

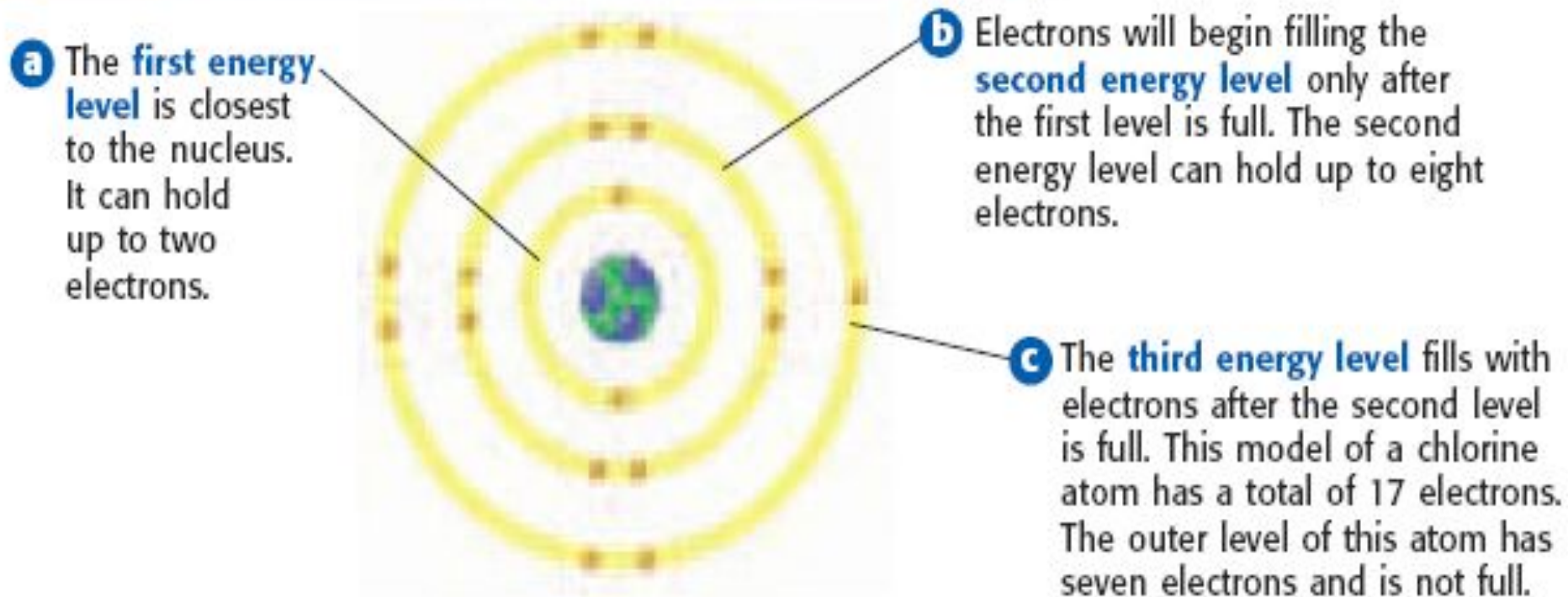


# Chemical Bonding

# 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



## 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.

Valence Electrons							
IA	IIA	IIIA	IVA	VA	VIA	VIIA	VIIIA
Li·	·Be·	·B·	·C·	·N·	·O·	·F·	·Ne·

In general, the number of valence electrons of a representative element is equal to the group number

Group → 1 2

Period ↓

1	1 H	
2	3 Li	4 Be
3	11 Na	12 Mg
4	19 K	20 Ca
5	37 Rb	38 Sr
6	55 Cs	56 Ba
7	87 Fr	88 Ra

13 14 15 16 17 18

					2 He
5 B	6 C	7 N	8 O	9 F	10 Ne
13 Al	14 Si	15 P	16 S	17 Cl	18 Ar
31 Ga	32 Ge	33 As	34 Se	35 Br	36 Kr
49 In	50 Sn	51 Sb	52 Te	53 I	54 Xe
81 Tl	82 Pb	83 Bi	84 Po	85 At	86 Rn
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.



