

# The Periodic table

# History of the periodic table

- There were a great many chemists who were investigating the chemical properties of elements in the 1800s. At that time there was no specific way of organizing the information about the elements. Each scientist had their own “in house” method.
- Dmitri Mendeleev was a Russian chemist, and is given most of the credit for arranging the modern periodic table.
- Mendeleev wrote out the known information about each element on a card, and spent hours shuffling and reorganizing them by various means

# How are elements organized?

- In Mendeleev's day, nothing was known about the sub atomic particles, but the relative atomic mass was known. He arranged his periodic table in order of increasing atomic mass and by reactivity.
- The modern periodic table still arranges atoms by reactivity, but uses the atomic number rather than the atomic mass.
- Each element has a box on the periodic table, which tells the element's specific information.

8
O
Oxygen
15.999

← **Atomic number: the number of protons in the nucleus**

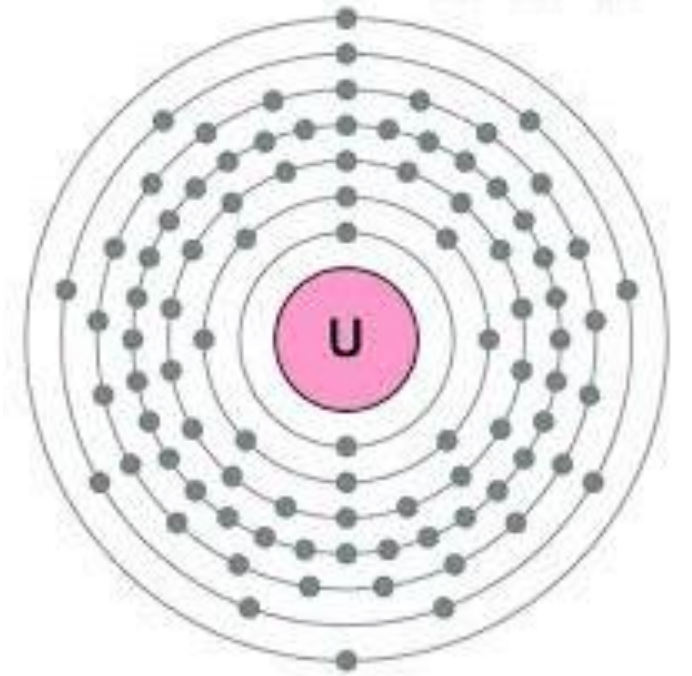
← **Atomic symbol: official abbreviation of element name**

← **Element Name: the English name of element**

← **Atomic mass: average number of protons and neutrons in one atom of this element.**

# Electron configuration

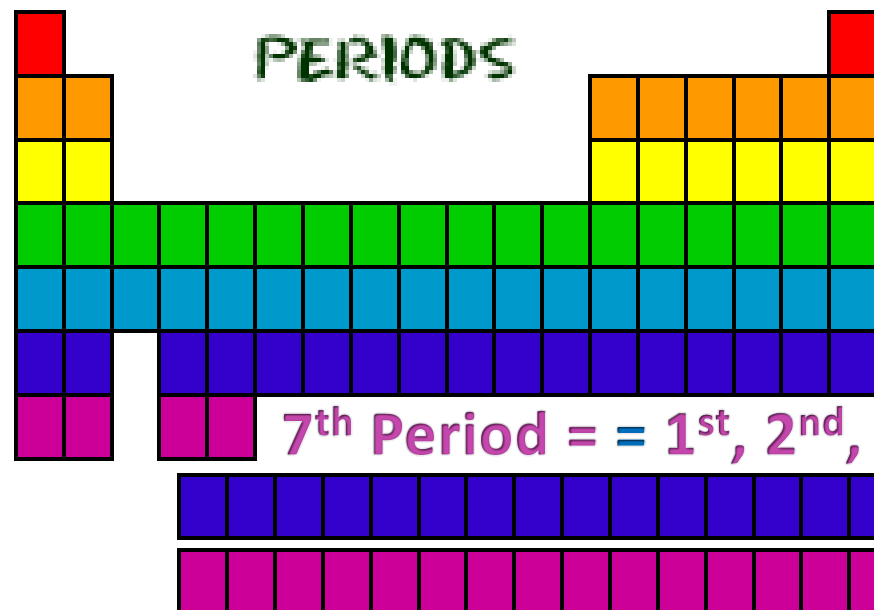
- Each electron shell can hold a specific number of electrons.
- The shells fill from the inside out. For example, if an atom has 8 electrons, the first two will fill the first shell, and the remaining six will be in the second shell.
- The Noble gases always have a full valence shell.



Period number	Electron capacity
1	2
2	8
3	8
4	18
5	18
6	32
7	32

# Patterns within the table

- The modern periodic table arranges atoms a system of rows and columns. The rows are called periods.
- Each period also represents one electron shell. For example, period one elements have one shell. Period two elements have two shells, etc.



