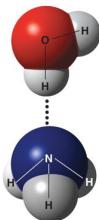


The Chemical Context of Life: Atoms, Bonding, Molecules

Today's Topics:

- Atomic Structure and bonding
 - Periodic Table
- Ionic Bonds
- Covalent Bonds

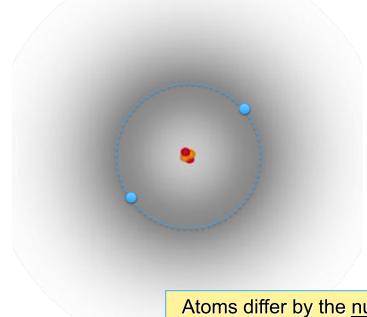


Sept 2, 2011

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Electron Cloud

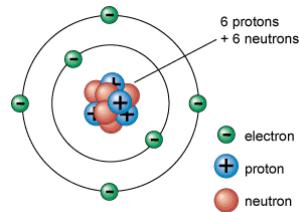
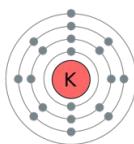
Helium



Atoms differ by the number of protons and electrons

Electrons are arranged in SHELLS

Potassium:
1 outer shell electron



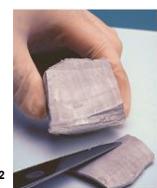
Fluorine:
7 outer shell electrons



Matter

Elements

Made up of **only One** type of atom



Compounds

Two or more types of atoms bonded together in a fixed ratio

Now a NEW SUBSTANCE



Figure 2.2 Sodium + Chlorine → Sodium Chloride

Periodic Table of the Elements

1	IA	H	IIA												O
2	IIA	Li	Be												He
3	III A	Na	Mg	IIIB	IVB	V B	VI B	VIB	VIB	VII	IB	IIB	IIIB	IV A	C
4	VIA	K	Ca	Sc	Ti	V	Cr	Mn	Fe	Co	Ni	Cu	Zn	V B	N
5	VIIA	Rb	Sr	Y	Zr	Nb	Mo	Tc	Ru	Rh	Pd	Ag	Cd	In	O
6	He	Cs	Ba	La	Hf	Ta	W	Re	Os	Ir	Pt	Au	Hg	Tl	F
7	Fr														Ne
	+Lanthanide Series	Ce	Pr	Nd	Pm	Sm	Eu	Gd	Tb	Dy	Ho	Er	Tm	Yb	
	+Actinide Series	Th	Pa	U	Np	Pu	Am	Cm	Bk	Cf	Es	Fm	Md	No	Lr

* Lanthanide Series	Ce	Pr	Nd	Pm	Sm	Eu	Gd	Tb	Dy	Ho	Er	Tm	Yb	Lu
+ Actinide Series	Th	Pa	U	Np	Pu	Am	Cm	Bk	Cf	Es	Fm	Md	No	Lr

- The **periodic table of the elements** shows the electron distribution for all the elements

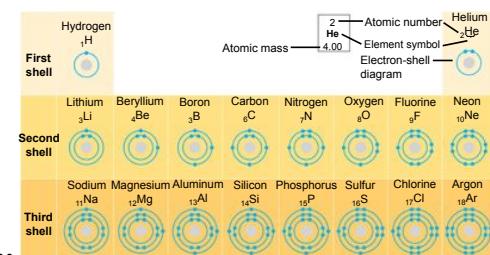
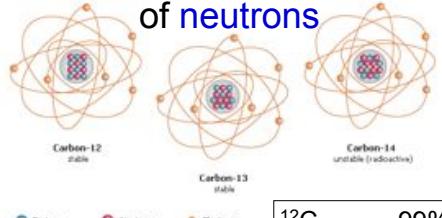


Figure 2.8

Isotopes differ in the number of neutrons



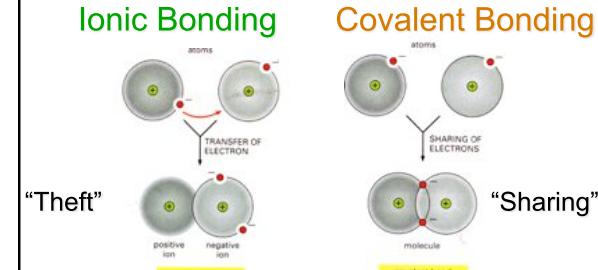
Are these isotopes charged?

