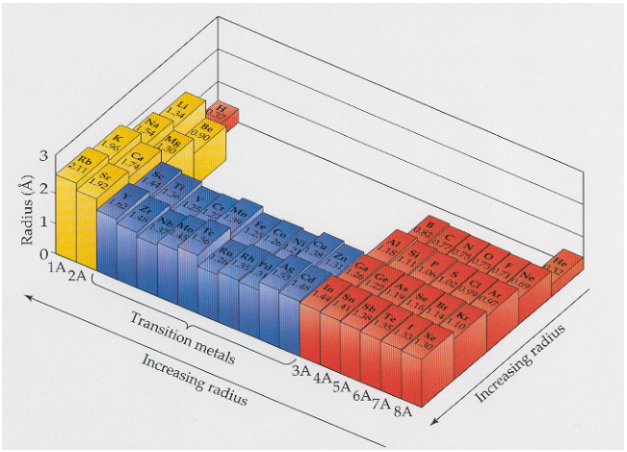
Bonding Overview & Ionic Bonding

Bonding Overview & Ionic Bonding

Periodic Trends

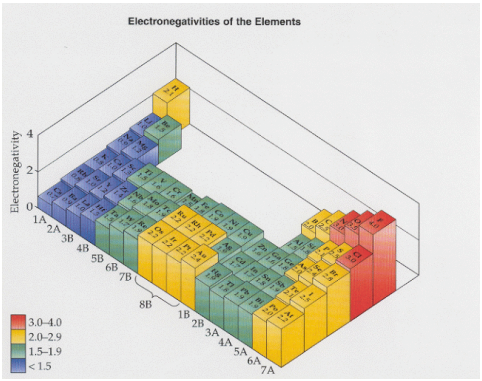
- Atomic Radius
  - Down a group
    - Radius increases as energy levels are added
- Across a period
  - Radius decreases due to the increased charge of the nucleus (Z)



Bonding Overview & Ionic Bonding

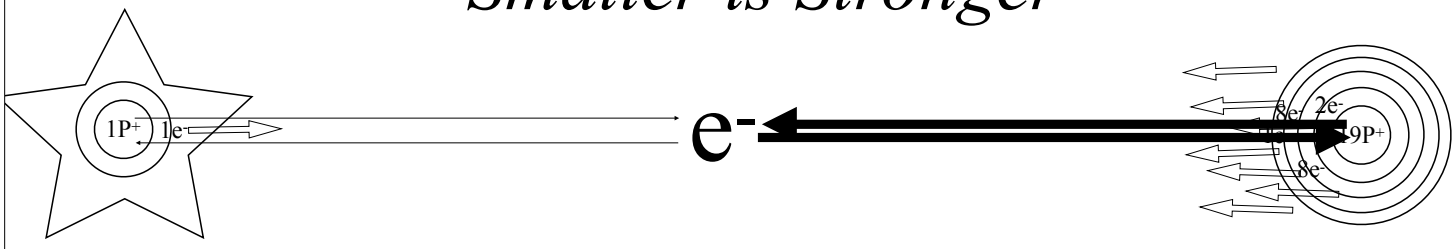
Periodic Trends

- Electronegativity
  - An atom's attraction for electrons from other atoms
  - "Stealing" power
  - Down a group
    - Decreases due to increased shielding
      - Shielding is the interference caused by the electrons circling the nucleus of the atom
  - Across a period
    - Increases due to increased nuclear charge and decreased shielding



Periodic Trends

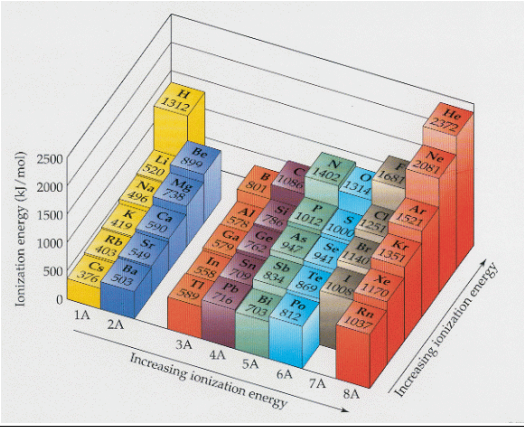
"Smaller is Stronger"