**1<sup>st</sup> Period = 1 Shell**

**2<sup>nd</sup> Period = 1<sup>st</sup> & 2<sup>nd</sup> shells**

**3<sup>rd</sup> Period = 1<sup>st</sup>, 2<sup>nd</sup> & 3<sup>rd</sup> Shells**

**4<sup>th</sup> Period = 1<sup>st</sup>, 2<sup>nd</sup>, 3<sup>rd</sup> & 4<sup>th</sup> Shells**

**5<sup>th</sup> Period = 1<sup>st</sup>, 2<sup>nd</sup>, 3<sup>rd</sup>, 4<sup>th</sup> & 5<sup>th</sup> Shells**

**6<sup>th</sup> Period = 1<sup>st</sup>, 2<sup>nd</sup>, 3<sup>rd</sup>, 4<sup>th</sup>, 5<sup>th</sup> & 6<sup>th</sup> Shells**

**7<sup>th</sup> Period = = 1<sup>st</sup>, 2<sup>nd</sup>, 3<sup>rd</sup>, 4<sup>th</sup>, 5<sup>th</sup>, 6<sup>th</sup> & 7<sup>th</sup> Shells**

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**7<sup>th</sup> Period = = 1<sup>st</sup>, 2<sup>nd</sup>, 3<sup>rd</sup>, 4<sup>th</sup>, 5<sup>th</sup>, 6<sup>th</sup> & 7<sup>th</sup> Shells**

- Elements are arranged in periods according to increasing electron affinity - how strongly the atom pulls electrons towards its nucleus.

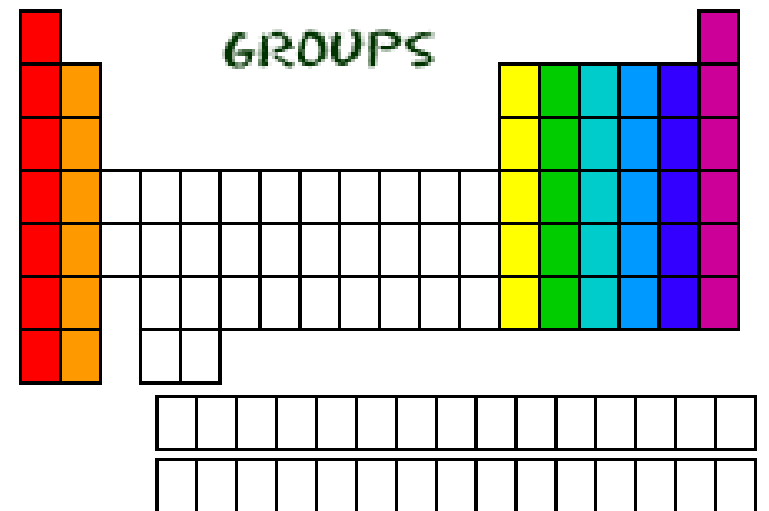
INCREASING ELECTRON AFFINITY

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	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														
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														
55 Cs	56 Ba	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	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
87 Fr	88 Ra	89 Ac	104 Rf	105 Db	106 Sg	107 Bh	108 Hs	109 Mt	110 Ds	111 Rg	112 Cn	113 Nh	114 Fl	115 Mc	116 Lv	117 Ts	118 Og														

