

Section 2: How Substances Dissolve

Preview

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- The Dissolving Process
- Surface Area

Key Ideas

- › Why is water called the universal solvent?
- › Why do substances dissolve?

Bellringer

One mixture you may be familiar with is the one formed when sugar is added to a glass of tea or lemonade. Eventually, the sugar dissolves, and the entire glass tastes sweeter than before.

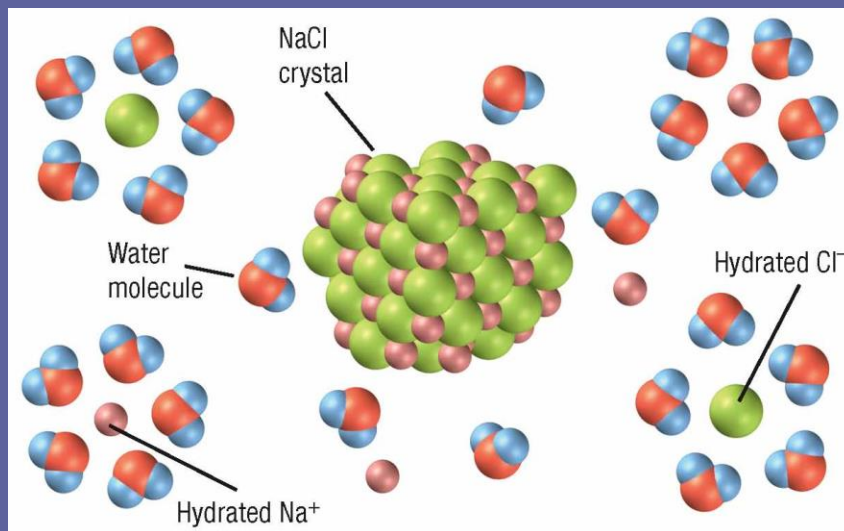
1. Does the sugar you add to the tea or lemonade dissolve faster before or after ice is added? What happens in each instance?
2. If more sugar is added to the tea or lemonade than will dissolve, what happens to the remaining undissolved sugar?
3. What can you do to help the sugar on the bottom of the glass dissolve?

Water: A Common Solvent

- › Why is water called the universal solvent?
- › Water is called the *universal solvent* because many substances can dissolve in water.
- Water can dissolve ionic compounds.
 - Water is a polar compound.
 - **polar**: describes a molecule in which the positive and negative charges are separated
 - Water molecules attract both positive ions and negative ions.

Water: A Common Solvent, *continued*

- Polar water molecules pull ionic crystals apart, as shown below.

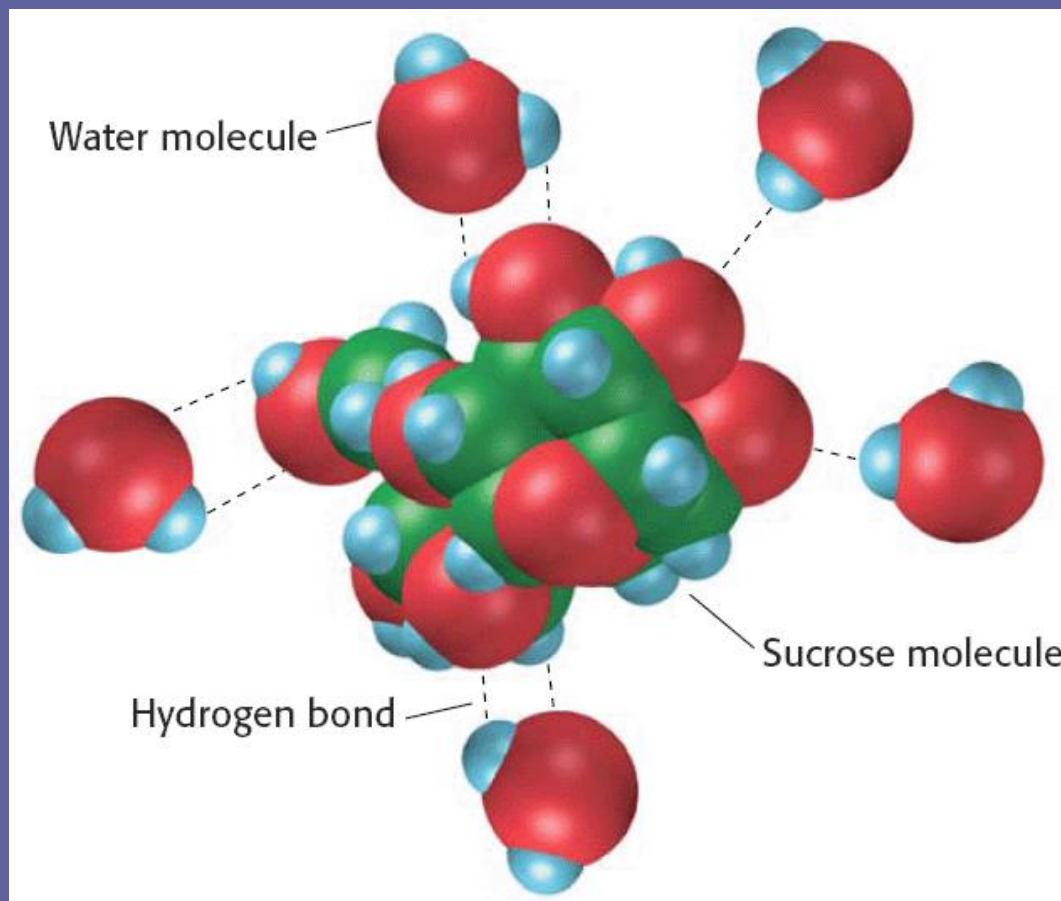


- The partially negative oxygen atoms of water molecules attract the positively charged sodium ions.
- The partially positive hydrogen atoms of water molecules attract the negatively charged chloride ions.