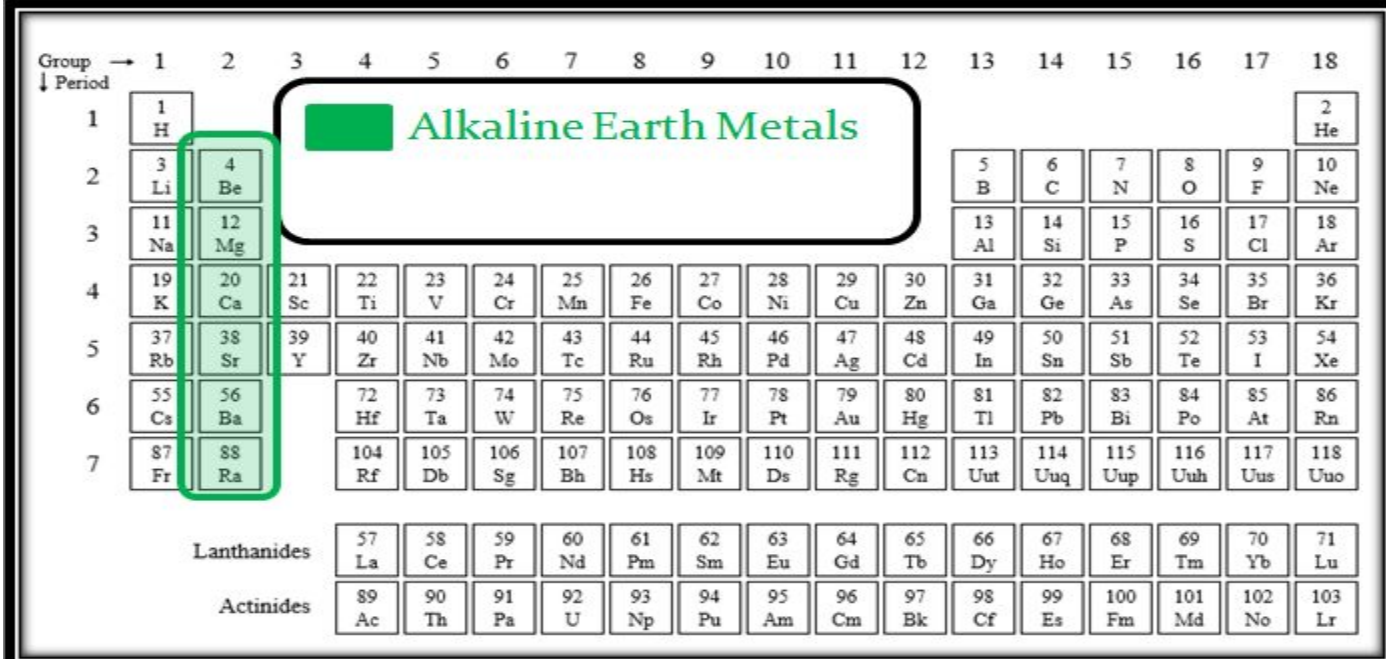
- All of the alkali metals:
- -Are shiny and soft.
- -Are highly reactive with other elements.
- -Easily lose their 1 valence electron.
- -In nature, are only found in salts - never by themselves.

The image shows a periodic table with the alkali metals (Group 1) highlighted in red. A red box labeled "Alkali Metals" is placed over the top part of the table, specifically covering the first column (Group 1) and the first few rows. The elements highlighted are Hydrogen (H), Lithium (Li), Sodium (Na), Potassium (K), Rubidium (Rb), Cesium (Cs), and Francium (Fr).