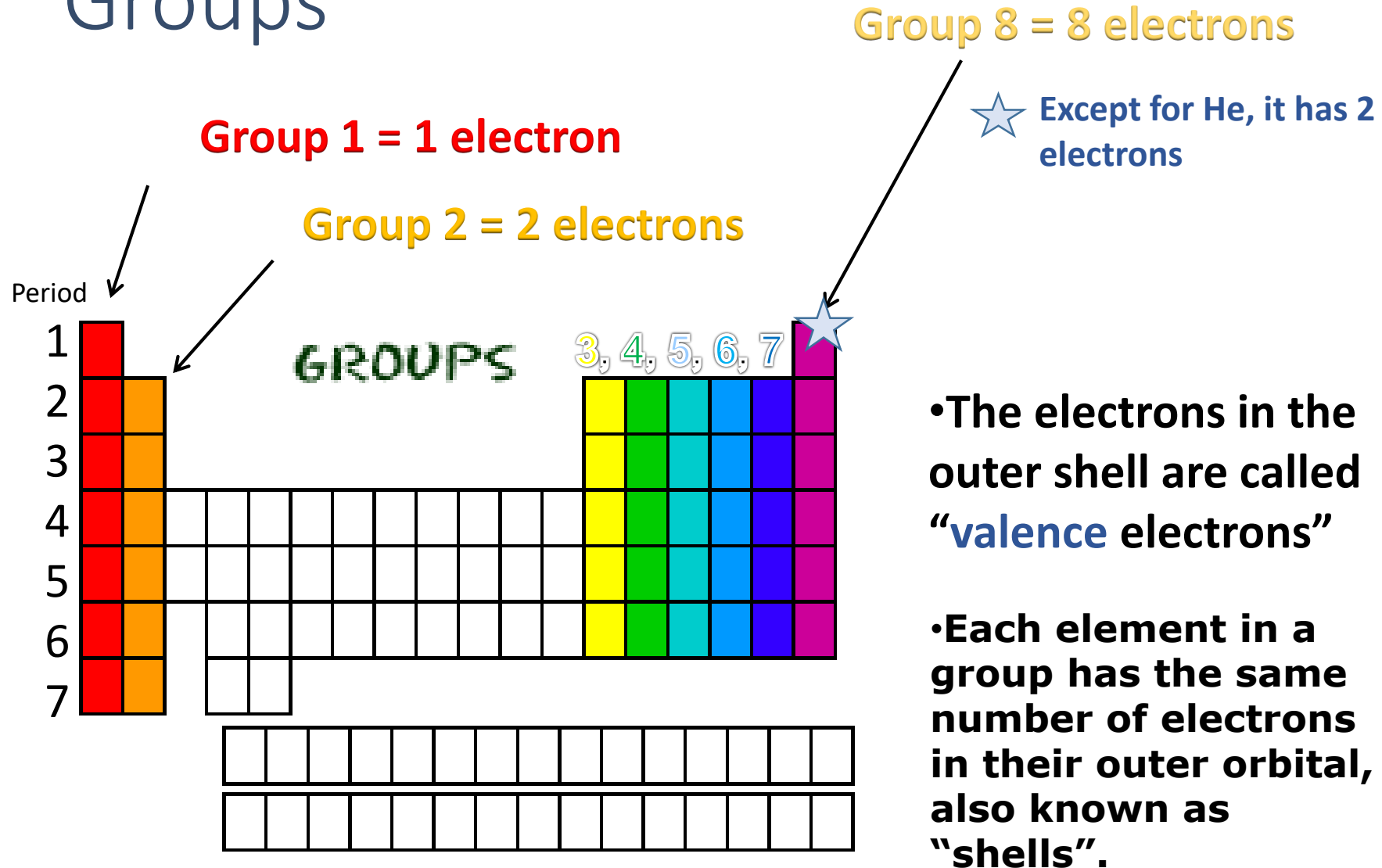
INCREASING ELECTRON AFFINITY

# Patterns within the table

- Groups are the vertical columns on the periodic table. The elements within a group all have the same valence electron configuration, with one additional filled orbital shell.
- Each element in a group is progressively larger than the last, so atomic mass increases as you move down the column.
- The similar valence electrons cause the elements of a period to have similar reactive properties and behaviors.
- Each group is numbered
  - group 1 are alkali metals
  - Group 2 are alkaline earth metals
  - etc