Bonding Overview & Ionic Bonding

Periodic Trends

- Ionization Energy
  - A measure of the energy needed to strip an electron from an atom
  - "Keeping" Power
  - Down a group
    - Decreases due to increased shielding
  - Across a period
    - Increases due to increased nuclear charge and decreased shielding



Bonding Overview & Ionic Bonding

Bond Types

- Chemical Bond
  - A force of attraction between two particles when these atoms or ions are strongly attracted coulombicly to one another
- Bond types
  - Ionic
    - The coulombic forces that exist between ions of opposite charge (thus the name)
    - Formed by a metal and a nonmetal
    - Process of formation
      - Stealing
      - Attraction
      - Lattice formation

Bonding Overview & Ionic Bonding

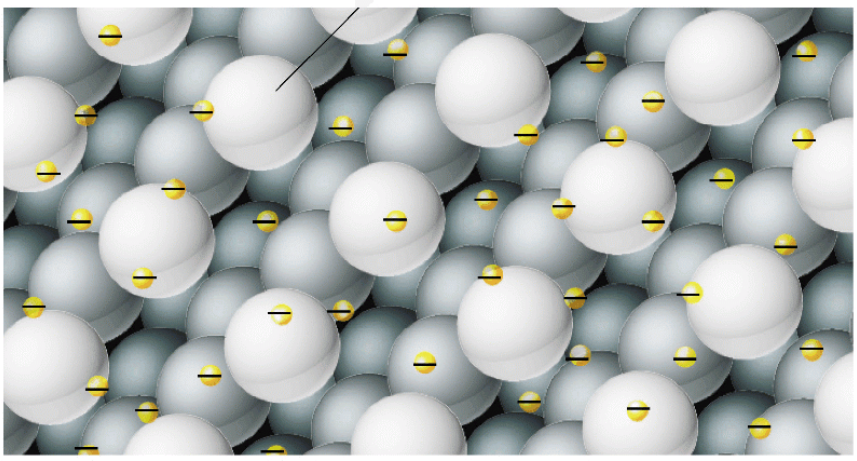
Bond Types

- Covalent
  - Results from the sharing of electrons between two atoms
  - Formed by two nonmetals
  - Process of formation
    - Hybridization
    - Sharing

Bonding Overview & Ionic Bonding

Bond Types

- Metallic
  - Delocalized bonds that exist between metal atoms which have low e-neg's and few valence electrons
  - Each atom is bonded to many of its neighbors
  - Bonding electrons are free to move throughout the structure of the metal



Bonding Overview & Ionic Bonding

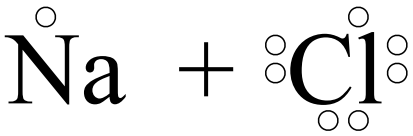
Ionic Bonding

- Consider the reaction of sodium and chlorine to form NaCl

Bonding Overview & Ionic Bonding

Ionic Bonding

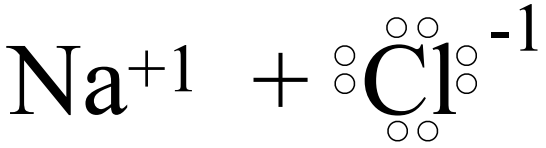
- Consider the reaction of sodium and chlorine to form NaCl



