Objective 8

Energy and heat 1:
predict heat in a physical heat transfer.
Apply heat equations ($q = m\ s\ \Delta T$,
heat gained = heat lost)

Energy and Heat

http://survival-mastery.com/skills/water-purifying/survival-water-purification.html

How long will it take to heat up my water?

What kind of pot should I use?

What fuel should I use?

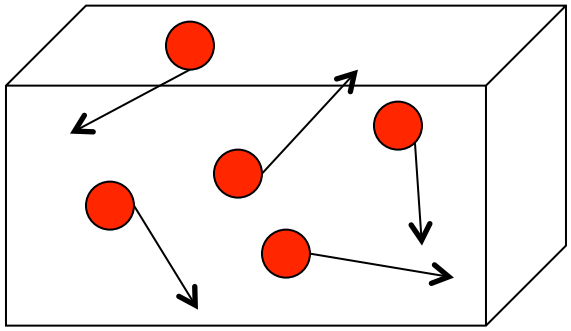
Energy *is the Ability to do Work.* ***Heat*** *is a type of Energy*

Shake hands with your neighbor.

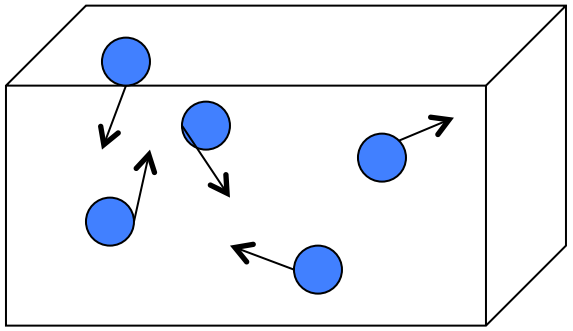
http://www.integritystaffing.com/blog/?p=4539

Is heat transferred?
Give reasons.

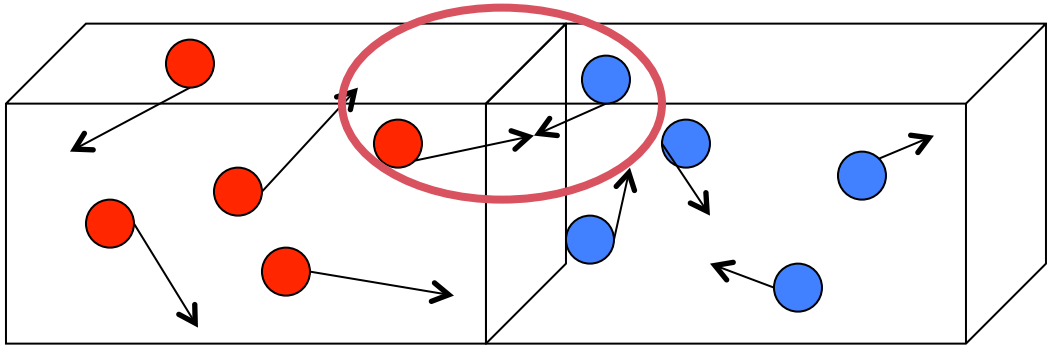
Heat *is the Energy TRANSFERRED between 2 objects due to a difference in TEMPERATURE.*



Hot object: atoms move fast



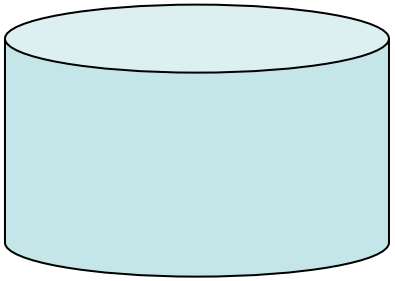
Cold object: atoms move slow



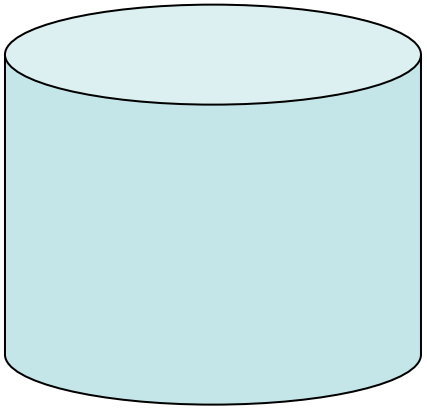
What happens when a fast atom collides with a slow one?

Objective: ID factors that determine heat

Heat *is the Energy transferred between 2 objects due to a difference in temperature.*



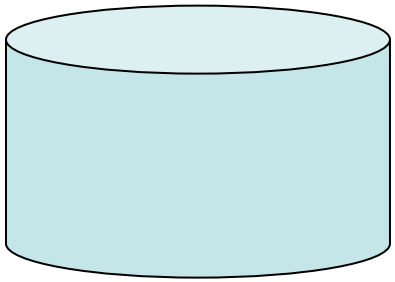
1 cup of water is heated from 25°C to 90°C.

