

SNS COLLEGE OF PHARMACY AND HEALTH SCIENCES

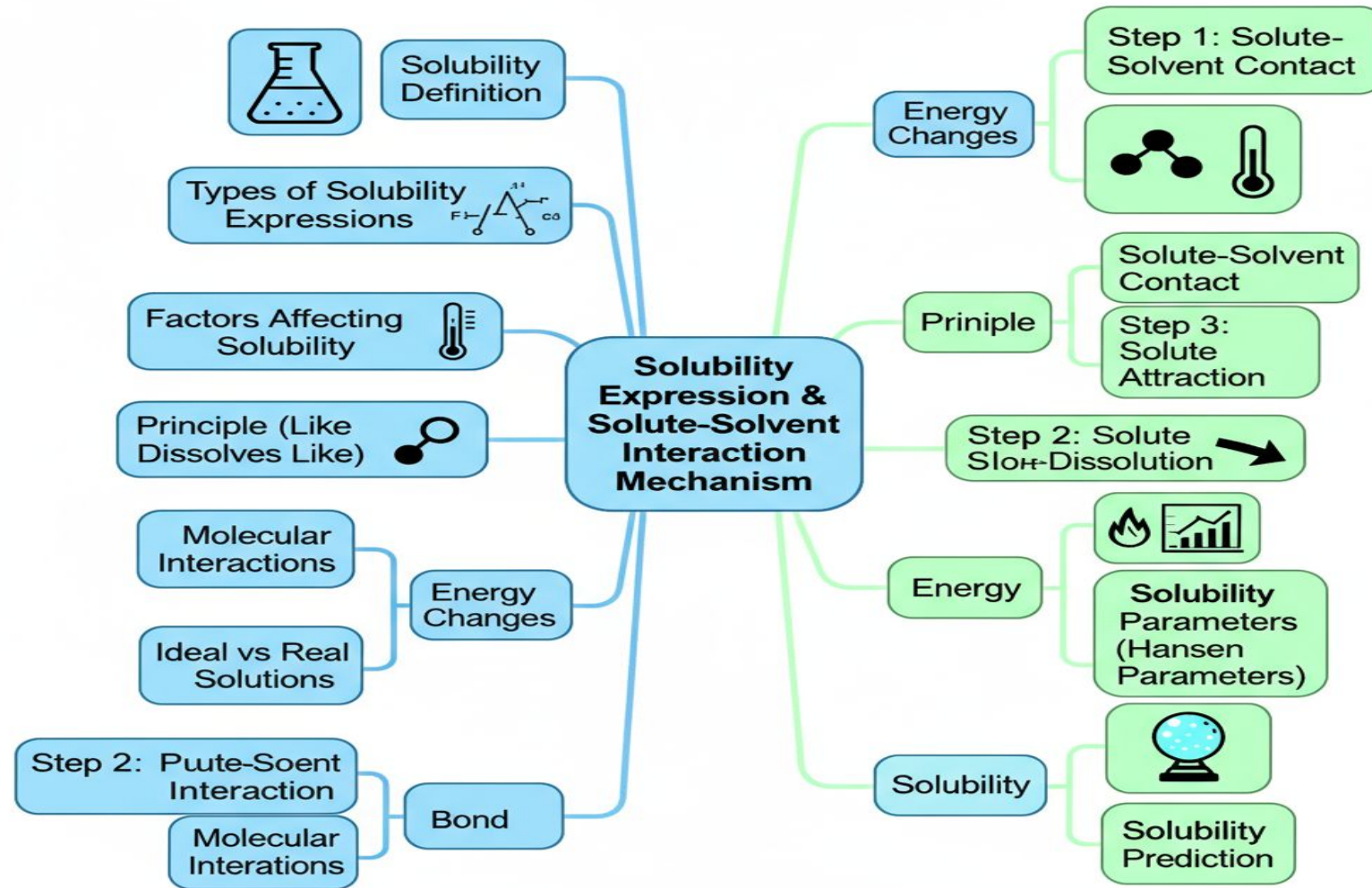


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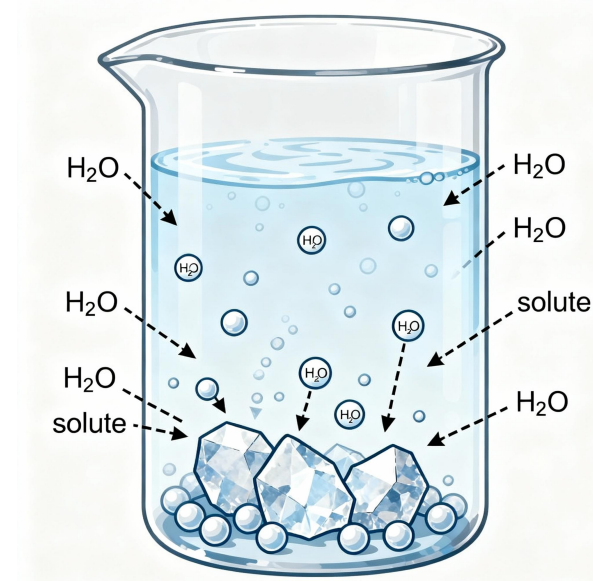
COURSE NAME :PHYSICAL PHARMACEUTICS (BP 302 T)

