Review Electromagnetic Radiation, Naming, and Chem Equations

November 3, 2022

Chemistry Department, Cypress College

Class Announcements

Lecture

- Share previous UCI Teaching Evaluation
- Hold off on reviewing the Exam and homework 8
- Review material from Chs 3 - 6
- Quiz and Homework assignment released Fri, Nov 4th at 3pm

Outline

Review: Wavelength and Rydberg Formula

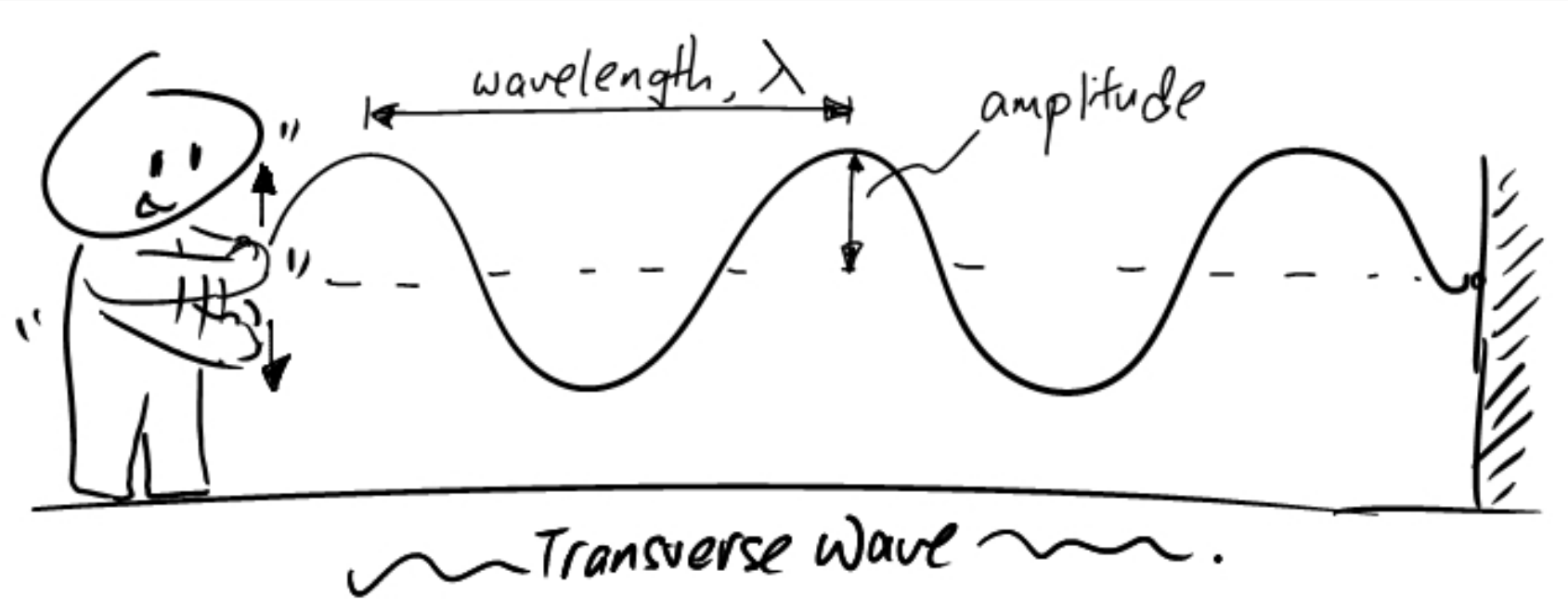
Review: Identifying Types of Compounds and Naming Compounds

- Ionic Compounds
- Molecular Compounds
- Acids and Bases

Review: Heat and Energy

Review: Chemical Equation

The Wave



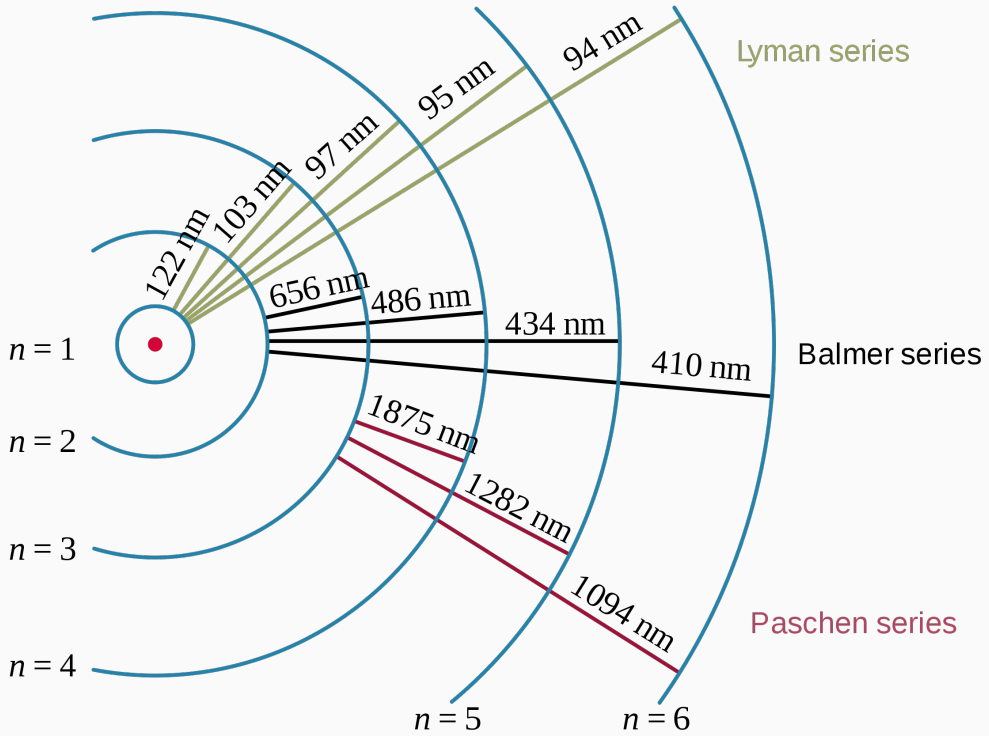
Practice: Determining the Wavelength

Suppose a 7.5m rope is shaken to yield 2.5 wavelength. Draw the wave for 7.5m rope. Determine the wavelength in m.

