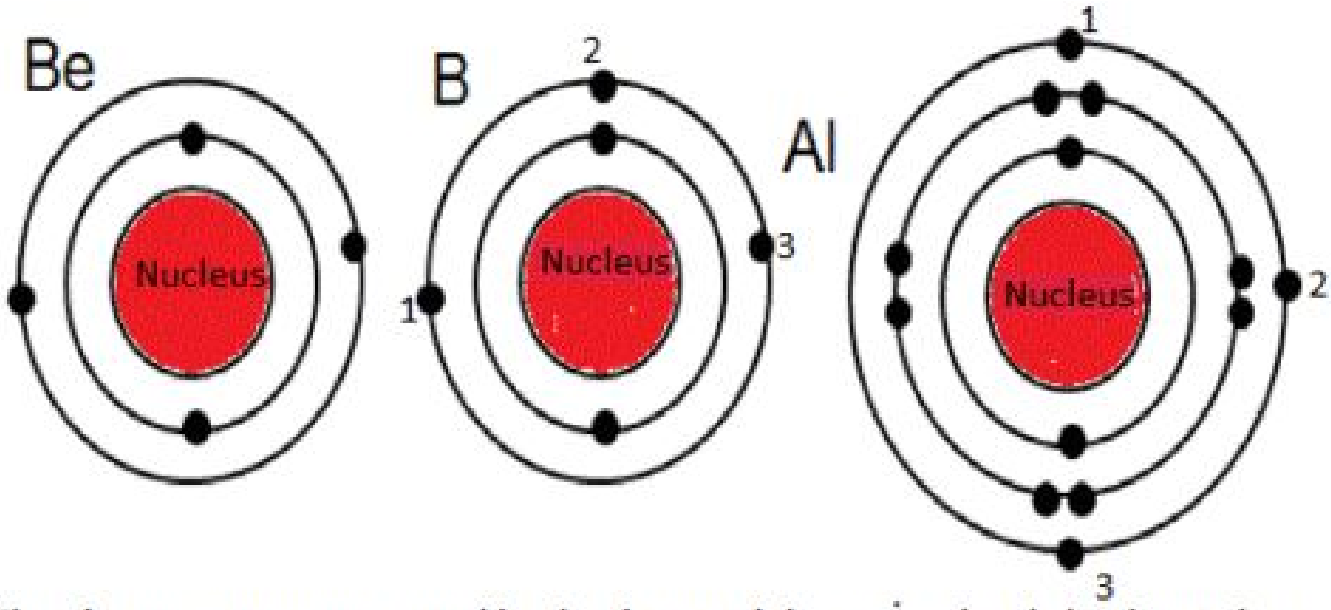
Notes on Chapter 5: Atoms and Bonding

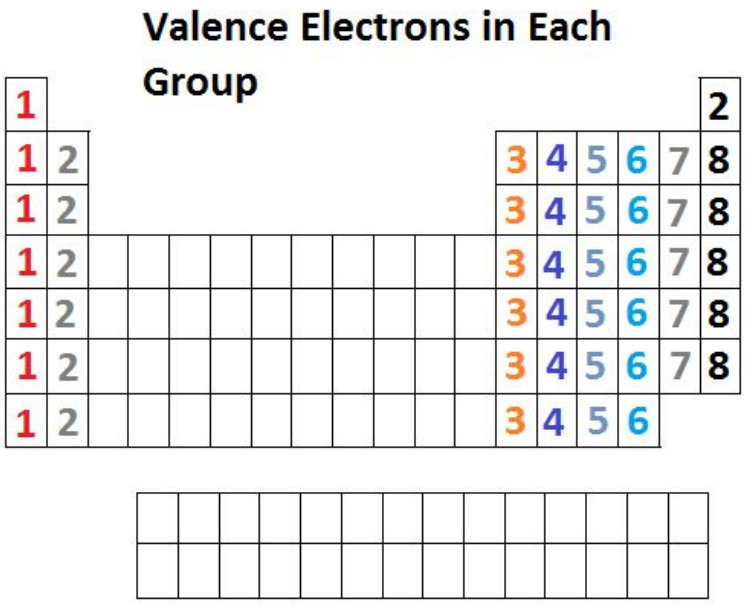
5.1 Atoms, Bonding, and the Periodic Table

