What is the **Law of Conservation of Energy**?

*Energy cannot be created nor destroyed*....but....

*Energy can be transformed from one type to another.*

In this diagram, **electrical energy** is converted into **thermal (heat) energy** and **light energy**.
There are many energy transformations in an automobile.

The explosion of the gasoline involves the release of chemical energy.

The chemical energy causes the pistons in the engine to move (mechanical energy)

The moving pistons affect many moving parts including a generator which produces electrical energy which keeps the battery charged.

The moving pistons and other moving parts also produce heat energy.
Objects can convert potential energy to kinetic energy or kinetic energy to potential energy.

The diagram below illustrates this relationship.
Kinetic Theory of Heat

We have just established that thermal energy flows as heat from a hotter object to a colder one. What happens to the particles of an object when this energy transfer occurs? Let's take a closer look at the surface where the two iron blocks meet.

The iron atoms of the hotter block move faster than those of the colder block. When thermal energy is transferred, the fast-moving particles of one block collide with the slower particles of the other block. As such collisions occur, the slower particles speed up and the faster particles slow down. Kinetic energy is transferred between the particles until they move at the same rate.

This transfer of kinetic energy is described by the kinetic theory of heat. It states that heat is transferred as thermal energy by the interaction of moving particles.

Heat flows from one object to another until both objects reach thermal equilibrium.
A. Temperature & Heat

1. Temperature is related to the average kinetic energy of the particles in a substance.

- When the horseshoe is hot, the particles in it move very quickly.
- When the horseshoe has cooled, its particles are moving more slowly.
What is Thermal Energy?
Particles of matter are in constant motion. This motion relates directly to the state of matter of the object (solids, liquids, or gases).  

**Temperature** affects how fast these particles move. The higher the temperature the faster the particles move. Moving particles possess kinetic energy.  

**Temperature** is defined as the *average kinetic energy of the particles of an object*. 
Thermal energy relationships

a. As temperature increases, so does thermal energy (because the kinetic energy of the particles increased).

b. Even if the temperature doesn’t change, the thermal energy in a more massive substance is higher (because it is a total measure of energy).
Heat

a. The flow of thermal energy from one object to another.

b. Heat always flows from warmer to cooler objects.

Cup gets cooler while hand gets warmer

Ice gets warmer while hand gets cooler
Thermal Energy is the sum total of all of the energy of the particles of an object.

Thermal energy and temperature are related though DIFFERENT.

Temperature is the average kinetic energy of the particles of an object.

Thermal energy is the total amount of energy of the particles of an object.

A bathtub full of water at 100°F has more thermal energy than a thimble of water at 100°F. The temperature is the same but the total amount of energy is different. The bathtub has more energy.
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Transferring Thermal Energy

How is Thermal Energy Transferred? YOU MUST KNOW THIS!!!!!!

Conduction – direct contact

Convection – through a fluid

Radiation – by electromagnetic waves
What is heat transfer by conduction?

Heat transfers as particles of an object increase their collisions as heated. These collisions transfer the heat energy through the object by colliding with adjacent particles.
What is heat transfer by convection?

Heat is transferred through a substance through currents. This occurs in fluids (liquids AND gases)

**Convection** currents are caused by heating of a liquid or gas, the liquid or gas rises, then cools and falls. This occurs in the mantle of the earth, And in the atmosphere.

Most of our weather patterns are the result of convection currents in the atmosphere.
What is heat transfer by radiation?

Radiation is heat transfer by electromagnetic waves. These wave may pass through all states of matter and also through NO matter – such as the vacuum of space.

This energy is often called radiant energy.

Radiant energy from the sun travels through the vacuum of until it reaches the earth.
Frost heaves

Thermal expansion and contraction causes major damage to roads in northern climates every winter.
Thermal expansion and contraction

As temperature increases, the average energy of particles increases, the particles move faster, and the space between the particles increases. **Materials expand (get bigger) as the temperature increases.**

As temperature decreases, the average energy of particles decreases, the space between the particles decreases. **Materials contract (get smaller) as the temperature decreases.**
When a liquid is heated, the average energy of molecules increases, particles move faster and bang into walls of container more frequently, exert pressure, cause the volume to expand.

When a liquid is cooled, the volume decreases, or contracts, because the particles move more slowly and need less room.

Example: Liquid mercury in a thermometer expands as it heats up, and moves up and down the tube.
If you were to carefully measure the width of cracks in the sidewalk at many different times during a two-year period, which would you expect to find?

a. The cracks would remain the same size throughout the time.
b. The cracks would be wider during winter than during the summer.
c. The cracks would be wider during the summer than during the winter.
d. The cracks would continue to widen as time passes.
A railroad track was built with all of the rails fitting tightly together, touching each other end-to-end. Six months later, the track was ruined when the rails expanded and buckled. What may have caused the rails to expand?

a. As the weather got warmer, the particles in the rails moved more slowly.
b. As the weather got colder, the particles in the rails moved more slowly.
c. As the weather got warmer, the particles in the rails moved faster.
d. As the weather got colder, the iron in the rails froze.
A metal lid is tightly screwed onto a glass jar. To get the jar open, I can hold the lid under hot water. Why am I then able to remove the lid?

a. Metal particles move more rapidly when heated so the particles moved further apart, and the lid became looser.
b. Metal particles move less rapidly when heated so the particles moved closer together, and the lid became looser.
c. The metal particles did not move. The water loosened the lid.
d. The metal particles melted because the water was so hot.