Rydberg Formula

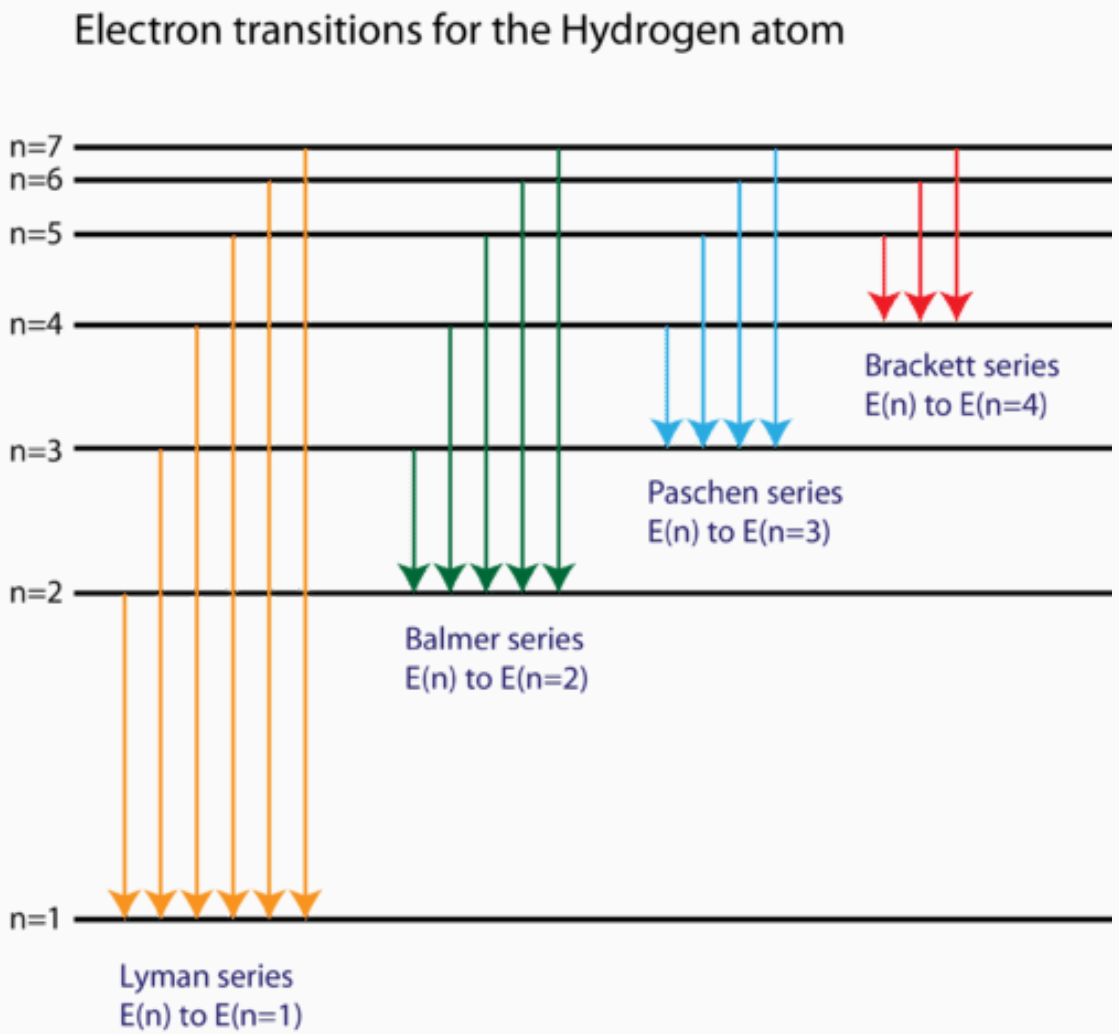
$$\frac{1}{\lambda} = R\left(\frac{1}{n_f^2} - \frac{1}{n_i^2}\right) \tag{1}$$

where n_f and n_i are the final and initial energy state, λ is the wavelength, and R is the Rydberg constant (1.097×10^7 m^{-1})



H Atom Spectra

Q: What do notice about the transition energy for n=1 to n=2 and n=2 to n=3?



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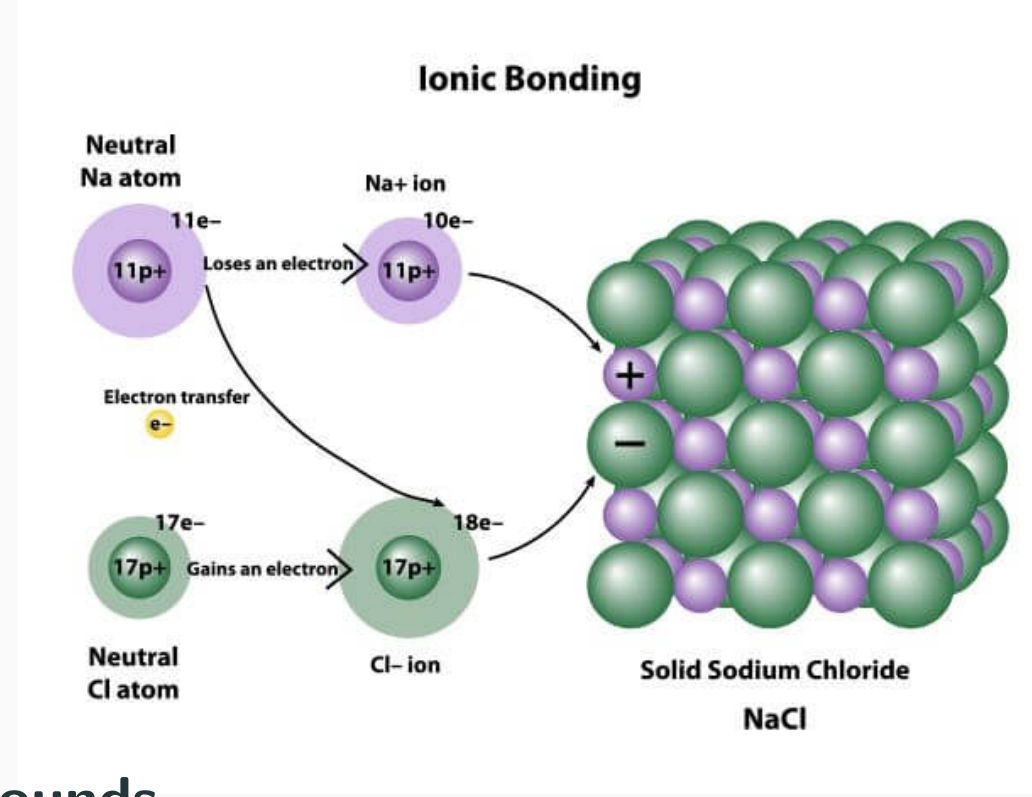
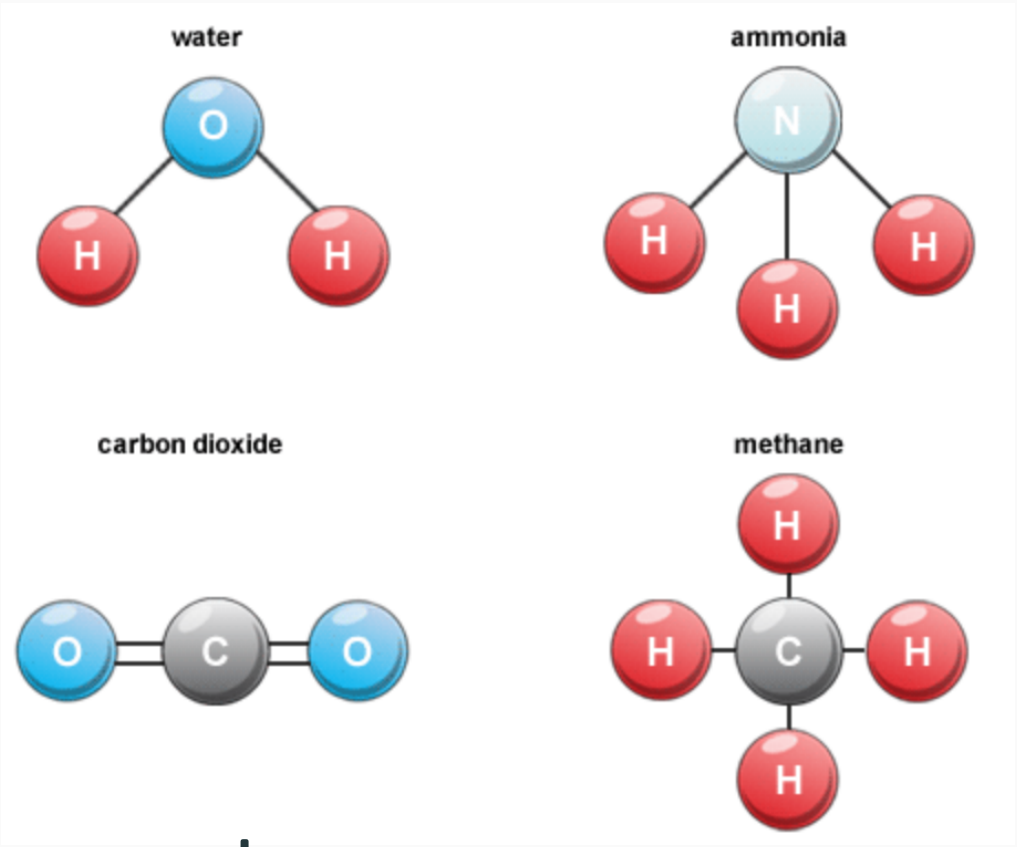
Properties of Ionic Compounds