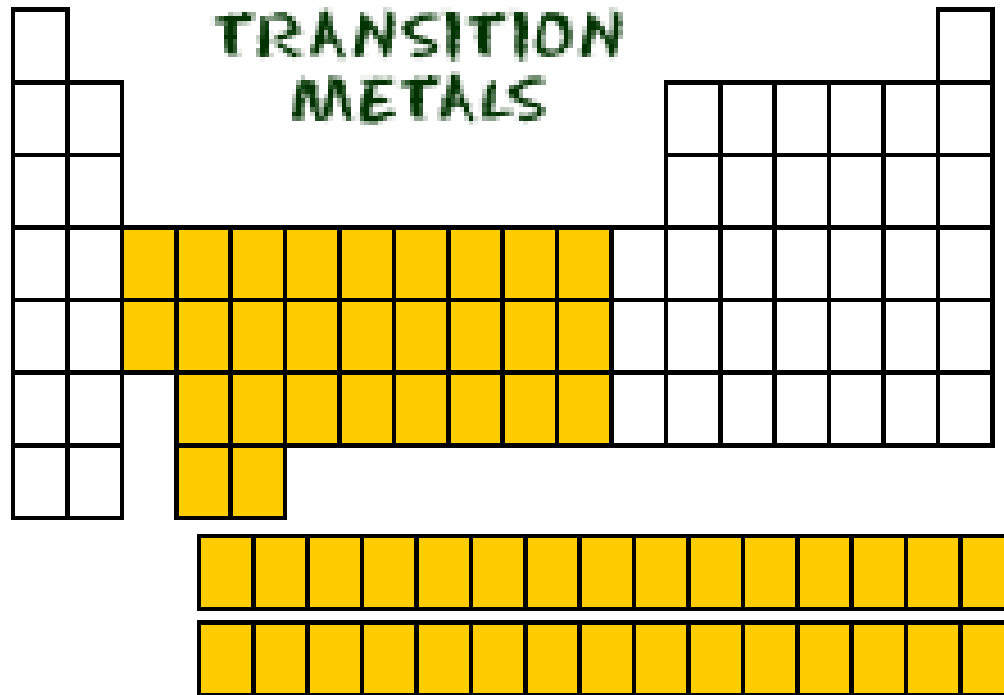


# Groups





# Transition Metals

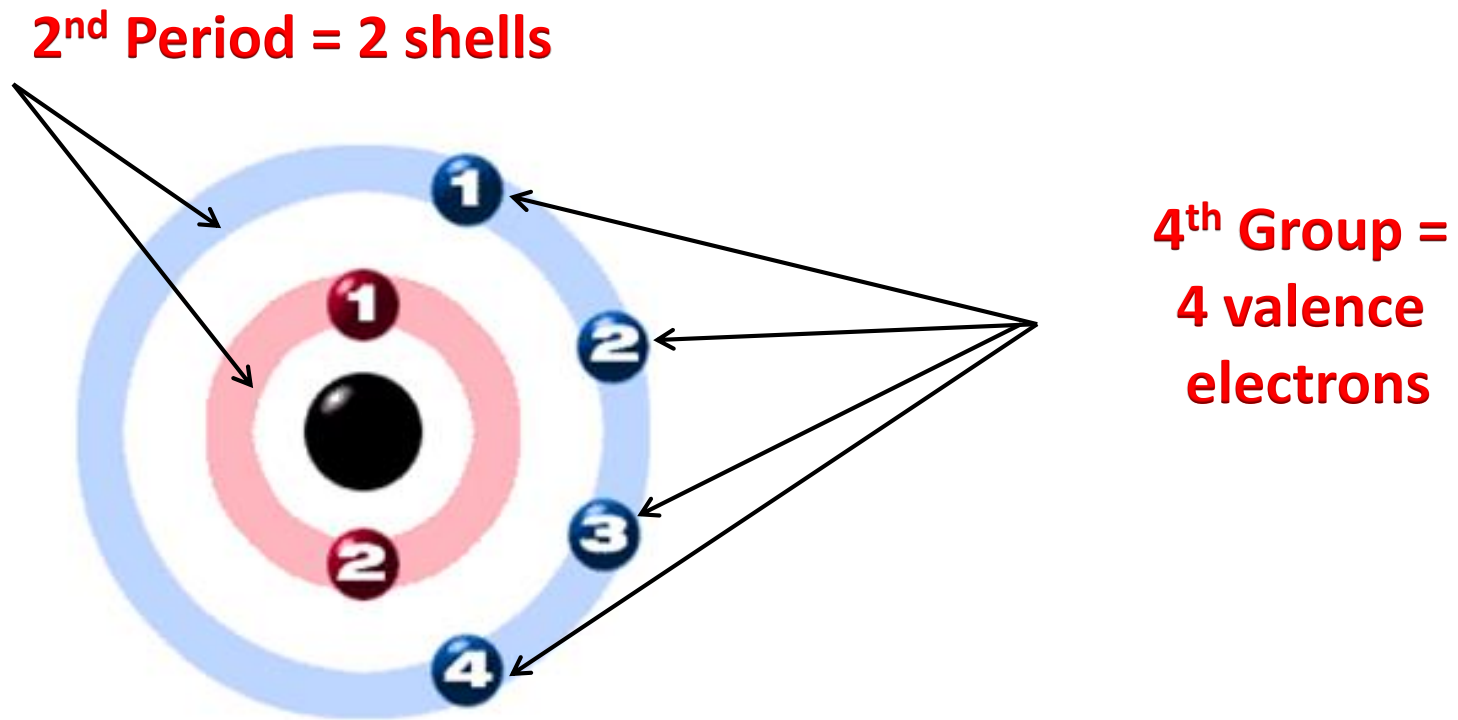


- **Transition Metals have slightly different rules for shells and valence electrons.**

- **They form metallic bonds, which is something you will learn about in High School Chemistry.**

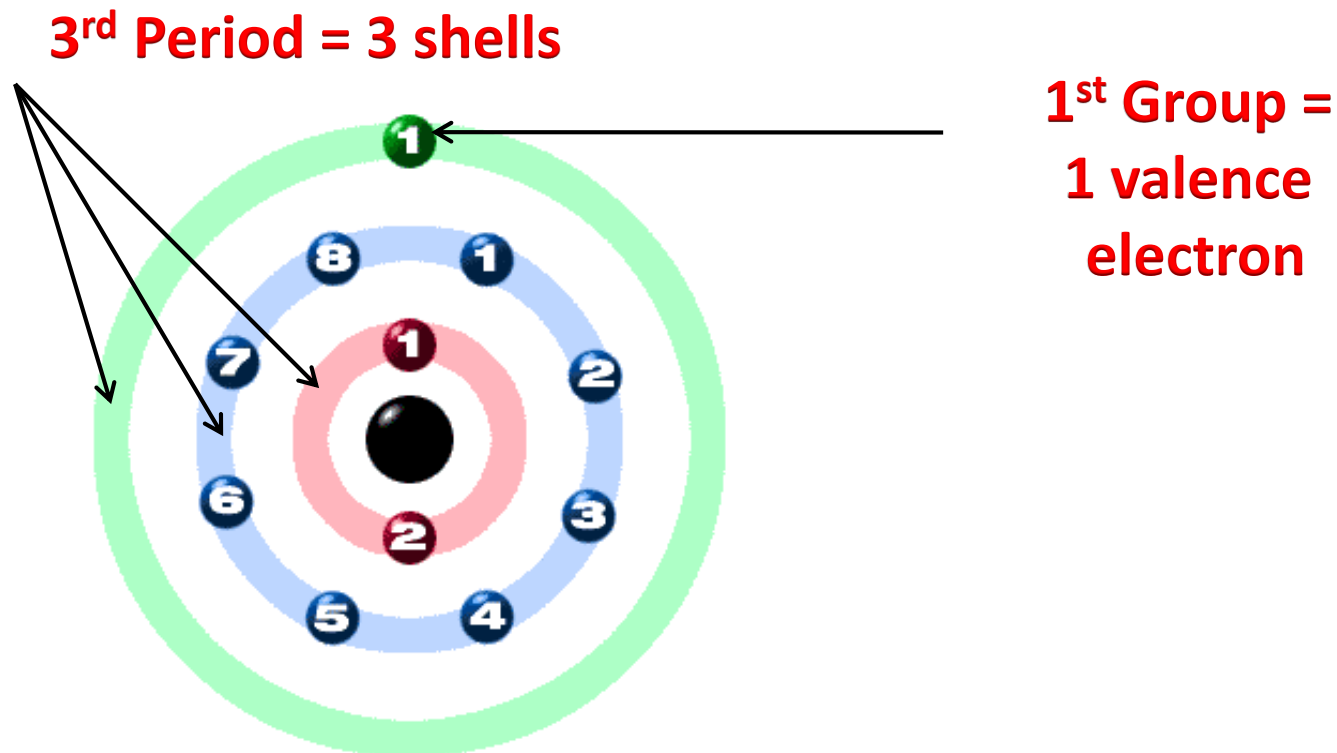
Determine the number of shells and the number of valence electrons for:

## Carbon - C



Determine the number of shells and the number of valence electrons for:

## Sodium - Na



**Write your answers on your handout.**

**S**

**Name the element.**

**Number of shells ?**

**Valence electrons ?**

Write your answers on your handout.

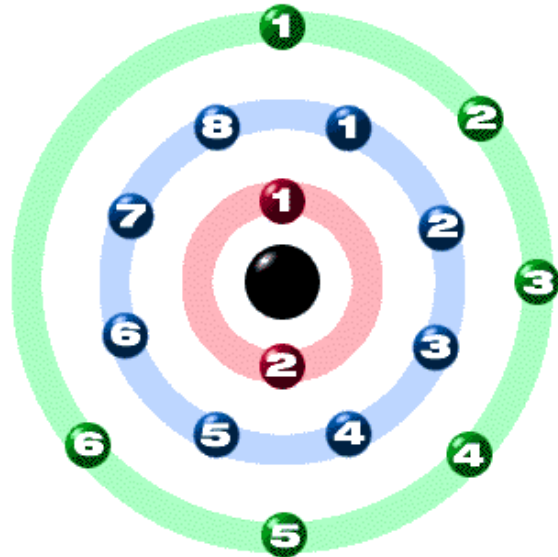
S

Name the element.  
Number of shells ?  
Valence electrons ?

Sulfur

3<sup>rd</sup> Period = 3 shells

6<sup>th</sup> Group = 6 valence  
electrons



**Write your answers on your handout.**

**K**

**Name the element.**

**Number of shells ?**

**Valence electrons ?**

Write your answers on your handout.

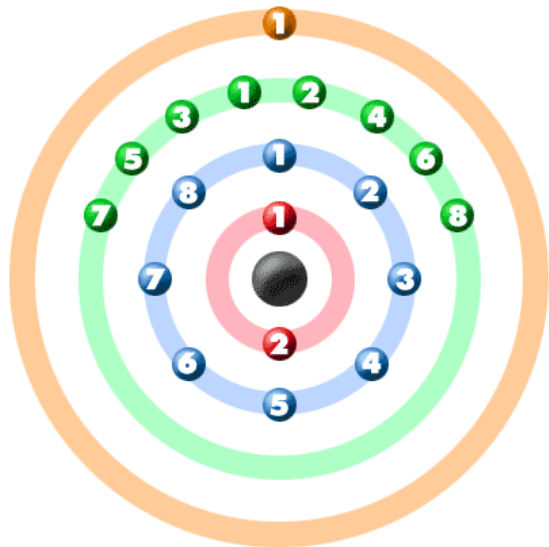
K

Name the element.  
Number of shells ?  
Valence electrons ?