Water: A Common Solvent, *continued*

- Dissolving depends on the forces between particles.
 - The forces between the solvent molecules and the particles of the substances must be greater than the force between the particles in the crystal.
- Water dissolves many molecular compounds.
 - Water forms hydrogen bonds with molecular compounds such as sugar.
- **hydrogen bond:** the intermolecular force occurring when a hydrogen atom that is bonded to a highly electronegative atom of one molecule is attracted to two unshared electrons of another molecule

Hydrogen Bonding



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Preview

Main

Water: A Common Solvent, *continued*

- Like dissolves like.
 - A solvent will dissolve substances that have molecular structures that are like the solvent's structure.
- Nonpolar compounds usually will not dissolve in water.
 - **nonpolar**: describes a molecule in which the centers of positive and negative charge are not separated
 - Nonpolar solvents are used to dissolve nonpolar materials.

Visual Concept: Like Dissolves Like



Oil and water	Water and rubbing alcohol	Oil and dry cleaning fluid
	Water molecule, H_2O	Tetrachloroethylene, C_2Cl_4
	Alcohol molecule, $\text{C}_3\text{H}_7\text{OH}$	Oil

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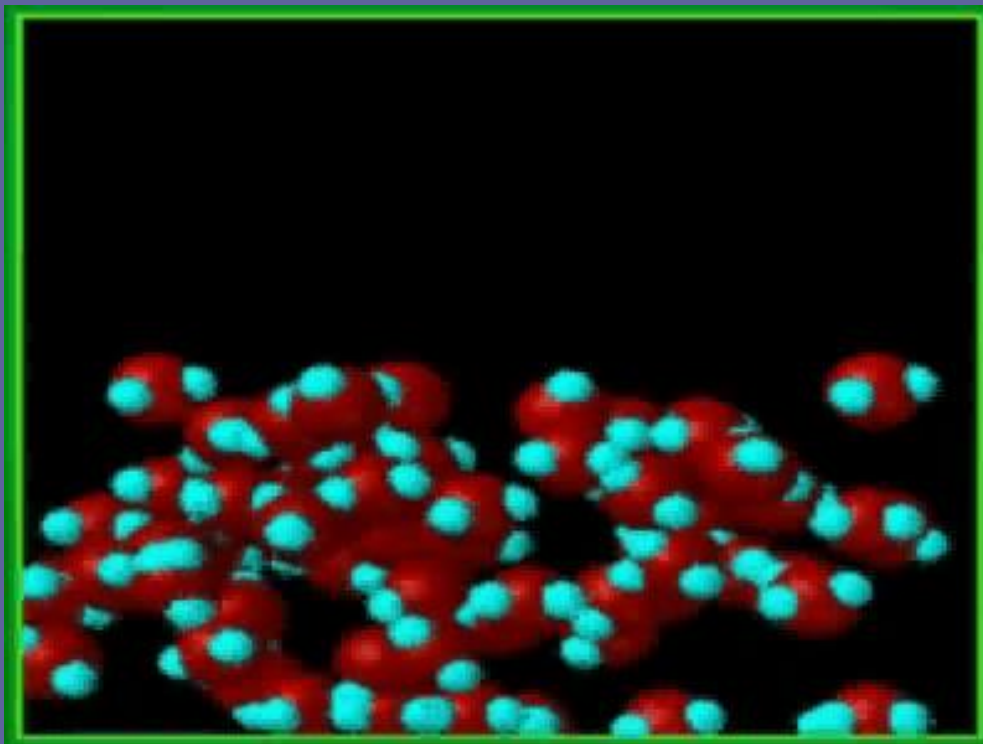
Preview

Main

The Dissolving Process

- › Why do substances dissolve?
- › The energy transferred from the solvent to the solute, as well as the attractive forces between the solvent and solute molecules, causes molecules at the surface of the crystal to dissolve.

Dissolving Process



The Dissolving Process, *continued*

- Solutes with a larger surface area dissolve faster.
 - More solute particles are exposed to the solvent.
- Stirring or shaking a solution helps the solute dissolve faster.
 - Dissolved solute particles diffuse throughout the solution faster.
 - More solute particles can dissolve.
- Solutes dissolve faster when the solvent is hot.
 - Collisions occur between solute and solvent particles more frequently and with more energy.

Surface Area

This salt crystal has a much smaller surface area than its total volume.



Visual Concept: Factors Affecting the Rate of Dissolution



The Dissolving Process, *continued*

- Solutes affect the physical properties of a solution.
 - Solutes increase the boiling point of a solution.
 - If you dissolve salt in water, it will boil at a higher temperature.
 - Solutes lower the freezing point of a solution.
 - The coolant mixture of ethylene glycol and water keeps a car's radiator fluid from freezing in winter.