III SEM / II YEAR

TOPIC 1 : Solubility Expression and Mechanism of Solute-Solvent Interactions



Introduction to Solubility

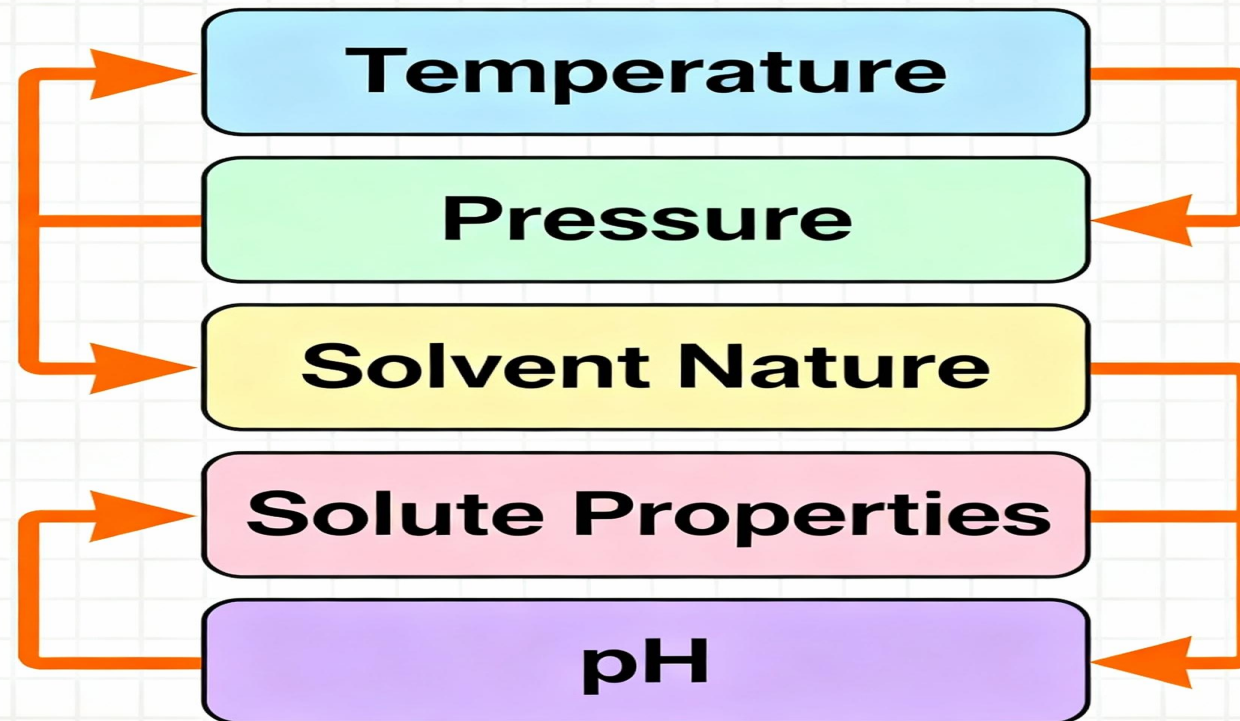


Solubility: Maximum amount of solute dissolved in a solvent at given temperature.