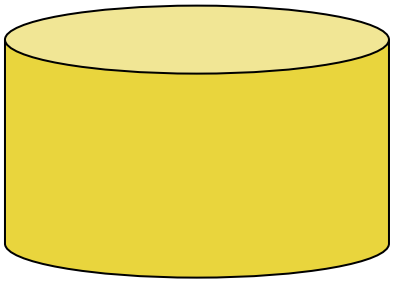


2 cups of water is heated from 25°C to 90°C.

Is the same amount of heat needed to heat each amount of water?

Objective: ID factors that determine heat

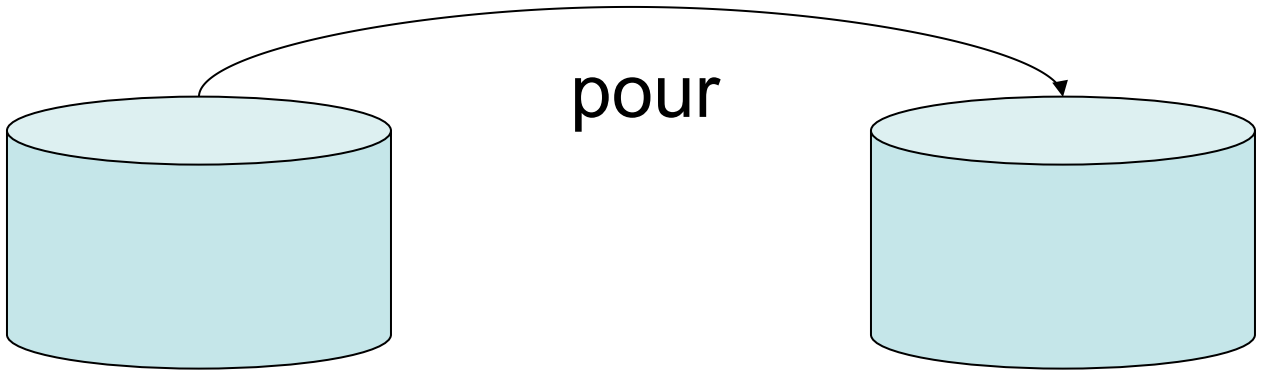




250 g of water is heated from 25°C to 75°C.

250 g of ethanol is heated from 25°C to 75°C.

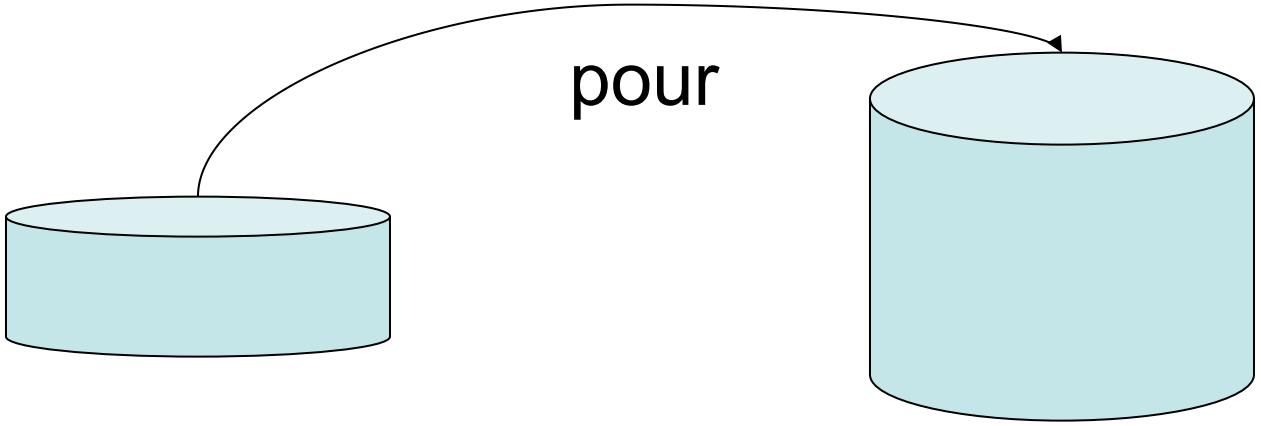
Is the same amount of heat needed to heat each amount of liquid?



50 ml of water at 25^{o}C

50 ml of water at 100^{o}C

What is the final temperature of the water?