Potassium

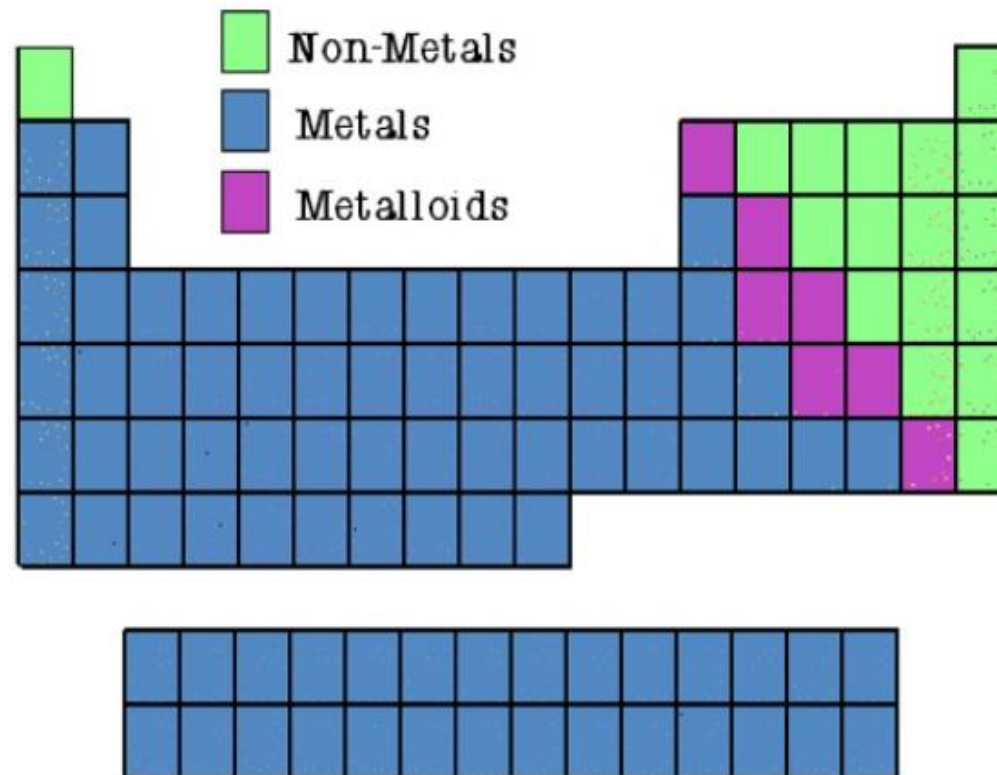
4<sup>th</sup> Period = 4 shells

1<sup>st</sup> Group = 1 valence  
electron



# Classification of Elements

- the elements on the periodic table are also classified according to their status as a metal, non-metal, or a metalloid (has properties of both).





# Metals

## Metals

- good conductors of heat and electricity.
- Lustrous (shiny)
- ductile (stretchable)
- malleable (can be pounded into sheets.)
- Corrosive in presence of water.



# Non-metals

- poor conductors of heat and electricity; some are useful as insulators.
- Non-ductile and non-malleable.
- brittle and break easily.
- Non-lustrous (dull).
- - Many are gases.



# Metalloids (semi-metals)

- have properties of both metals and non-metals.
- solids that may or may not be lustrous.
- conduct heat and electricity better than non-metals but not as well as metals. (semiconductors are useful in electronics, where electrical conductivity is good, but heat conductivity is bad.
- are ductile and malleable.



# Element families

- Elements are divided up into groups called families based on their physical and chemical characteristics and behaviors
- Some, like the alkali metals, alkaline metals, halogens, and noble gases are a single group on the periodic table
- The transition metals are made of several groups.
- Other families, like the other metals, halogens, and nonmetals are composed of a few elements from several groups.
- There are nine families

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	57* La	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	89** Ac	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

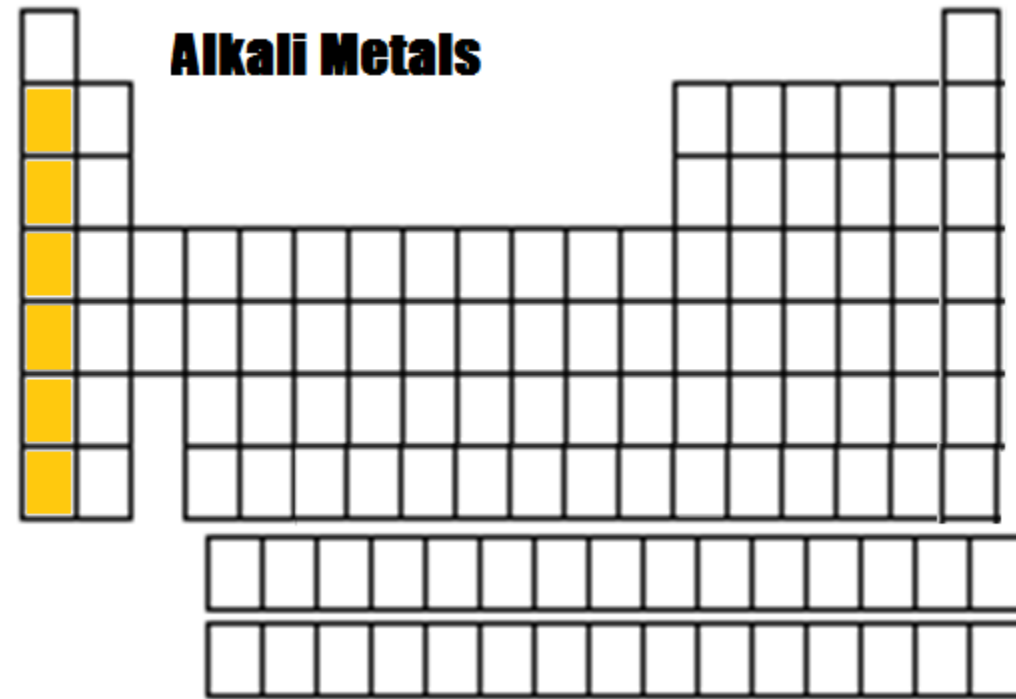
○ Non Metals	● Noble Gases
● Alkali Metals	● Metalloids
● Alkaline Metals	● Halogens
● Transition Metals	● Other Metals
● Rare Earth Elements	