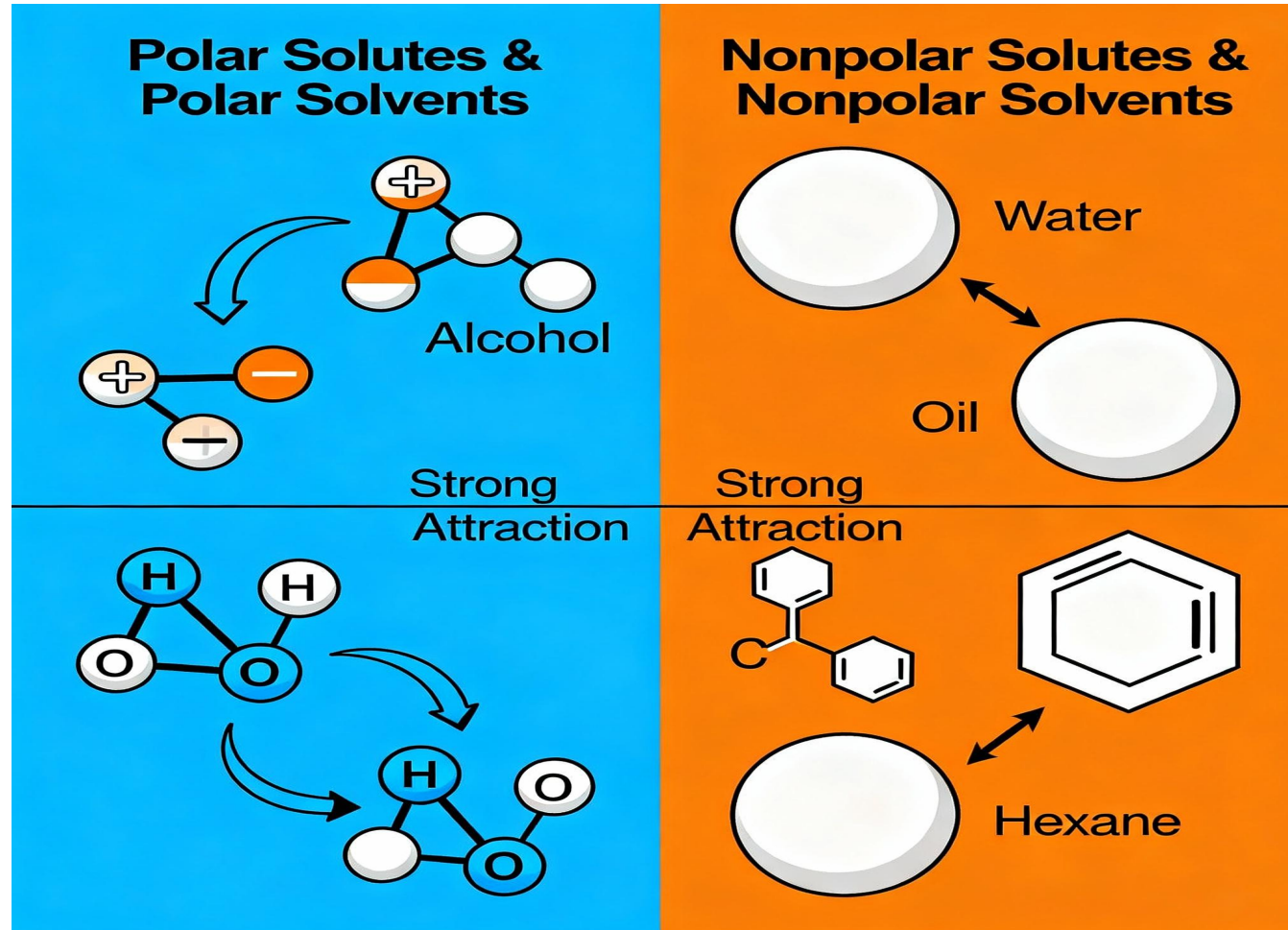
Types of Solubility Expression

Solubility Expression	Definition	Unit/Measure	Example
Molarity (M)	Moles of solute per liter of solution	mol/L	1 M NaCl = 1 mole NaCl per liter
Molality (m)	Moles of solute per kilogram of solvent	mol/kg	1 m NaCl = 1 mole NaCl per kg solvent
Mole Fraction (x)	Ratio of moles of solute to total moles	Unitless (between 0 and 1)	$x = \frac{n_{solute}}{n_{solute} + n_{solvent}}$
Percent by Weight (% w/w)	Mass of solute per 100 mass units of solution	%	5% NaCl = 5 g NaCl in 100 g solution
Percent by Volume (% v/v)	Volume of solute per 100 volume units of solution	%	10% alcohol = 10 mL alcohol in 100 mL solution