25 ml of water at 25^{o}C

75 ml of water at 100^{o}C

Is the final temperature of the water the same as above?

Heat is the **Transfer** of energy from one object to another due to a *Difference In Temperature*.

3 Factors determine heat transferred:

- *Mass* - amount of substance
- *Temperature* - average KE of a substance
- *Specific Heat* - amount of E required to raise 1 g of a substance 1°C. (*see specific heat table in textbook*)

$$\textbf{Heat} = q = m\, s\, \Delta T$$

Do conductors have a high specific heat or low specific heat?

3 types of heat transfer: Conduction, Convection, Radiation

http://www.dreamstime.com/stock-photography-hand-reaching-down-image8307552

http://candlefind.com/candle-reviews/avery-jordan-candle-reviews/friendly-fumes-scented-candles.html

Hot Object Touches a Cold Object:

Heat gained by cold object = - Heat lost by hot object

heat gained is (+) heat = endothermic
heat lost is (-) heat = exothermic

What is gaining heat? What is losing heat?

Objective: Use the ***Heat Equations*** to Calculate q

Problem: 1 cup (240 ml) of H_2O is heated from 25°C to 90°C. Calculate q.

A typical hot water heater holds 30 gallons of water. The normal temperature setting is 120°F. Calculate the heat needed to raise the T of 30 gallons of water from room temperature to 120°F.

Objective: Use the ***Heat Equations*** to Calculate q

Problem: 1 cup (240 ml) of H_2O is heated from 25°C to 90°C. Calculate q.

Solution: **q = 65,210 J**

Heat = m s (T_f - T_i)

q = (240 g) (4.18 J/g°C) (90°C - 25°C)

How much heat is needed to heat 2 cups of H_2O from 25°C to 90°C?

How much heat is needed to heat 240 g of ethanol from 25°C to 75°C?

Objective: Use the ***Heat Equations*** to Calculate T_f

Problem: 50 ml H_2O at 100°C is added to 50 ml H_2O at 25°C. Calculate the final temperature of the water.

Objective: Use the ***Heat Equations*** to Calculate T_f

Problem: 50 ml H_2O at 100°C is added to 50 ml H_2O at 25°C. Calculate the final temperature of the water.

Solution: **T_f = 62.5°C**

Heat gained by cold water = - Heat lost by hot water

$$m_c\, s_c\, (T_f - T_{ic}) = -\, m_h\, s_h\, (T_f - T_{ih})$$

What is gaining heat? What is losing heat?

7 variables in the heat equation. Know 6 and solve for 1.

Which variables do you know? Which variable do you solve for?

Objective: Use ***Heat Equations*** to Measure Specific Heat (Lab 7)

Problem: A 53.1 g piece of metal at 100°C is added to 50 ml H_2O at 25°C. The final temperature is 32.4°C. Calculate the specific heat of the metal. What is the identity of this metal?

Lab 7: Use ***Heat Equations*** to Measure **Specific Heat**

Problem: A 53.1 g piece of metal at 100°C is added to 50 ml H_2O at 25°C. The final temperature is 32.4°C. Calculate the specific heat of the metal. What is the identity of this metal?

Solution: **s = 0.43 J/g °C**

Heat gained by cold object = - Heat lost by hot object

$$m_c\, s_c\, (T_f - T_{ic}) = -\, m_h\, s_h\, (T_f - T_{ih})$$

What is gaining heat? What is losing heat?

7 variables in the heat equation. Know 6 and solve for 1. Which variables do you know? Which variable do you solve for?

Design an experiment to measure specific heat.

http://stantonplumbing.org/tankless-water-heaters/

A typical hot water heater holds 40 gallons of water. The normal temperature setting is 120^{o}F.

Calculate the heat needed to raise the T of 40 gallons of water from 70^{o}F (21^{o}C) to 120^{o}F (49^{o}C).

When natural gas burns (combusts), it produces 802 kJ/mole = 50.1 kJ/g.

How many g of natural gas is needed to heat 40 gallons of water from 70^{o}F (21^{o}C) to 120^{o}F (49^{o}C)?

A typical hot water heater holds 40 gallons of water. The normal temperature setting is 120°F.

http://stantonplumbing.org/tankless-water-heaters/

http://www.sanfranciscosentinel.com/?p=171477

PG&E charges $1.10/therm for natural gas (methane = CH_4).
1 therm = 105.4804 MJ
How much does it cost to heat 40 gallons of water from 70°F (21°C) to 120°F (49°C) using natural gas?

PG&E charges $0.165/kW hr for electricity.
1 kW hr = 3.6 MJ
How much does it cost to heat 40 gallons of water from 70°F (21°C) to 120°F (49°C) using electricity?