Ionic Compounds

- Highly conductive and strong electrolyte - ability to carry electricity (electrons)
- High melting and boiling points, high density

Properties of Molecular Compounds



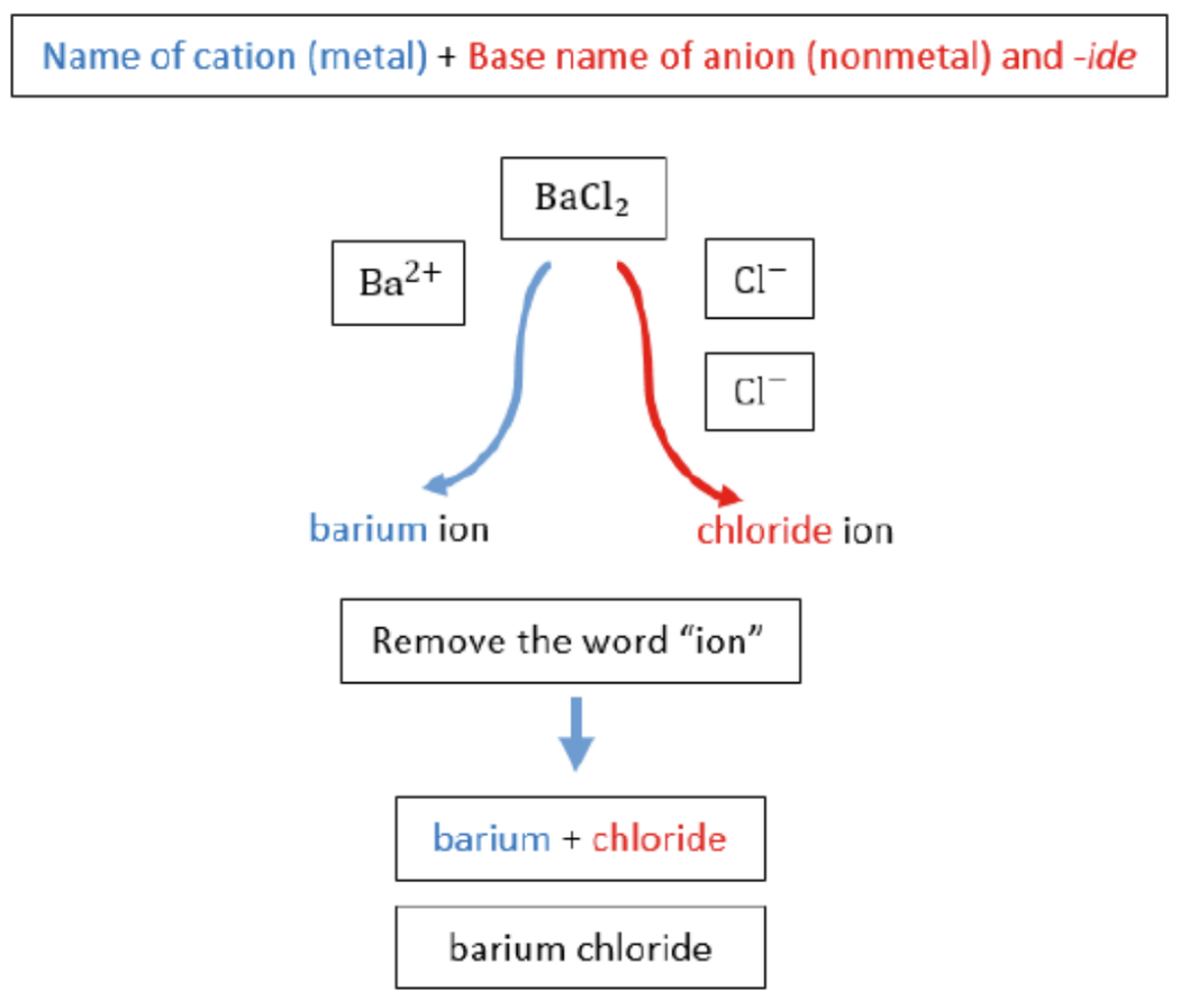
Molecular Compounds

- Not conductive and weak electrolyte
- Low melting and boiling points, low density

Naming Ionic Compounds

The metal cation is named first, followed by the nonmetal anion.

The word ion is dropped from both parts.



