

## 8<sup>th</sup> grade Physical Science comprehensive study guide

### Unit 2 – Nature of Matter

atoms/molecules; atomic models; physical/chemical properties; physical/chemical changes; types of bonds; periodic table; states of matter; phase changes; elements/compound/mixtures; Law of Conservation of Matter

### Unit 3 – Transformation of Energy

forms of energy; Law of Conservation of Energy; transfer of heat; conductors/insulators; thermal expansion; nuclear fission/fusion

### Unit 4 – Waves and Electromagnetic Radiation

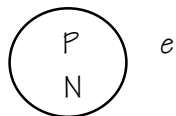
behavior of waves in different mediums; EM/ mechanical waves; EM spectrum; wave characteristics; Doppler effect; pitch/intensity

### Unit 5 – Force and Motion

force/mass/motion; acceleration; speed/velocity; balanced/unbalanced forces; Newton's Laws; types of friction; Law of Conservation of Momentum; simple machines; work; power, efficiency

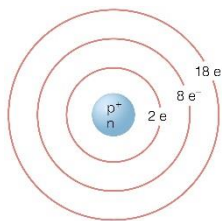
### Unit 6 – Forces in Nature

gravity; Law of Universal Gravitation; current; series/parallel circuits; magnets; electromagnets



subatomic particle	charge
proton	+
electron	-
neutron	0

Bohr model:

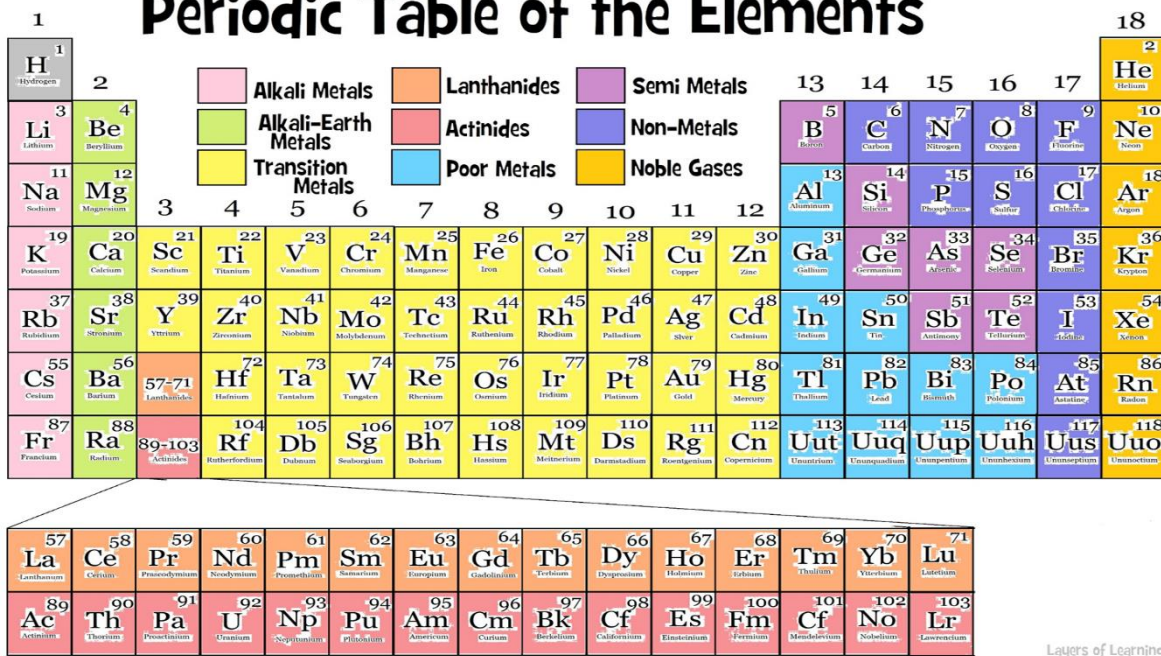


Electron dot model:



valence number – how many electrons at atom will gain or lose to fill up a level or go down one level. A complete shell is stable.