Group →	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
↓ Period	1																	2
1	H																	He
2	Li	Be											B	C	N	O	F	Ne
3	Na	Mg											Al	Si	P	S	Cl	Ar
4	K	Ca	Sc	Ti	V	Cr	Mn	Fe	Co	Ni	Cu	Zn	Ga	Ge	As	Se	Br	Kr
5	Rb	Sr	Y	Zr	Nb	Mo	Tc	Ru	Rh	Pd	Ag	Cd	In	Sn	Sb	Te	I	Xe
6	Cs	Ba		Hf	Ta	W	Re	Os	Ir	Pt	Au	Hg	Tl	Pb	Bi	Po	At	Rn
7	Fr	Ra		Rf	Db	Sg	Bh	Hs	Mt	Ds	Rg	Cn	Uut	Uuq	Uup	Uuh	Uus	Uuo
Lanthanides			57	58	59	60	61	62	63	64	65	66	67	68	69	70	71	
Actinides			89	90	91	92	93	94	95	96	97	98	99	100	101	102	103	
			La	Ce	Pr	Nd	Pm	Sm	Eu	Gd	Tb	Dy	Ho	Er	Tm	Yb	Lu	
			Ac	Th	Pa	U	Np	Pu	Am	Cm	Bk	Cf	Es	Fm	Md	No	Lr	

# □ All of the Alkaline Earth Metals:

- -Are shiny and silvery-white.
- -Are somewhat reactive with other elements.
- -Easily lose their 2 valence electrons

