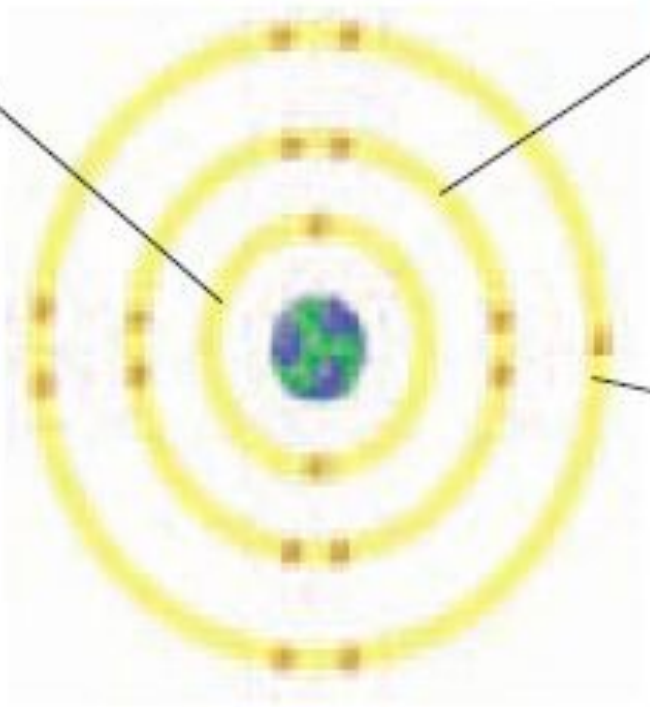
Chemical Bonding

1. What are valence electrons?

- Are the electrons that are in the outermost energy level and are held most loosely.

Figure 2 **Electron Arrangement in an Atom**



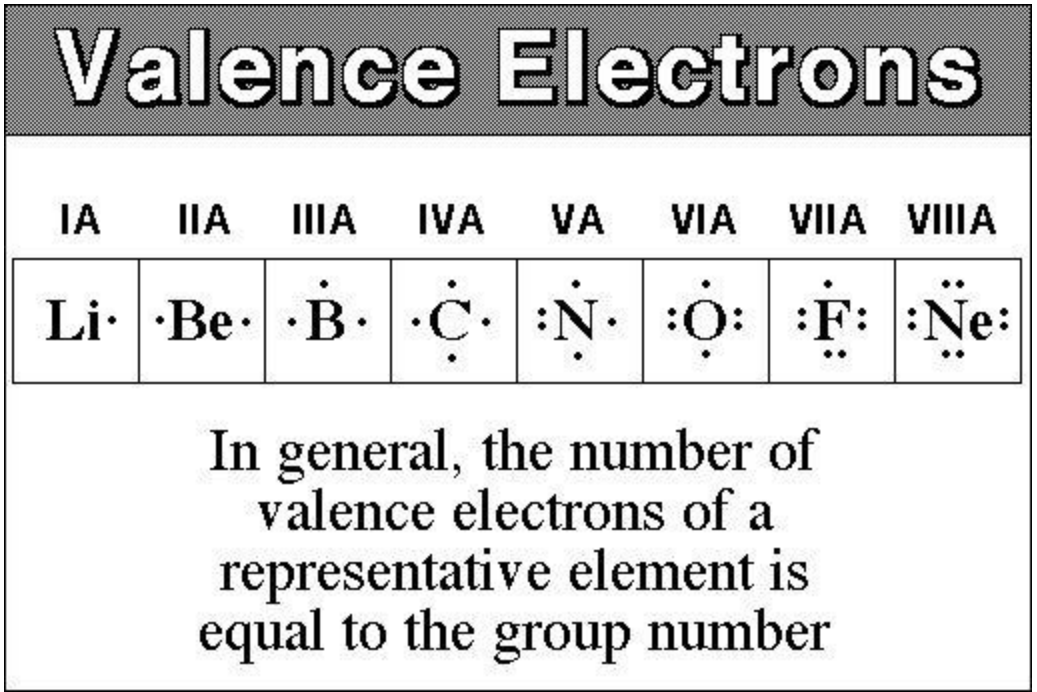
a The **first energy level** is closest to the nucleus. It can hold up to two electrons.