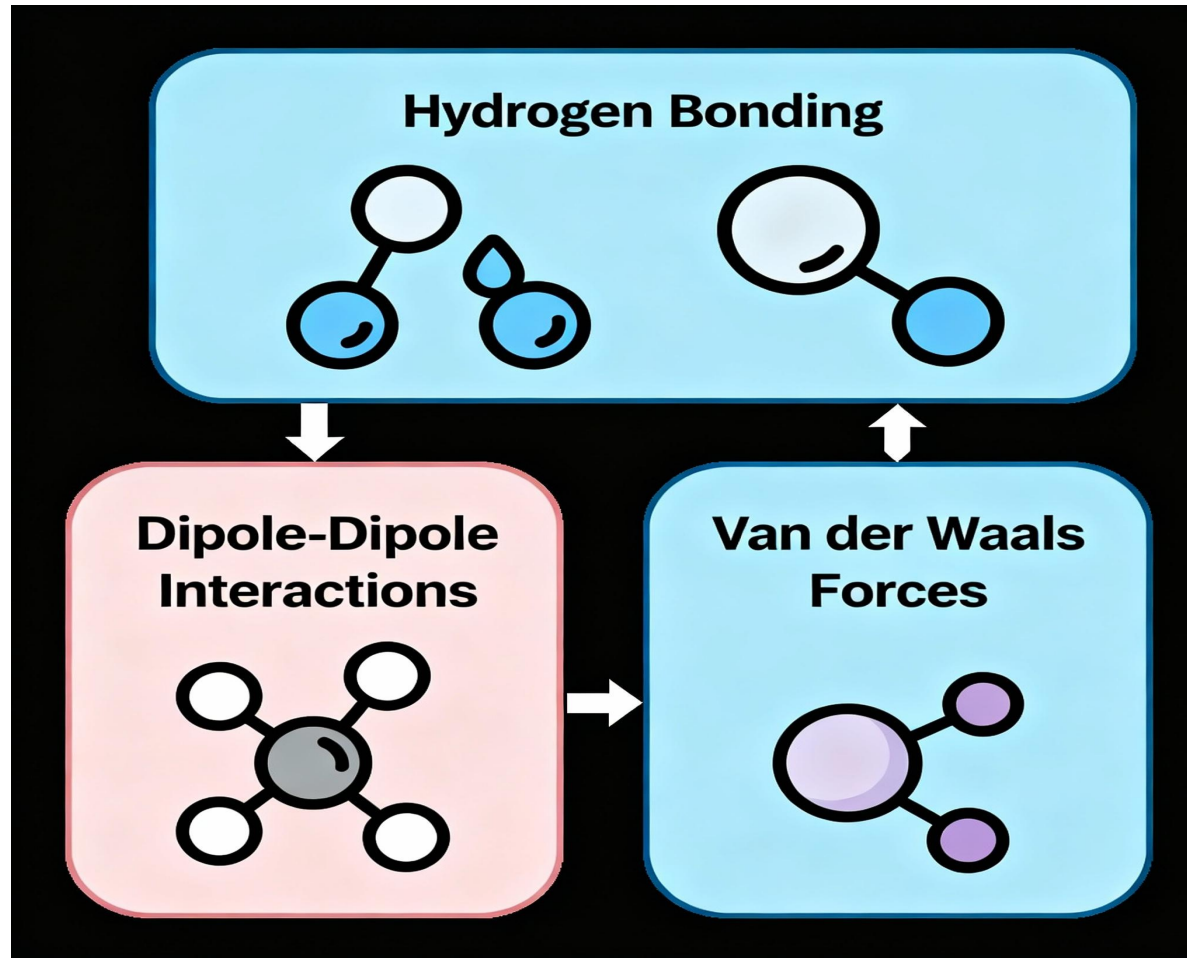
Factors Affecting Solubility



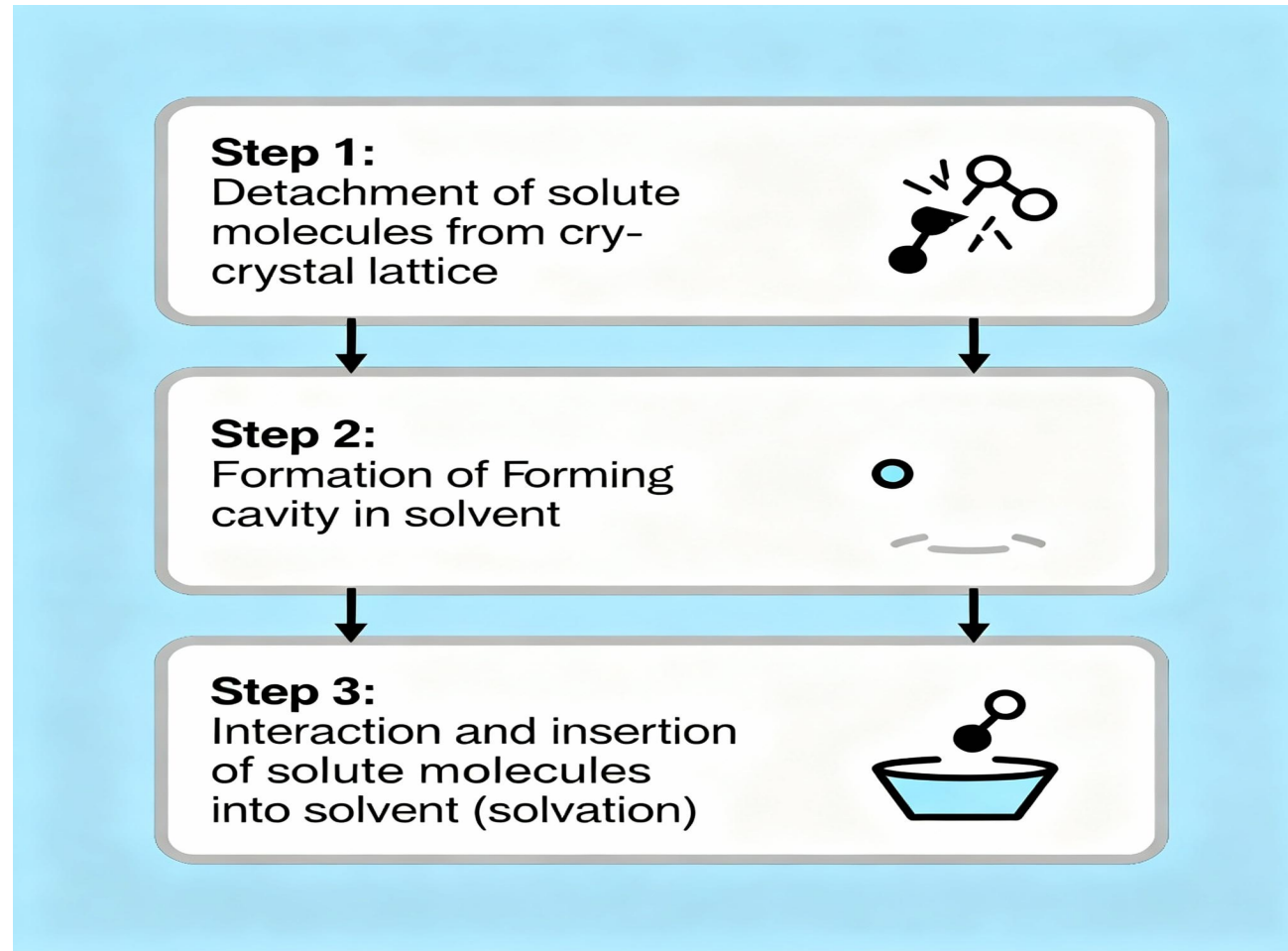
Principle of "Like Dissolves Like"



