## Thermal Energy

- KE which gets dispersed into/absorbed from molecules in the environment
- The effect of this is observed as a change in the temperature of the surroundings
- Completely random in the kinds of motions it exhibits and in its direction

**Note:**

Once KE is thermalized,
only a portion of it can be converted back into PE

The remainder was dispersed and diluted
into the environment, and is effectively lost.

The ***amount of thermal energy*** is determined by:

1. ***Temperature***

   The higher the temp,
   the higher the thermal energy
2. ***Sample size***

   A cup of 80° water has more thermal energy than a teaspoon of 80° water
3. ***Composition***

   $E_{solid} < E_{liquid} < E_{gas}$

## Temperature

A measure of the ***average kinetic energy*** of particles in a material

Describes the speed that the molecules "jiggle"

## Heat

*(the flow of thermal energy)*

Adding or removing thermal energy to a substance causes a change in the matter

*Either*:

The ***temperature changes***

or

The ***phase changes***

If it's causing the temperature to change:

**How much** the temperature of a material changes depends on:

- The ***amount of heat*** added or removed
- The **mass** of the substance
- ***What the substance is***

## Specific Heat Capacity

The energy required to raise the temperature of 1 gram of a substance by 1°C

$C_p$

J/g°C or J/g·K

*(Note: a 1°C change is also a 1 K change)*

- Each substance has a unique $C_p$
- Substances with a high $C_p$ can absorb or release lots of thermal energy without a significant change in temperature
- Water has a relatively high $C_p$ (4.18 J/g°C)

$$q = m\Delta T C_p$$

q = heat energy

m = mass

$\Delta T$ = temperature change

$C_p$ = specific heat capacity

Ex: If 1642 J of heat is added to 0.0230kg of iron, how much would the temperature change? ($C_p$ for iron = 0.470 J/g°C)

$$q = m\Delta T C_p$$

$$1642J = (23.0g)\Delta T(0.470J/g^0C)$$

$$\Delta T = \frac{1642J}{23.0g)(0.470J/g^0C)} = 152^0C$$

## Molar Heat Capacity

The energy required to raise the temperature of 1 mole of a substance by 1°C

J/mol°C or J/mol·K