# Periodic Table of the Elements



Periods  
→

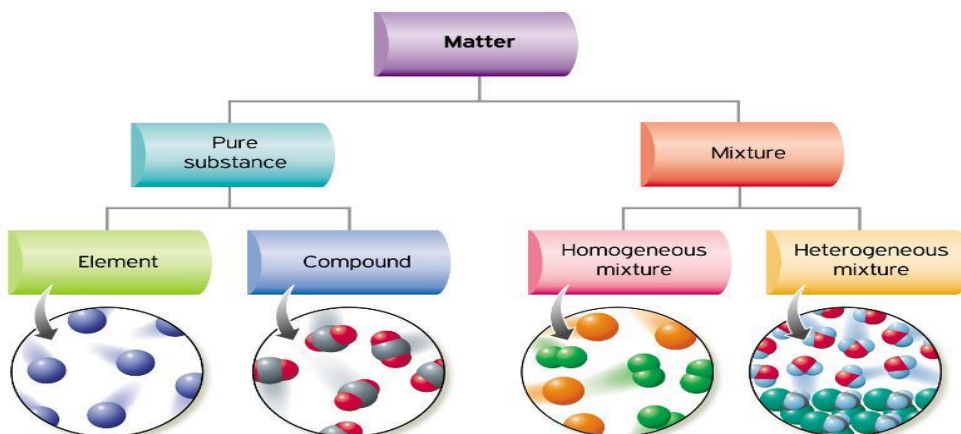
families  
(also called groups)  
↓

element type	properties
metal	good conductors of heat & electricity, luster, malleable, ductile, left side of periodic table
nonmetal	poor conductors of heat & electricity, dull, brittle, right side of periodic table
metalloid	properties of both metals & nonmetals, semiconductors, stair-step between metals/nonmetals

types of bonds:

ionic	N-M	Na Cl, Na F
covalent	N-N	H <sub>2</sub> O, CO <sub>2</sub>
polyatomic	3+ different elements	H <sub>2</sub> SO <sub>4</sub> , HCO <sub>3</sub>

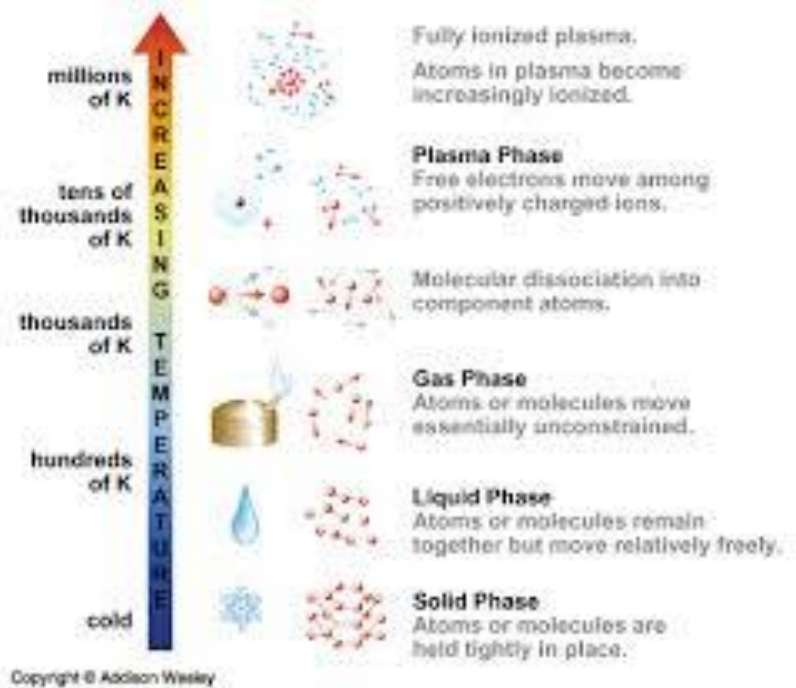
elements, compounds and mixtures



A molecule is 2 or more atoms chemically combined. They might be two of the same kind of atom, like O<sub>2</sub>, or two different kinds of atoms, like CO<sub>2</sub>.

type of mixture	properties	examples
solution	solute dissolves completely in solvent	sweet tea, koolaid
colloid	small particles that remain suspended, filters light	milk, whipped cream,
suspension	larger particles that settle out, shake to mix	Italian dressing

	phase change	energy is...
vaporization	liquid to gas	gained
condensation	gas to liquid	lost
freezing	liquid to solid	lost
melting	solid to liquid	gained
sublimation	solid to gas	gained



**Physical Properties**  
- Do not change what the object is

**Chemical Properties**  
- Tells you the types of changes matter can undergo

Examples of physical properties: smell, color, boiling point, freezing point, melting point, magnetivity, density.

