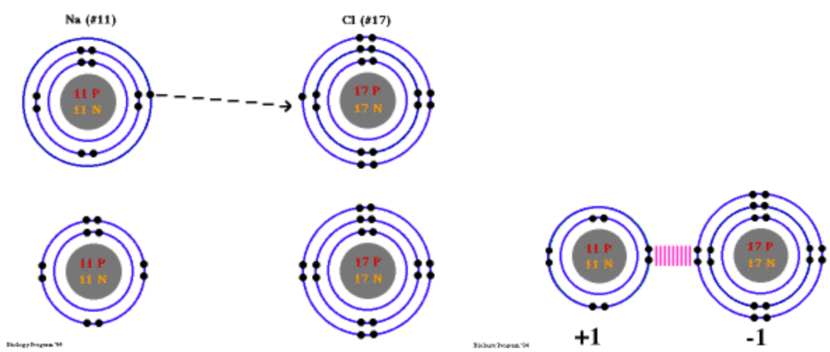
Chemical Bonds

NOBLE GASES (Group VIII)
inert - no (almost) reactions
electronic configuration - filled outer shell
high **ionization energy** - E needed to remove an electron

He - only material that does not freeze at normal pressure
superfluid at T < 1 K
flows without friction
macroscopic quantum mechanical properties
like superconductors

IONIC BOND - typically "salts"
valence electrons - those in incomplete
highest energy orbitals
ion - atom that has gained or lost an electron
usually to complete a shell
charged!

typically between
Group I - alkali metals
have an extra electron
Group VII - halogens
need one more electron



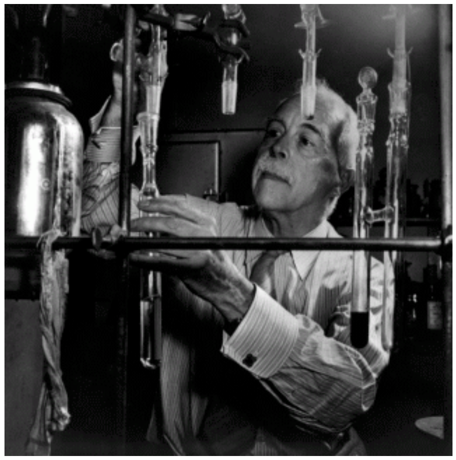
transfer of electron(s)
completes (fills) orbitals
in donor and recipient
creates oppositely
charged ions
attractive electrical force
hold ions together

COVALENT BOND - holds molecules together

MOLECULE - smallest unit of a substance that can have
a stable independent existence.

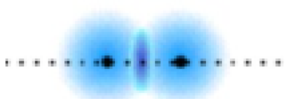
Gilbert N. Lewis (1875-1946)
chemist
1st to isolate **heavy water**
H replaced by deuterium
sharing electrons can achieve
Noble Gas structure
filled shells

introduced **Lewis Diagram**
electron dot symbols



number of dots
(valence electrons)
= column number
except for He
position atoms and
draw dots so that
electrons can be shared

H—H



1s   1s

Table 14–8 LEWIS STRUCTURES OF HYDROGEN THROUGH ARGON

I	II	III	IV	V	VI	VII	VIII
H·							He:
Li·	·Be·	·B·	·C·	·N·	:O·	:F·	:Ne:
Na·	·Mg·	·Al·	·Si·	·P·	:S·	:Cl·	:Ar:

dash notation also indicates
single, double, or triple bonds

Goal: get 8 (or 2) dots near each atom

Table 14–9 LEWIS STRUCTURES OF SOME COVALENT MOLECULES

Substance	Lewis Structure	Dash Formula	Substance	Lewis Structure	Dash Formula
Bromine	:Br:Br:	Br—Br	Carbon dioxide	·O::C::O·	O=C=O
Chlorine	:Cl:Cl:	Cl—Cl	Ammonia	H:N:H H	H—N—H | H
Fluorine	:F:F:	F—F			
Iodine	:I:I:	I—I	Methane	H H:C:H H	H | H—C—H | H
Hydrogen	H:H	H—H			
Oxygen	O::O	O=O	Carbon tetrachloride	:Cl: :Cl:C:Cl: :Cl:	Cl | Cl—C—Cl | Cl
Nitrogen	:N⁝⁝N:	N≡N			

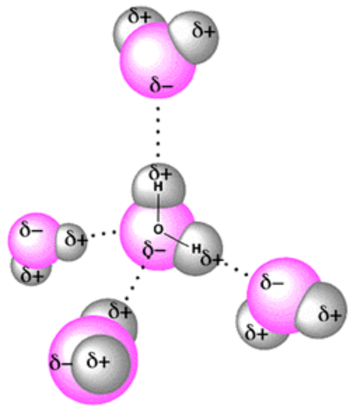
POLAR MOLECULES

unequally shared electrons
in covalent bond
has + and - "poles"

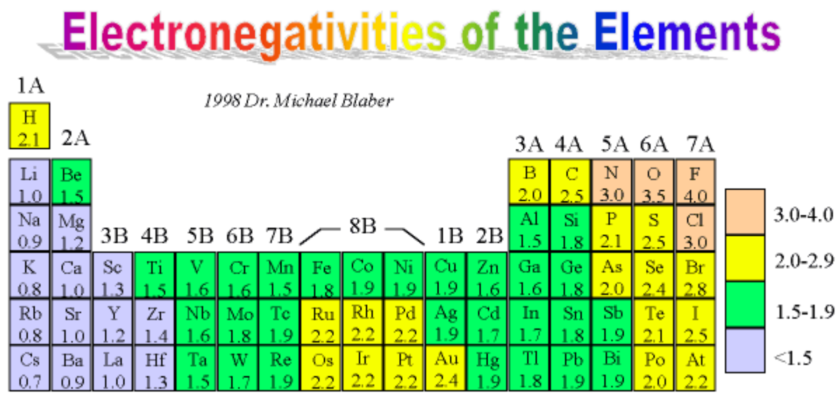
important example: H_2O

oxygen holds electrons tighter than hydrogen

hydrogen bond



Ability of an atom to attract an electron gives:



EN diff	BOND type	electron distribution
0	non-polar covalent	shared equally
0-1.7	polar covalent	shared unequally
> 1.7	ionic	complete transfer

What type of bond is **H-O**? **Cl-Cl**? **K-F**?

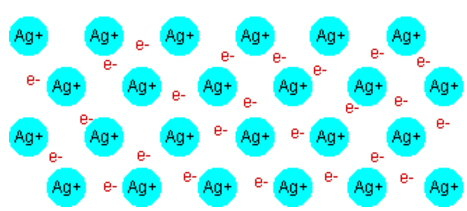
METALLIC BOND

outer electrons

conduction electrons

shared among all atoms

positive charge remains around each nucleus



opposite of Thomson's Plum Pudding atom model

conduction electrons hold metal together

they are free to move and give high electrical and thermal conductivity

non-directional bond

atoms can move relative to each other

malleable - can be rolled or hammered into shape

ductile - can be drawn into wires