Naming Molecular Compounds

Prefix	Number	Prefix	Number	Prefix	Number
mono-	1	penta-	5	octa-	8
di-	2	hexa-	6	nona-	9
tri-	3	hepta-	7	deca-	10
tetra-	4				

1. Use numerical prefix for the element (usually ignore the first when using "mono")
2. Add "-ide" to the second element

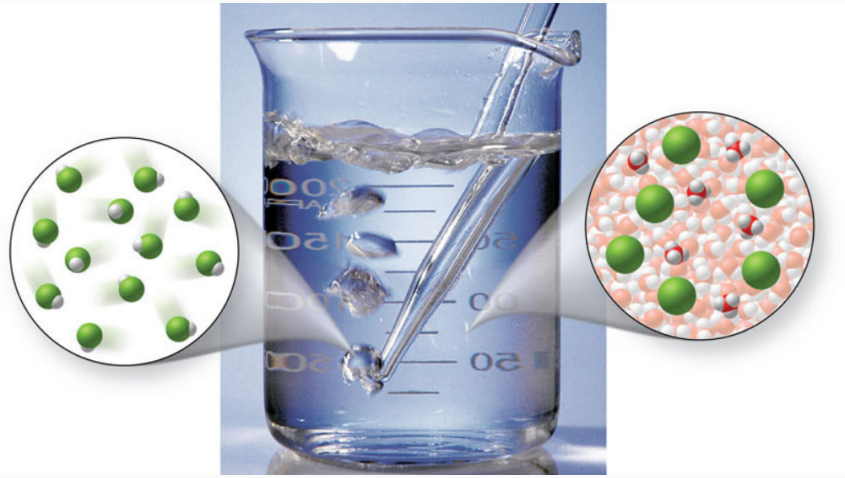
Practice: Naming Binary Molecular Compounds

- H_2O
- N_2O_4
- CO
- CH_4
- PF_5
- BF_3
- SiO_2
- XeF_4

Practice: Determining Molecular Formula

- Sulfur trioxide
- Nitrogen trihydride
- Dihydrogen monoxide
- Carbon tetrafluoride
- Selenium dichloride
- Dinitrogen pentaoxide
- Sulfur hexafluoride
- Phosphorus trifluoride

Naming Acids and Bases



1. If anion ends in "-ide," add "hydro" before the root of the anion name followed by "-ic acid"
2. If anion ends in "-ate," use the root of the anion name followed by "-ic acid"
3. If anion ends in "-ite," use the root of the anion name followed by "-ous acid"

Practice: Naming the Acid

- HCl
- HNO_3
- H_2CO_3
- H_2SO_3
- H_3PO_4
- $HClO_2$
- HBr
- HNO_2
- H_2SO_3
- H_2S

Practice: Determining Molecular Formula

- Cloric acid
- Phosphoric acid
- Sulfurous acid
- Hydrosulfuric acid
- Chromic acid
- Nitric acid
- Hypochlorous acid
- Hydrobromic acid

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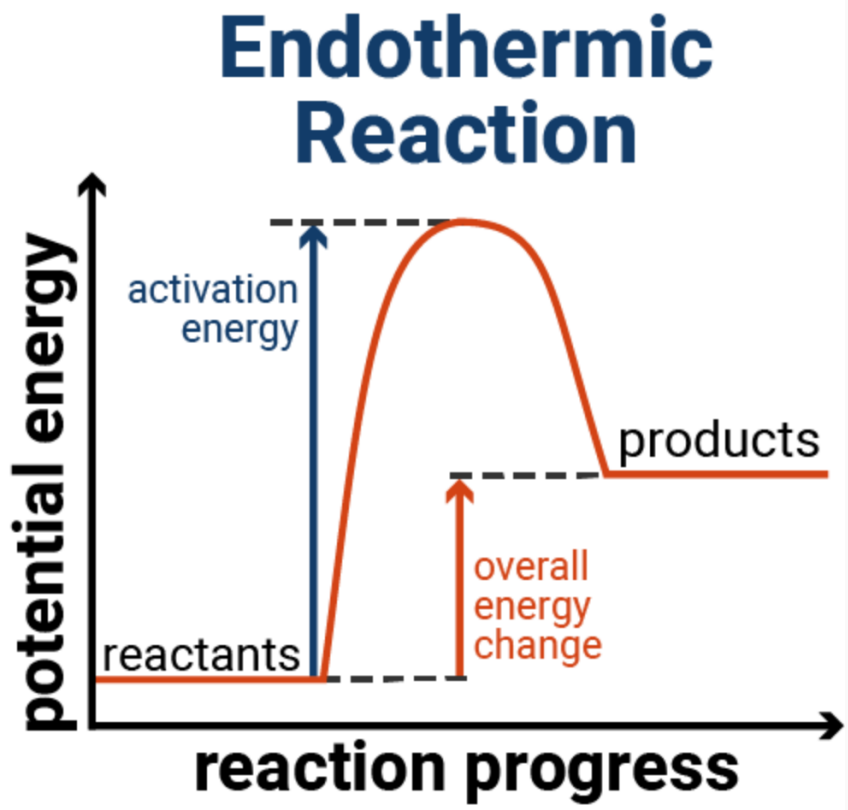
Endothermic and Exothermic Reactions

