

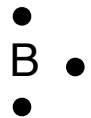
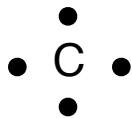
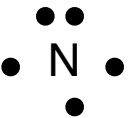
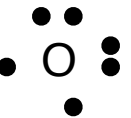
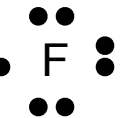
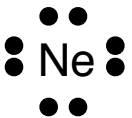




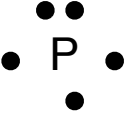
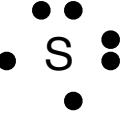
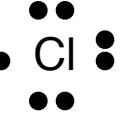
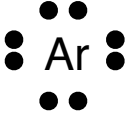


Electron Dot Diagrams and Bonding

- A. All pure substances can be classified into one of two categories.
1. Elements are substances composed of one kind of atom.
 2. Compounds are substances composed of two or more different elements bonded (connected) together in specific ratios of atoms.
- B. An elements chemical properties involve what other elements it can combine with and the number of atoms of each element involved in the bonding. These depend on the number of electrons in an atoms outermost electron shell.
1. Different elements can have the same or different number of electrons in their outer shell as another element.
 2. When bonds form between atoms they need to form a stable arrangement.
 3. A stable arrangement for an atom is reached when its outer shell of electrons is full.
 - a. Hydrogen(H) and Helium(He) have one electron shell capable of holding just 2 electrons.
 - b. The outer electron shell of all other elements is capable of holding 8 electrons.
- C. Scientists have devised a simple way to illustrate these outer shell electrons using an Electron Dot (or Lewis) Diagram.
1. Using the symbol for an element, place dots representing the electrons in their outer shell around the top, bottom, and two sides of the symbol as shown below for the elements in period 2 of the periodic table.

 Li	 Be	 B	 C	 N	 O	 F	 Ne
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2. Elements in the same groups/families as the above elements have the same number of electrons in their outer shell as shown below. This is why elements in the same group/family have similar properties.

 Na	 Mg	 Al	 Si	 P	 S	 Cl	 Ar
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D. Electron dot diagrams are used to show how bonds occur in elements.

1. Hydrogen has one electron in its outer (and only) electron shell.



2. It needs to have 2 electrons in the outer shell to be stable.

a. Hydrogen gas H_2 , is shown here: $\text{H}\bullet\bullet\text{H}$

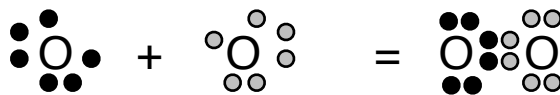
b. Each hydrogen atom shares its electron with the other hydrogen atom. When electron pairs are shared between atoms it's called covalent bonding. A molecule of hydrogen gas has a single covalent bond.

c. If the atoms share 2 electrons a single covalent bond is formed.

d. If the atoms share 4 electrons a double covalent bond is formed.

e. If the atoms share 6 electrons a triple covalent bond is formed.

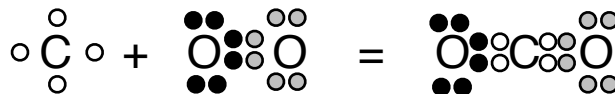
3. The two oxygen atoms below each have six electrons in their outer electron shell.



a. A molecule of oxygen gas has a double covalent bond.

E. Electron dot diagrams are also used to show how bonds occur in compounds.

1. Compounds made of elements that are near each other in the periodic table usually form covalent bonds as in carbon dioxide (CO_2).



a. A molecule of carbon dioxide gas has two double covalent bonds.

2. Compounds made of elements that are far from each other in the periodic table usually form ionic bonds as in sodium chloride (NaCl).

a. In ionic bonding, electrons aren't shared between atoms.

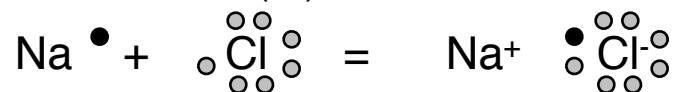
b. Instead, the electrons are transferred from one atom to another.

c. The atom that gains electrons becomes negatively charged due to the extra negatively charged electrons.

d. The atom that loses electrons becomes positively charged due to having a greater number of positively charged protons than negatively charged electrons.

e. Atoms that become electrically charged in this way are called ions, and since opposite charges attract each other, ionic bonds are very strong and difficult to break.

- f. The example below shows an atom of Sodium(Na) with its one electron in the outer shell, and Chlorine(Cl) with seven electrons in its outer shell.



- g. This makes the Sodium(Na) atom, have a charge of positive one since it lost its one electron, and the Chlorine(Cl) atom now has a charge of negative one since it gained one electron.
- h. Sodium chloride (NaCl) or table salt, is made up of these ions and is referred to as an ionic solid.