Do they have different chemical bonding properties?

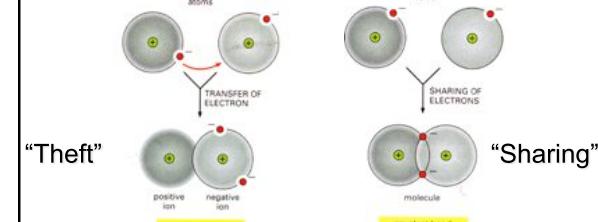
^{12}C	99%
^{13}C	1%
^{14}C	tiny bit

Bonding:

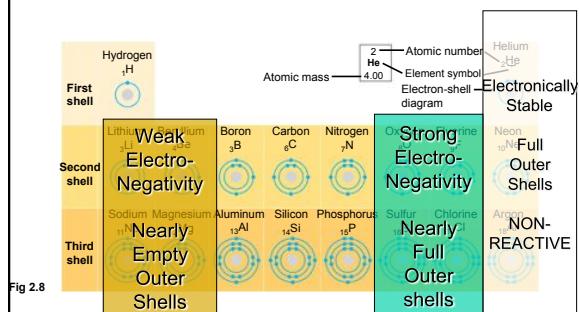
Ionic Bonding



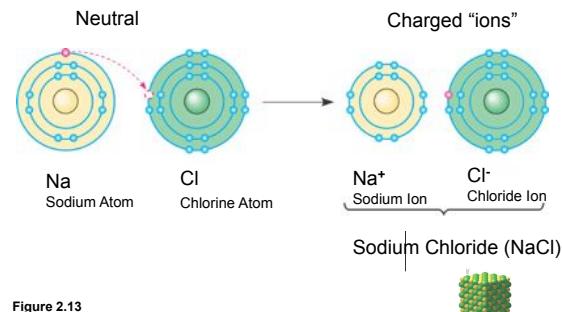
Covalent Bonding



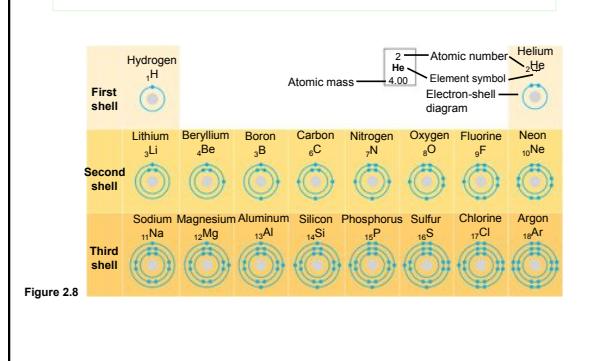
When atoms have very different Electronegativities, form an Ionic Bond



Ionic Bonding

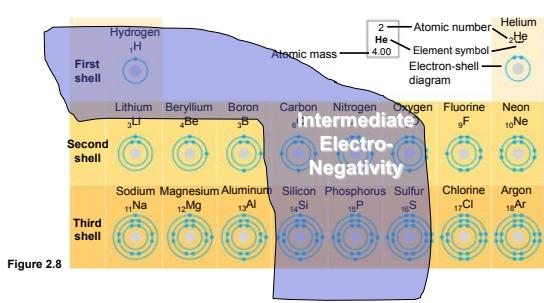


What are some other ionic compounds?



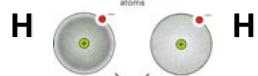
Covalent Bonds

Form between atoms of similar electronegativity



Covalent Bonding: "Sharing"

Same electronegativity

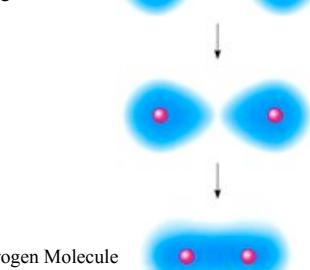


- Full outer shells
- Atoms overlap
- Physically connected with fixed geometry
- Molecules



Covalent Bond Formation

Hydrogen Atoms



Hydrogen Molecule

Covalent Bonds have a Specific Geometry

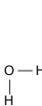
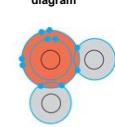
Name (molecular formula)

Electron-shell diagram

Structural formula

Space-filling model

Water (H_2O)



Methane (CH_4)

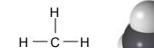
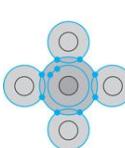
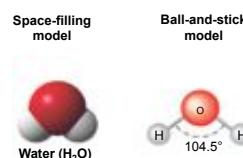


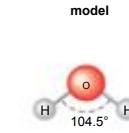
Figure 2.11

Space-filling model



Water (H_2O)

Ball-and-stick model



104.5°

Hybrid-orbital model (with ball-and-stick model superimposed)

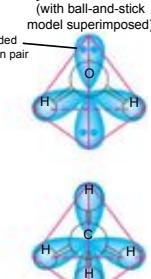


Figure 2.16

Double Bonds

Name and Molecular Formula

Electron-distribution Diagram

Lewis Dot Structure and Structural Formula

Space-filling Model

Oxygen (O_2)



These oxygen atoms share two pairs of electrons.



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Missing

2

always makes

2

3

4

3

4

bonds



electrons

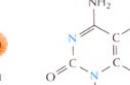
water



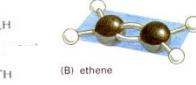
water



oxygen

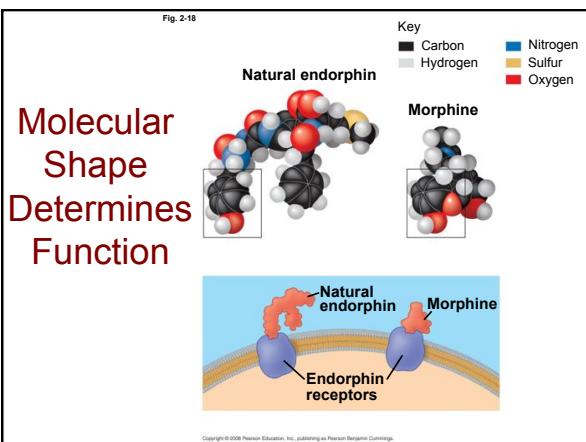
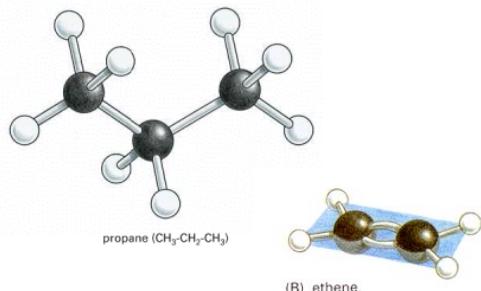


cytosine



(B) ethene

Molecular Shape determines Function



Water

Oxygen is more electronegative than hydrogen

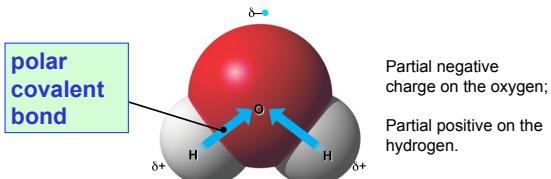


Figure 2.12