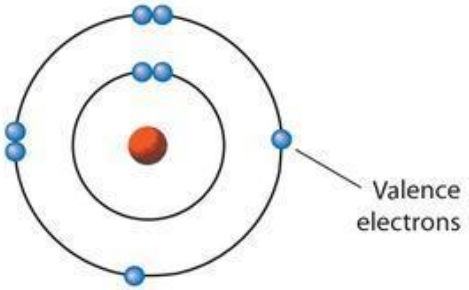


The electrons are represented by the dots, and the energy levels by the circles around the nucleus. Beryllium has a total of 4 electrons, 2 in the 1st energy level and 2 in the 2nd energy level. Only the outermost electrons actually interact with the other elements, since the inner ones are shielded by the outer electrons, similar to how when you look at each other, you only see our outer skin cells. The outermost electrons are called **valence electrons**. Valence electrons are the electrons found in the outermost energy level. Notice how Boron and Aluminum both have 3 valence electrons in their outermost used shell. This explains why they have similar chemical properties. They are also in the same column on the periodic table, for this very reason, the same number of valence electrons

Valence electrons:

- have the highest energy level
- held the most loosely
- determines the way in which elements can bond

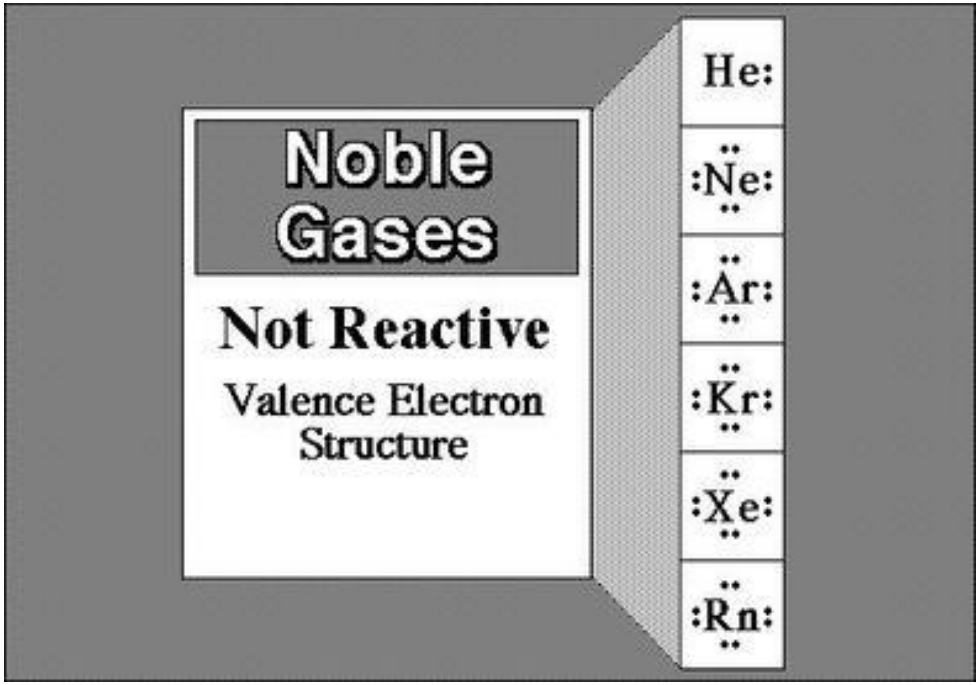




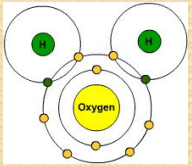
Electron dot diagram

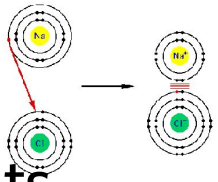
Includes the element's symbol surrounded by dots. Each dot represents a valence electron.

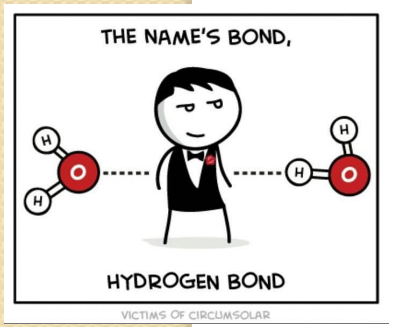
Elements are more stable (less likely to react) when they have eight valence electrons . (Helium only has 2.)



Atoms want to have a stable outer level. They will want to either get rid of their valence electrons or gain electrons to equal 8 (or 2 for hydrogen).







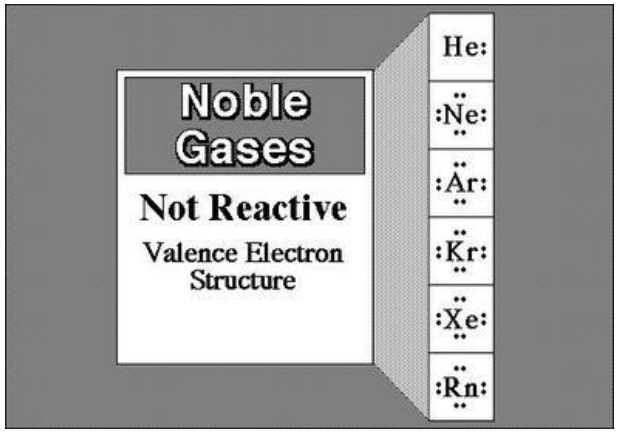
A chemical bond – a force of attraction- results because of the rearrangement of electrons between atoms.The electrons might be shared or transferred. In any case, the change results in a chemical reaction – a new substance is formed.

The periodic table gives you information about the arrangement of electrons in atoms. This, then, gives you a clue as to which elements combine and how.

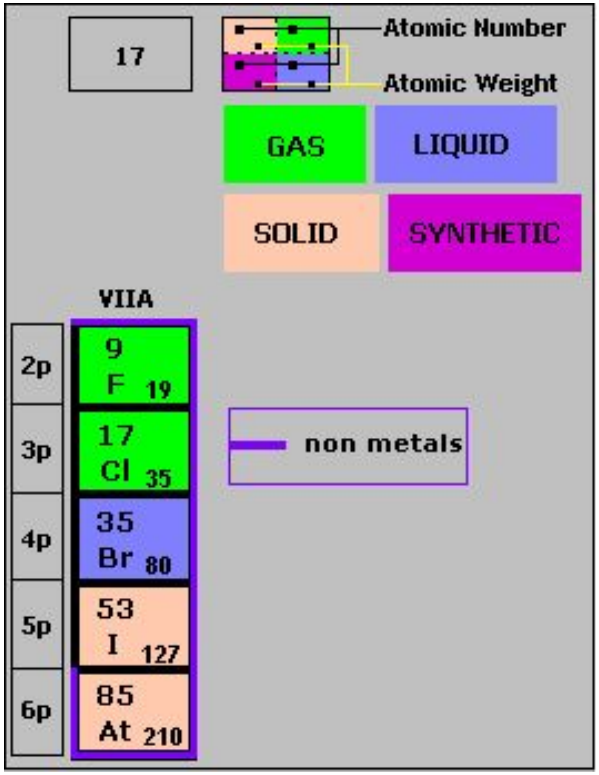
Look at your periodic table. Except for Period 1, a period ends when the number of valence electrons reaches **eight**.

The next period begins with atoms having valence electrons with **higher energy**.

The elements within a group have similar properties because they all have the **same number of valence electrons in their atoms.**

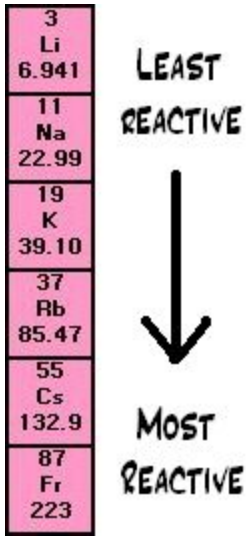


Once again, the noble gases have 8 valence electrons, making them stable. This is the reason they do not react easily with other elements.



The halogens in Group 17 have 7 valence electrons, needing just one more electron to become stable. This is why they react easily with other elements whose atoms can give up or share electrons.

The alkali metals in Group 1 have only one valence electron. Their next lower energy level has a stable set of 8 electrons. Lithium is the exception since its lower stable set has 2 electrons. This makes the alkali metals very reactive.



Groups 2 -12 have one, two, or three valence electrons. They react by losing these electrons, especially when they combine with oxygen or one of the halogens.

How reactive a metal is depends on how easily its atoms lose valence electrons.
Group 2 is almost as reactive as Group 1.
Platinum (Pt) in Group 10 and gold (Au) in Group 11are unreactive.

Most nonmetals are gases at room temperature, five are solids, and one is a liquid. All have 4 or more, meaning they will either gain or share their electrons in order to have 8 valence electrons.

Nonmetals combine with metals by gaining electrons.
Nonmetals can combine with nonmetals by sharing electrons.

Of the metals, hydrogen and the halogens are highly reactive, but fluorine beats them all! It is so reactive that it even forms compounds with some of the noble gases!

Metalloids lie along the zig-zag line between the metals and nonmetals. They have anywhere from 3 to 6 valence electrons. They will either lose them or share them when forming compounds. Depending on the conditions, will determine if they act like a metal or a nonmetal.

Hydrogen is placed up in the top left-hand of the periodic table near Group 1because it only has one valence electron. However, it is considered to be a nonmetal. It is reactive but it acts differently than the alkali metals.