Chapter 8 Lesson 1: Electrons and Energy Levels

Vocabulary

- Chemical bond
- Valence electron
- Electron dot diagram

The Periodic Table

- Except for hydrogen, elements on the left side are metals
- Nonmetals are on the right side
- Metalloids form the stair-step between metals and nonmetals

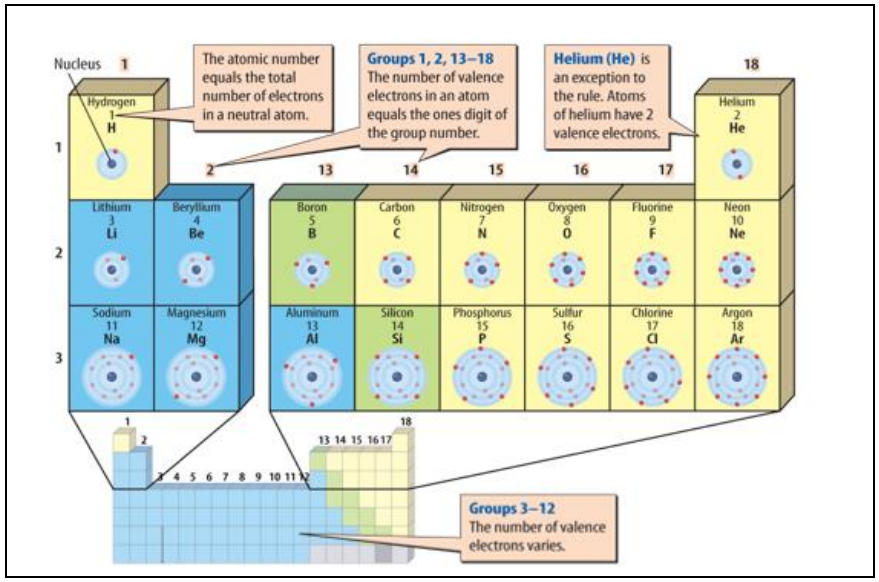
Atoms Bond

- Atom Review:
  - Nucleus: protons (positive charge), neutrons (no charge)
  - Electrons: negative charge, move around nucleus at a distance corresponding to its amount of energy
  - Atomic number is the number of protons in each atom.

- **Chemical bond**: a force that holds two or more atoms together in a compound

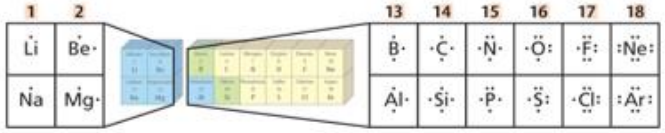
- Energy Levels: areas of space in which electrons move around the nucleus
  - Electrons closest to nucleus: least amount of energy
  - Electrons farthest from nucleus: greatest amount of energy
- The attractions between the positive nucleus of one atom and the negative electrons of another atom is what creates a chemical bond.
- **Valence electron**: an outermost electron of at atom that participates in chemical bonding.
  - The number of valence electrons helps determine the type and number of bonds that an atom can form.

The periodic table can tell you how many valence electrons an atom has.



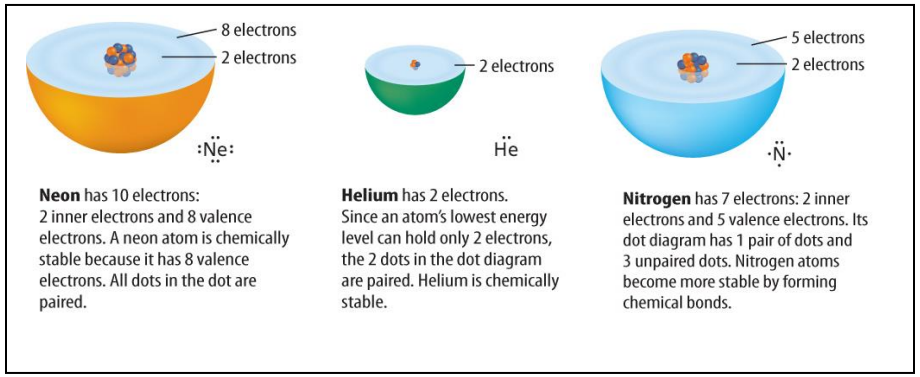
- In 1916, American chemist Gilbert Lewis developed the **electron dot diagram**, a model that represents valence electrons in an atom as dots around the element's chemical symbol.