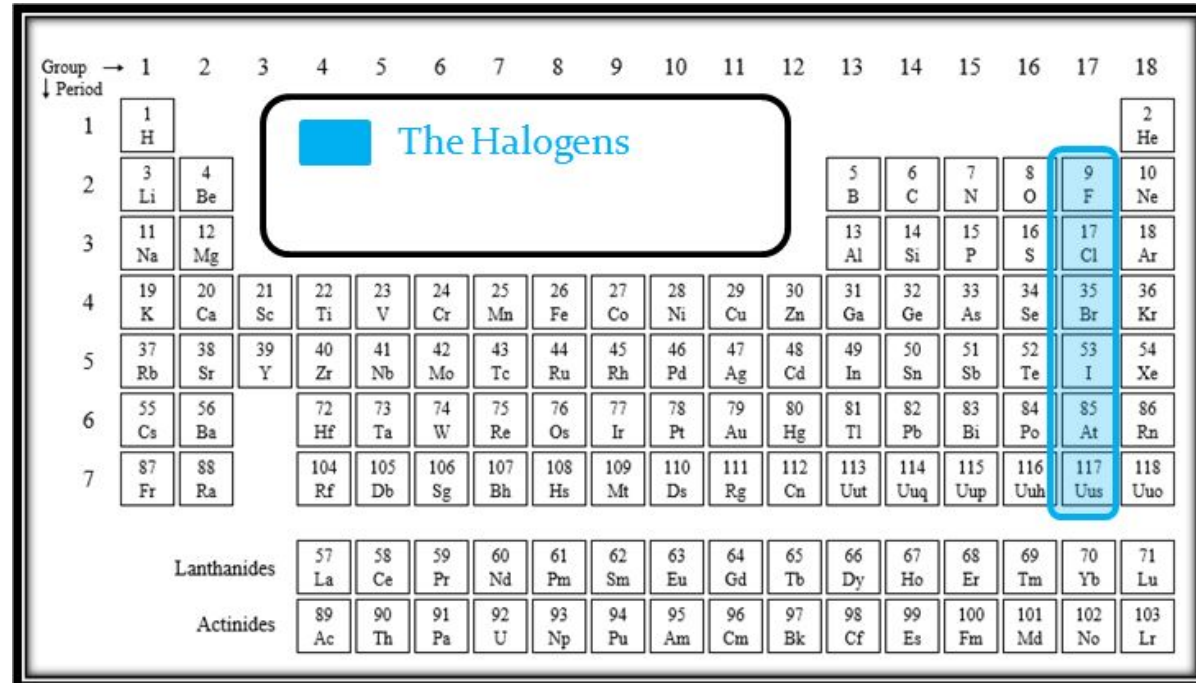


The image shows a periodic table with the Alkaline Earth Metals highlighted in green. A green box labeled "Alkaline Earth Metals" is placed over the elements in Group 2. The elements highlighted are Be, Mg, Ca, Sr, Ba, and Ra. The periodic table includes group and period numbers, and labels for Lanthanides and Actinides.

Group →	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
↓ Period																		
1	1 H																	2 He
2	3 Li	4 Be											5 B	6 C	7 N	8 O	9 F	10 Ne
3	11 Na	12 Mg											13 Al	14 Si	15 P	16 S	17 Cl	18 Ar
4	19 K	20 Ca	21 Sc	22 Ti	23 V	24 Cr	25 Mn	26 Fe	27 Co	28 Ni	29 Cu	30 Zn	31 Ga	32 Ge	33 As	34 Se	35 Br	36 Kr
5	37 Rb	38 Sr	39 Y	40 Zr	41 Nb	42 Mo	43 Tc	44 Ru	45 Rh	46 Pd	47 Ag	48 Cd	49 In	50 Sn	51 Sb	52 Te	53 I	54 Xe
6	55 Cs	56 Ba		72 Hf	73 Ta	74 W	75 Re	76 Os	77 Ir	78 Pt	79 Au	80 Hg	81 Tl	82 Pb	83 Bi	84 Po	85 At	86 Rn
7	87 Fr	88 Ra		104 Rf	105 Db	106 Sg	107 Bh	108 Hs	109 Mt	110 Ds	111 Rg	112 Cn	113 Uut	114 Uuq	115 Uup	116 Uuh	117 Uus	118 Uuo
			Lanthanides	57 La	58 Ce	59 Pr	60 Nd	61 Pm	62 Sm	63 Eu	64 Gd	65 Tb	66 Dy	67 Ho	68 Er	69 Tm	70 Yb	71 Lu
			Actinides	89 Ac	90 Th	91 Pa	92 U	93 Np	94 Pu	95 Am	96 Cm	97 Bk	98 Cf	99 Es	100 Fm	101 Md	102 No	103 Lr

# □ 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.



The periodic table below highlights the halogens in blue. A blue box labeled "The Halogens" is placed over the transition metals. The elements highlighted are Fluorine (F), Chlorine (Cl), Bromine (Br), Iodine (I), Astatine (At), and Ununseptium (Uus).