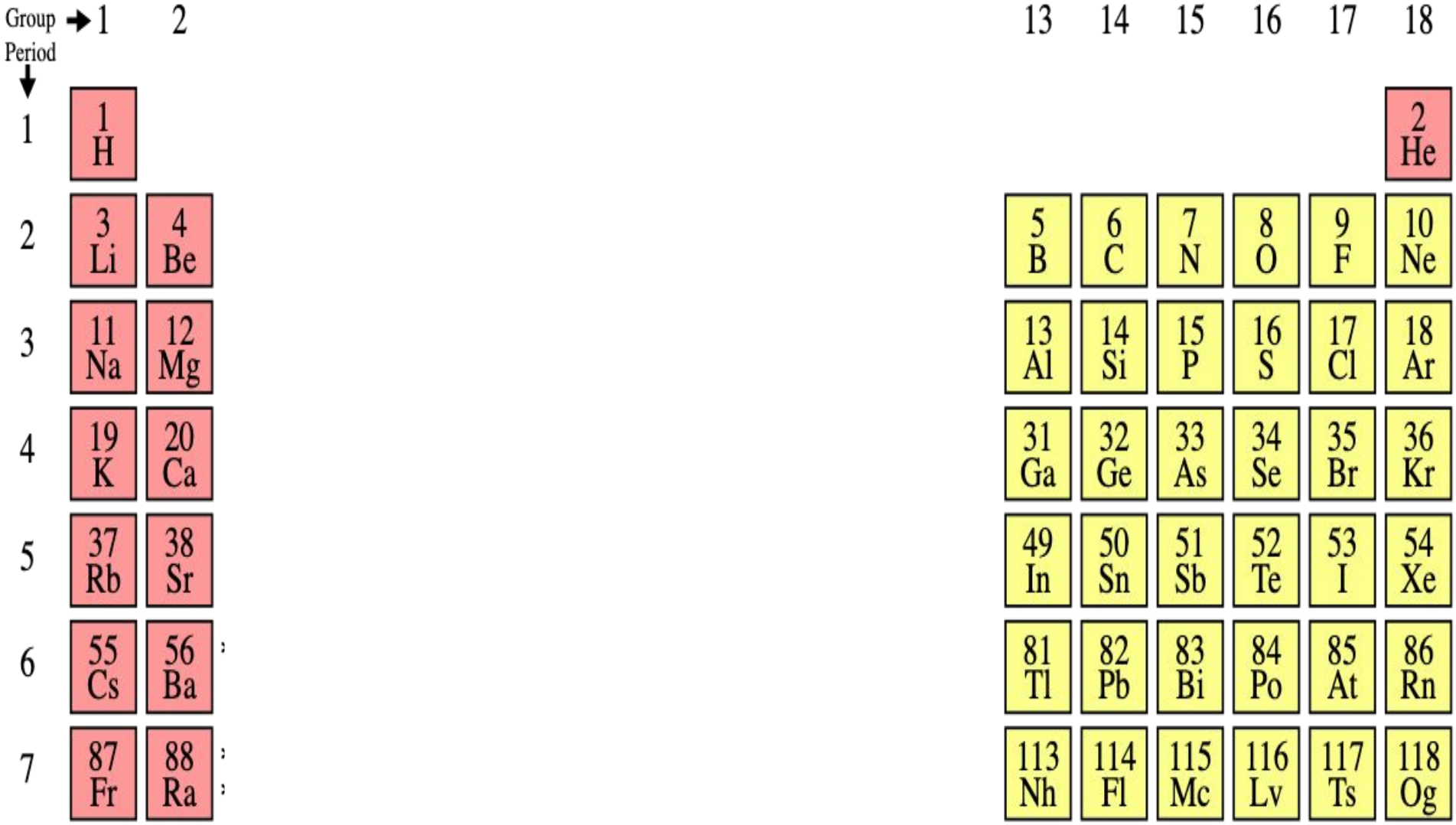
b Electrons will begin filling the **second energy level** only after the first level is full. The second energy level can hold up to eight electrons.

c The **third energy level** fills with electrons after the second level is full. This model of a chlorine atom has a total of 17 electrons. The outer level of this atom has seven electrons and is not full.

2. How is the reactivity of elements related to valence electrons?

- The number of valence electrons in an atom of an element determines the ways in which the atom will bond with other atoms.

