What is **HEAT**?

- It's the flow of energy due to a difference in temperature.
  - From a higher temperature (higher kinetic energy) to a lower temperature (less kinetic energy)
- THERE IS NO SUCH THING AS COLD!
  - It's just the absence of heat!
- What is **temperature**?
  - It's the average amount of kinetic energy a substance has from its moving atoms/ molecules
    - Kinetic energy is the energy of motion!

Equation

$$q = mC\Delta T$$

- q: heat energy – measured in joules (J)
- m: mass - measured in grams (g)
- C: heat capacity – how much heat a substance can hold, measured in joules/gram•degrees Celsius
  J/g°C
- ΔT: change in temperature, measured in °C
  $\Delta T = T_{final} - T_{initial}$

q is negative - it's exothermic (released heat)
q is positive - it's endothermic (absorbed heat)

- Unit for Heat (q)

Joules (J) or calories (cal) or kilocalories (Cal)

4184 J = 1000 cal = 1 Cal (kcal)

(Ex) Fruit Loops 110 Cal. Convert to cal & J.

$$\frac{110\ \text{Cal}}{1} \left| \frac{1000\ \text{cal}}{1\ \text{Cal}} \right. = 110000\ \text{cal}$$

$$\frac{110\ \text{Cal}}{1} \left| \frac{4184\ \text{J}}{1\ \text{Cal}} \right. = 460{,}240\ \text{J}$$

(Ex) Hot Cheetos 160 Cal. Convert to Joules.

$$\frac{160\ \text{Cal}}{1} \left| \frac{4184\ \text{J}}{1\ \text{Cal}} \right. = 669{,}440\ \text{J}$$

- Temperature Conversions

$$°F = 1.8(°C) + 32°$$

$$°C = \frac{(°F - 32°)}{1.8}$$

(Ex) Convert 37°C to °F

$$°F = 1.8(37°C) + 32°$$
$$°F = 98.6°F$$

(Ex) Convert -40°F to °C

$$°C = \frac{(-40° - 32°)}{1.8} = -40°C$$

$q = mC\Delta T$

Ex (1) How much (heat) is needed to raise the temperature of 10.0g of aluminum from 22.2°C to 55.5°C. The heat capacity of aluminum is .900 J/g°C

$q = ?$
$m = 10.0\,g$
$C = .900\ J/g°C$
$\Delta T = 55.5°C - 22.2°C = 33.3°C$

$q = (10.0\,g)(.900\ J/g°C)(33.3°C)$

$q = 300.\ J$

Endothermic

(2) A 15.75g piece of iron released 1086.75J of energy (heat) as its temperature lowered from 175.0°C to 25.00°C. Calculate the heat capacity of iron. $q = mC\Delta T$

$q = -1086.75\ J$
$m = 15.75\,g$
$C = ?$
$\Delta T = 25.00°C - 175.0°C = -150.0°C$

$-1086.75\ J = (15.75\,g)\,C\,(-150.0°C)$

$\frac{-1086.75\ J}{-2362.5\ g°C} = \frac{(-2362.5\ g°C)\,C}{-2362.5\ g°C}$

$.4600\ J/g°C = C$