Molecular Interactions in Solubility

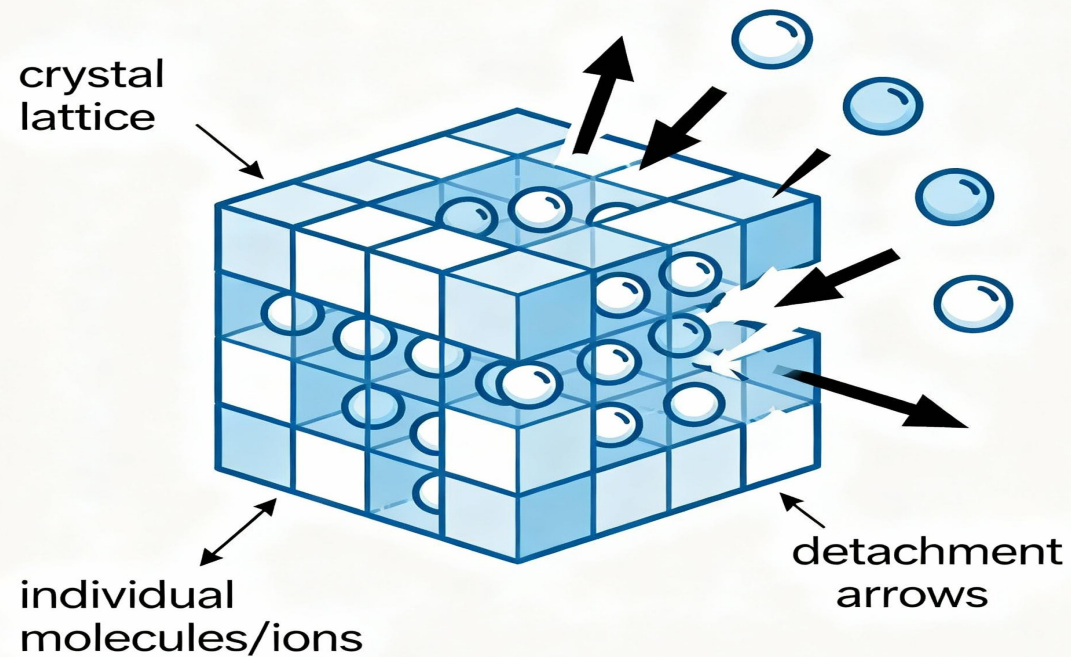


Mechanism of Solute-Solvent Interaction (Overview)