Exo - external; exothermic reactions give off heat

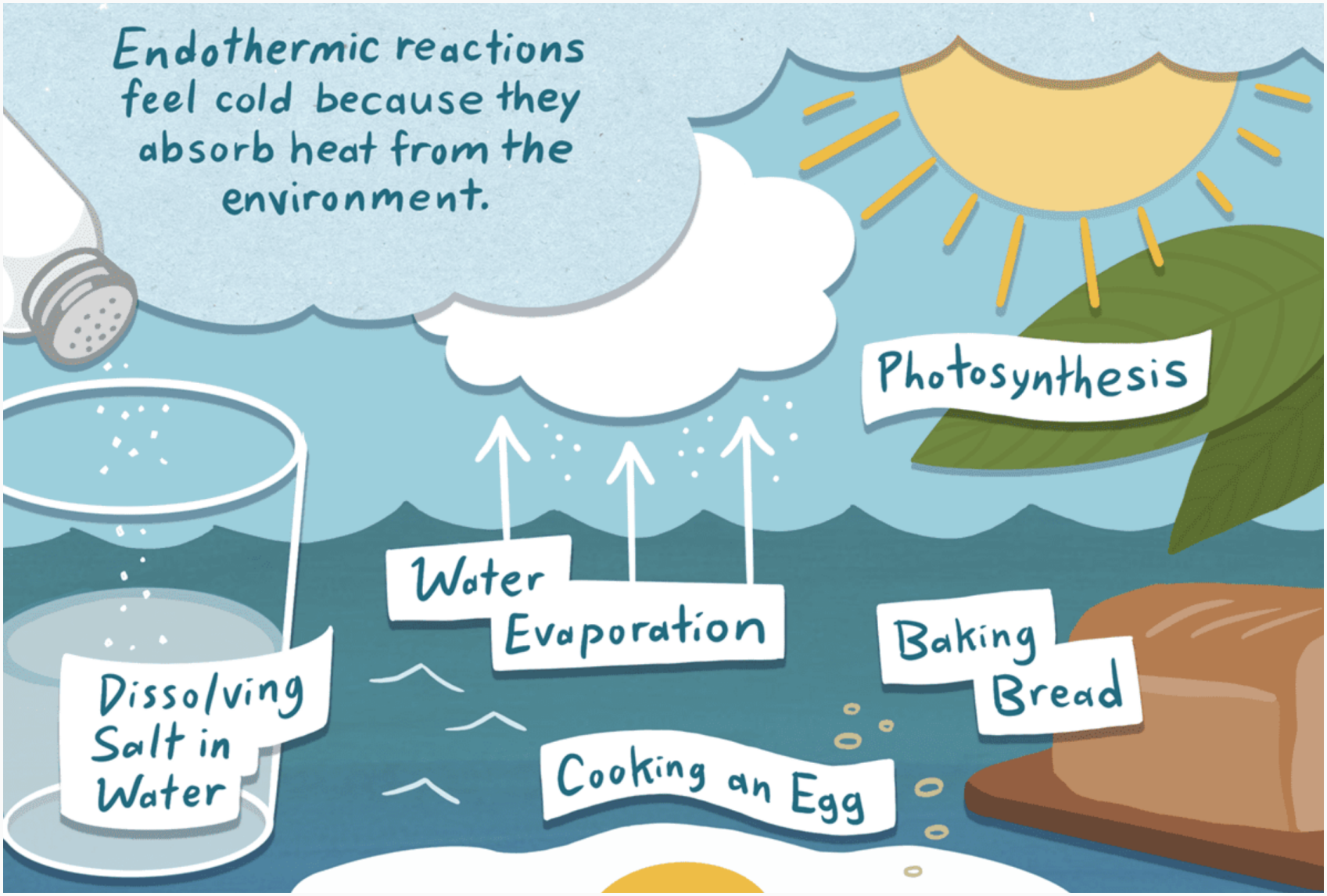
Endo - internal; endothermic reactions absorb heat

Endothermic Reaction Diagram

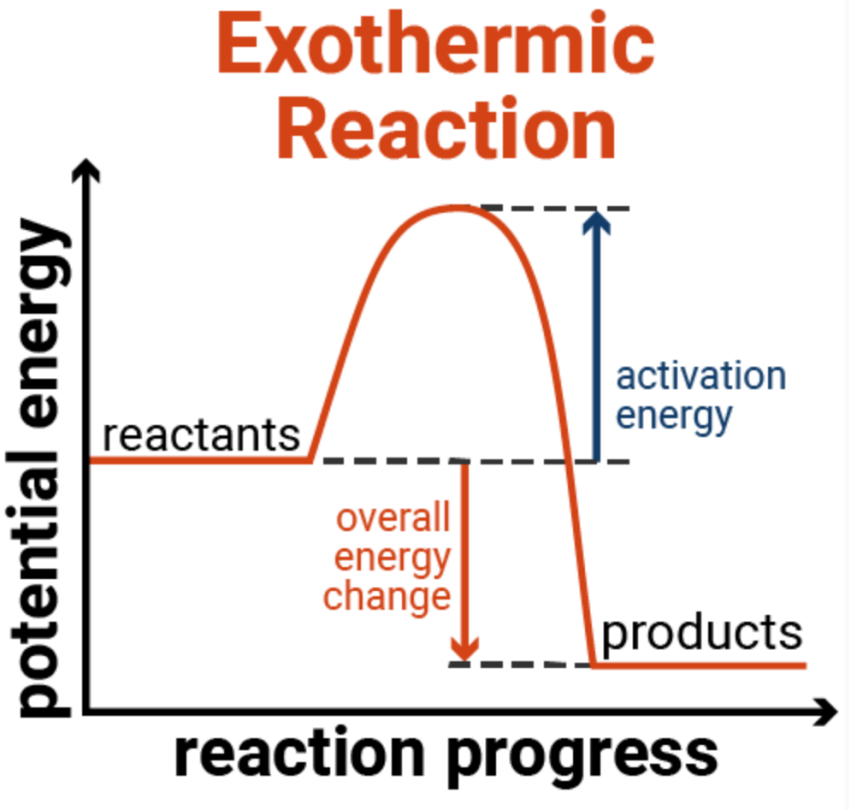


- **Recall Potential energy** - ability to do work; $\Delta E_{\text{products}} > \Delta E_{\text{reactants}}$
- **Activation energy** - minimum energy to start the reaction; determines the rate at which the reaction undergoes

