temperature and thermal energy, which is hotter, a glass of boiling water or a bathtub of lukewarm water, (the glass or course)

which has more thermal energy? the bathtub

if the glass and bath tub where both cold, which would take more energy to heat up? the bath tub.

matter and temperature,
object expand when heated and contract when cooled.

this called thermal expansion

when heated , the molecules move faster and take up more space, causing the expansion. they grow bigger.

cooling down slows the molecules down and they take up less space.

this is why bridges and railroad tracks have expansion joints.

solids and liquids expand only a little bit when heated because their molecules remain touching.

gases expand greatly when heated since they consist of independent particles.

electrical resistance is a measure of a material's ability to conduct electricity.

metals generally have a low resistance, which means that they easily allow electricity to flow.

most material's electrical resistance increases with an increase in temperature.

viscosity is the measure of a material's resistance to flow.

water has a very low viscosity.

syrup is highly viscous.

most material's viscosity decreases with an increase in temperature.

NOTE: lubricants have a high viscosity that reduces friction.

HEAT

heat is the flow of thermal energy from one place to another.

when we talk about only one object we should use the term thermal energy.

the second law of thermodynamics

changing energy changes the amount of energy you can keep and use.

all the energy is still present but we can't use it.

if the amount of usable energy increases in one part of a system, it must decrease in another part.

Hebrews 1:11 informs us of the inevitable "heat death" of the universe.

things run down and wear out.

this law started at the fall of man.

entropy, is the measure of the amount of unusable energy. it is always increasing.

the universe is running out of usable energy

it must have had a time when the energy was put in.

heat is the flow of energy.

if too much energy is transferred to you too quickly you receive a burn.

there are three different processes of heat transfer.

1. conduction
2. convection
3. radiation

heat is transferred by conduction when the objects touch

the fast motion of the molecules on the stove transfers to the molecules in the pan, speeding them up.

equilibrium when the pan is at the same temperature as the stove, no more temperature rise occurs.

there is a balance between the temperatures, which means they are at equilibrium.

conductors transfer heat well by touching

metals are good conductors

silver is the best metallic conductor

solids mainly transfer heat by conduction

convection heating occurs from currents in a fluid.

this is how you are heating your house, the heat spreads through your furnace.

colder, denser gases fall while hotter, lighter gases rise.

this is called a convection current.

Natural convection occurs under the influence of gravity.

forced convection uses fans to move hot air or cold air.

atmospheric convection causes many kinds of winds.

radiation is heat flowing without any matter between.

this is how thermal energy is transferred to the earth from the sun.

the electromagnetic radiation transports the energy.

different colors absorb more or less heat.

different building materials have different amounts of insulating abilities

combining the insulating abilities with the thickness of the material gives the R-value.

aerogel- the worlds lightest solid substance!

it is the best known insulator that we have today.

thermos bottles- they are excellent insulators.

it has tight seal to prevent convection.

it has a silver surface to reflect radiation.

the empty space between the casing and the outer space can prevent conduction

heat capacity- is the thermal energy in joules that an object must gain in order to change its temperature by 1 degree Celsius

unit for heat capacity is J/ C

z large object of the same material has a higher heat capacity than a smaller object of the same substance.

Specific heat capacity, of just specific heat, measure the heat capacity per gram of substance. this mean that the value is specifically for that substance.

C_{sp}

$$\triangle Q = m c \triangle T$$

J/g * Celsius

M = mass in grams
Change in temp is $\triangle$ t
heat = Q is in joules

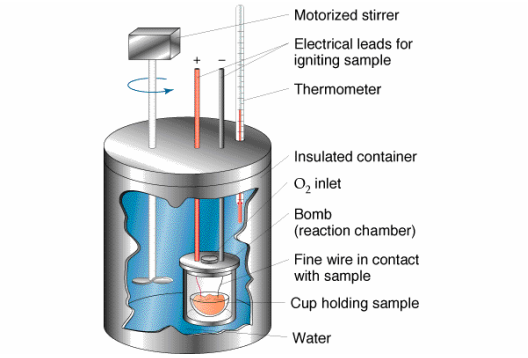
in order to find the heat necessary to change the temperature of an object a certain amount.

A calorimeter measure the specific heat of object.

water has a very high specific heat.

water is 4.18

heat an phase change, does water always heat up if thermal energy is added?
no



there is no change in temperature during a phase change.

the energy is used to break or form the bonds.

this means that there is no temperature change when you are going from freezing to boiling to melting.

phase change has now heat change.