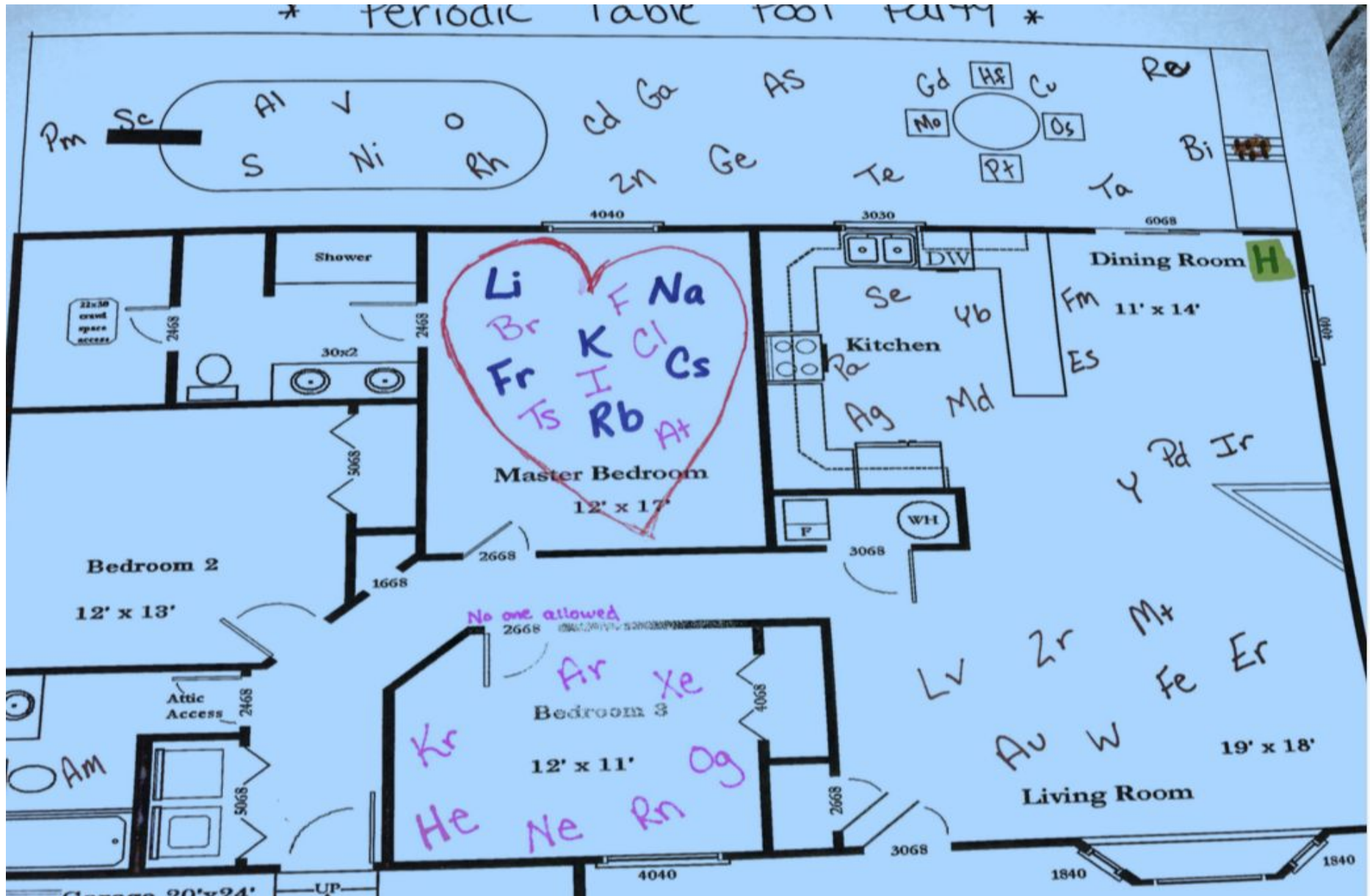
Group →	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
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5	37 Rb	38 Sr	39 Y	40 Zr	41 Nb	42 Mo	43 Tc	44 Ru	45 Rh	46 Pd	47 Ag	48 Cd	49 In	50 Sn	51 Sb	52 Te	53 I	54 Xe
6	55 Cs	56 Ba		72 Hf	73 Ta	74 W	75 Re	76 Os	77 Ir	78 Pt	79 Au	80 Hg	81 Tl	82 Pb	83 Bi	84 Po	85 At	86 Rn
7	87 Fr	88 Ra		104 Rf	105 Db	106 Sg	107 Bh	108 Hs	109 Mt	110 Ds	111 Rg	112 Cn	113 Uut	114 Uuq	115 Uup	116 Uuh	117 Uus	118 Uuo
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			Actinides	89 Ac	90 Th	91 Pa	92 U	93 Np	94 Pu	95 Am	96 Cm	97 Bk	98 Cf	99 Es	100 Fm	101 Md	102 No	103 Lr