Examples of Endothermic Reactions

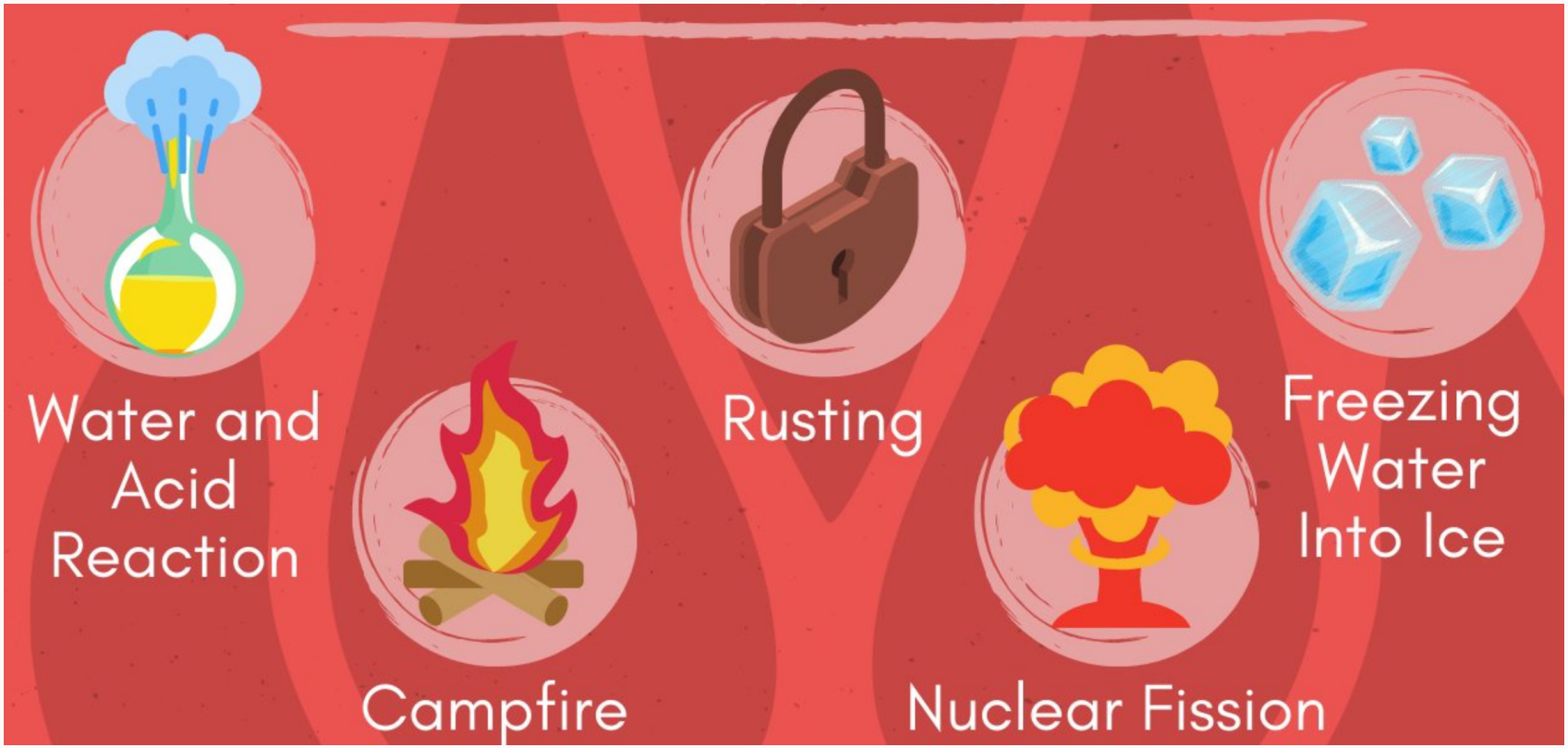


Exothermic Reaction Diagram

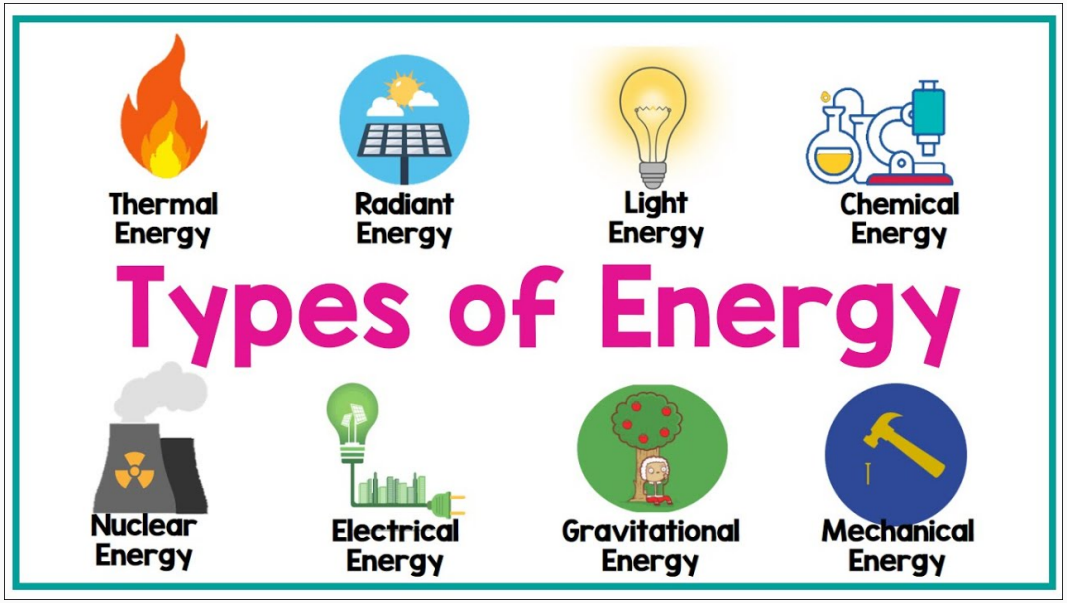


- **Potential energy** - $\Delta E_{\text{products}} < \Delta E_{\text{reactants}}$
- Products are more stable than reactants since preference for lower energy state