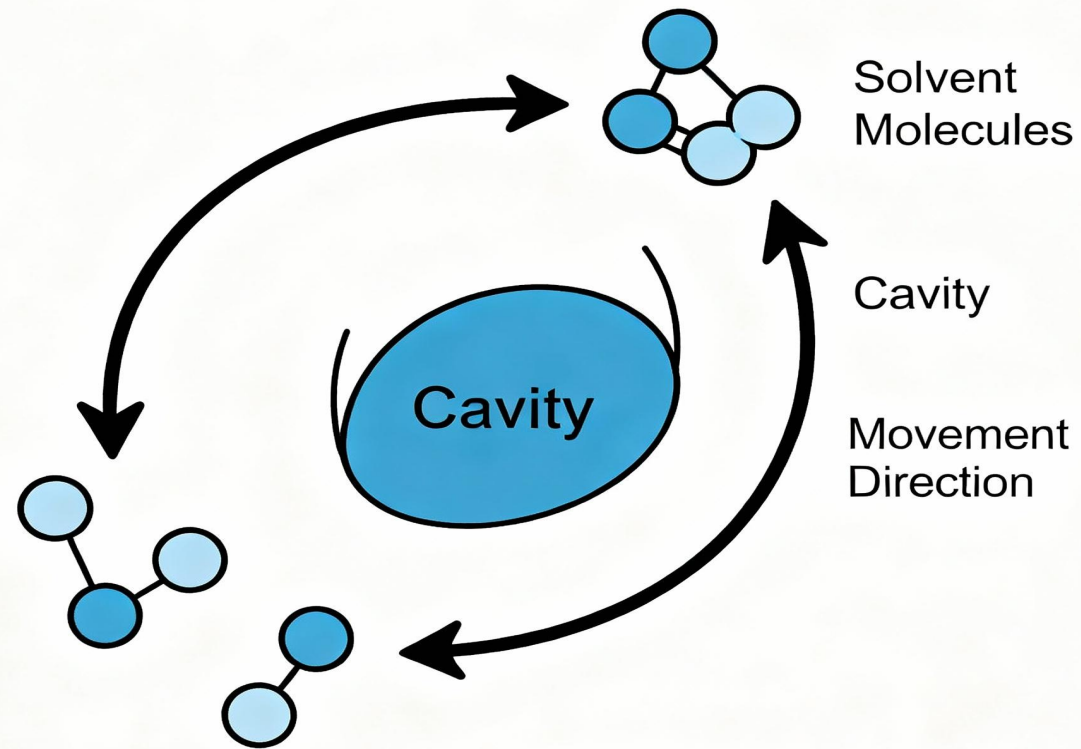


Step 1 - Detachment of Solute Molecules

Step 1: Crystal Lattice Breakdown

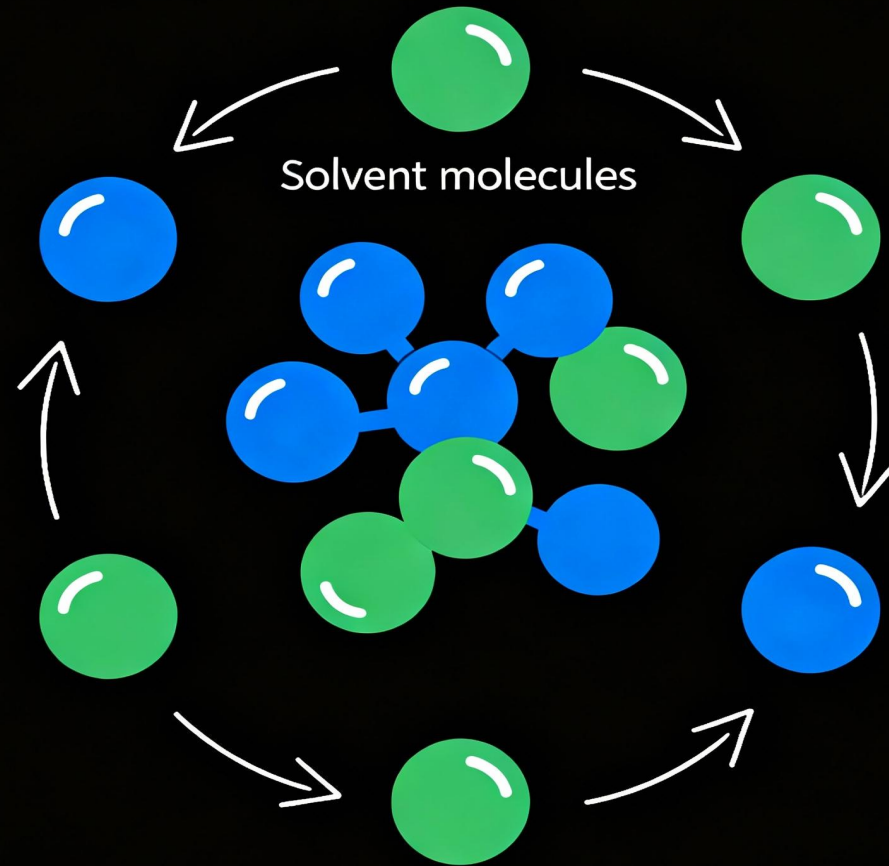


Step 2: Solvent Molecule Rearrangement



Step 3: Solute-Solvent Interaction

Solute molecules



Energy Changes During Solubility

Step	Process Description	Energy Change
Detachment of Solute	Breaking solute molecules/ions from crystal lattice	Endothermic (energy absorbed)
Formation of Cavity	Creating space in solvent molecules for solute	Endothermic (energy absorbed)
Solvation (Insertion and Interaction)	Surrounding solute with solvent molecules, forming bonds	Exothermic (energy released)

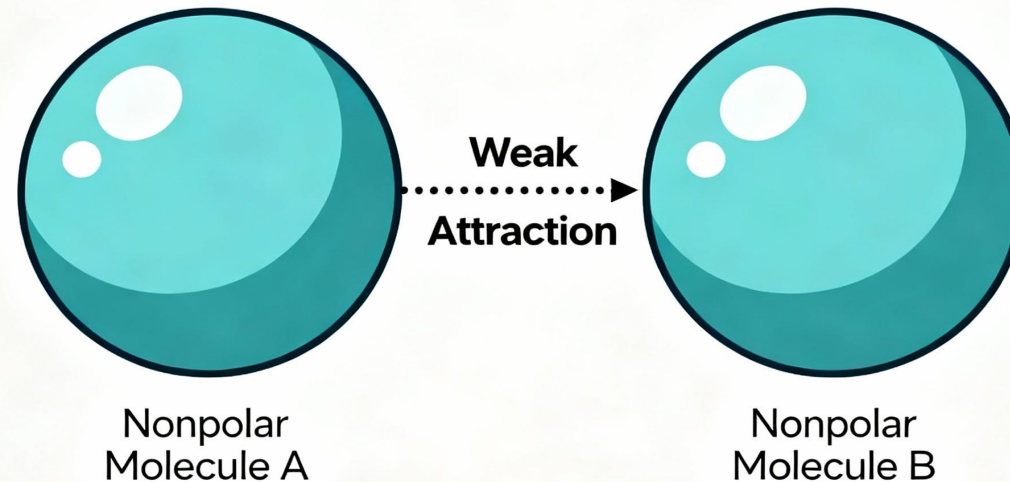
Ideal vs Real Solutions

Property	Ideal Solutions	Real Solutions
Raoult's Law Behavior	Follows Raoult's law accurately	Deviates from Raoult's law
Intermolecular Interactions	Interactions between solute-solute, solvent-solvent, solute-solvent are similar	Interactions differ in strength (weaker or stronger)
Volume Change on Mixing	No volume change (additive volumes)	Volume change occurs (contraction or expansion)
Heat of Mixing (Enthalpy Change)	Zero heat change (no heat evolved or absorbed)	Heat evolved or absorbed (exothermic or endothermic)
Solution Non-ideality	No non-ideality; ideal mixing	Non-ideal; activity coefficients differ from 1