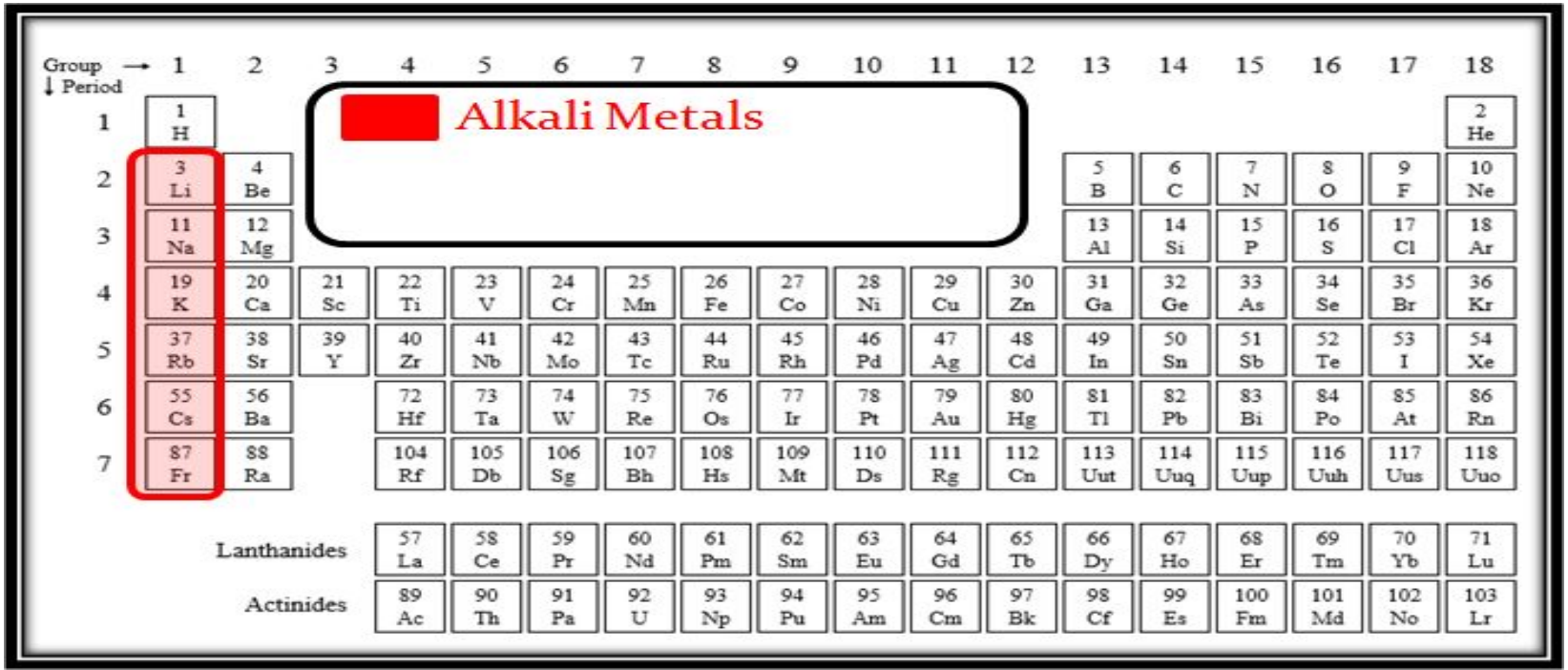



Group
Period
1
2
13
14
15
16
17
18
1 H
2 He
3 Li
4 Be
5 B
6 C
7 N
8 O
9 F
10 Ne
11 Na
12 Mg
13 Al
14 Si
15 P
16 S
17 Cl
18 Ar
19 K
20 Ca
31 Ga
32 Ge
33 As
34 Se
35 Br
36 Kr
37 Rb
38 Sr
49 In
50 Sn
51 Sb
52 Te
53 I
54 Xe
55 Cs
56 Ba
81 Tl
82 Pb
83 Bi
84 Po
85 At
86 Rn
87 Fr
88 Ra
113 Nh
114 Fl
115 Mc
116 Lv
117 Ts
118 Og