Examples of Exothermic Reactions



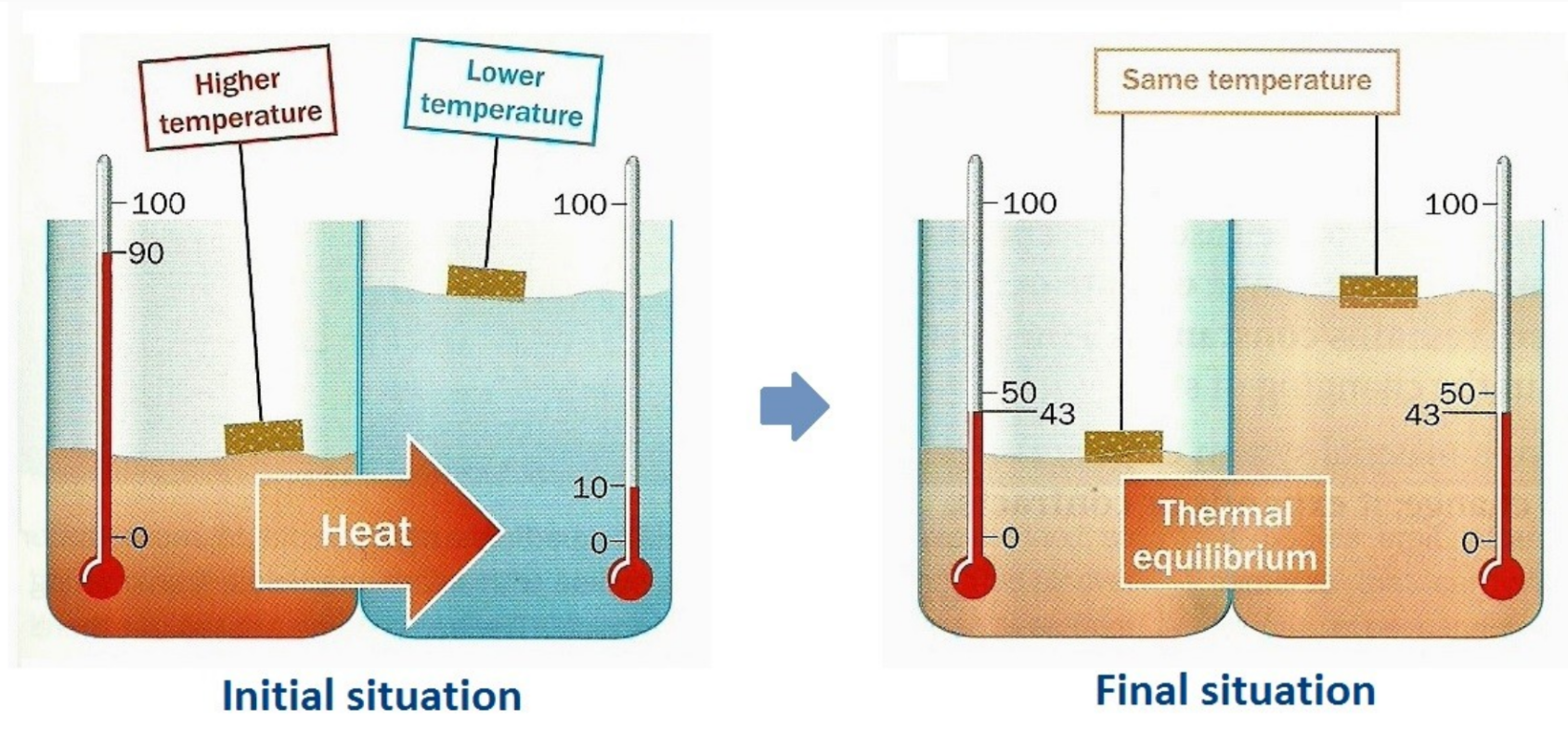
Law of Conservation of Energy



Energy is neither created nor destroyed

- Energy can be converted from form to another e.g. mechanical, chemical, thermal, nuclear, electrical and vibrational energy
- Converting from one energy form to another is never 100% efficient; there is always a loss of energy

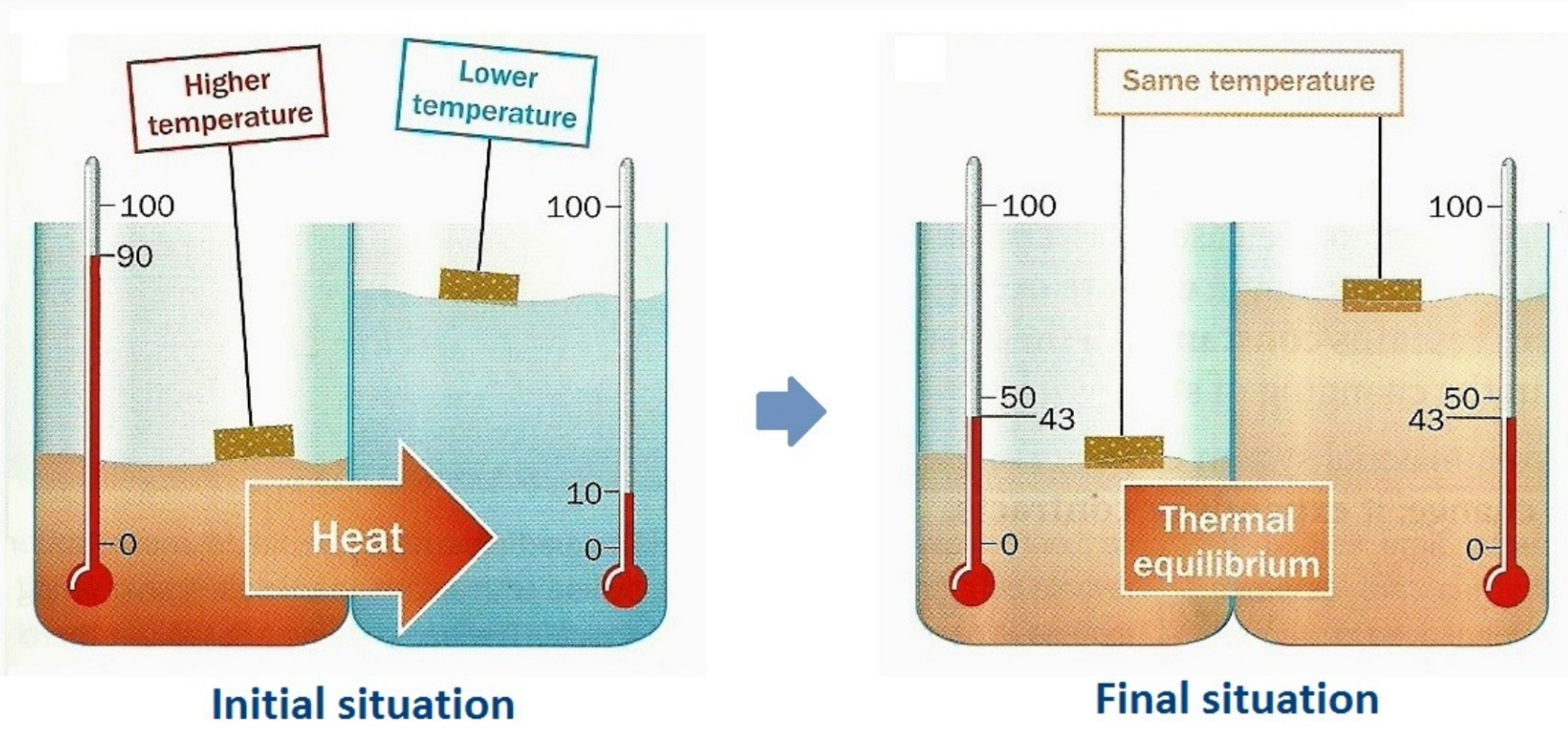
Thermal Energy



Heat flows from “hot” to “cold”

Thermal Energy

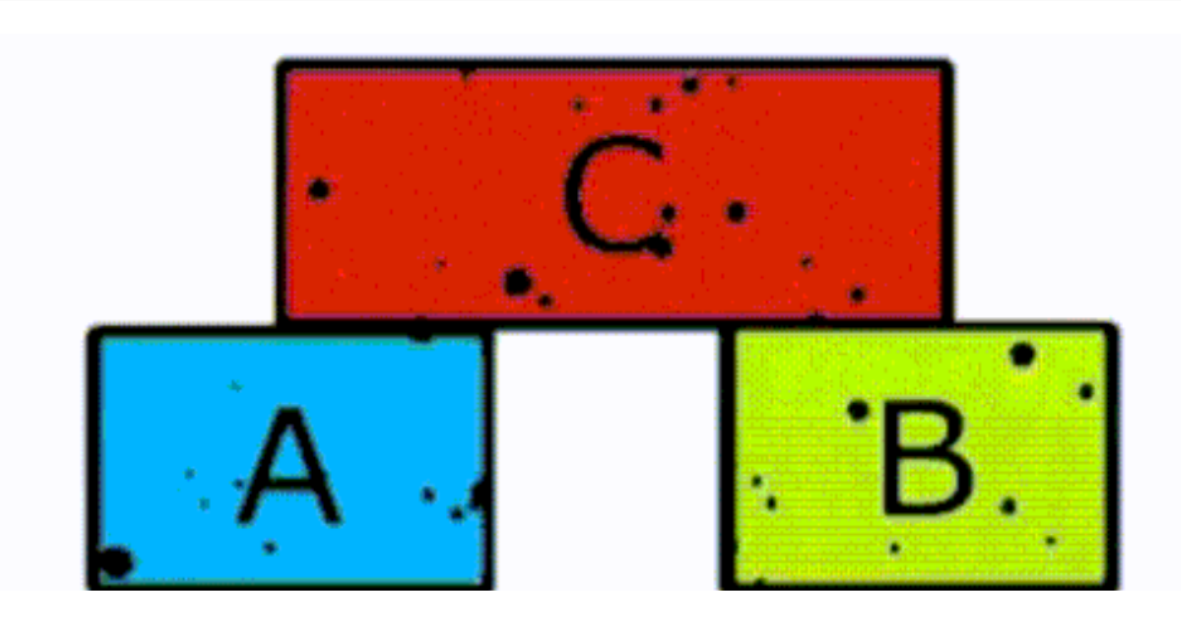
Thermal Equilibrium - there is no "net" heat transfer



