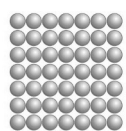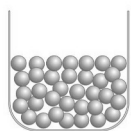## State of Matter and Bonding
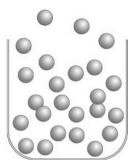
Solid
The molecules that make up a solid are arranged in regular, repeating patterns. They are held firmly in place but can vibrate within a limited area.
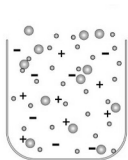
Liquid
The molecules that make up a liquid flow easily around one another. They are kept from flying apart by attractive forces between them. Liquids assume the shape of their containers.

Gas
The molecules that make up a gas fly in all directions at great speeds. They are so far apart that the attractive forces between them are insignificant.
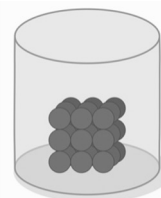
Plasma
At the very high temperatures of stars, atoms lose their electrons. The mixture of electrons and nuclei that results is the plasma state of matter.
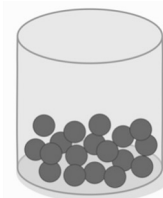
2

State of Matter and Polarity

SOLID LIQUID GAS

Ionic Compounds
Strong opposite charge strong connections

Polar Molecules
Ion like connections, all molecules to attract

Non-Polar Molecules
Little to no attraction, molecules stay apart

3

Valence Shell Electron Pair Repulsion

VSEPR Theory – Molecules take shape based on e⁻ pair repulsion

number and arrangement of electron pairs	molecular shapes			number and arrangement of electron pairs	molecular shapes		
2	linear	linear		5	trigonal bipyramidal	trigonal bipyramidal	seesaw	T-shaped
3	trigonal planar	trigonal planar	angular	6	octahedral	octahedral	square pyramidal	square planar
4	tetrahedral	tetrahedral	trigonal pyramidal	angular				

4

Polarity and Molecular Shape
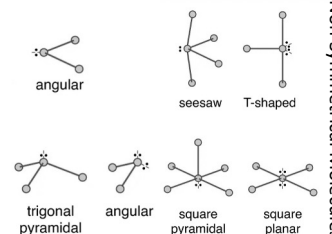
For a molecule to be polar the following must be true

One or More Polar Bonds

Electronegativity Difference (*ED*)

$$ED = E_{higher} - E_{lower}$$

Ionic Bond
Transfer of Electrons
ED > 1.4 (*w/metal*)

Polar Covalent Bond
Unequal Sharing of Electrons
ED < 1.4 & > 0.50

Non-Polar Covalent Bond
Equal Sharing of Electrons
ED ≤ 0.50

Electronegativity Difference

Molecule is *not* symmetrical

angular   seesaw   T-shaped

trigonal pyramidal   angular   square pyramidal   square planar

Non-Symmetrical Molecules

5

Mixing Substance – Solutions & Mixtures

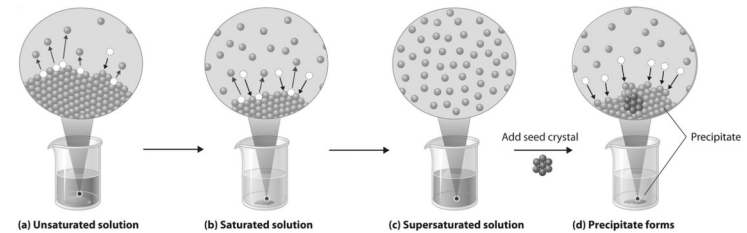| Solution	Mixture
A combination of two substances where one substance dissolves completely in the other. The solution is said the be "*homogenous*" (*one phase*)	A combination of two substances where the two substances mix, but do not dissolve. The solution is said the be "*heterogenous*" (*Mult. phase*) since the substances don't dissolve

Phase
A form that matter takes in a substance. A *single phase* refers to one or more substances that dissolve completely into each other. *Multiple phases* refer to two substances that don't dissolve / can be separated.
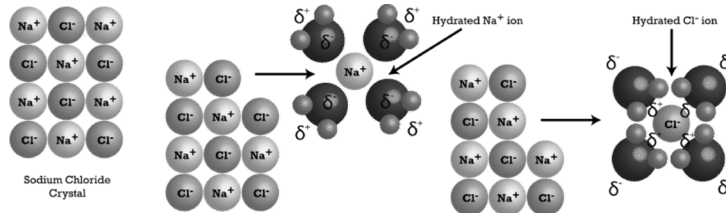
6

The solvation (*making solution*) process

(a) Unsaturated solution (b) Saturated solution (c) Supersaturated solution (d) Precipitate forms

A **solute** (*smaller part of mixture*) is added to the **solvent** (*larger part*) which starts **unsaturated** (*starts to dissolve*), then eventually becomes **saturated** (*maximum solute that can dissolve*).
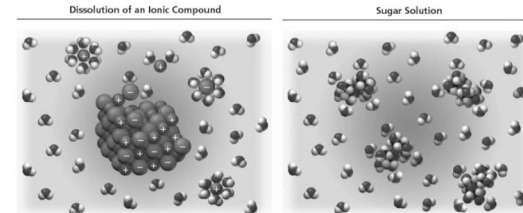
7

Ionic Compound Polar Molecule Solvation

An **ionic compound** dissolves in water because water is a **polar molecule**. The **+ end** of the water attracts the **– anion** of the salt, while to **– end** of the water attracts the **+ cation** dissolving the salt.
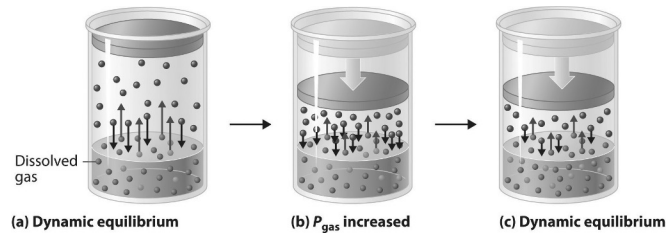
8

Ionic Compound vs Polar Non-Polar State

An **ionic compound** dissolves in water due to the *separation of ions*. **Polar molecules** dissolve due to the *partial + and – ends* attaching to water. **Non-Polar molecules** have limited interaction with water.

9

Dissolving Non-Polar gases in water

Dissolved gas

(a) Dynamic equilibrium   (b) P_{gas} increased   (c) Dynamic equilibrium

Non-Polar Gas Molecules can dissolve in water. Under **low pressure** a small amount of molecules naturally mix with water. Under **high pressure** more gas is forced between water molecules and dissolve.

10

States of Matter and Solutions *Key Terms*

Solids
State of matter with particles that are compressed together with strong connections between atoms

Liquid
State of matter with particles that break and reform bonds bet. atoms

Gas
State of matter with particles that have little attraction with others

Solution
Combination of two substances in a single form (*can't see indiv parts*)

Solute
Part of a solution in the smallest amount (*added to solvent*)

Solvent
Part of a solution in the largest amount (*added to solute*)

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