Examples of chemical properties: reactivity with water, combustibility, ability to oxidize, pH

\*\*\*you can only observe a chemical property by undergoing a chemical change\*\*\*

**Ask yourself if change is a matter of style or substance.**

**PHYSICAL (style) change**

Physical changes do not result in new substances. Water, whether ice, liquid or steam, is still H<sub>2</sub>O. Boiling point and freezing point are just two of several physical properties which identify water.

**CHEMICAL (substance) change**

Chemical changes produce new substances with different chemical makeups and properties than the original substance. When burned, wood produces new substances, one of which is called ash.

AND REMEMBER, WHETHER A CHANGE IN STYLE OR SUBSTANCE...

... ONLY CHANGES IN ENERGY PRODUCE CHANGES IN MATTER.



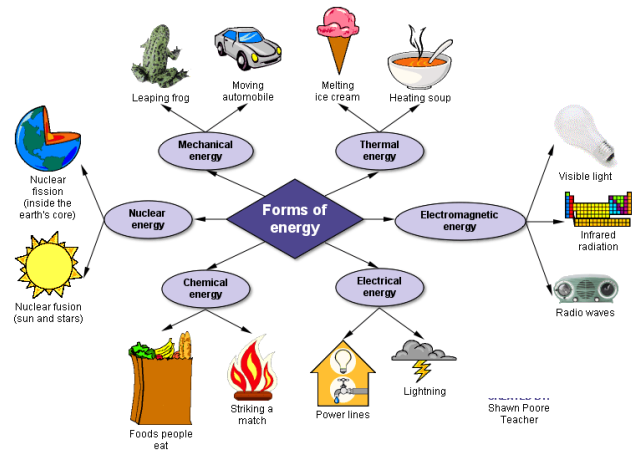
You can change the appearance of matter, but the amount doesn't change. This is called the Law of Conservation of Matter

Energy can be sorted into two main categories:

Potential (stored or position)                      Kinetic (motion)

- gravitational
- elastic
- chemical

An object with mechanical energy has both potential and kinetic energy.

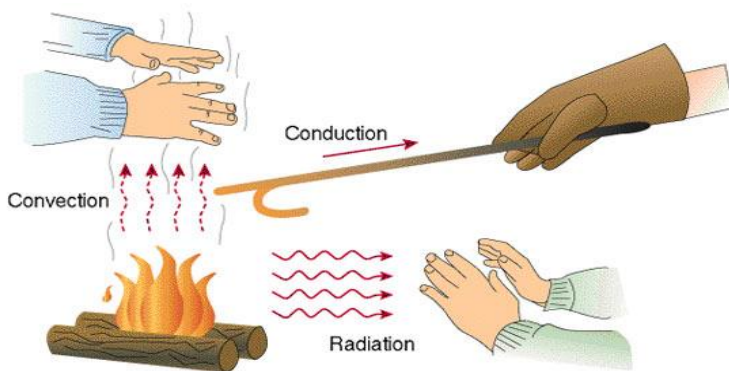
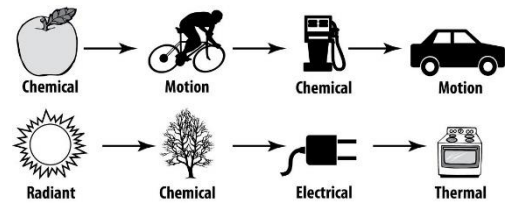


Remember MRS. CHEN

Mechanical – Radiant (EM) – Sound – Chemical – Heat (thermal) – Electrical - Nuclear

The Law of Conservation of Energy states that the total amount of energy in a system remains constant ("is conserved"), although energy within the system can be changed from one form to another or transferred from one object to another.

