# Mechanical Energy Notes

**Energy** - The "something" that enables work to be done . Also known as that which causes change.
**Work** is the amount of energy required to move an object, or released by the motion of an object, a certain distance; motion must be in the same direction of the applied force. If work is done on an object by its surroundings, the work is positive. When work is done by an object on its surroundings, the work is negative. The sign of the work indicates the direction of energy transfer. From this we can determine that **work** is the applied force multiplied by the distance traveled, both in the same direction:

$$W = \vec{F} \cdot \Delta x$$

**The law of conservation of energy** - energy cannot be created nor destroyed; it can only change forms.
When work is done on an object to lift it to a certain height above the ground it is given **gravitational potential energy *($PE_G$)***, or stored energy of position. $PE_G$ is the potential energy of an object due to its position relative to another object, the earth is often "the other" object. As a result the usual equation in physics for $PE_G$ is

$$PE = mgh$$

When allowed to fall gravity does work on the object, causing it to fall. As the object speeds up it gains **kinetic energy** as it loses an equal amount of potential energy. **Kinetic energy** is the energy of motion. An object in motion has undergone a change to get moving, therefore we say it has kinetic energy which it received when it started moving. The equation for kinetic energy is

$$KE = \frac{1}{2} mv^2$$

We usually define **mechanical energy** as the sum of all the kinetic and potential energy. Since the energy of an object must be conserved, the kinetic energy used to place a book on a shelf is stored in the book as potential energy, all the while the total mechanical energy staying constant.
The **Work-energy theorem** states that work equals the change in kinetic energy. This idea can also be manipulated to include potential energy as well. When an object is placed a certain height above the ground it has gravitational potential energy. So:

**$W = \Delta KE$** **$\Delta KE = -\Delta PE$** (the negative indicating loss of energy)

**UNITS** of energy and work

**USCS --> ft˙lb; calorie; Calorie**

**SI --> N˙m or Joule (J)**

**POWER** is the rate at which work is done. The faster the work is done, the more power.

$$P = \frac{W}{\Delta t}$$

The SI unit of power is the **watt (W)** which is simply a **Joule/second.**