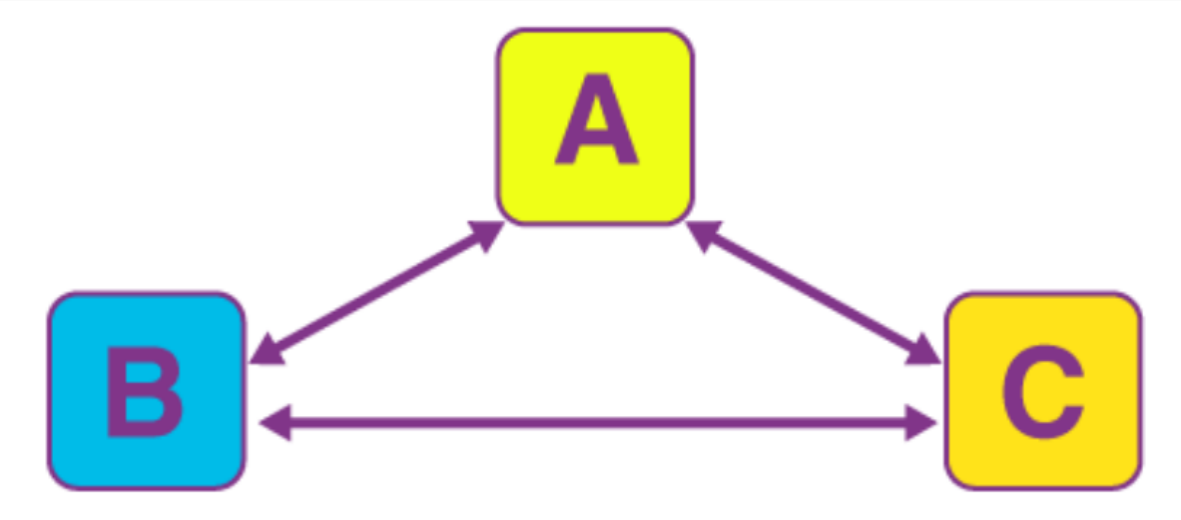
Heat flows from "hot" to "cold"

Practice: Zeroth Law of Thermodynamics

Q: Suppose blocks A and C are in thermal equilibrium. In addition, blocks C and B are in thermal equilibrium as well. What conclusion can be drawn about the temperature of blocks A (T_A) and B (T_B)?



Zeroth Law of Thermodynamics



"If two thermodynamic systems are each in thermal equilirbium with a third one, then they are in thermal equilibrium with each other."

Quantifying Heat

$$q = mC\Delta T \tag{2}$$

where q is heat, m is the mass (g), C is specific heat capacity (J/(°C g)) and T is temperature (°C)

Practice: Thermal Equilibrium

Suppose there are two objects of the same material and mass. One is at a hot temperature T_H and the second object is at a cold temperature T_C. Both come into contact and reach thermal equilibrium isolated from the surrounding. Determine the final temperature T_f.

Practice: Thermal Equilibrium

Suppose there are two objects of the same material but one object is 2 times the mass of the other. One is at a hot temperature T_H and the second object is at a cold temperature T_C. Both come into contact and reach thermal equilibrium isolated from the surrounding. Determine the final temperature T_f.

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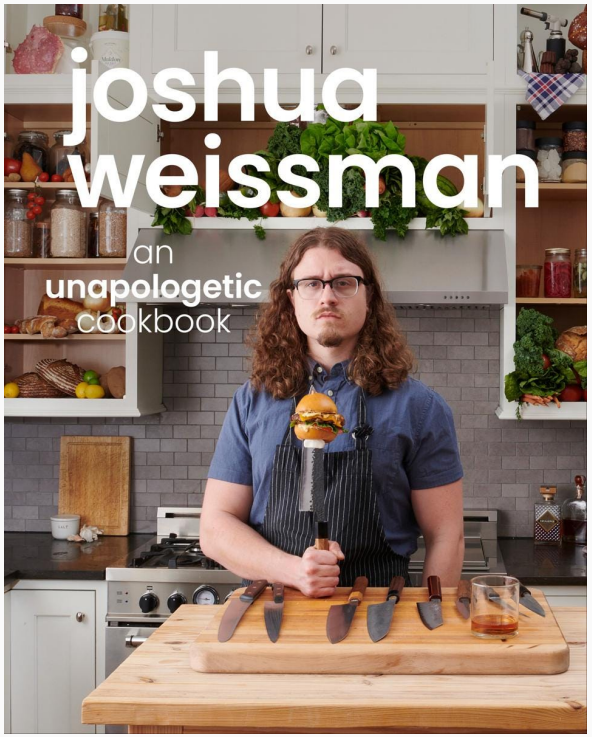
Meaning of a Chemical Equation

$$aA + bB \rightarrow cC + dD \tag{3}$$

where a, b, c, and d are coefficients for the reactants A/B and products C/D

- Provides the means to determine how much product is produced for a given amount of reactants
- Relate to molar masses, number of molecules, amount of moles and masses

Analogy to Recipe Cookbook



Analogy: Cookbook recipe- Popeyes Chicken but better

Photosynthesis

$$6CO_2(g) + 6H_2O(l) \rightarrow C_6H_{12}O_6(s) + 6O_2(g) \tag{4}$$

Properties

- Balanced chemical equation satisfies the conservation of mass
- Coefficients in front of the molecules represent the relative moles of reactants and products
- **Q:** How many moles of $H_2O(l)$ are needed to react with 12 moles of $CO_2(g)$?

Practice: Acid-Base Reaction

Suppose you have 50mL of 1.5M HCl(aq) and you attempt to neutralize the acid with 1M NaOH(aq). Write the balanced chemical reaction. Determine what volume of 1M NaOH(aq) is needed.

Approaching Limiting Reactant Problems

$$\mathrm{R1} + \mathrm{R2} \rightarrow \mathrm{P1} \tag{5}$$

- Given a certain amount of each reagents (R1 and R2) to produce P1, determine how much the R2 is needed to completely react with R1
- Based on that calculated value, determine whether there is enough R2 to completely react with R1
- If the amount of R2 is less than what is needed, then R2 is the limiting
- If the amount of R2 is more than what is needed, then R2 is the excess