### Energy Transformations



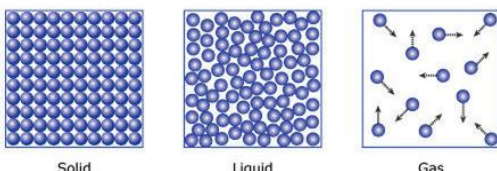
methods of heat transfer

vaporization	
evaporation	boiling
vaporization at the surface only	vaporization throughout

*conduction* – thermal energy transferred through the collision of molecules

*convection* – currents facilitate the transfer of heat (for example air currents – hot air rises, cooler air sinks)

*radiation* – method of heat transfer that does not require contact; may be transferred through space.



increasing thermal energy →

*thermal expansion* – as most objects gain thermal energy (heat up), they expand due to molecular movement. An exception to this is water which expands as it freezes.

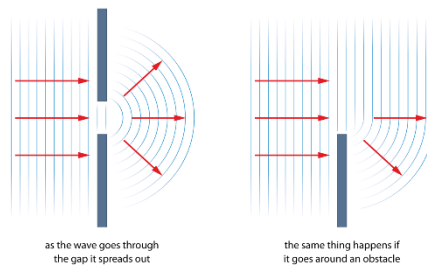
Wave characteristics

There are 2 main kinds of waves – mechanical and electromagnetic (EM)

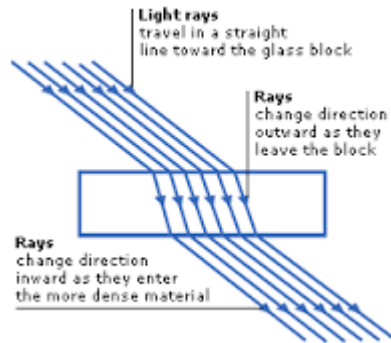
requires a medium		can travel in a vacuum (space)	
mechanical		electromagnetic	
transverse	longitudinal (compressional)	radio	
		microwaves	
		infrared	
		visible	
		ultraviolet	
		X-rays	
		gamma	
perpendicular particle movement	parallel particle movement		

- transmitted
- reflected
- scattered
- absorbed
- refracted

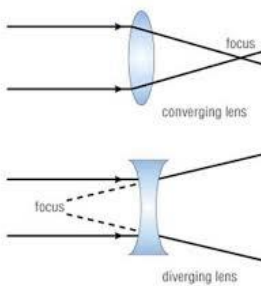
diffraction



- opaque
- translucent
- transparent

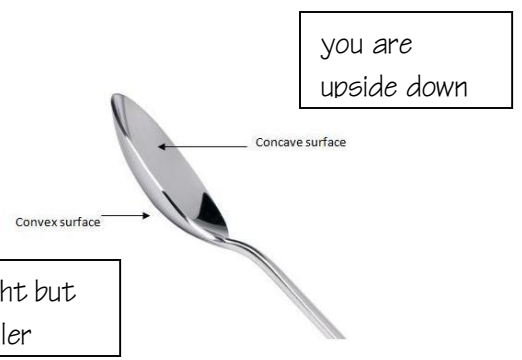


Light waves refract, or bend, as they enter a material with a different density. As they exit the material again, they will return to the original angle of incidence.

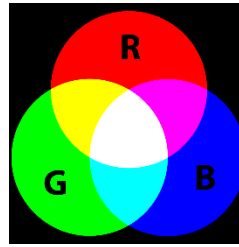
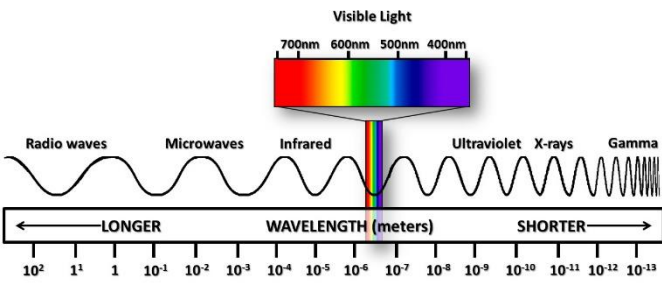