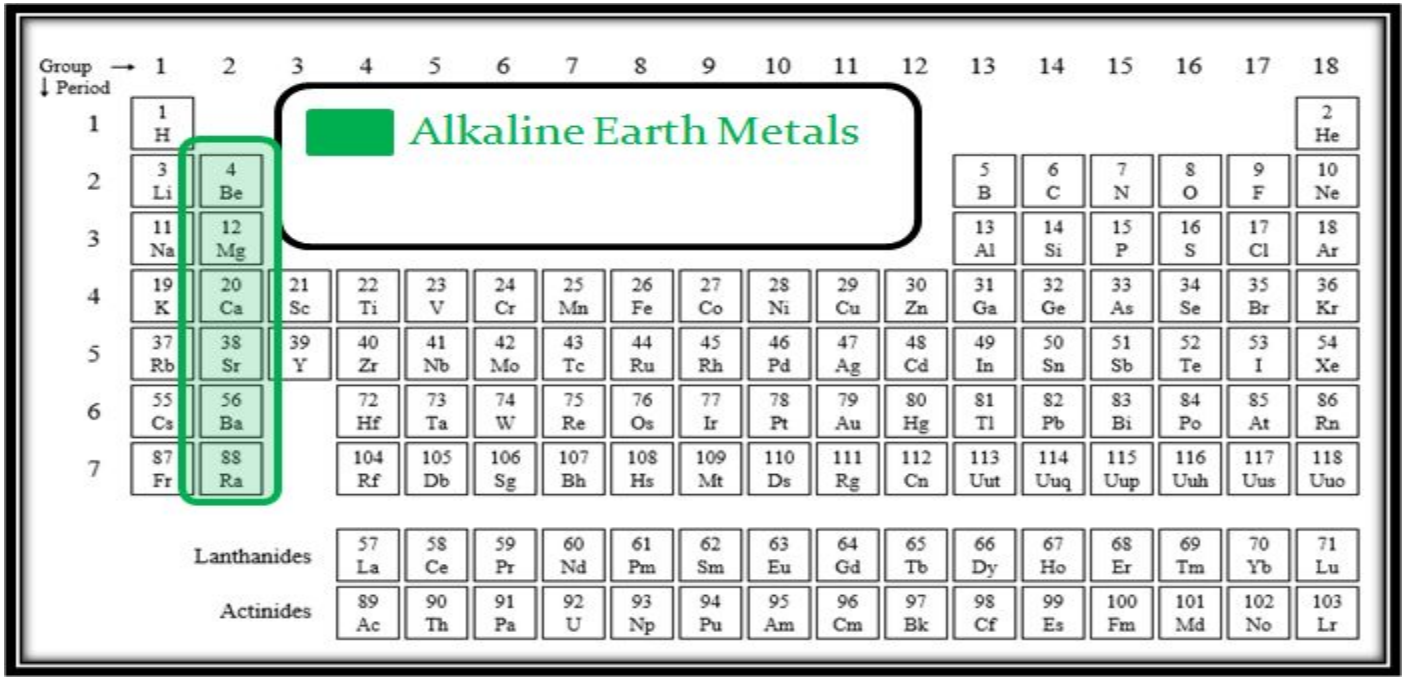
4. What makes atoms unstable?

- Incompletely filled valence electron shells.
- Atoms are stable when they have 0 or 8 electrons in outer level.
- They will gain, lose, or share electrons to empty or fill outer level.

- All of the alkali metals:
  - -Are shiny and soft.
  - -Are highly reactive with other elements.
  - -Easily lose their 1 valence electron.
  - -In nature, are only found in salts - never by themselves.



- All of the Alkaline Earth Metals:
  - -Are shiny and silvery-white.
  - -Are somewhat reactive with other elements.
  - -Easily lose their 2 valence electrons

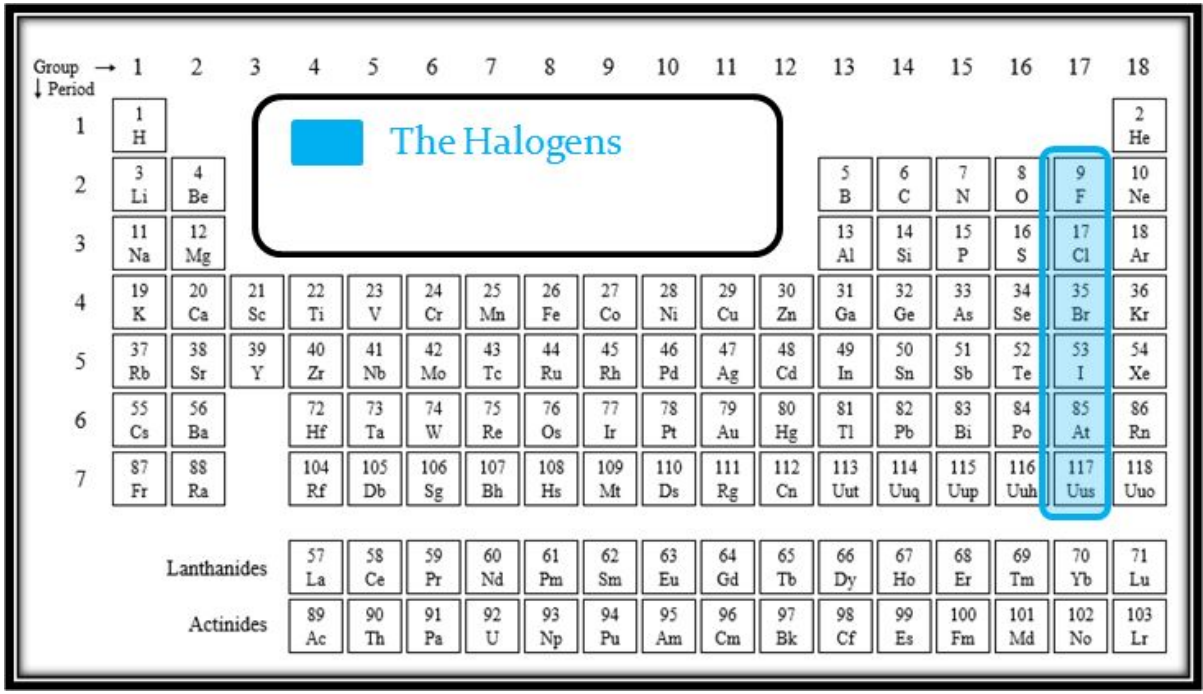


All of the Halogens:

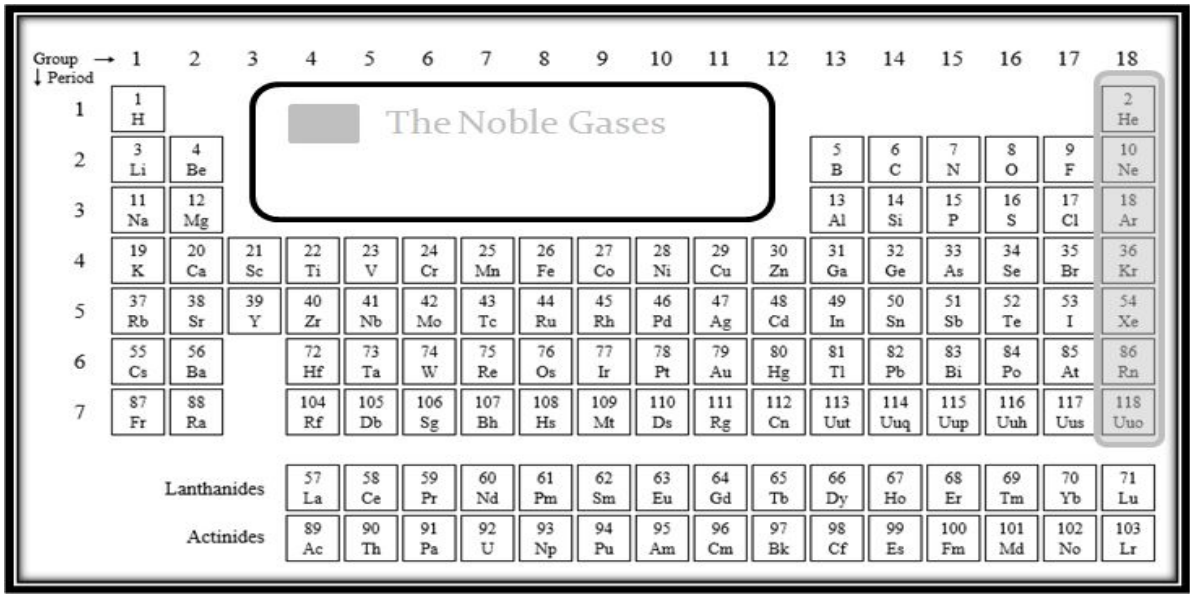
-Are non-metallic.

-Are toxic.