Bonding Overview & Ionic Bonding

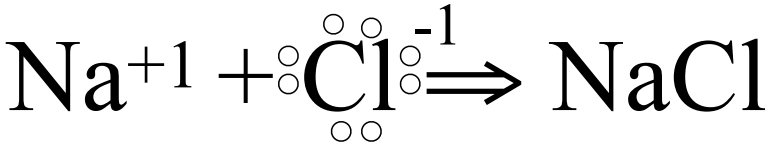
Ionic Bonding

- Consider the reaction of sodium and chlorine to form NaCl



Bonding Overview & Ionic Bonding

Ionic Bonding



- The reaction of Na with Cl is very exothermic

Classification of Matter

Making Table Salt

Bonding Overview & Ionic Bonding

Ionic Bonding

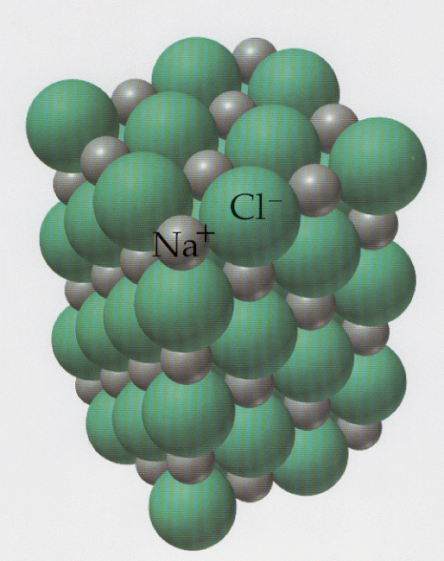
$$Na^{+1} + \cdot\dot{\underset{\cdot\cdot}{\underset{\cdot\cdot}{Cl}}}\cdot^{-1} \Longrightarrow NaCl$$

- The reaction of Na with Cl is very exothermic
- However....
  - Losing electrons is an endothermic process
  - Gaining electrons is an exothermic process
  - Losing electrons tends to be more endothermic than gaining electrons is exothermic
- Why, then, are ionic formation reactions exothermic?

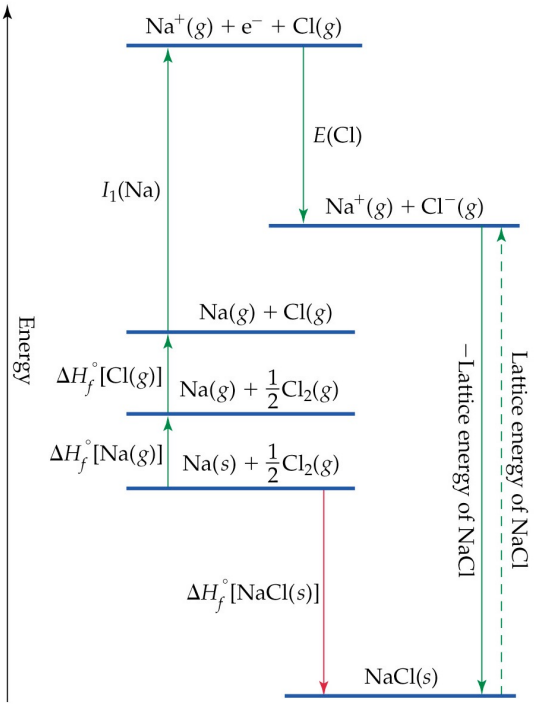
Bonding Overview & Ionic Bonding

Lattice Energy

- As the attraction between the oppositely charged ions draws the ions together, energy is released as the ions form a solid array or lattice.



Bonding Overview & Ionic Bonding



Bonding Overview & Ionic Bonding

Lattice Energy

TABLE 8.2 Lattice Energies for Some Ionic Compounds

Compound	Lattice Energy (kJ/mol)	Compound	Lattice Energy (kJ/mol)
LiF	1030	$MgCl_2$	2326
LiCl	834	$SrCl_2$	2127
LiI	730		
NaF	910	MgO	3795
NaCl	788	CaO	3414
NaBr	732	SrO	3217
NaI	682		
KF	808	ScN	7547
KCl	701		
KBr	671		
CsCl	657		
CsI	600		

- Predictors of strength
  - Ionic Size
    - The larger the ions the weaker the lattice
  - Ionic Charge
    - The greater the ionic charge the stronger the lattice

Bonding Overview & Ionic Bonding

Ionic Size - Review on Your Own

- Depends on
  - Nuclear charge
  - Number of electrons the atom possesses
  - The energy level the valence electrons occupy
- Rules
  - Cations tend to be smaller than their parent atoms
    - Removal of electrons
      - Empties largest orbitals
      - Less electron-electron repulsion
  - Anions tend to be larger than their parent atoms
    - Adding electrons
      - Adds more electrons to distant orbitals
      - More electron-electron repulsion

Bonding Overview & Ionic Bonding

Homework

- 8.2 / 8.3 / 8.17
- 8.21
  - (a) Define the term lattice energy.
  - (b) Which factors govern the magnitude of the lattice energy of an ionic compound?
- 8.23 / 8.29