convex lens

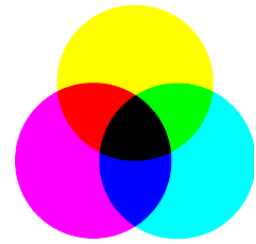
concave lens



visible light spectrum

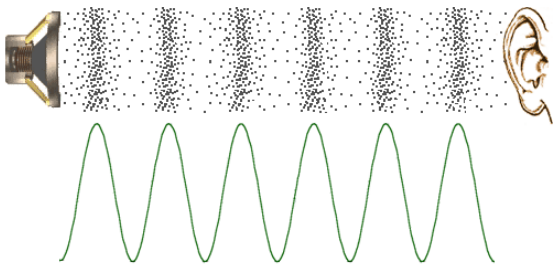


primary colors of light



primary colors of pigment

Sound waves are an example of compressional or longitudinal waves

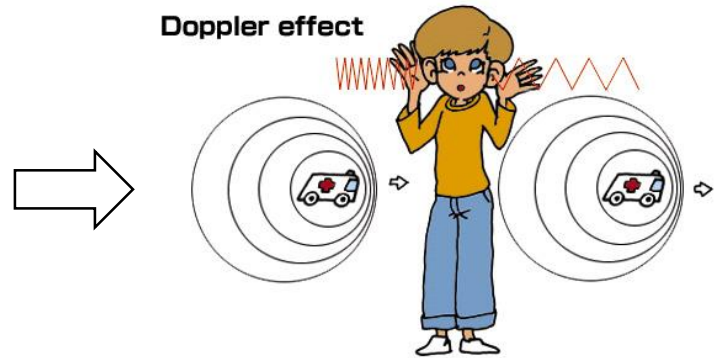


Pitch is determined by the frequency. Higher frequency equals higher pitch.

Loudness or intensity is determined by the amplitude. Greater amplitude equals louder or more intense sound.

Remember that pitch is determined by frequency. As the sound is approaching the observer, the air particles are compressed creating a higher frequency wave (higher pitch). After the vehicle passes, he is observing the more spread out, or lower frequency waves (lower pitch).

Doppler effect

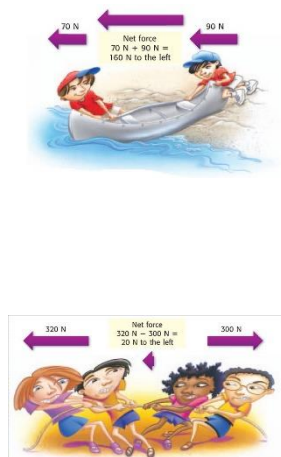


a force is a push or a pull

**Balanced and Unbalanced Forces**

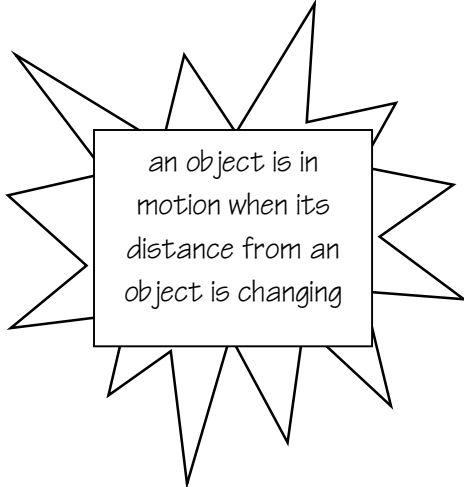
**Balanced Forces:** Equal forces that act on an object from opposite sides. The object doesn't move.

**Unbalanced Forces:** Unequal forces that act on an object from opposite sides, but make the object move.



forces in the same direction are added

forces in opposite directions are subtracted



only unbalanced forces result in movement

Velocity Vs. Speed	
<b>Velocity:</b> Velocity is the <b>vector</b> quantity that signifies the magnitude of the rate of change of position and also the <b>direction</b> of an object's movement.	<b>Speed:</b> Speed is the <b>scalar</b> quantity that Signifies only the magnitude of the rate of change of an object's movement.
<b>Example:</b> 	<b>Example:</b> 

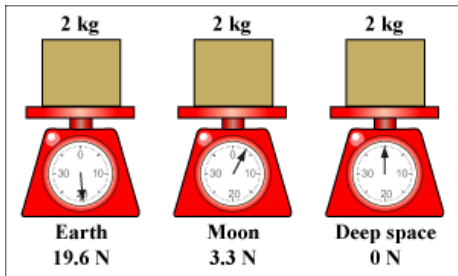
velocity and speed are not the same thing!