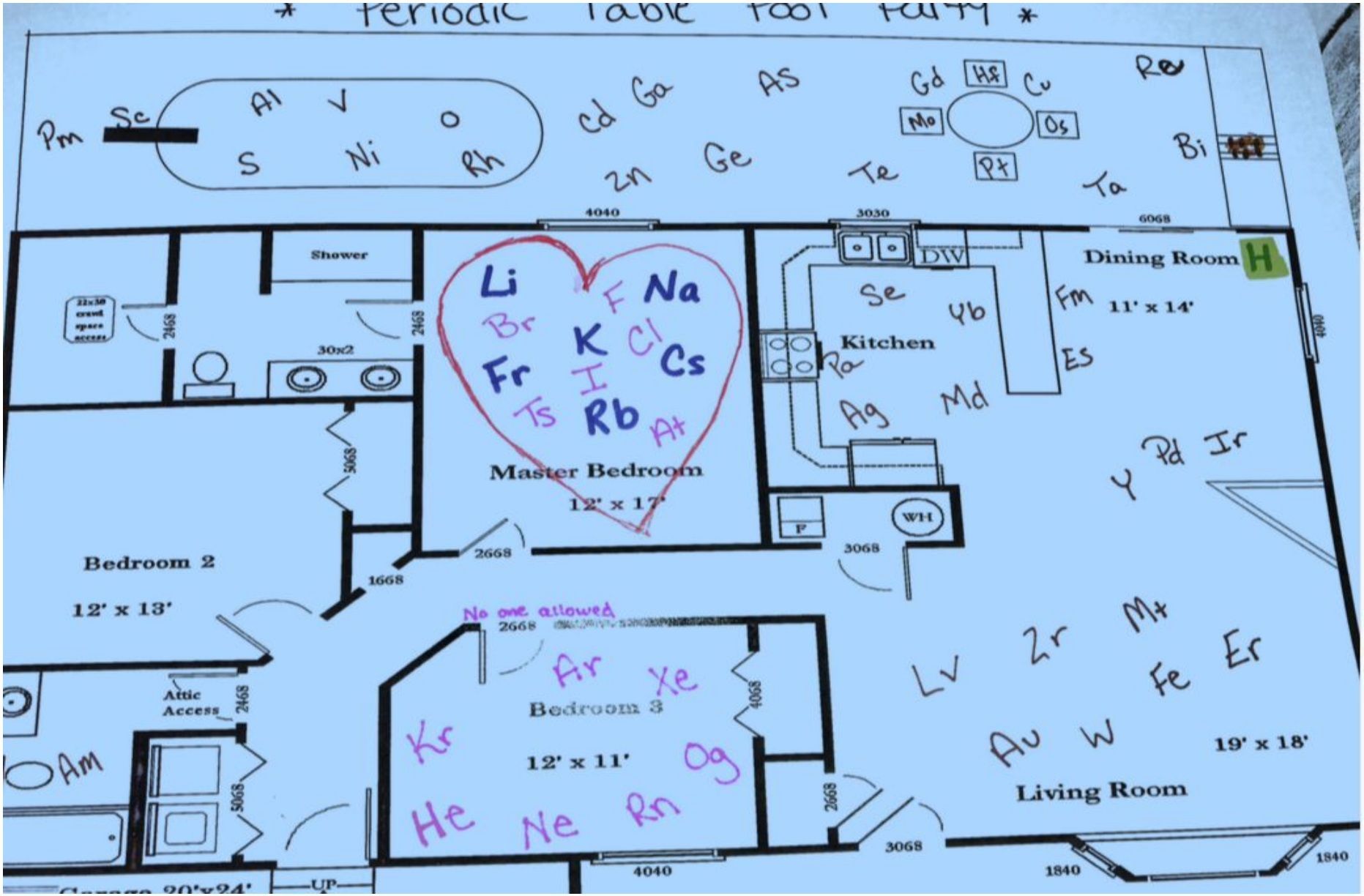
-Are highly reactive...they are short 1 electron in order to have a full outer shell.



- All of the Noble Gases:
  - -Almost never react with any other element.
  - -Have full outer shells.
  - -Are very stable.
  - -Are all gases.
  - -Are odorless and colorless.
  - -



The Element Party Example



Valence Electrons and Lewis Dot Structures

Awesome video!

Stop video after H_2O explanation

Canvas

LEWIS DOT PRACTICE IN CANVAS

- Pair up and complete

10. What is a compound?

- A substance made up of two or more different elements.
- The properties of the compound are different from the elements by themselves.

11. What is a chemical formula?

- A shorthand way to use chemical symbols and numbers to represent a substance.
- Ex: H_2O H = hydrogen

O = oxygen

Figure 1 Chemical Formulas of Different Substances

Water

H_2O

Water molecules are made up of 2 atoms of hydrogen bonded to 1 atom of oxygen.

Oxygen

O_2

Oxygen is a diatomic molecule. Each molecule has 2 atoms of oxygen bonded together.

Glucose

$C_6H_{12}O_6$

Glucose molecules have 6 atoms of carbon, 12 atoms of hydrogen, and 6 atoms of oxygen.

Why it is so important to remember capital vs lowercase letters

Figure 6 **Examples of Similar Symbols and Formulas**

Co

Cobalt The chemical symbol for the element cobalt is Co. Cobalt is a hard, bluish gray metal.

CO

Carbon Monoxide The chemical formula for the compound carbon monoxide is CO. Carbon monoxide is a colorless, odorless, and poisonous gas.

CO_2

Carbon Dioxide The chemical formula for the compound carbon dioxide is CO_2. Carbon dioxide is a colorless, odorless gas that you exhale.

