

# Science Starter

- Determine the mass of  $3.64 \times 10^{23}$  particles of Na.

# Energy and Heat

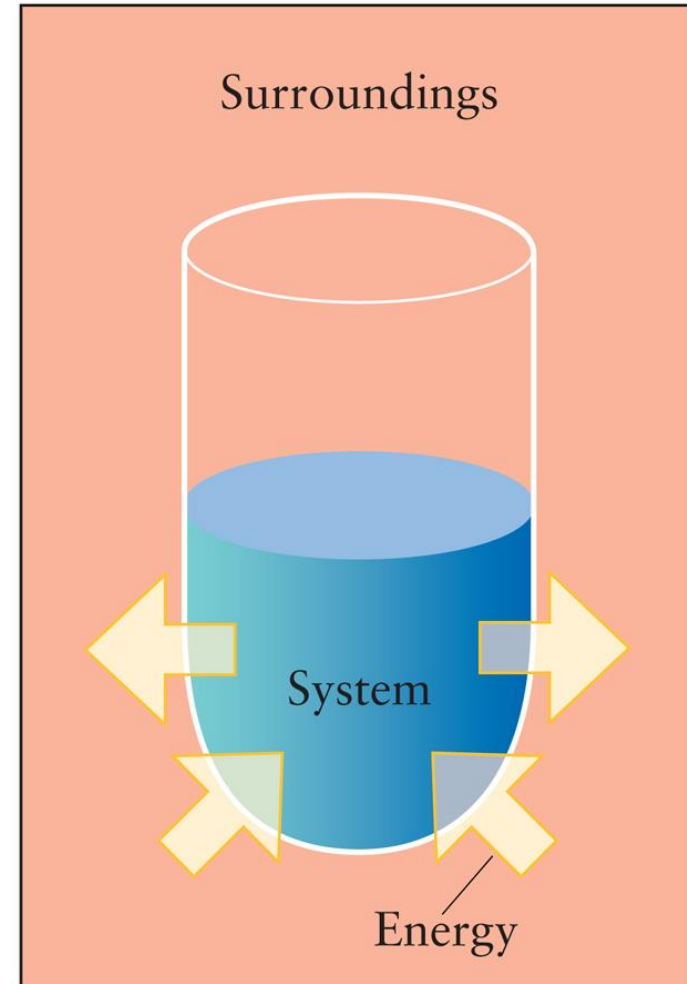
Chemistry-Arbor Prep

# What is Thermochemistry?

- Thermochemistry is the study of energy associated with chemical reactions and state changes.
  - The energy stored in chemical bonds (intra and inter) is said to be potential energy.
- We can study thermochemistry by calculating the heat ( $q$ ), by the temperature change of a substance ( $s$ )
  - NOTE: HEAT IS NOT TEMPERATURE! Heat is determined by a temperature change.

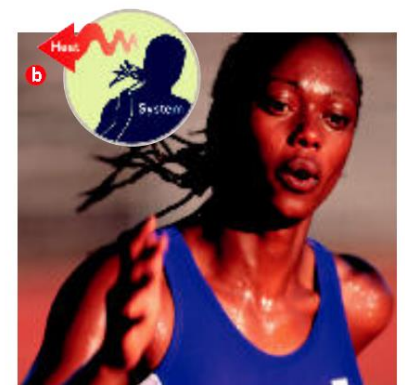
# Heat flows from a warm object to a cold one.

- System: part of the universe that you are paying attention to.
- Surroundings: everything else.
- The law of conservation of energy states that energy can't be created or destroyed. If a system loses energy, the universe gains it.



# Endo Vs Exothermic

- In thermochemistry, reactions are defined as endothermic or exothermic.
  - Endothermic processes absorbs heat and the surroundings cool.
    - The  $q$  value for exothermic processes is positive.
    - I.e: cold packs
  - Exothermic processes release heat and the surroundings warm.
    - The  $q$  value for exothermic processes is negative.
    - I.e: body warmth



# Energy Calculations

- Heat energy can be calculated in two different units, the calorie and the joule.
  - There are 4.184 Joules = 1 calorie
  - The Calories on the box of cereal are kilocalories.
- The heat capacity of an object is the energy required to increase the temperature of a substance up  $1^{\circ}\text{C}$ .
  - There is a specific heat capacity which is the amount of energy needed to raise the temperature of 1 gram of a substance up  $1^{\circ}\text{C}$ . The units are  $\text{J}/(\text{g}^{\circ}\text{C})$

# Table of Specific Heats

**Specific Heats of Some Common Substances**

Substance	Specific Heat	
	J/(g·°C)	cal/(g·°C)
Water	4.18	1.00
Grain alcohol	2.4	0.58
Ice	2.1	0.50
Steam	1.7	0.40
Chloroform	0.96	0.23
Aluminum	0.90	0.21
Iron	0.46	0.11
Silver	0.24	0.057
Mercury	0.14	0.033

# Formula Using Specific Heat

$$q = m \cdot C_p \cdot \Delta T$$

q is the heat energy (either in cal or joules)

$C_p$  is the specific heat

$\Delta T$  is the temperature

m is the mass



# Algebra Review

- Rearrange the formula from the previous box to solve for the heat capacity ( $\text{mass} * C_p$ )
- Rearrange the formula from the previous box to solve for the specific heat capacity ( $C_p$ )

# Practice Problems

The temperature of a 95.4-g piece of copper increases from 25.0°C to 48.0°C when the copper absorbs 849 J of heat. What is the specific heat of copper?

When 435 J of heat is added to 3.4 g of olive oil at 21°C, the temperature increases to 85°C. What is the specific heat of the olive oil?

How much heat is required to raise the temperature of 250.0 g of mercury 52°C?

# Practice Problems

Using calories, calculate how much heat 32.0 g of water absorbs when it is heated from 25.0°C to 80.0°C. How many joules is this?

# STAMP IT!!!

A chunk of silver has a heat capacity of  $42.8 \text{ J/}^\circ\text{C}$  and a mass of 181 g. Calculate the specific heat of silver.