

# ELEMENTS AND THE PERIODIC TABLE

## Chapter 5.5

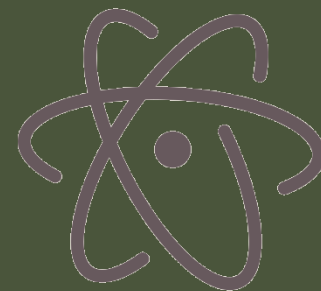
H																		He
Li	Be											B	C	N	O	F		Ne
Na	Mg											Al	Si	P	S	Cl		Ar
K	Ca	Sc	Ti	V	Cr	Mn	Fe	Co	Ni	Cu	Zn	Ga	Ge	As	Se	Br		Kr
Rb	Sr	Y	Zr	Nb	Mo	Tc	Ru	Rh	Pd	Ag	Cd	In	Sn	Sb	Te	I		Xe
Cs	Ba		Hf	Ta	W	Re	Os	Ir	Pt	Au	Hg	Tl	Pb	Bi	Po	At		Rn
Fr	Ra		Rf	Db	Sg	Bh	Hs	Mt	Uun	Uuu	Uub							
			La	Ce	Pr	Nd	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

# History of the table

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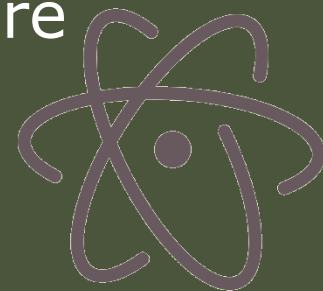
- ❑ As chemists gathered information about elements, several attempted to form a table that would show patterns correctly
- ❑ The first to make a version that worked was Dmitri Mendeleev
- ❑ Based on the **Periodic Law**: *“When elements are placed in increasing order of atomic number, patterns arise at regular intervals”*
- ❑ Developed independently by Mendeleev and Lothar Meyer



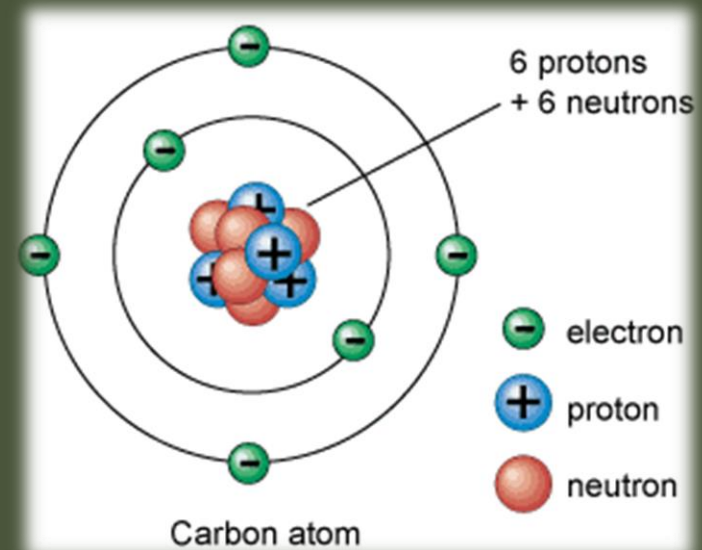
# Connections to the atom

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- ❑ In order to understand the periodic table and its trends, we need to know about the atomic models
- ❑ Atoms are made of an inner core called the **nucleus** (protons and neutrons – collectively called **nucleons**) and electrons floating around it
- ❑ **Protons** carry a positive charge, **electrons** carry a negative charge, **neutrons** are neutral
- ❑ Nucleons are approximately 1800 x more massive than electrons



- The shells that electrons travel around the nucleus are tens of thousands times larger than an individual proton
  - Even the proton radius is still being ironed out :  
Proton radius
- So, the majority of mass of an atom comes from the nucleus whereas the size comes from the electron cloud



# Ions

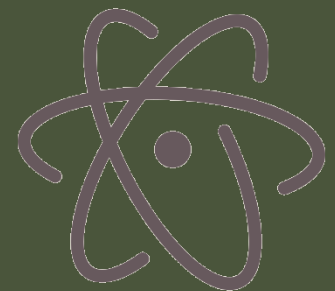
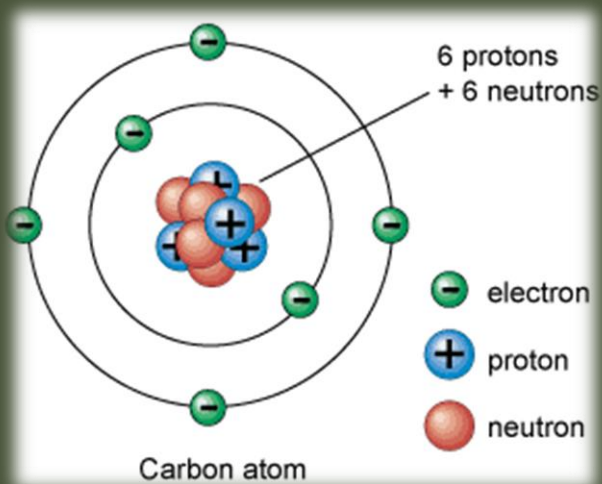
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- ❑ When the number of electrons does not equal the number of protons, it becomes an **ion**
- ❑ If an atom gives up an electron, it is now called a **cation**
- ❑ An **anion** has gained electrons
- ❑ This tendency to gain or lose electrons is dependent on the nucleus of the atom

# PERIODIC TABLE

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- ❑ A structured arrangement of elements that helps us to explain and predict physical and chemical properties.
- ❑ Open to the Periodic table at back of your text
- ❑ The periodic table is put into two categories: Metals and Nonmetals



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- ❑ The periodic table can be looked at with an understanding of the number of protons and electrons
  - ❑ As you read left to right, top to bottom (just like reading a book), the number of protons increases
  - ❑ To the left hand side of the periodic table is metals, right hand side is non-metals
  - ❑ They are divided by the “**staircase line**”
  - ❑ The elements that touch the line are called **metalloids** because they have properties of both metals and non-metals



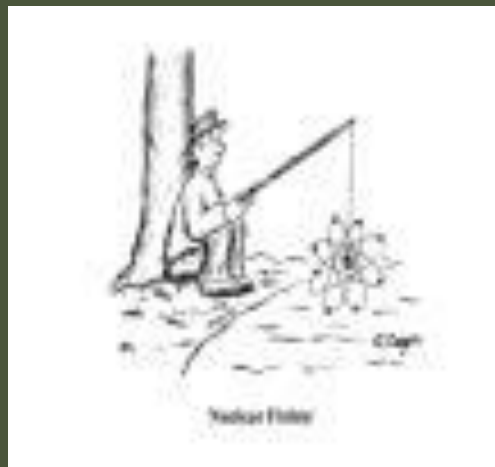


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- ❑ Metals are arranged towards the left side of the table.
  - ❑ Examples: Sodium, Potassium, Lithium, and calcium
  - ❑ Nonmetals are generally found on the right side of the table
  - ