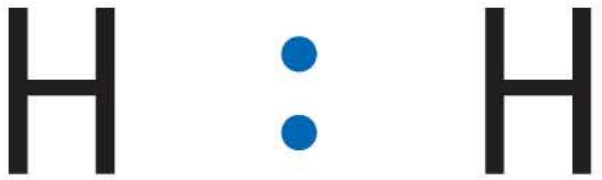
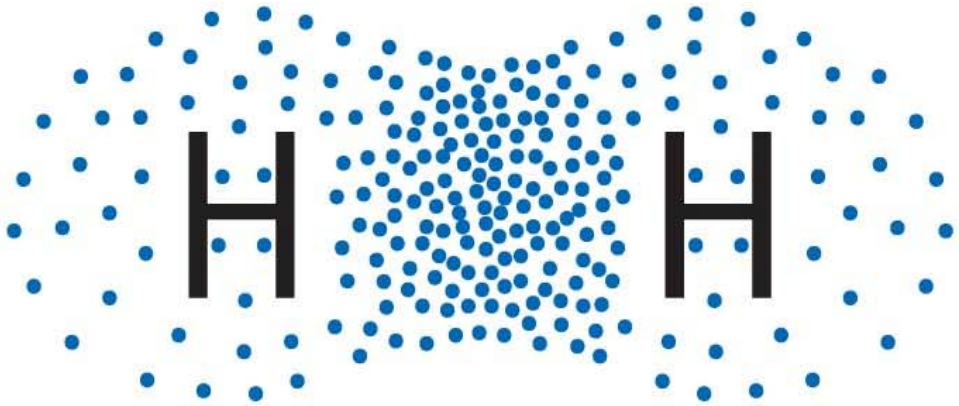
Covalent Bonds
Solutions, Mixtures

Chapter 15-16

Nonpolar Covalent Bonds

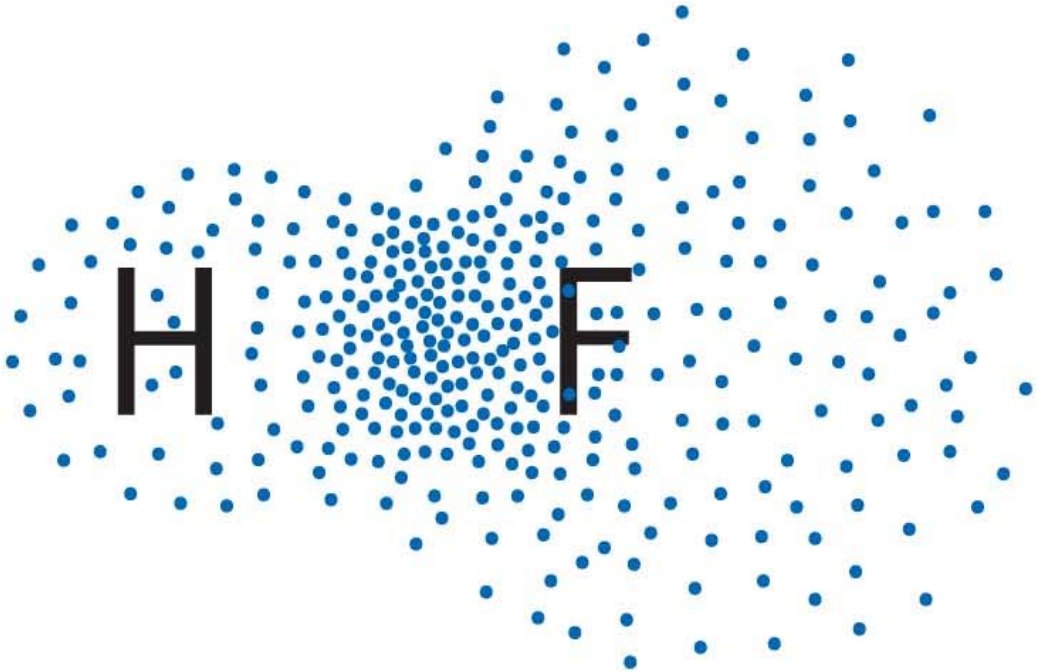
- Electrons are shared evenly when the two atoms are the same element





Polar Covalent Bonds

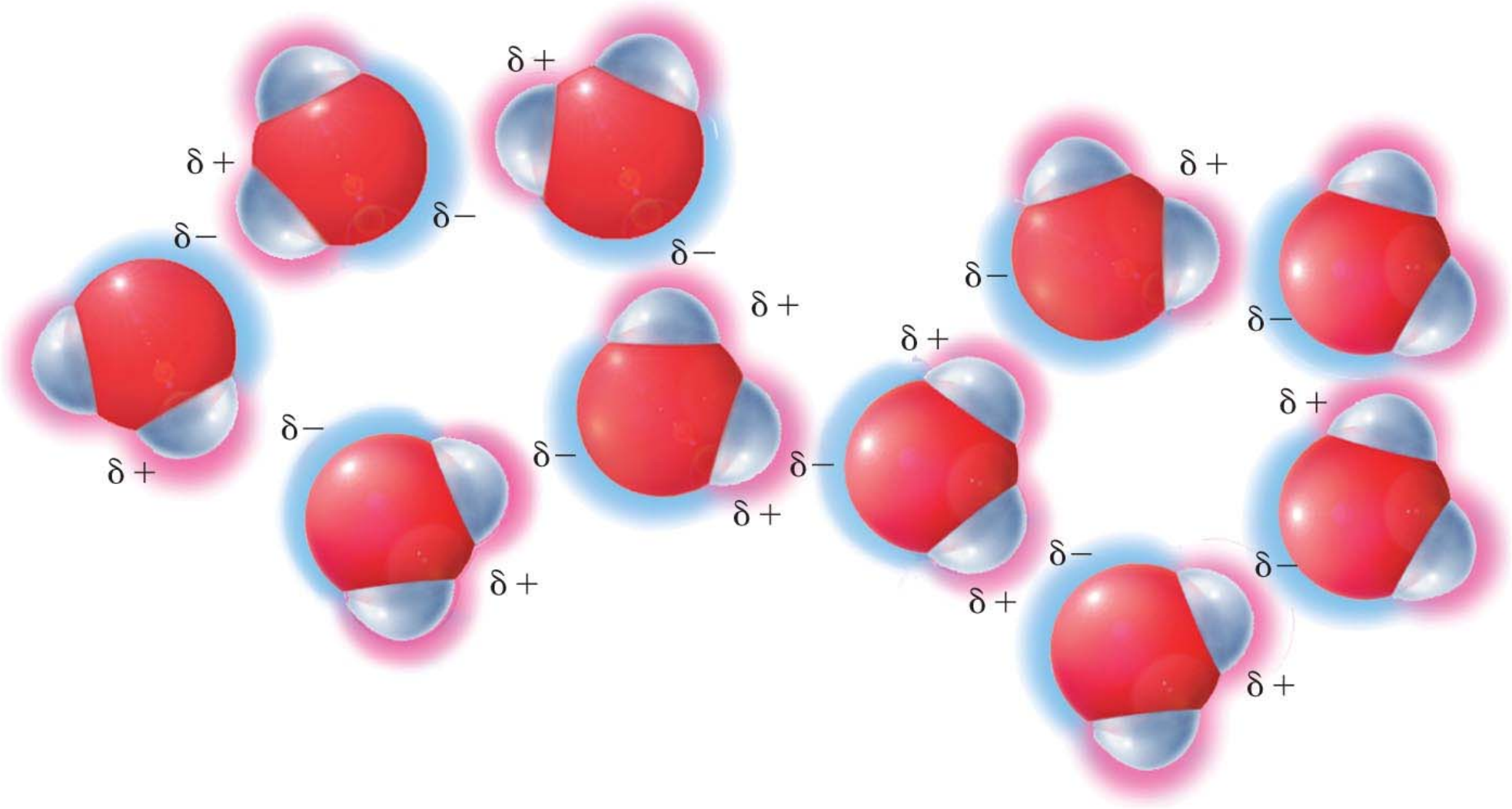
- Shared *unevenly* when the bonded atoms are different elements



Polarity of covalent bonds

- Closer together on the periodic table, less polar bond
- Further apart on the periodic table, more polar bond
- Molecules are called ‘dipoles’
- Ionic bonds are extremely polar—beyond covalent

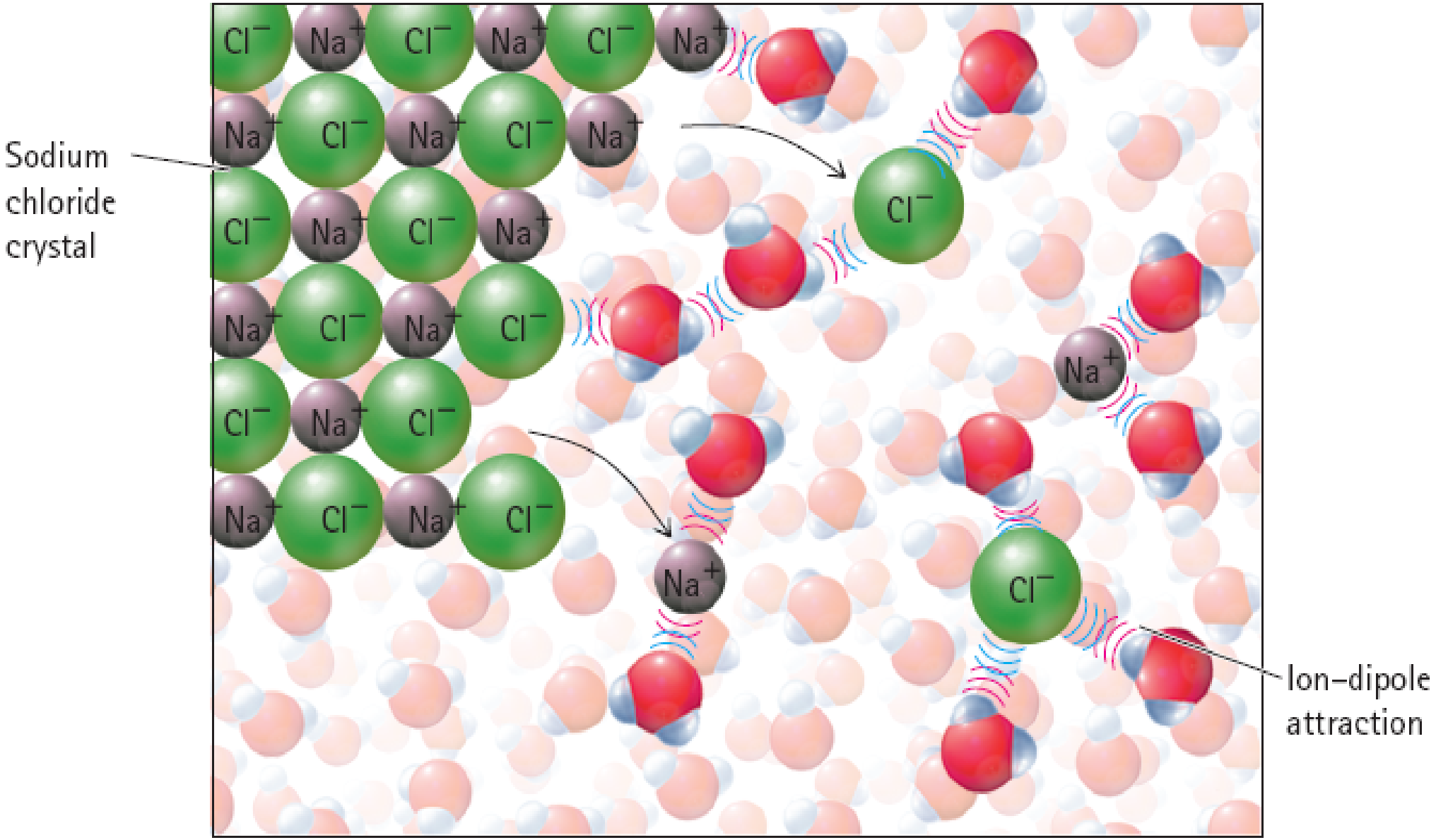
Molecular Polarity



Molecular Attractions

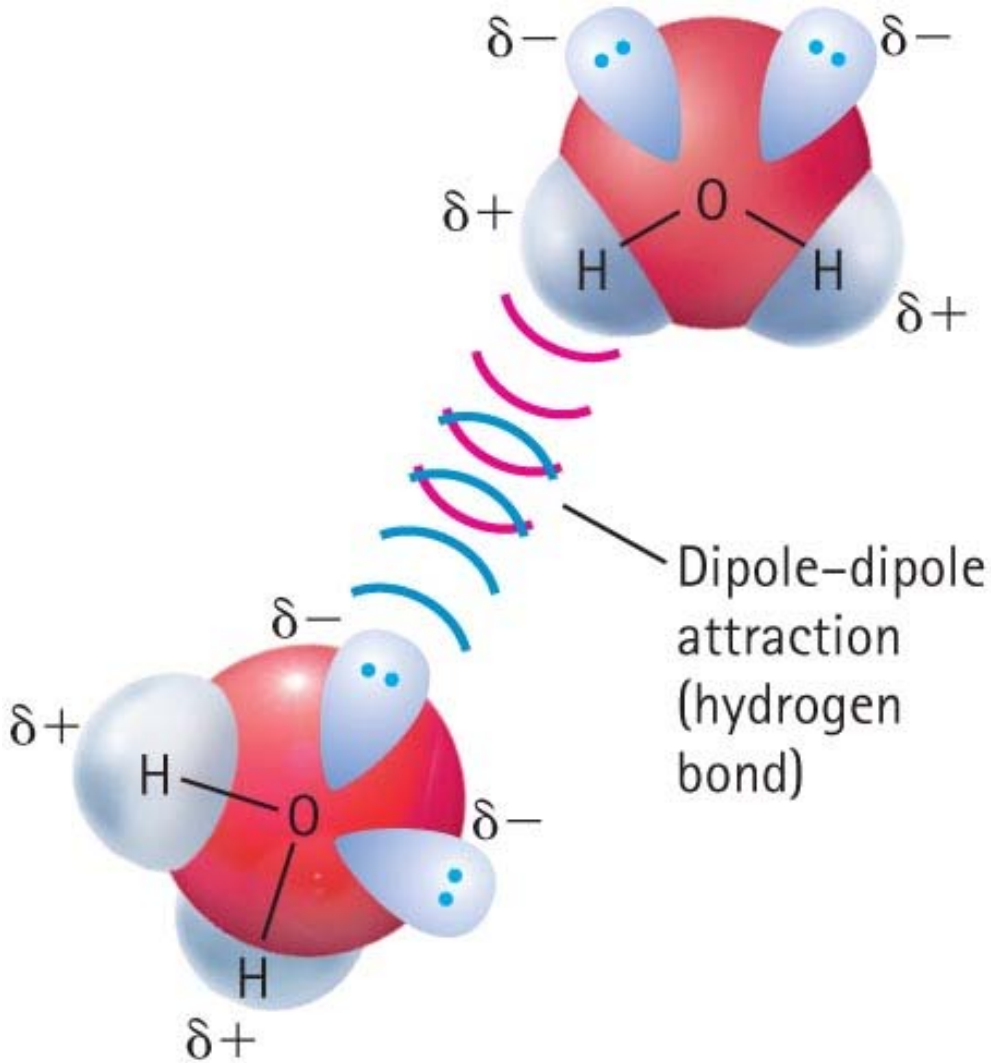
- Electrical attractions between molecules that does not result in bonding
  - Ions
  - Polar molecules
  - Non-polar molecules

- Water and salt
  - Ions of NaCl attract dipole of water

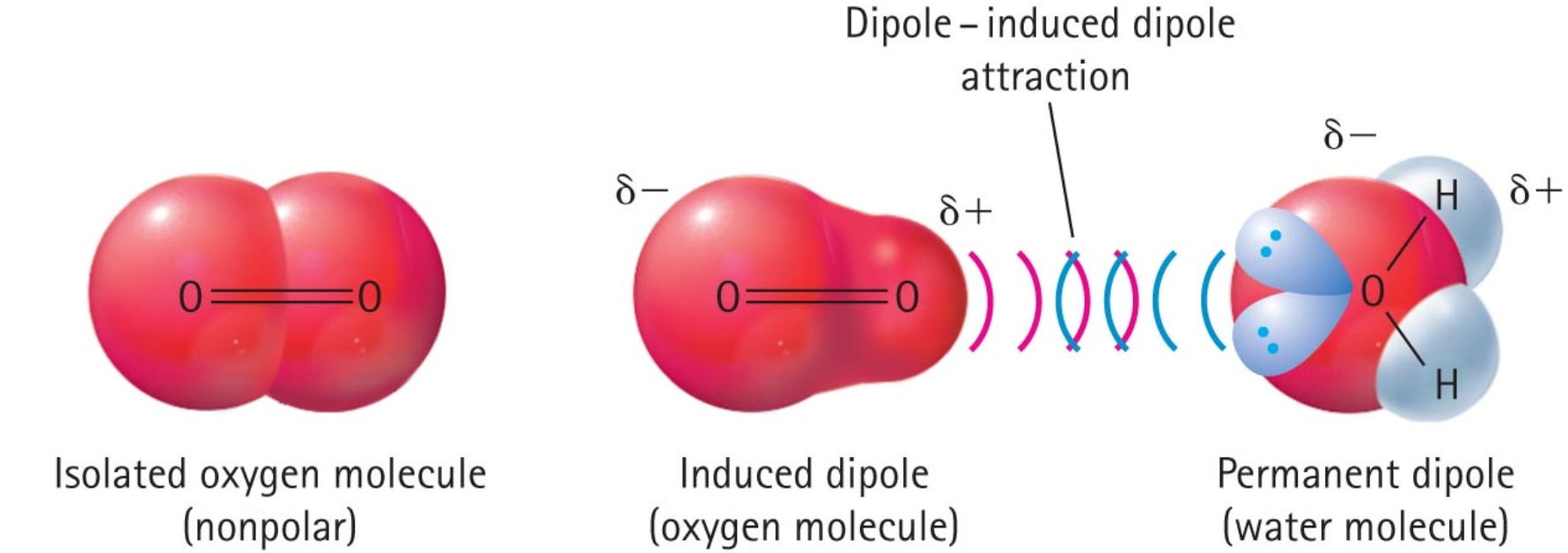


Aqueous solution of sodium chloride

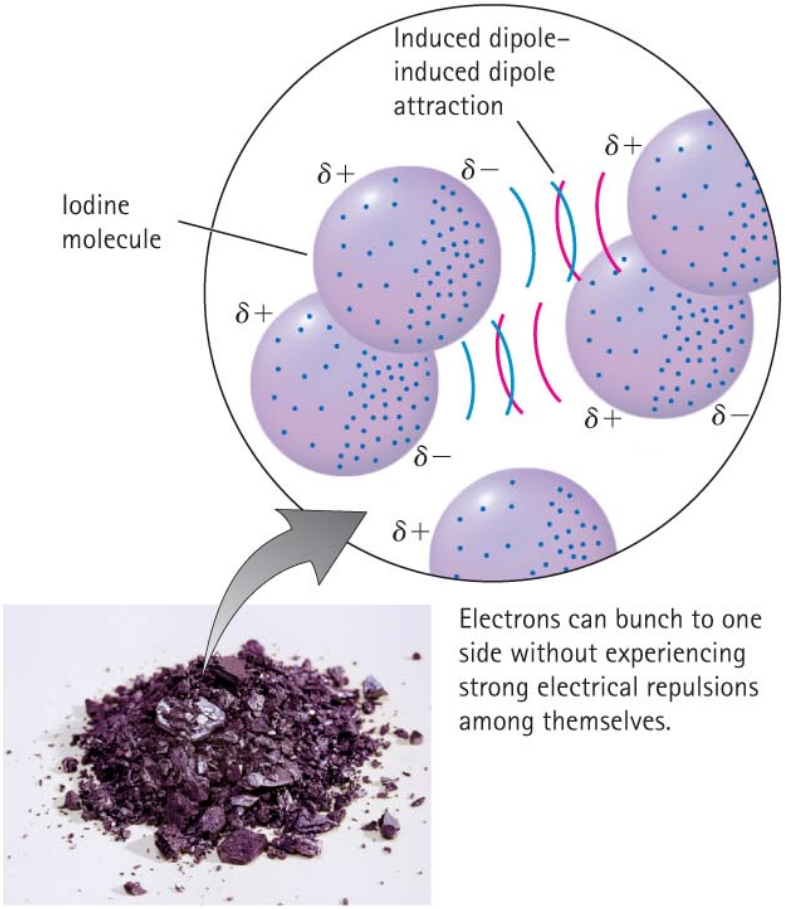
- Water and … water
  - Dipoles of water attract one another



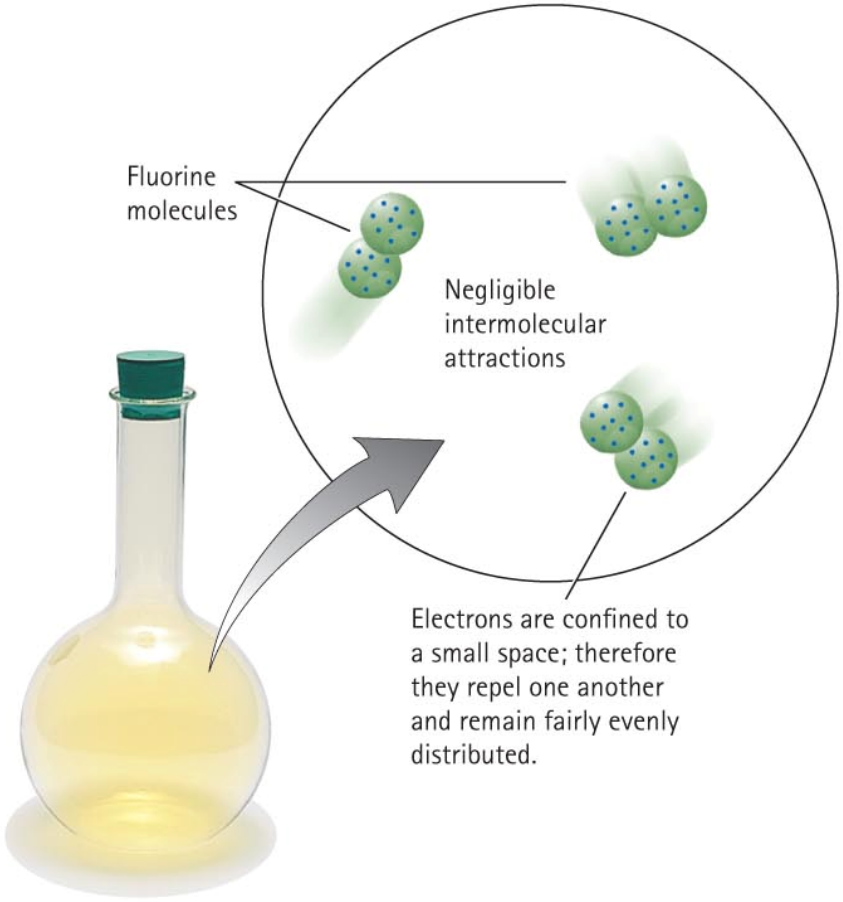
Some non-polar molecules can be distorted into dipoles by polar molecules--Oxygen and water



Molecules can develop induced dipoles especially if they are large

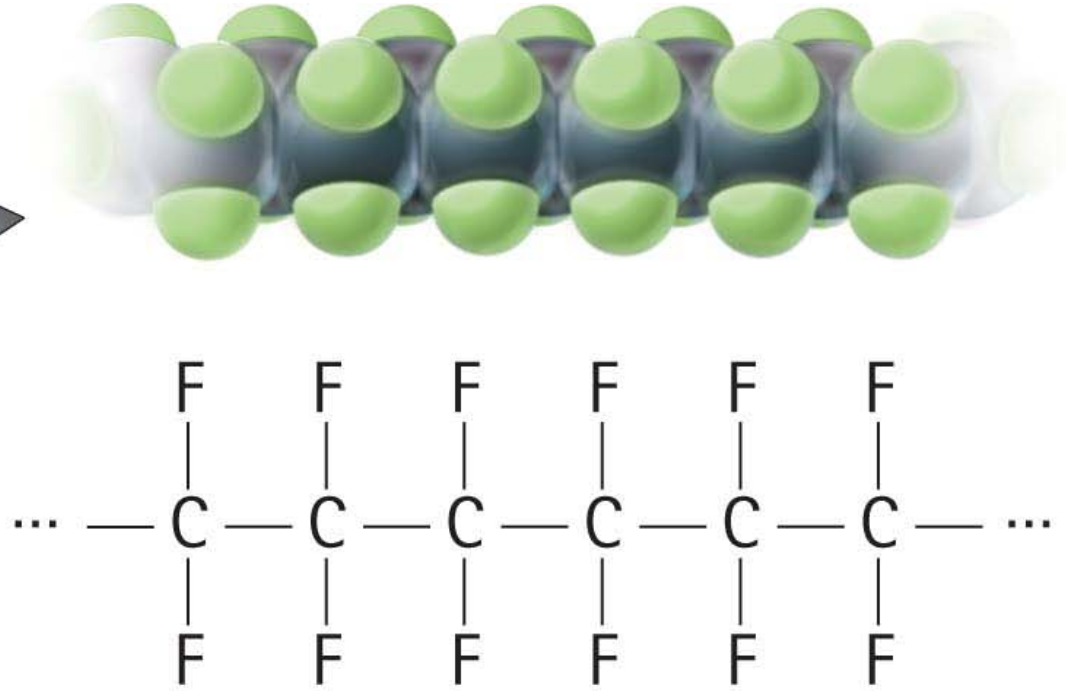


(a) Iodine, I_2, a solid at room temperature



(b) Fluorine, F_2, a gas at room temperature

Teflon is nonstick



- Because the teflon molecules are non-polar and don't readily become induced dipoles, few things stick to teflon

Pure Substance

- A material consisting of only one type of element or compound
  - Element: not bonded to another type of atom
  - Compound: more than one type of atom bonded together
    - Ionic bonding
    - Metallic bonding
    - Covalent bonding

Mixture

- A collection of two or more pure substance that can be separated by physical means
  - Homogeneous: all samples of the mixture have the same ratio of components
  - Heterogeneous: different components can be seen as individual substances
- Most materials are mixtures

Granite

"Snow" in snow globe

Pizza

(a) Heterogeneous mixtures

Air

Clear seawater

White gold

Homogeneous Mixtures

- Composition is the same throughout
- Solution: all components are in the same phase (which may be any phase)
- Suspension: there are different phases present

Solutions

A homogeneous mixture consisting of ions or molecules

- Solvent—the major component
- Solute—the minor components
- ‘Saturated’—no more solute will dissolve in the solvent

Polarity and solubility

- If solvent and solute have similar polarity, there is solubility
- If the solvent and solute have different polarity, low solubility

Concentration of Solution

- The amount of solute in solution

$$\text{Concentration} = \frac{\text{Solute}}{\text{Solution}}$$

- Measured in
  - Grams per liter
  - Parts per million ppm
  - # of molecules per liter: M molar concentration

Parts per million

- Milligrams of solute per liter of solution

$$1\ \text{ppm} = \frac{1\ \text{part solute}}{1{,}000{,}000\ \text{parts solution}} = \frac{1\ \text{milligram solute}}{1\ \text{liter solution}}$$

Number of Molecules

- 602,214,150,000,000,000,000,000
- 602 billion trillion
- 6.02×10^{23}
- A ‘mole’ of molecules

Mole of atoms

- 6.02×10^{23}
- Atomic mass is
  - number of atomic mass units of an atom
  - number of grams of a mole of atoms
- Or molecular mass of a molecule is number of grams of molecules

Formula Mass

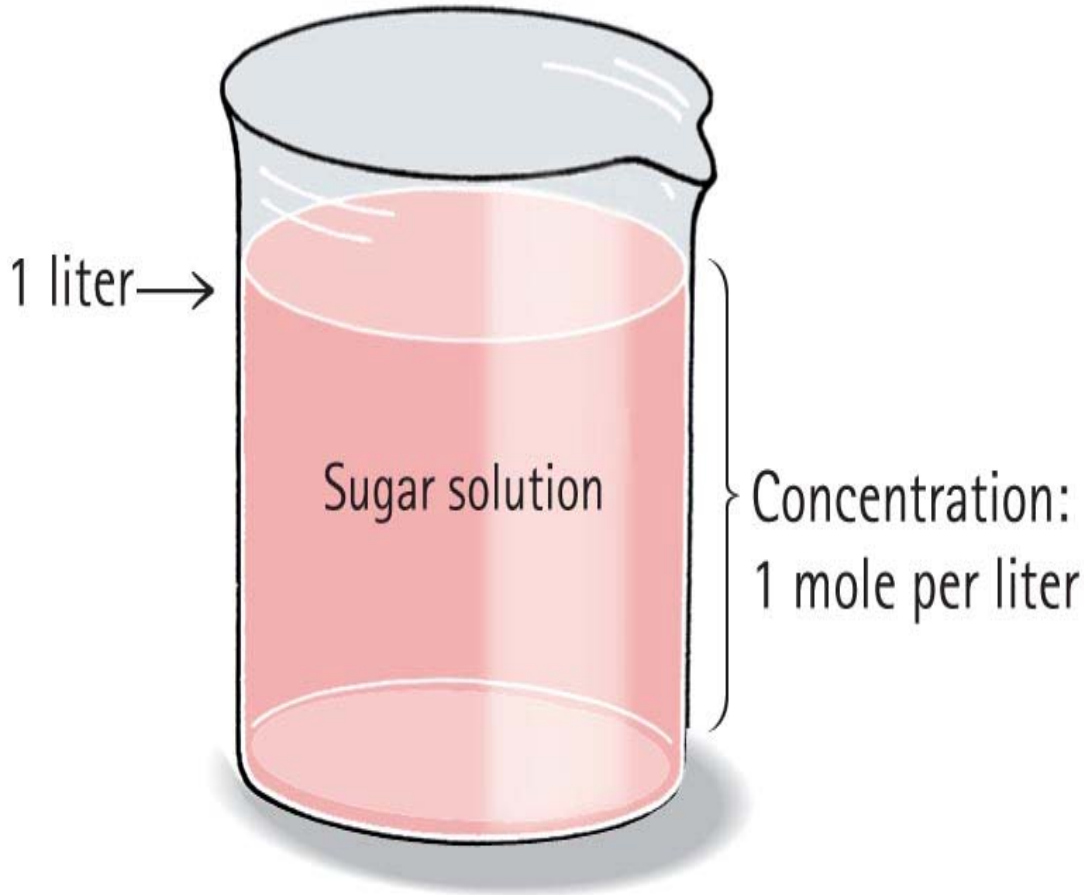
- Mass of a mole of atoms or molecules

Carbon, C	12
Oxygen, O_2	32
Carbon dioxide, CO_2	44
Sucrose, $C_{12}H_{22}O_{11}$	342