Polar Solvent-Polar Solute Interaction

Van der Waals Forces Forces Between Nonpolar Molecules

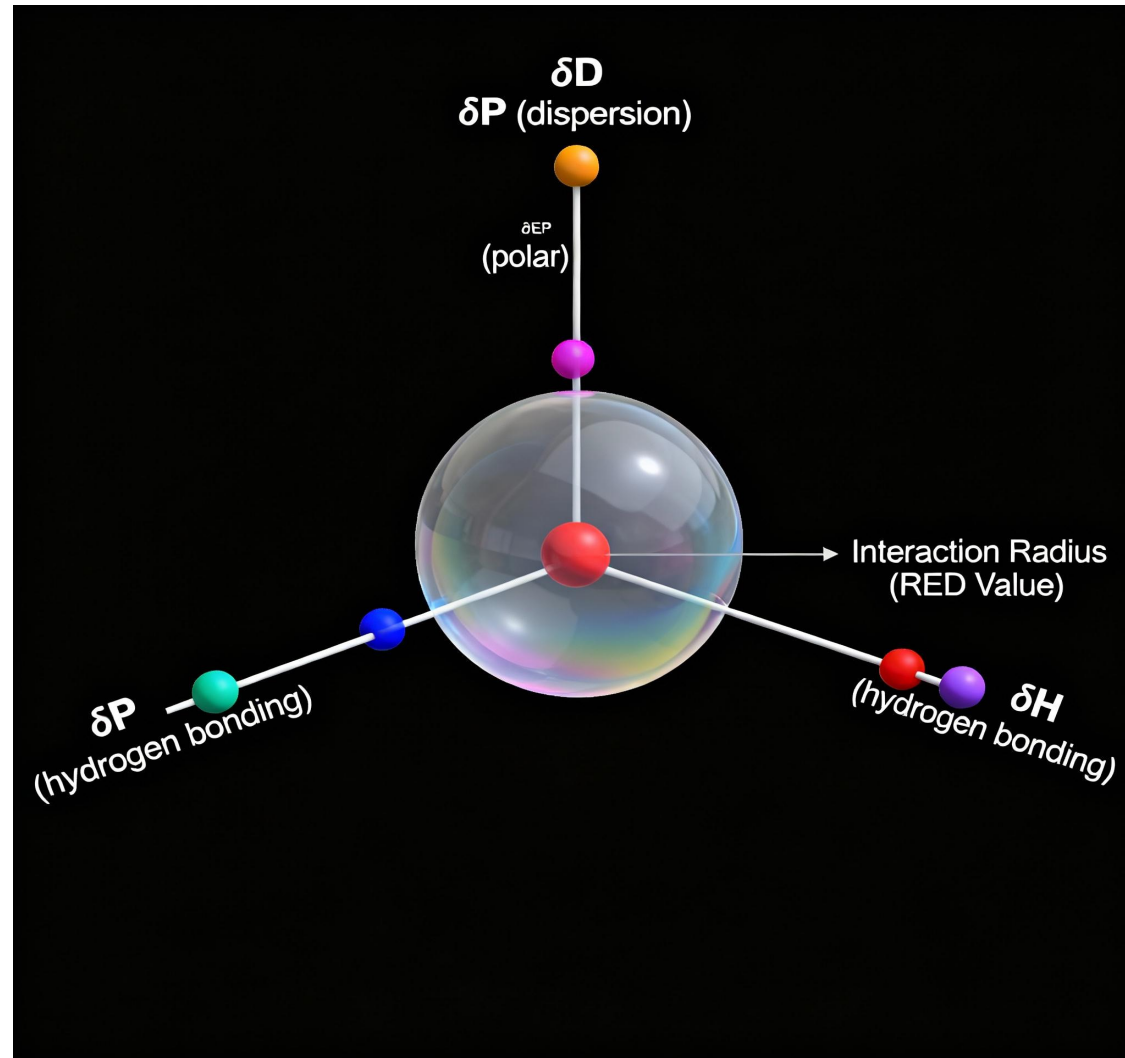
Weak Intermolecular Attractions



Solubility Parameters (Hansen Parameters)

Parameter	Description	Nature of Interaction	Energy Component
δD (Dispersion)	Dispersion forces	Nonpolar interactions	London dispersion forces
δP (Polar)	Polar interactions	Dipole-dipole interactions	Electrostatic interaction energy
δH (Hydrogen bonding)	Hydrogen bonding capability	Specific polar interactions	Hydrogen bond energy

Solubility Prediction Using Hansen Parameters



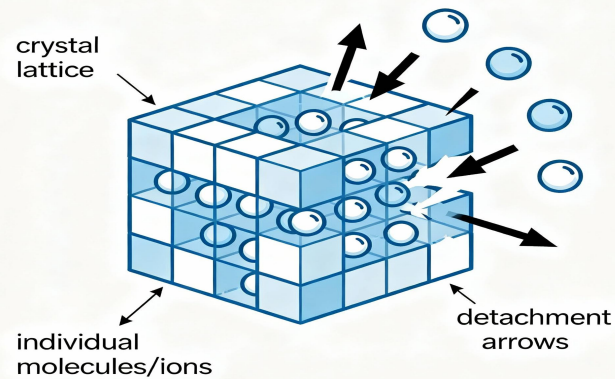
ASSESSMENTS

1. What are the three main steps in the mechanism of solute-solvent interaction?

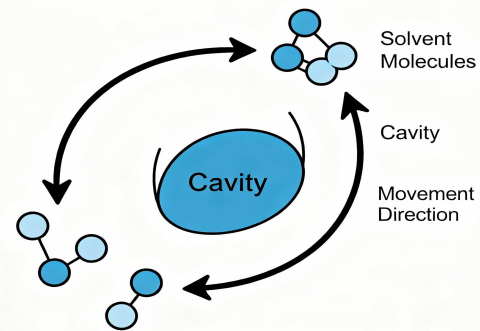


steps in the mechanism of solute-solvent interaction?