Steps for writing a dot diagram	Beryllium	Carbon	Nitrogen	Neon
1 Identify the element's group number on the periodic table.	2	14	15	18
2 Identify the number of valence electrons. • This equals the ones digit of the group number.	2	4	5	8
3 Draw the electron dot diagram. • Place one dot at a time on each side of the symbol (top, right, bottom, left). Pair up the dots until all are used.	Be·	·Ċ·	·N̈·	:N̈e:
4 Determine if the atom is chemically stable. • An atom is chemically stable if all dots on the electron dot diagram are paired.	Chemically Unstable	Chemically Unstable	Chemically Unstable	Chemically Stable
5 Determine how many bonds this atom can form. • Count the dots that are unpaired.	2	4	3	0



- Atoms with 8 valence electrons are chemically stable and do not easily react with other atoms.
- Atoms with 1-7 valence electrons are reactive or chemically unstable, and easily bond with other atoms to form chemically stable compounds.
- The elements in group 18 are called noble gases
    - With exception of helium, noble gases have 8 valence electrons and are chemically stable.

Atoms gain, lose, or share valence electrons and become chemically stable.



Chapter 8 Lesson 2: Compounds, Chemical Formulas, and Covalent Bonds

Vocabulary

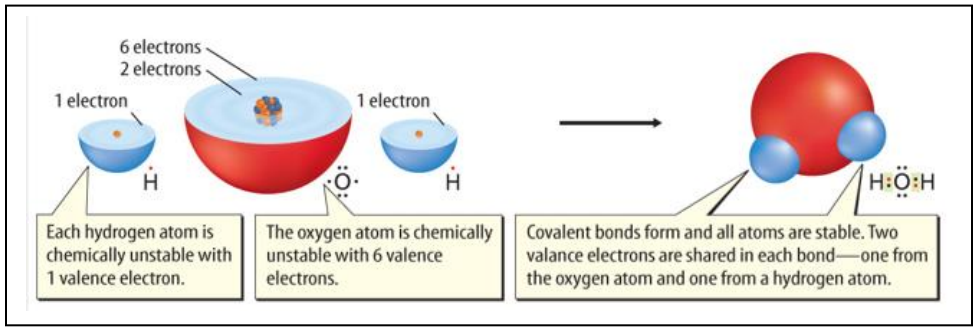
-Covalent bond	-Polar molecule
-Molecule	-Chemical Formula

From Elements to Compounds

- Compounds are chemical combinations of different types of atoms
- Chemical bonds join atoms together

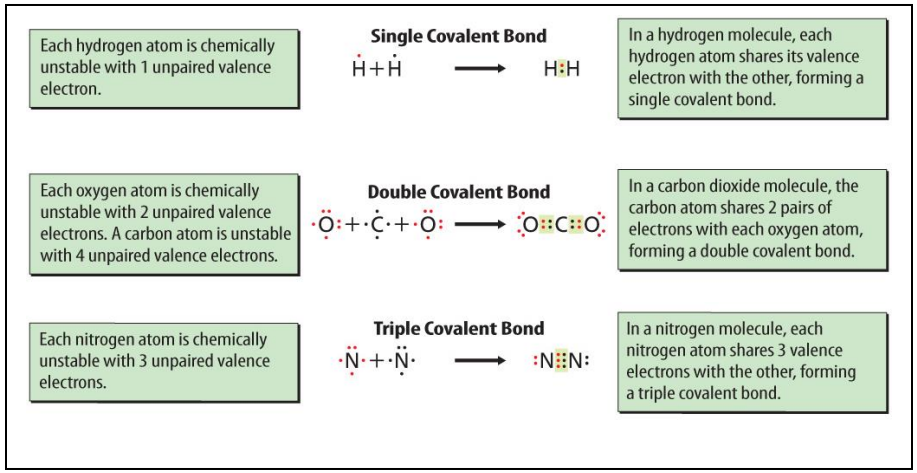
Covalent Bonds – Energy Sharing

- **Covalent bond**: a chemical bond formed when two atoms share one or more pairs of valence electrons
- A compound formed from many covalent bonds is called a covalent compound
- Atoms with less than 8 valence electrons become chemically stable by forming a chemical bond



- A single covalent bond exists when two atoms share one pair of valence electrons
- A double covalent bond: share two pairs of valence electrons
- A triple covalent bond: share three pairs of valence electrons

The more valence electrons that two atoms share, the stronger the covalent bond is between the atoms