Which source is cheaper to heat water?

How to Keep your Coffee Hot?

http://www.clipartguide.com/_pages/1552-0906-3020-1509.html

Does it depend on the cup the coffee is in? Does it stay hot longer in a metal cup or styrofoam cup? Why?

If you want to keep your beverage hot, should you pre-heat the cup? Why?

If you want to keep you beverage cold, should you chill the cup? Why?

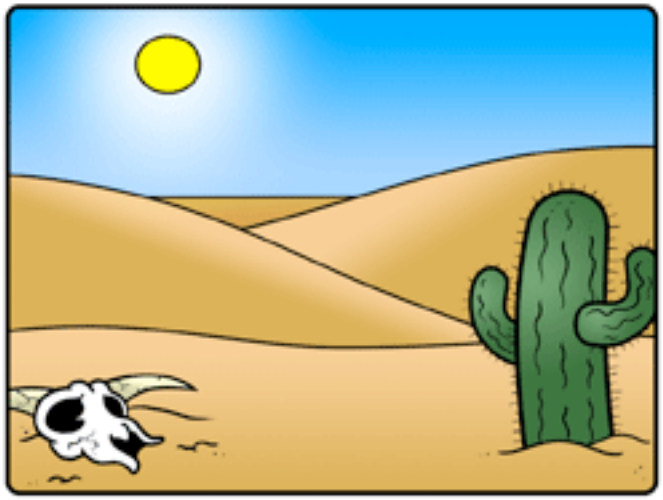
If you want to keep your food warm, should you pre-heat your plate? Why?

What Does Water Have To Do With It?

Hint: see specific heat

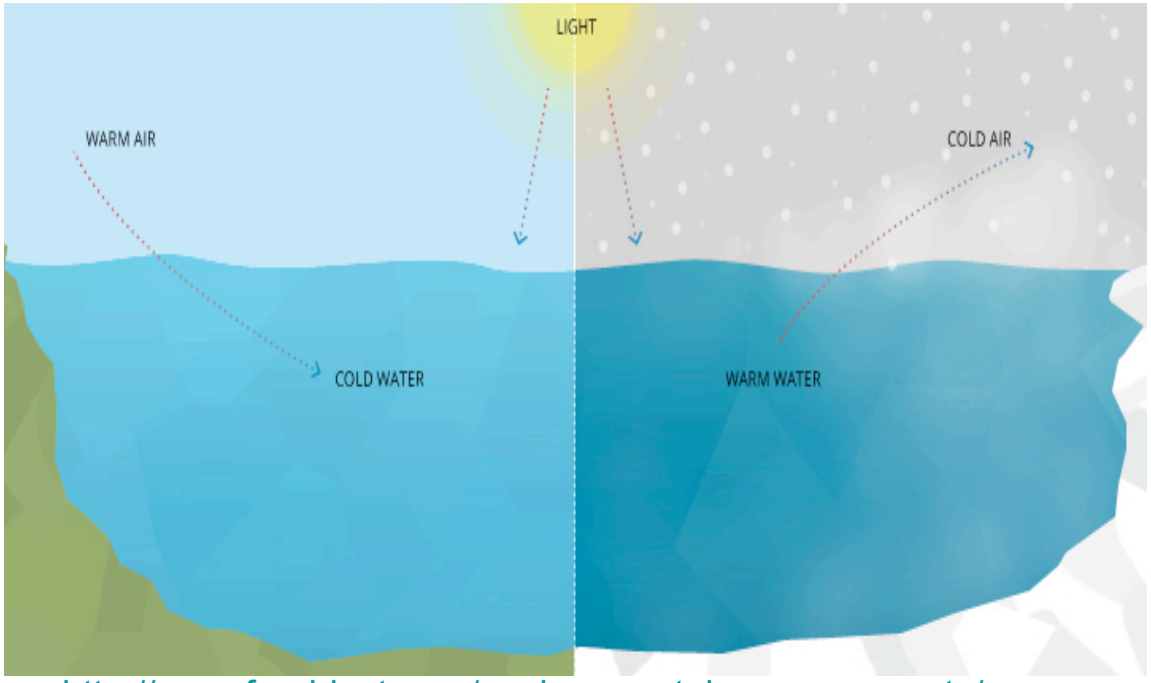
Water = 4.18 J/g^{o}C

Sand = 0.8 J/g^{o}C



http://www.how-to-draw-cartoons-online.com/image-files/cartoon-desert.gif

Cooler near a body of water



http://www.fondriest.com/environmental-measurements/parameters/water-quality/water-temperature/

Hotter where there's no water