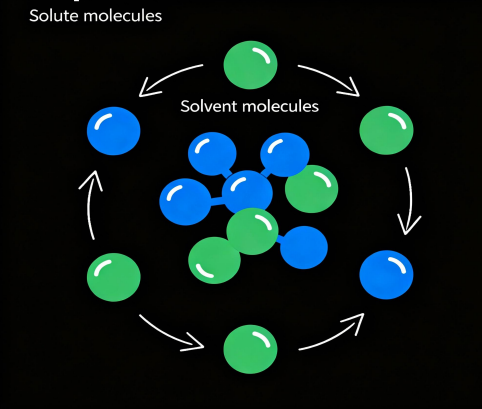
Step 1: Crystal Lattice Breakdown



Step 2: Solvent Molecule Rearrangement



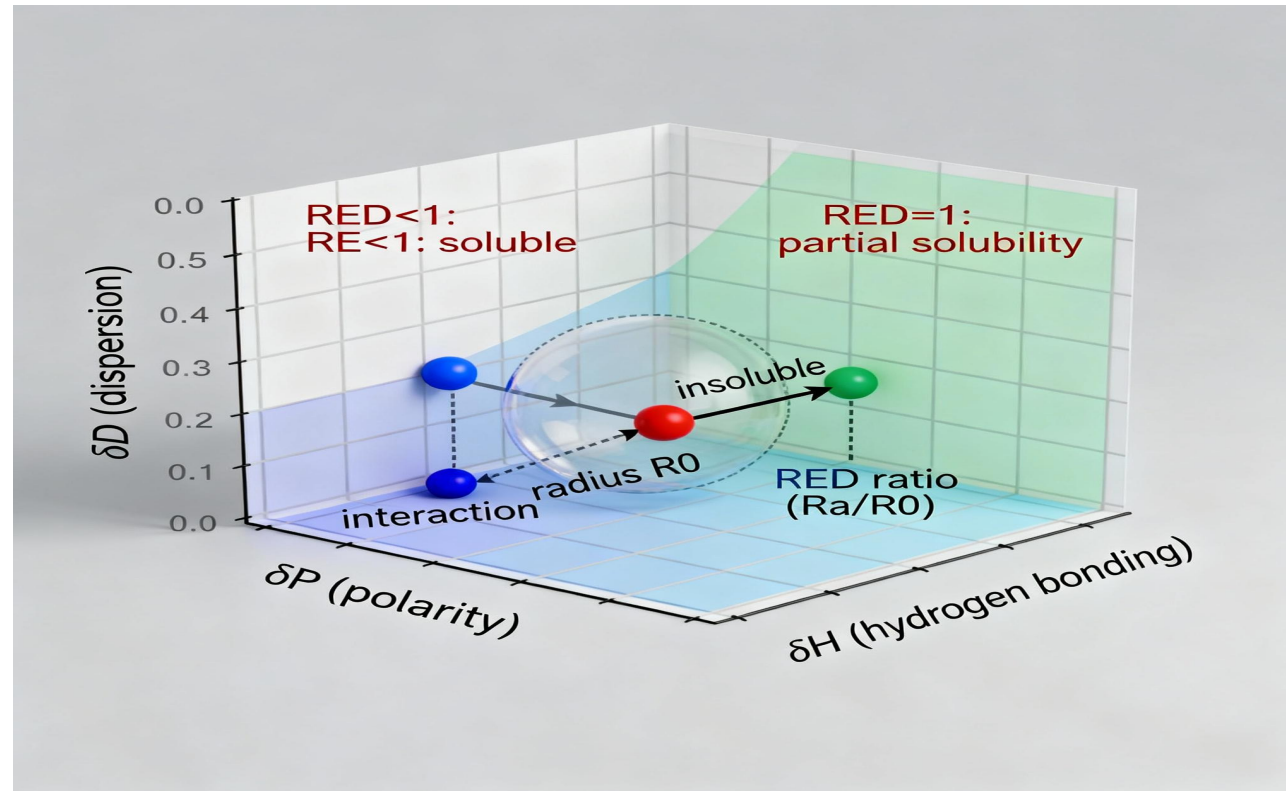
Step 3: Solute-Solvent Interaction



2.How do Hansen solubility parameters help predict the solubility of a solute in a solvent?

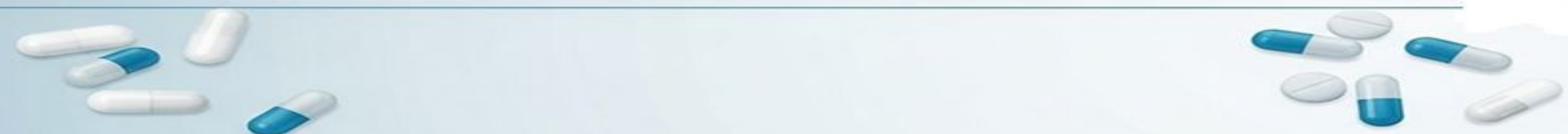


Hansen solubility parameters help predict the solubility of a solute in a solvent?



REFERENCES

- Physical Pharmaceutics textbooks and lecture notes on solubility and solution chemistry.
- Hansen, C. M. (2007). Hansen Solubility Parameters: A User's Handbook. CRC Press.
- "Solubility and Solute-Solvent Interactions," Slideshare.net, 2023-2024 presentations.
- PharmacyGuideline.com article on "Solubility Expressions and Mechanisms of Solute Solvent Interactions," 2024.



Thank You