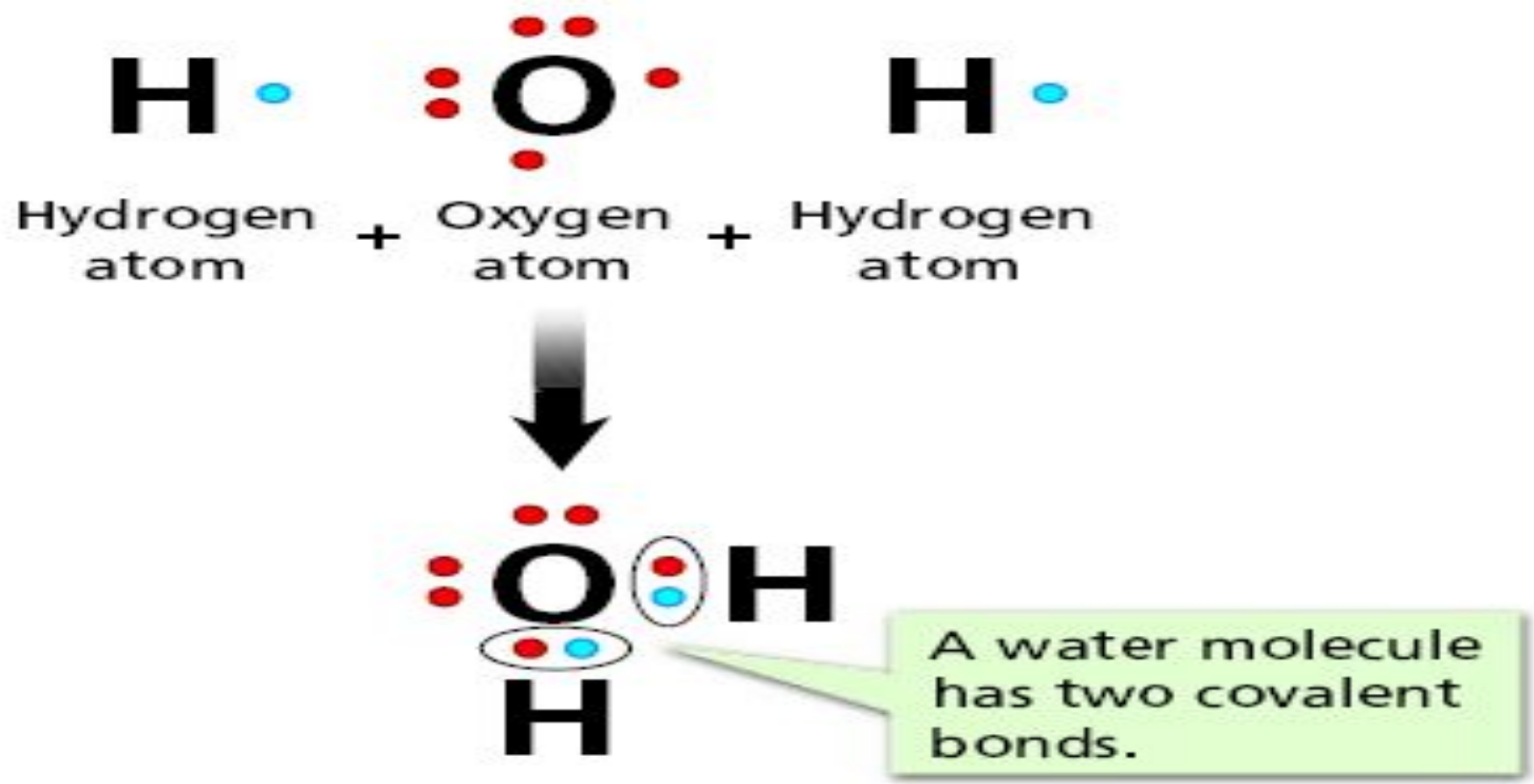
Formulas of Familiar Compounds	
Compound	**Formula**
Water	H_2O
Carbon dioxide	CO_2
Methane	CH_4
Propane	C_3H_8
Sugar (sucrose)	$C_{12}H_{22}O_{11}$
Rubbing alcohol	C_3H_8O
Ammonia	NH_3
Sodium chloride	NaCl
Baking soda	$NaHCO_3$