## Acceleration

= change in velocity

change in speed    Change in Direction    Change in both

weight is gravity's pull on an object's mass



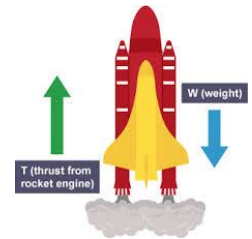
types of friction:

1. static (an object that is not moving)
2. sliding
3. rolling
4. fluid (liquids & gases)



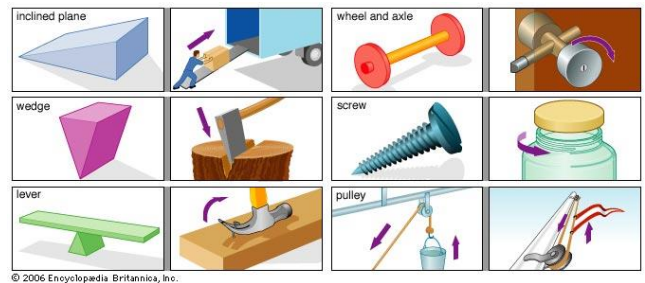
Newton's Three Laws of Motion:

1. Objects in motion tend to stay in motion, objects at rest stay at rest unless acted on by an outside force. (inertia)
2. Force = mass x acceleration
3. For every action there is an equal and opposite reaction.

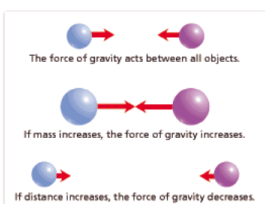


## SIMPLE MACHINES

Simple machines may convert one type of force to another, change the direction of an applied force or trade distance travelled for force applied.

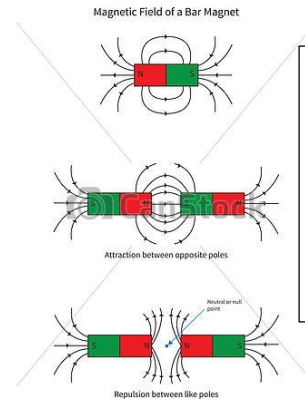
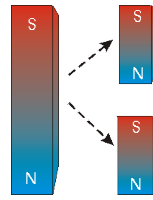
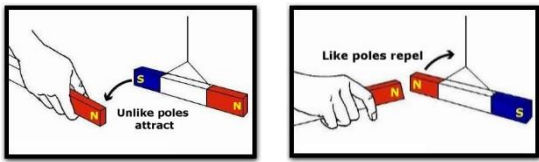


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Every object exerts gravitational force on every other object. The force exerted depends on how much mass the objects have and the distance between them.

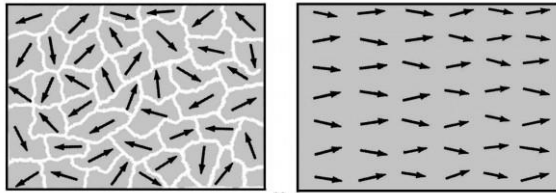
A magnet is a material that contains or is attracted to iron.



a magnetic field is the area in which a magnetic force can be exerted

Unmagnetized

Magnetized



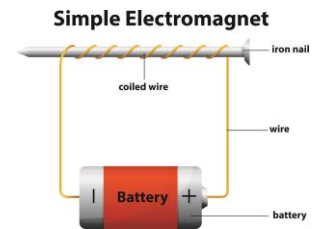
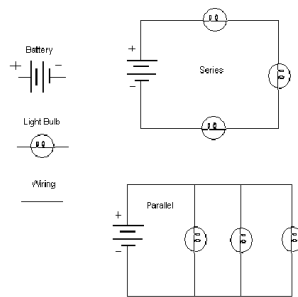
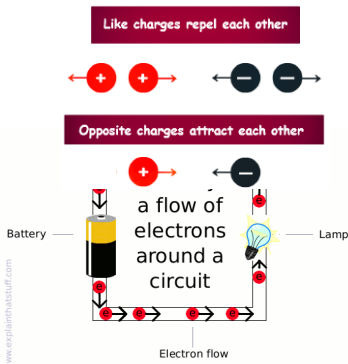
(a)