*Lanthanides	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	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

# The Alkali Metal

## Group 1

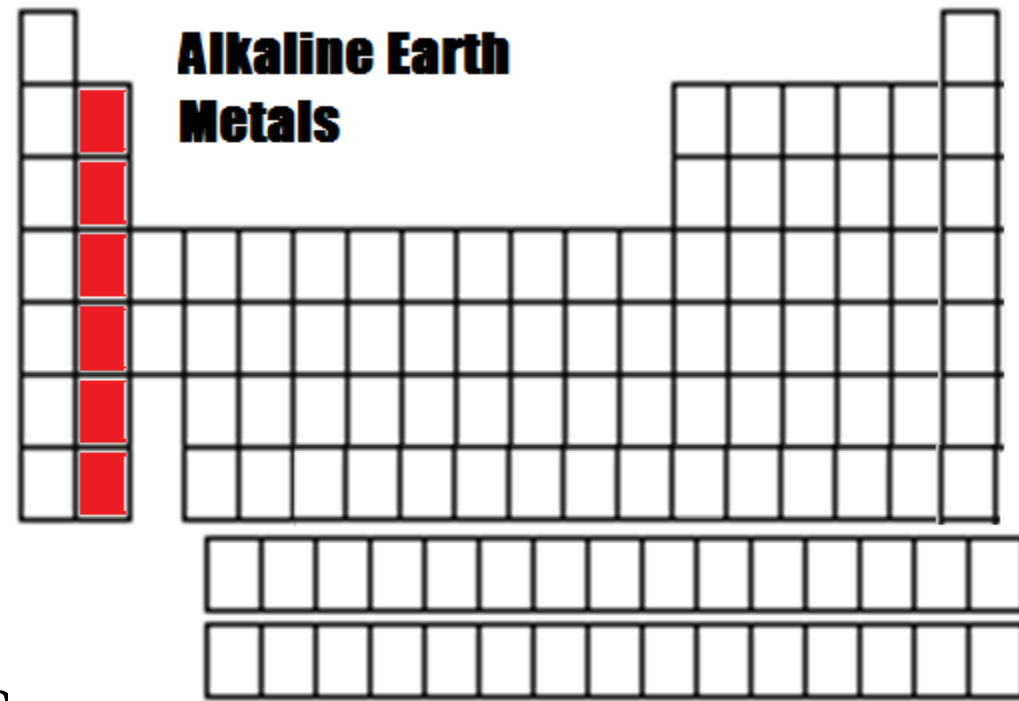
- Hydrogen is *not* a member, it is a **non-metal**
- Soft and silvery metals
- 1 electron in the outer shell
- Want to lose 1 electron to complete their valence shell, making them *very* reactive, esp. with water
- Conduct electricity



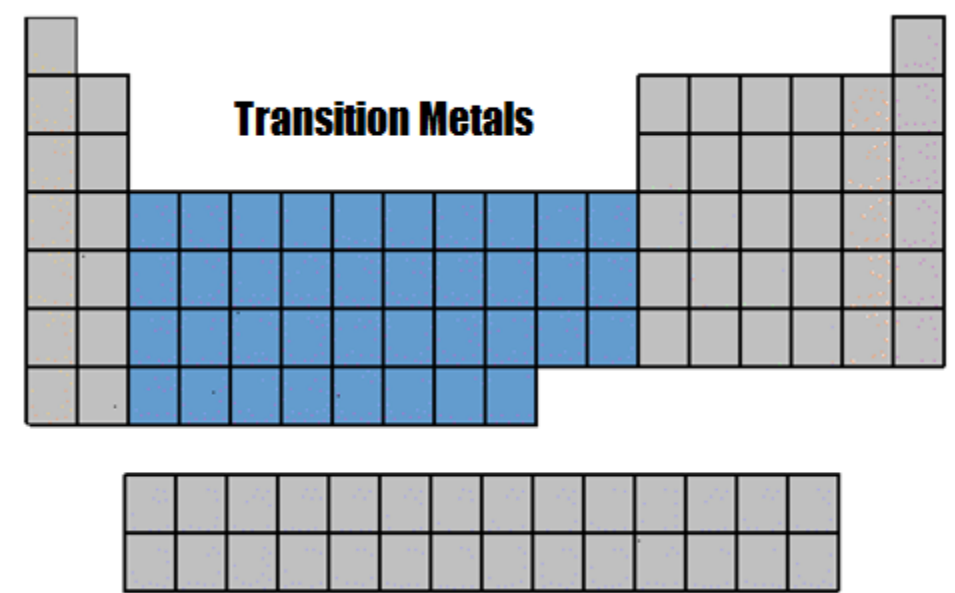
# The Alkaline Metal

## Group 2

- White and malleable
- 2 electrons in the outer shell
- Want to lose 2 electrons to complete the valence shell, making them very reactive, but less than Alkali metals
- Conduct electricity