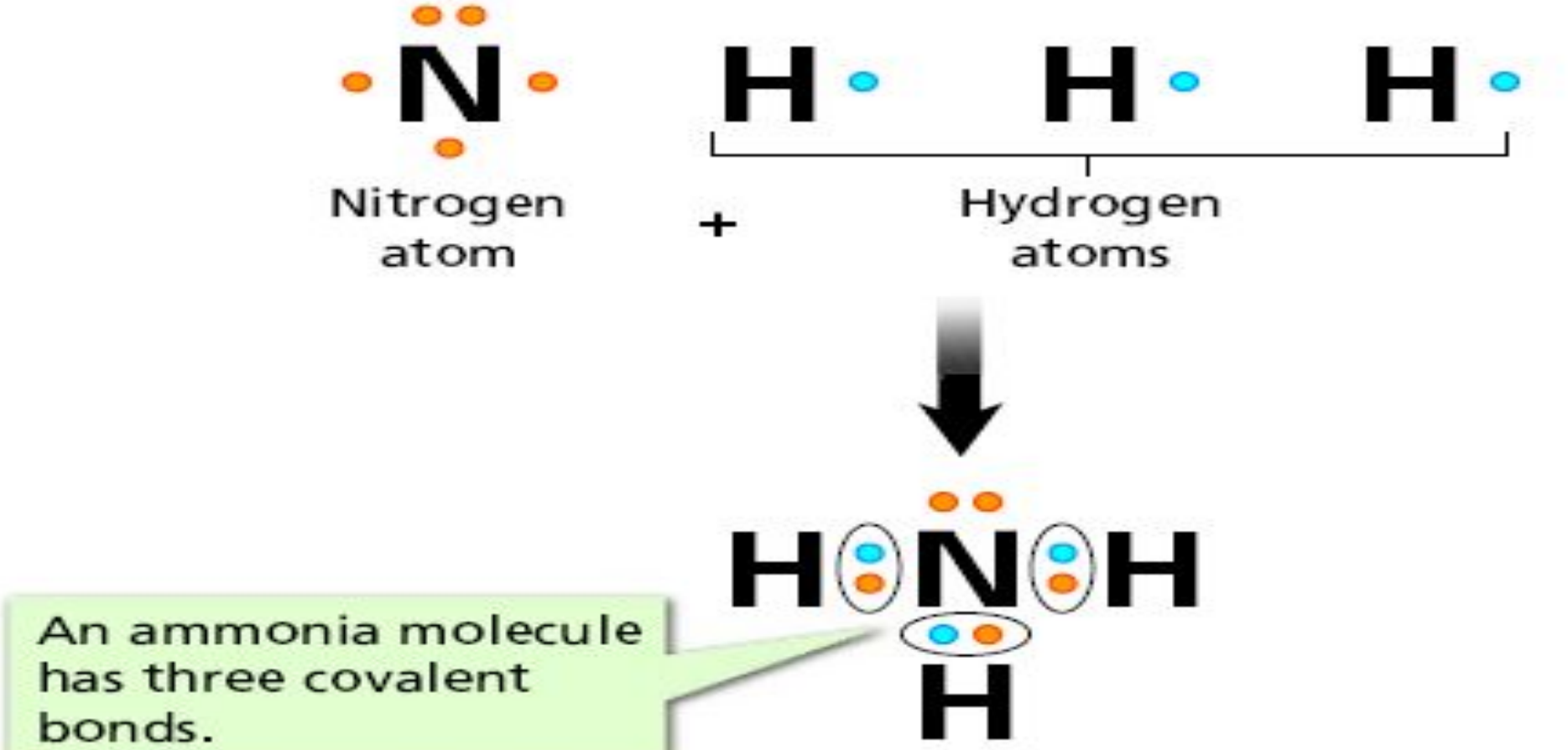
Crash Course Video

(4:20-7:15)

5. What is chemical bonding?

- The joining of atoms to form new substances.


H
O
H
Hydrogen atom
+
Oxygen atom
+
Hydrogen atom
O
H
H
A water molecule has two covalent bonds.


N
H
H
H
Nitrogen atom
+
Hydrogen atoms
H
N
H
H
An ammonia molecule has three covalent bonds.

6. Why do atoms bond?

- To become more stable

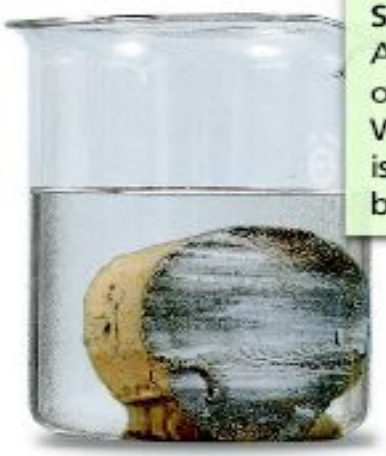
Example:

Sodium (Na) +

(Explosive metal!)

- Chlorine (Cl)
  (toxic gas!)

= NaCl (table salt)



▲ Sodium metal

Sodium Atom
A sodium atom has one valence electron. When the electron is lost, the atom becomes more stable.

Transfer of an electron

Chlorine Atom
A chlorine atom becomes more stable when it gains one electron.

▲ Chlorine gas

Sodium Ion ▶
The sodium atom becomes a sodium ion with a 1+ charge.

◀ **Chloride Ion**
The chlorine atom becomes a chloride ion with a 1− charge.

Ionic Compound: Sodium Chloride ▶
The positive sodium ions and negative chloride ions attract each other. This attractive force is an ionic bond. Each sodium ion balances the charge of one chloride ion so overall, the compound is electrically neutral.

Try these 2 showing they are happy, happy, happy and, therefore, bonded.

1.

2.