(b)

Some materials can become temporary magnets when their magnetic domains are aligned.

transfer of charges:

- friction
- conduction
- induction

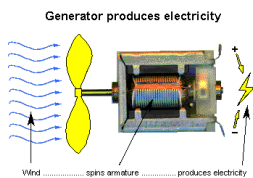


An electric current produces a magnetic field. You can use the "Right hand rule" to determine the direction of the field

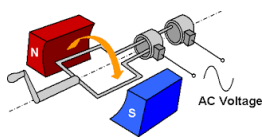
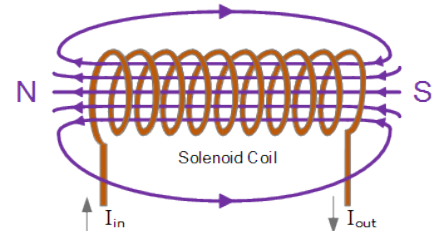


an electromagnet is a strong magnet that can be turned on and off

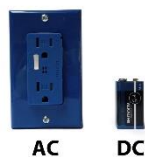
mechanical energy



Electromagnetic field due to the flow of current

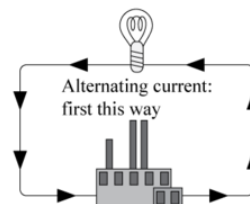


An electric motor works the opposite way – it transforms electrical energy into mechanical energy.

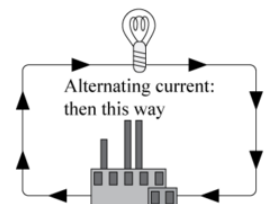


AC

DC



Alternating current: first this way



Alternating current: then this way



## 8<sup>th</sup> grade Physical Science content standards

S&P1. Students will examine the scientific view of the nature of matter.

- a. Distinguish between atoms and molecules.
- b. Describe the difference between pure substances (elements and compounds) and mixtures.
- c. Describe the movement of particles in solids, liquids, gases, and plasmas states.
- d. Distinguish between physical and chemical properties of matter as physical (i.e., density, melting point, boiling point) or chemical (i.e., reactivity, combustibility).
- e. Distinguish between changes in matter as physical (i.e., physical change) or chemical (development of a gas, formation of precipitate, and change in color).
- f. Recognize that there are more than 100 elements and some have similar properties as shown on the Periodic Table of Elements.
- g. Identify and demonstrate the Law of Conservation of Matter.

S&P2. Students will be familiar with the forms and transformations of energy.

- a. Explain energy transformation in terms of the Law of Conservation of Energy.
- b. Explain the relationship between potential and kinetic energy.
- c. Compare and contrast the different forms of energy (heat, light, electricity, mechanical motion, sound) and their characteristics.
- d. Describe how heat can be transferred through matter by the collisions of atoms (conduction) or through space (radiation). In a liquid or gas, currents will facilitate the transfer of heat (convection).

S&P3. Students will investigate relationship between force, mass, and the motion of objects.

- a. Determine the relationship between velocity and acceleration.
- b. Demonstrate the effect of balanced and unbalanced forces on an object in terms of gravity, inertia, and friction.
- c. Demonstrate the effect of simple machines (lever, inclined plane, pulley, wedge, screw, and wheel and axle) on work.

S&P4. Students will explore the wave nature of sound and electromagnetic radiation.

- a. Identify the characteristics of electromagnetic and mechanical waves.
- b. Describe how the behavior of light waves is manipulated causing reflection, refraction, diffraction, and absorption.
- c. Explain how the human eye sees objects and colors in terms of wavelengths.
- d. Describe how the behavior of waves is affected by medium (such as air, water, solids).
- e. Relate the properties of sound to everyday experiences.
- f. Diagram the parts of the wave and explain how the parts are affected by changes in amplitude and pitch.

S&P5. Students will recognize characteristics of gravity, electricity, and magnetism as major kinds of forces acting in nature.

- a. Recognize that every object exerts gravitational force on every other object and that the force exerted depends on how much mass the objects have and how far apart they are.
- b. Demonstrate the advantages and disadvantages of series and parallel circuits and how they transfer energy.
- c. Investigate and explain that electric currents and magnets can exert force on each other.