- We will use the formula mass of substances

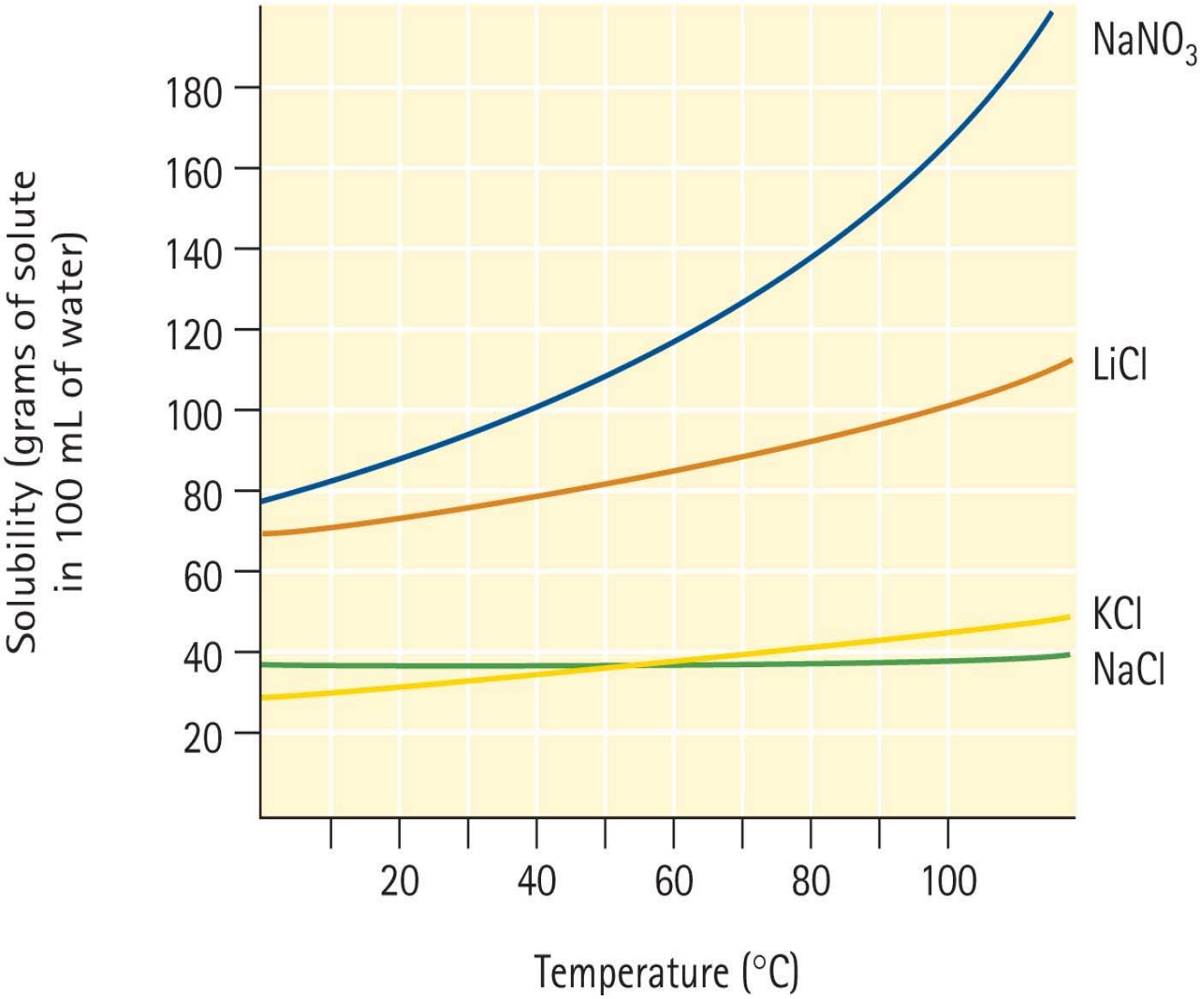
Molarity

- Moles of solute per liter of solution
- 1 M sucrose solution



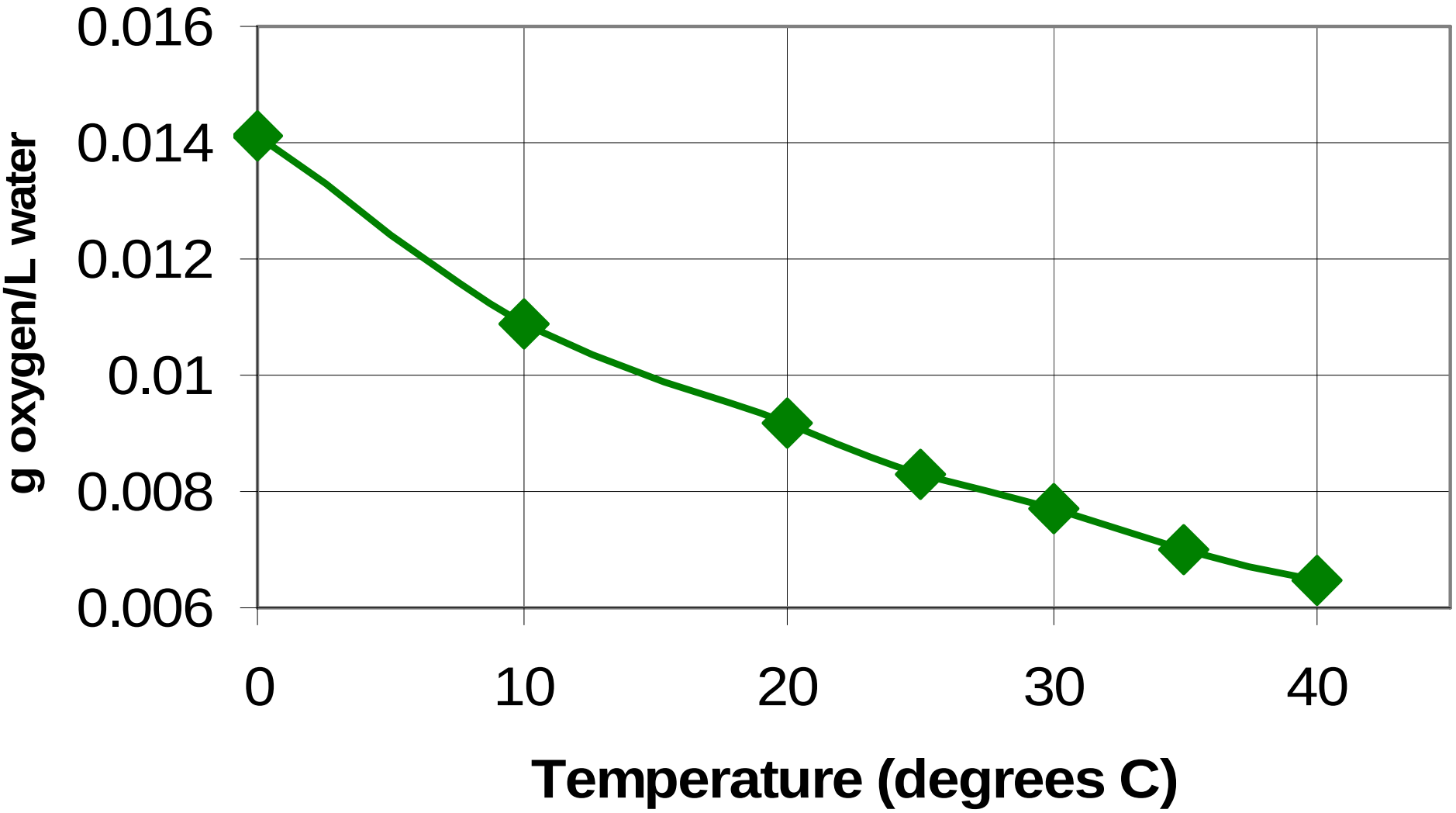
1 mole of sucrose
equals
342 grams of sucrose
equals
6.02×10^{23} molecules of sucrose

Solubility



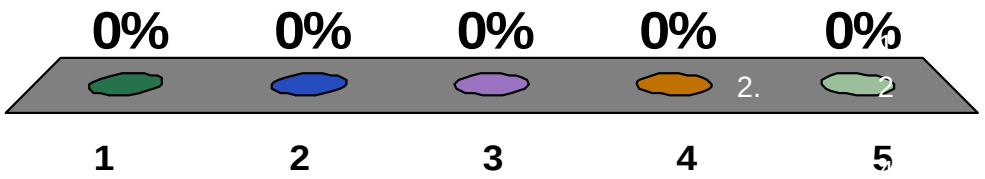
- Ability of solute to dissolve in a solvent
- Often temperature dependent

Oxygen Solubility



What volume of solution would be needed to make a 0.5 M NaOH solution using 0.5 moles of the compound?

1. 250 mL
2. 500 mL
3. 750 mL
4. 1000 mL
5. 2500 mL



Solubility factors

- Temperature of substances
- Types of molecules
  - Polar molecules are soluble in polar solvents
  - Nonpolar molecules are soluble in nonpolar solvents
- Acidity of solvent, especially for polar molecules

Insoluble

- Does not dissolve to any appreciable extent in the solvent
- Salt is insoluble in oil
- Salt is soluble in water