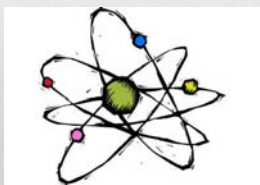


SBI4U BIOCHEMISTRY

Atoms, Bonding &
Molecular Polarity



Adapted from <http://sciencereview.com/biochemistry-unit-1-course-info.html>

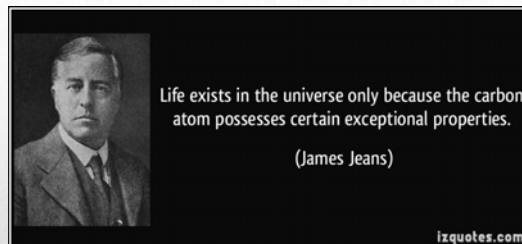


Chemistry Review

6 types of atoms make up 99% of all living organisms

Naturally Occurring Elements in the Human Body

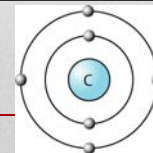
Element	Symbol	Atomic #	% of human body weight
Oxygen	O	8	65.0
Carbon	C	6	18.5
Hydrogen	H	1	9.5
Nitrogen	N	7	3.3
Calcium	Ca	20	1.5
Phosphorus	P	15	1.0
Potassium	K	19	0.4
Sulfur	S	16	0.3
Sodium	Na	11	0.2
Chlorine	Cl	17	0.2
Magnesium	Mg	12	0.1



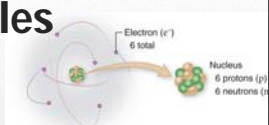
(James Jeans)

ixquotes.com

Why so special?



Subatomic Particles



The element **carbon** - 6th element in the periodic table

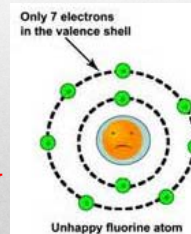
6	Atomic Number = # of protons = # electrons
C	Symbol
Carbon	
12.011	Mass Number = protons + neutrons

Why are electrons so important?

- The **chemical behavior** of an atom is determined by its **electron configuration**

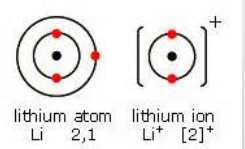
→ **Outermost shell**
(valence electron/shell)

- Atoms with incomplete valence shells are **chemically reactive**.



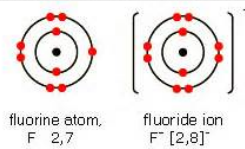
Seeking Stability

- Cations** – positively charged ion, lose electron(s)
- Anions** – negatively charged ion, gain electron(s)



lithium atom
Li 2,1

lithium ion
Li⁺ [2]⁺

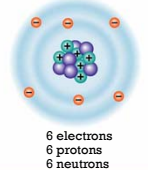
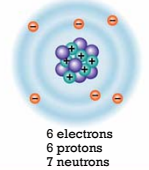
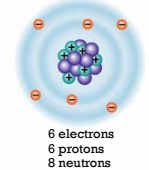


fluorine atom,
F 2,7

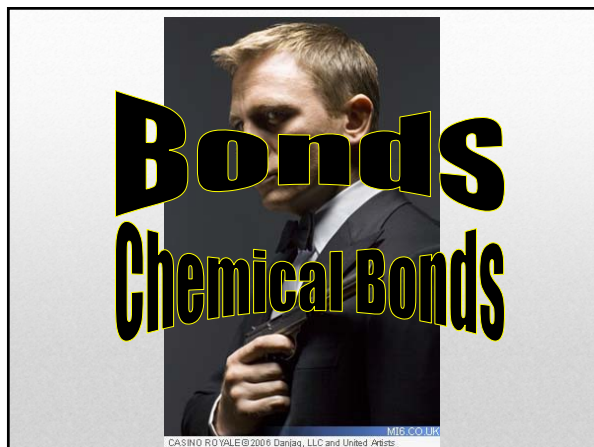
fluoride ion
F⁻ [2,8]⁻

Octet Rule = atoms tend to **gain, lose or share** electrons so as to have 8 electrons

Isotopes are atoms of the same element that vary in the number of neutrons.

Nonradioactive carbon-12	Nonradioactive carbon-13	Radioactive carbon-14
		
6 electrons 6 protons 6 neutrons	6 electrons 6 protons 7 neutrons	6 electrons 6 protons 8 neutrons
98.9 %	1.1%	<0.0001%


Because they have the same number of **electrons**, all isotopes of an element have the same chemical properties.



