14-1

- Matter: is made up of particles that are in constant motion.

- Kinetic Energy: energy of motion
- Temperature: measure of the kinetic energy of the individual particles in matter

- As temperature increases, the particles move faster and the kinetic energy increases.
  In a mug of hot milk compared with the same mug but with cold milk, the temperature is higher, the particles move faster, kinetic energy is higher.

- Temperature Scales

	Freezing Point of Water	Boiling Point of Water	Intervals
Celsius/Centigrade (used around the world)	0	100	100 equal pats
Fahrenheit (used in US)	32	212	180 equal parts
Kelvin (used in Physical Science)	273	373	100 equal parts

- Experiments have led scientists to conclude that – 273 degrees Celsius or zero degrees Kelvin is the lowest temperature possible. At this temperature, called the absolute zero, no more energy can be removed from matter.

- Thermal Energy: the total energy of all the particles moving in a substance. It depends on
- temperature: two examples of matter having the same # of particles and state, the higher the temperature, the more the thermal energy
- # of particles: two examples of matter having the same temperature and state, the more the particles the more the thermal energy
- state of matter, two examples of matter having the same temperature and # of particles, the gaseous state has the most thermal energy since the particles have the most freedom to move around

14-2

- Heat: transfer of thermal energy from a substance at higher temperature to the one at lower temperature
- Heat is transferred in three ways:
- conduction: through direct contact of particles, ex. touching a metal spoon in boiling water
- convection: through movement of currents in fluids (warm is less dense and rises, cold is denser and sinks), ex. bird soaring/gliding
- radiation: through waves; no matter is involved, ex. feeling the sun's heat through infrared rays
- Conductor: transfers energy well, ex. metal
  Insulator: doesn't transfer energy well, ex. wood, air, fat, fiberglass, hair/fur/feather
- Specific Heat: amount of energy needed to raise the temperature of 1 Kilogram of a substance by 1 Kelvin; measured in Joules/Kg x K
- Change in Energy = Mass x Specific Heat x change in temperature; measured in Joules

14-3

- States of matter differ in the arrangement of the particles not the chemical composition.
- solid: particles packed together and vibrate in fixed positions; definite volume and shape
- liquid: particles close together but can move around; definite volume but not shape
- gas: particles move very fast and don't stay together; no definite volume or shape
- Change of state happens when thermal energy is absorbed or released.

<u>Thermal energy added</u>

- melting
- vaporization
- sublimation

<u>Thermal energy removed</u>

- freezing
- condensation
- sublimation

- Thermal Expansion: expanding of matter when heated. Applications are thermometers, teeth, thermostats (read about these in the book, pg. 453-4).

14-4

- Heat engine: transfers thermal energy into mechanical using combustion of fuel
- internal combustion: happens inside the engine, ex. car
- external combustion: happens outside the engine, ex. steam engine
- Refrigerator: uses outside energy source (electric motor) to transfer thermal energy from cool area to warm
- motor compresses the refrigerant substance
- pressure and temperature increase
- the gas gives off thermal energy to the outside air
- gas changes to liquid
- liquid evaporates into gas
- gas cools as it passes through radiators
- gas pumped into tubes inside the walls of refrigerator
- gas absorbs heat from food inside
- energy used again to start the cycle