# The Transition Metal family



## Groups in the middle

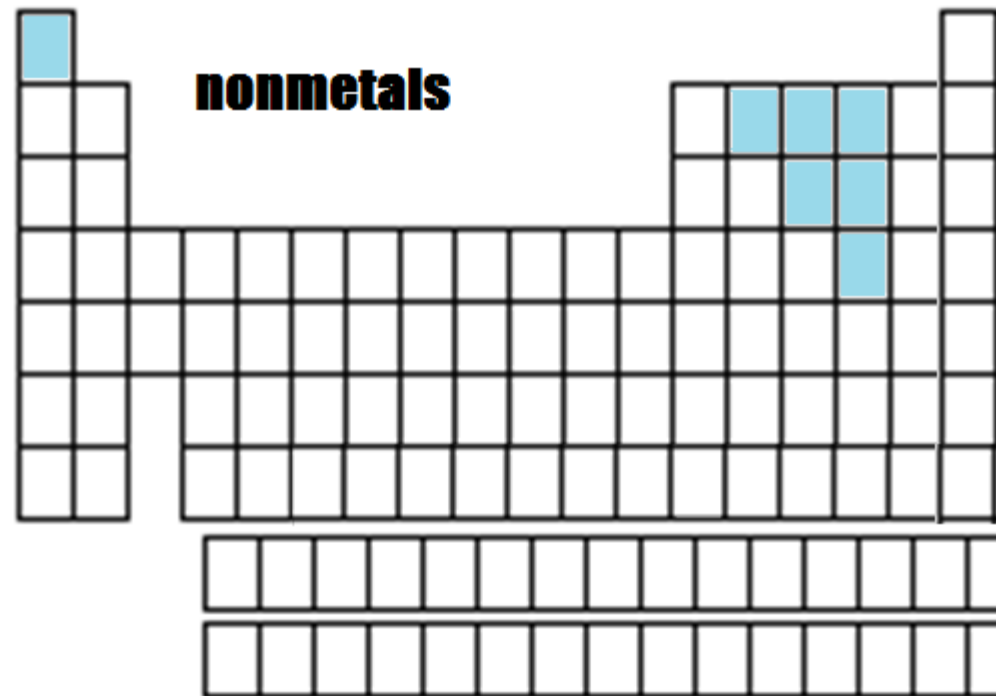
- Valence shells of the same atom can have 2, 3, or 4 valence electrons, making them able to bond with many elements in a variety of configurations.
- The transition metals are able to put up to 32 electrons in their second to last shell.
- Ductility, malleability, and luster make some are useful for jewelry.
- Good conductors of heat and electricity.







# The nonmetals

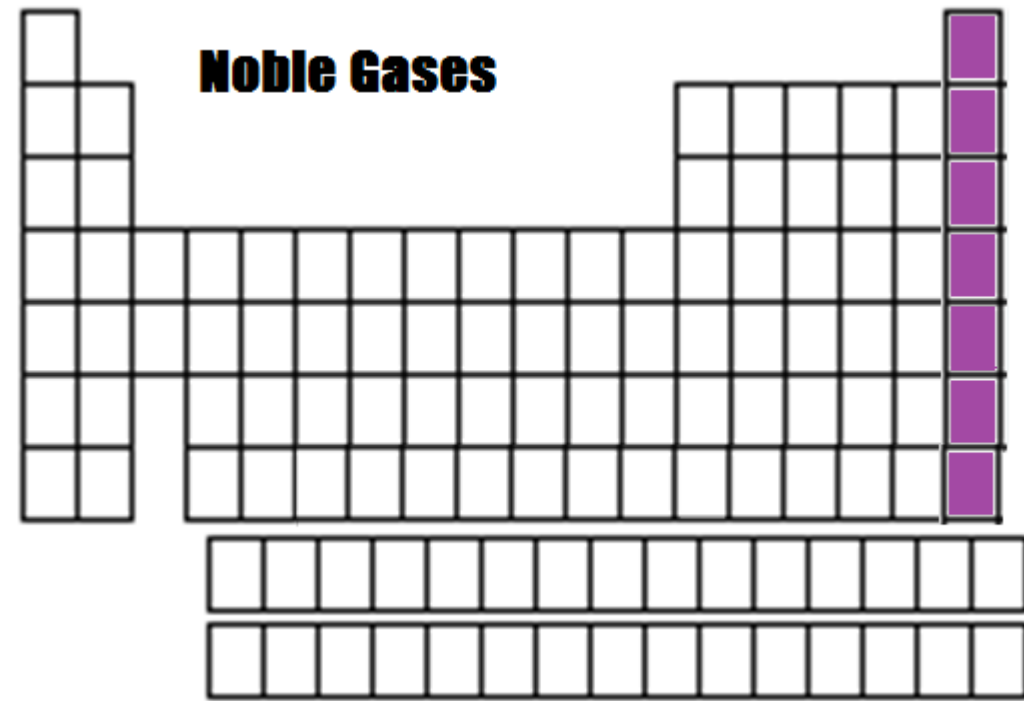




# The noble gases

## Group 8

- Exist as gases
- Non-metals
- 8 electrons in the outer shell = Full
- Helium (He) has only 2 electrons in the outer shell = Full
- Not reactive with other elements



# The Lanthanides & Actinides

- Some are Radioactive
- The rare earths are silver, silvery-white, or gray metals.
- Conduct electricity