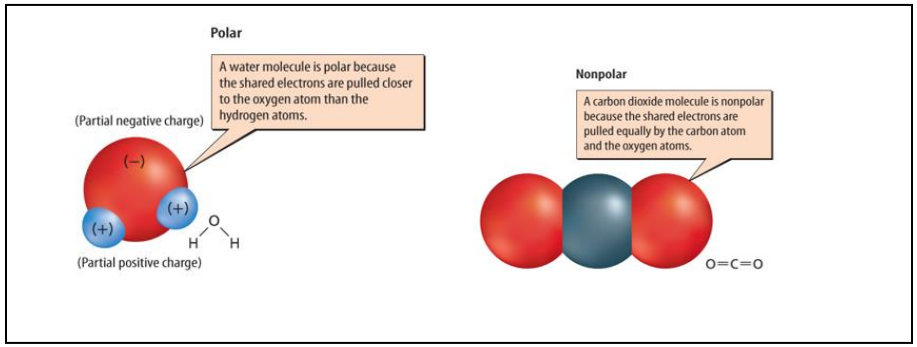


Covalent Compounds

- When two or more atoms share valence electrons, they form a stable covalent compound.
- Covalent compounds usually have low melting and boiling points
- Usually gases or liquids at room temperature, but can also be solids
- Poor conductors of thermal energy and electricity

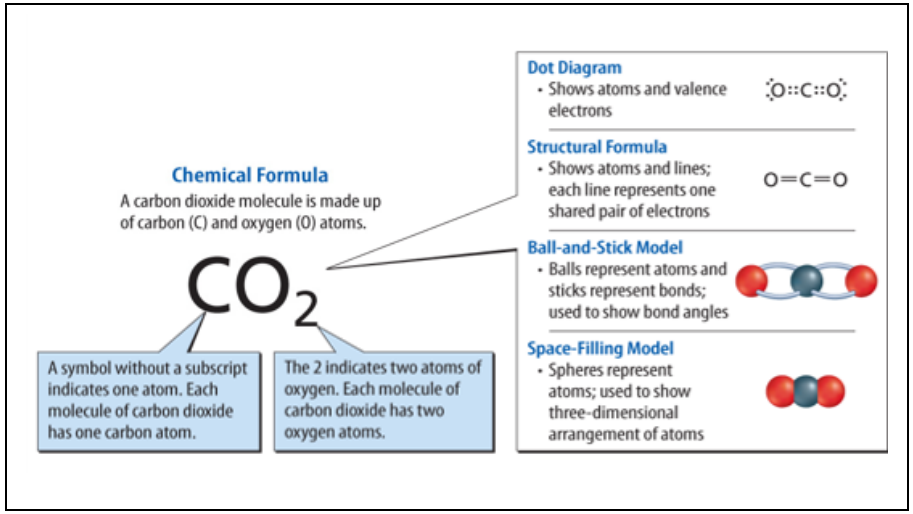
- A **molecule** is a group of atoms held together by covalent bonding that acts as an independent unit.

- A molecule that has a partial positive end and a partial negative end because of unequal sharing of electrons is a **polar molecule**
- Atoms of a polar molecule share their valence electrons unequally
- Atoms of a nonpolar molecule share their valence electrons equally



- A **chemical formula** is a group of chemical symbols and numbers that represent the elements and number of atoms of each element that make up a compound
- A chemical formula describes the types of atoms in a compound or molecule, but it does not explain the shape or appearance of the molecule