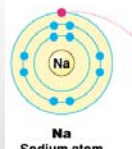
Bonds are formed by the **sharing** or **transfer** of electrons

2 Types of Chemical Bonds

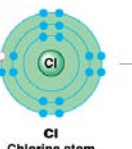
- Ionic Bonds**
- Covalent bonds**



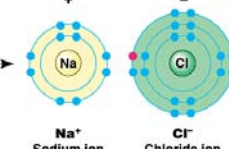
Ionic Bonds – occur when one atom **donates or gives up** one or more electrons



Na atom
Sodium atom

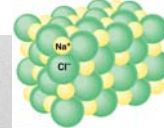


Cl atom
Chlorine atom




Na⁺
Sodium ion
(a cation)

Cl⁻
Chloride ion
(an anion)



Sodium chloride (NaCl)







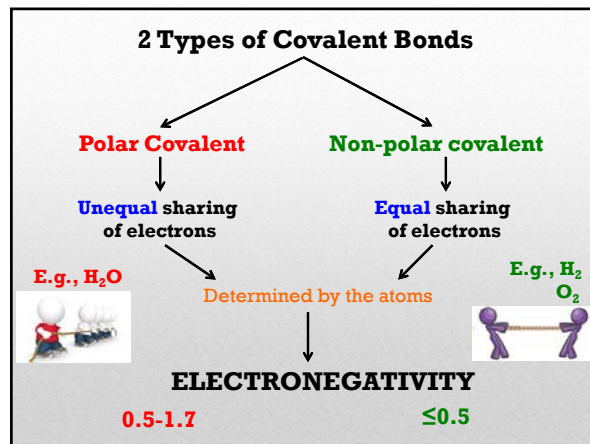
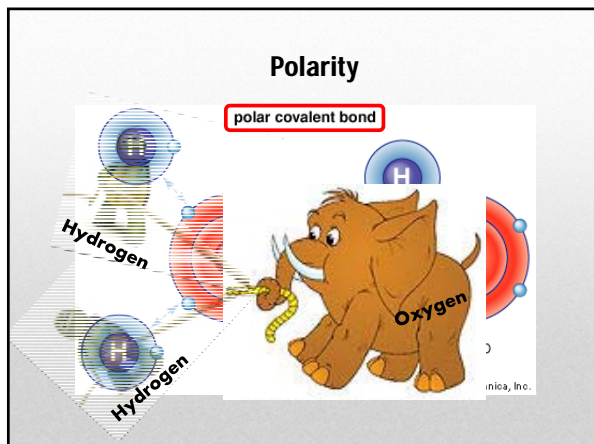
Salt crystals

Ionic Compound (Na⁺Cl⁻)

Opposite charges attract to form ionic bonds

Covalent Bonds – involve a **sharing** of a pair of valence electrons between atoms.

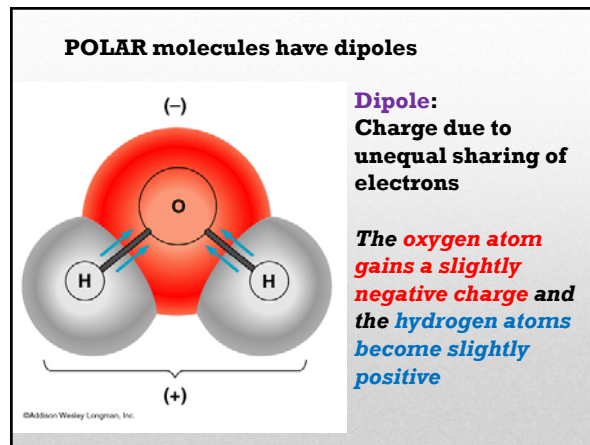
Molecular Formula	Electron Configuration	Structural Formula	
H ₂		H—H Single bond	Single covalent bond
O ₂		O=O Double bond	Double covalent bond
CH ₄ Methane		H H—C—H H	Four single covalent bonds
H ₂ O Water		O—H H	Two single covalent bonds



Electronegativity

- The measure of the relative abilities of bonding atoms to **attract electrons**

↑ Electronegativity = Stronger pull of shared electrons



Hydrogen bonds

- Hydrogen bonds are weak forces between polar molecules and hydrogen (due to dipoles)

Hydrogen bond

Between hydrogen and molecules with N,O,F

WATER:

- Since water is polar, it can **attract** other water molecules:
COHESION
- It also **attracts** to other molecules:
ADHESION

Oxygen is a NON-POLAR molecule

But so is carbon tetrachloride

Does Shape Really Matter?

Shape & Polarity

Solubility of Substances in Water

Due to its polarity, water is a great solvent.
What is happening in the example below?

Water is great at dissolving both ionic (+,-) compounds and polar molecules. **WHY?**

Solubility of Substances in Water

Hydrophilic (means water-loving) compounds interact with water by **dissolving** in it.

E.g., **Anions** (chloride ions) in salt attracted to + poles of water
Polar molecules (sugar) can bond to dipoles

Solubility of Substances in Water

Hydrophobic (means water-hating) compounds do not interact with water because they **cannot form intermolecular bonds**

E.g., **Non-polar** compounds are **insoluble** in water

Oil – non-polar compound of carbon and hydrogen

Some Other Bonds...

London

- Weakest
- Between all molecules
- Temporary unequal distribution of e⁻
- He--He

Van der Waals (Intermolecular)

- Dipole – dipole
- Polar molecules
- H-Cl ----H-Cl