- 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.
- -

Group →	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
↓ Period																		
1	1 H			The Noble Gases											2 He			
2	3 Li	4 Be											5 B	6 C	7 N	8 O	9 F	10 Ne
3	11 Na	12 Mg											13 Al	14 Si	15 P	16 S	17 Cl	18 Ar
4	19 K	20 Ca	21 Sc	22 Ti	23 V	24 Cr	25 Mn	26 Fe	27 Co	28 Ni	29 Cu	30 Zn	31 Ga	32 Ge	33 As	34 Se	35 Br	36 Kr
5	37 Rb	38 Sr	39 Y	40 Zr	41 Nb	42 Mo	43 Tc	44 Ru	45 Rh	46 Pd	47 Ag	48 Cd	49 In	50 Sn	51 Sb	52 Te	53 I	54 Xe
6	55 Cs	56 Ba		72 Hf	73 Ta	74 W	75 Re	76 Os	77 Ir	78 Pt	79 Au	80 Hg	81 Tl	82 Pb	83 Bi	84 Po	85 At	86 Rn
7	87 Fr	88 Ra		104 Rf	105 Db	106 Sg	107 Bh	108 Hs	109 Mt	110 Ds	111 Rg	112 Cn	113 Uut	114 Uuq	115 Uup	116 Uuh	117 Uus	118 Uuo
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# The Element Party Example



# Valence Electrons and Lewis Dot Structures

[Awesome video!](#)

Stop video after H<sub>2</sub>O 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.

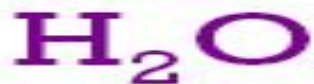
# 11. What is a chemical formula?

- 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



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



Oxygen



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



Glucose



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<sub>2</sub>

**Carbon Dioxide** The chemical formula for the compound carbon dioxide is CO<sub>2</sub>. Carbon dioxide is a colorless, odorless gas that you exhale.

## Formulas of Familiar Compounds

Compound	Formula
Water	$\text{H}_2\text{O}$
Carbon dioxide	$\text{CO}_2$
Methane	$\text{CH}_4$
Propane	$\text{C}_3\text{H}_8$
Sugar (sucrose)	$\text{C}_{12}\text{H}_{22}\text{O}_{11}$
Rubbing alcohol	$\text{C}_3\text{H}_8\text{O}$
Ammonia	$\text{NH}_3$
Sodium chloride	$\text{NaCl}$
Baking soda	$\text{NaHCO}_3$

[Crash Course Video](#)

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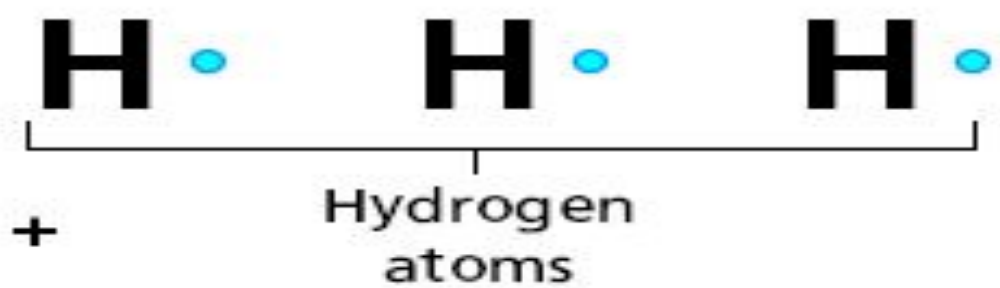


# 5. What is chemical bonding?

- The joining of atoms to form new substances.



A water molecule has two covalent bonds.



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



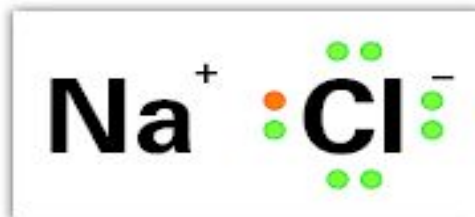
**Chlorine Atom**  
A chlorine atom becomes more stable when it gains one electron.



▲ 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.