Chemical formulas and molecular models provide information about molecules



Chapter 8 Lesson 3: Ionic and Metallic Bonds

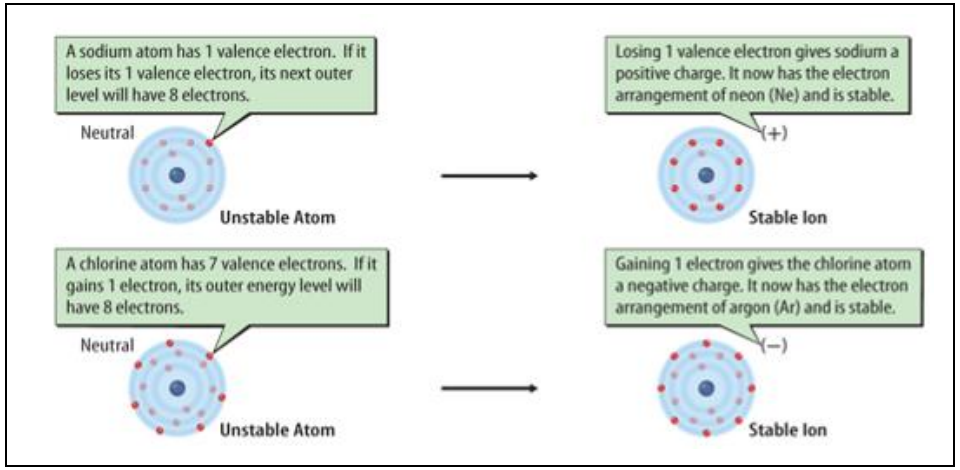
Vocabulary

-Ion	-Ionic bond	-Metallic bond

Understanding Ions

- An **ion** is an atom that is no longer electrically neutral because it has lost or gained valence electrons.
- Because electrons have negative charge, losing or gaining an electron changes the overall charge of an atom.
- Atoms that lose valence electrons become ions with a positive charge
- Metal atoms, such as sodium, become more stable when they lose valence electrons and form a chemical bond with a nonmetal

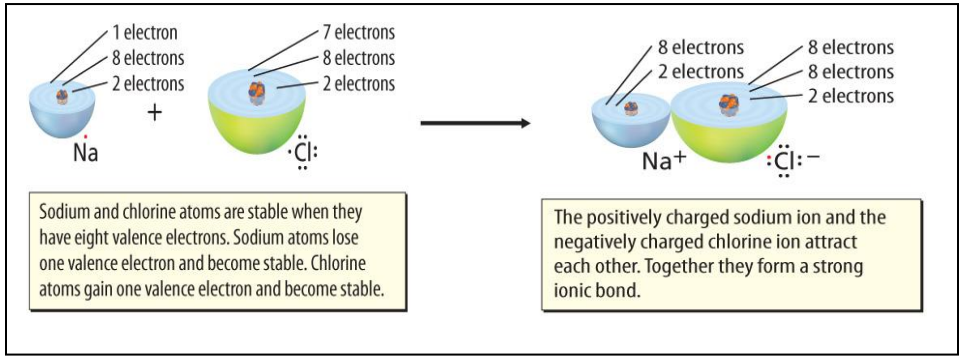
- Sodium atoms have a tendency to lose a valence electron. Chlorine atoms have a tendency to gain a valence electron.



- Atoms are electrically neutral because they have the same number of protons and electrons
- Once an atom gains or loses electrons, it becomes a charged ion.

Ionic Bonds – Electron Transferring

- When forming a compound, the nonmetal atoms gain the electrons lost by the metal atoms
- The attraction between positively and negatively charged ions in an ionic compound is an **ionic bond**
- An ionic bond forms between Na and Cl when an Na atom transfers an electron to a Cl atom



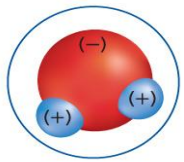
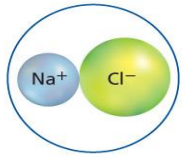
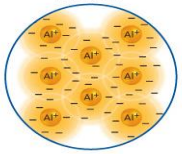
Ionic Compounds

- Individual ions in an ionic compound are strongly attracted to each other
- Covalent compounds are made up of many molecules
- When nonmetal ions bond to metal ions in an ionic compound there is a large collection of oppositely charged ions and no molecules

Metallic Bonds – Electron Pooling

- A **metallic bond** is a bond formed when many metal atoms share their pooled valence electrons
- Valence electrons in metals are not bonded to one atom
- Instead, a "sea of electrons" surrounds the positive ions
- Metals are good conductors of thermal energy and electricity
- Metals are shiny because the valence electrons at the surface of a metal interact with light

Covalent, Ionic, and Metallic Bonds

Type of Bond	What is bonding?	Properties of Compounds
Covalent  Water	nonmetal atoms; nonmetal atoms	• gas, liquid, or solid • low melting and boiling points • often not able to dissolve in water • poor conductors of thermal energy and electricity • dull appearance
Ionic  Salt	nonmetal ions; metal ions	• solid crystals • high melting and boiling points • dissolves in water • solids are poor conductors of thermal energy and electricity • ionic compounds in water solutions conduct electricity
Metallic  Aluminum	metal ions; metal ions	• usually solid at room temperature • high melting and boiling points • do not dissolve in water • good conductors of thermal energy and electricity • shiny surface • can be hammered into sheets and pulled into wires