HEAT

Energy transfer within a system

What is temperature?

What do you think of when you think of temperature?

How hot or cold something is

It’s actually the average kinetic energy of the particles in an object

The higher the average kinetic energy (molecules moving more rapidly) the higher the temperature

Units and Water Temperature

We measure temperature in 3 different units:

	Fahrenheit (°F)	Celsius (°C)	&	Kelvin (K)
Freezing point of water:	32°F	0°C		273 K
Boiling point of water:	212°F	100°C		373 K

How do we convert between them?

°C to °F

$$T_F = 1.8T_C + 32$$

°F to °C

$$T_C = \frac{T_F - 32}{1.8}$$

°C to K

$$T_K = T_C + 273$$

Let’s Practice

1. Convert 50°F to Celsius

2. Convert 19°C to Fahrenheit

3. Convert 87°C to Kelvin

4. Convert 28°F to Kelvin

Absolute Zero

In order for an object to have a temperature of absolute zero, the total kinetic energy within the object must be 0.

This is theoretically at 0 K or -273ºC

This temperature has not yet been obtained, but scientists are getting close. Freaky things start happening at these temperatures…

So what is Heat?

Heat is the energy transferred between objects that are different temperatures.

The greater the difference in temperatures of 2 objects, the faster the energy will be transferred as heat

This transfer can either occur through **Conduction** or **Convection**

Conduction

Heat transfer between two objects that are touching

Usually occurs in metal

Examples: Using a metal pot to boil water (The metal is touching the heating coil)

Burning your hand on a car engine (The metal of the engine transfers heat to your skin)

Conductors and Insulators

Conductor: Any material that allows the transfer of energy.

Examples: Metal Pots

Glass bowls

Insulator: Materials that do not allow the transfer of energy

Examples: Hot pads

Ceramic Bowls

Convection

The movement of matter due to differences in density that are caused by temperature variations.

Air currents carry warmer air to colder areas.

Warm air expands and rises

Examples: Adding hot water to a cold pool (The heat flows throughout the pool)

Using your household heater (The warm air pushes the cold air out)

How does Heat travel?

1. Radiation… Not what you're thinking

For us right now, this is the energy transferred as electromagnetic waves (visible light and infrared waves)

Our sun radiates light and heat

How does Heat travel?

2. Through the collision of high energy (Hot) particles with low energy (cool) particles

Every material has a **Specific Heat** that allows us to determine their ability to transfer heat

Specific Heat

Specific Heat: the quantity of heat required to raise a unit of mass of homogeneous material 1 K given constant pressure and volume

$$Q = mc\Delta T$$

Q – Heat Energy m(J)

m – mass (kg)

c – specific Heat $\left(\frac{J}{kg \cdot K}\right)$

ΔT – Change in temperature (K or ^{o}C)

Laws of Thermodynamics

Govern the way we deal with heat transfer

1st Law: The total energy used in any process is conserved

2nd Law: The energy transferred as heat always moves from an objects at higher temperatures to objects at lower temperatures

Entropy: A measure of the randomness or disorder of a system

As entropy increases, less energy is in a form that can be used.

Phase Change Diagram

One way in which we will study the transfer of heat is through phase change diagrams