
Many of the particles are deflected toward the magnetic poles, where Earth's magnetic field lines are closest together. As the particles approach Earth, they react with oxygen and nitrogen in Earth's atmosphere. These interactions can be seen at night as vast, moving sheets of color—red, blue, green or violet—that can fill the whole sky. These displays are known as the ***Northern Lights*** or the Southern Lights.

SECTION 2 (PP. 712-718): CURRENT CAN PRODUCE MAGNETISM.

Georgia Standards: S8P5c – *Investigate and explain that electric currents and magnets can exert a force on each other;* **S8CS2a – *Follow correct procedures for use of scientific apparatus.***

1. **An electric current produces an electric field.**
   Both permanent and temporary magnets result from the magnetic field formed from a moving electric charge.
   - ***Permanent magnets*** result from the spinning of unpaired electrons, which are electrically charged particles.
   - ***Temporary magnets*** can also be formed in this manner, but the magnetic domains don't remain aligned. Temporary magnets known as ***electromagnets*** are produced by electric current, which consists of moving a charge.

   In the electromagnet below, coils of wire around an iron core create a magnet as long as electric charge flows. When current stops flowing, the magnetism stops.



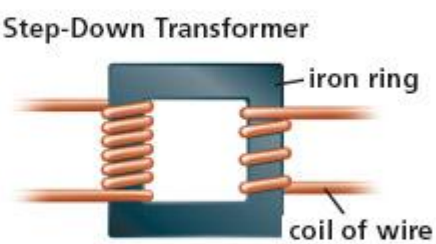
2. **Motors use electromagnets.**
   The main parts of an electrical motor include a ***voltage source***, a ***shaft***, an ***electromagnet***, and at least ***one additional magnet***. The shaft of the motor turns other parts of the device. When current from the voltage source flows through the coil, a magnetic field is produced around the electromagnet. The poles of the magnet interact with the poles of the electromagnet, causing the motor to turn.
   - The poles of the magnet push on the like poles of the electromagnet, causing the electromagnet to turn.
   - As the motor turns, the opposite poles pull on each other.
   - When the poles of the electromagnet line up with the opposite poles of the magnet, a part of the motor called the ***commutator*** reverses the polarity of the electromagnet. Now, the poles push on each other again and the motor continues to turn.

SECTION 3 (PP. 719-725): MAGNETISM CAN PRODUCE CURRENT.

Georgia Standards: S8P5c – *Investigate and explain that electric currents and magnets can exert force on each other*; S8CS2b – *Demonstrate appropriate techniques in all laboratory situations.*

1. **Magnets are used to generate an electric current.**
   Essentially, a ***generator*** is the opposite of an electric motor. The motor uses a moving charge to produce a magnetic field, and the generator uses a moving magnet to produce an electric charge.
   - The magnet and the wire through which the current passes must be moving relative to each other. It doesn't matter which one moves, as long as one of them does.
   - The current produced can be either ***direct current*** (DC) which flows in one direction only, or ***alternating current*** (AC) which changes direction at regular intervals.

2. **Magnets are used to control voltage.**
   A transformer either increases or decreases voltage. In a transformer, two coils of wire are wrapped around an iron ring. Current through the first coil causes the ring to become an electromagnet. The electromagnet induces a current in the second coil.
   - If the first coil has more loops, the voltage decreases, and the system is called a ***step-down*** transformer.



   - If the first coil has fewer loops than the second coil, the voltage increases, and the system is called a ***step-up*** transformer.

SECTION 4 (PP. 726-731): GENERATORS SUPPLY ELECTRICAL ENERGY.

Georgia Standards: S8P5c – *Investigate and explain that electric currents and magnets can exert force on each other*; S8CS3f – Use ratios and proportions, including constant rates, in appropriate problems.

1. **Generators provide most of the world's electrical energy.**
   Electric power is not the electrical energy produced, but a measure of the rate at which some other form of energy is converted to electrical energy. It is also the rate at which an appliance converts electrical energy into another form of energy, such as light or heat. For example,
   - Most electrical energy is produced by generators

- The rate at which the chemical energy in fossil fuels or the kinetic energy of falling water is converted to electrical energy is electric power.

The current distributed from electrical generating plants is too great to be useful in home and businesses. The current must pass through a step-down transformer before it is useful.

2. **Electric power can be measured.**
The unit used to measure power is the ***watt***. Because the watt is a small unit, ***kilowatts*** are often used to measure power in a building.

The amount of energy used is the product of the rate at which the energy is used (power) and the time over which it is used. Its unit of measurement is the ***kilowatt-hour (kWh)***.

$$Electric\ Power = Voltage\ \cdot Current$$
(P = VI)

Typical Power Ratings

Appliance	Watts
DVD player	20
Radio	20
Video game system	25
Electric blanket	60
Light bulb	75
Stereo system	100
Window fan	100
Television	110
Computer	120
Computer monitor	150
Refrigerator	700
Air conditioner	1000
Microwave oven	1000
Hair dryer	1200
Clothes dryer	3000