

# Temperature

I. **Temperature** is the quantity that tells how hot or cold something is compared with a standard

A. Temperature is directly proportional to the average kinetic energy of molecular translational motion

B. The warmth you feel when you touch a hot surface is the kinetic energy transferred by molecules in the surface to molecules in your fingers.

## II. Temperature Scales Hint: $C = K - 273.15^\circ$

$T_c = (5/9) * (T_f - 32)$ ;  $T_c$  = temperature in degrees Celsius,  $T_f$  = temperature in degrees Fahrenheit

$T_f = (9/5) * T_c + 32$ ;  $T_c$  = temperature in degrees Celsius,  $T_f$  = temperature in degrees Fahrenheit

### A. Celsius

1. Boiling ( $H_2O$  at 0 ft.):
2. Room temperature:
3. Freezing ( $H_2O$  at 0 ft.):

### B. Fahrenheit

1. Boiling ( $H_2O$  at 0 ft.):
2. Room temperature:
3. Freezing ( $H_2O$  at 0 ft.):

### C. Kelvin

1. Boiling ( $H_2O$  at 0 ft.):
2. Room temperature:
3. Freezing ( $H_2O$  at 0 ft.):

## Heat

I. **Heat** is the energy that transfers from one object to another because of a temperature difference between them

A. Objects are said to be in **thermal contact** when heat flows from one object to another that it is touching

B. Heat flows from higher-temperature substances into lower-temperature substances.

## Thermal Equilibrium

I. When objects in thermal contact reach the same temperature they are said to be in **thermal equilibrium** and no heat flows between them.

## Internal Energy

I. Matter does not contain heat. Matter is said to have internal energy due to the kinetic and potential energies of its atoms and molecules.

## Measurement of Heat

I. We know that heat is energy transferred from one substance to another by a temperature difference

II. When a substance absorbs heat, the resulting temperature change depends on the mass as well as the type of substance

III. The common unit for heat is the **calorie**

A. The calorie is defined as the amount of heat required to raise the temperature of 1 gram of water by 1 degree Celsius

B. A kilocalorie is 1000 calories and is the heat unit used in rating foods

C. A kilocalorie is often referred to as a Calorie (written with a capital C to distinguish it)

D. The calorie and the Calorie are units of energy

E. One calorie equals 4186 joules of energy

F. The energy value in food is determined by burning the food and measuring the energy that is released as heat.

## Specific Heat Capacity

I. The quantity of heat required to raise the temperature of a substance

A. Water has a high specific heat capacity while aluminum has a low specific heat capacity

B. Think of specific heat capacity at thermal inertia (the resistance of a substance to change its temperature)

## The High Specific Heat Capacity of Water

I. A small amount of water can absorb a great deal of heat

A. Water is a useful cooling agent

B. Inversely, water takes a long time to cool

## Thermal Expansion

I. When the temperature of a substance is increased, its molecules move farther apart

A. Most matter expands when heated, contracts when cooled

B. Gases expand/contract the most, then liquids, then solids.

II. Different materials expand at different rates.

A. A bimetallic strip is a thin piece of two metals welded together.

B. Because the metals have different rates of expansion, the strip will bend one way when cooled and the other when heated.

## Expansion of Water

### I. Odd properties of water

A. Start with water at 0° Celsius

B. As it warms it contracts!

C. Until 4° Celsius

D. After 4° Celsius it expands!

E. Get your facts straight:

\*Will a sample of 4° Celsius water expand, contract, or remain unchanged in volume when it is heated?

\*Will a sample of 4° Celsius water expand, contract, or remain unchanged in volume when it is cooled?

F. Most liquids have their greatest density at their freezing points.

G. If this were true for water then when water froze it would sink to the bottom of lake.

H. Water cannot freeze before first passing through 4° Celsius and at that point it sinks because it is most dense

I. When all of the water in a lake is 4° Celsius then the top can start to freeze from the winds above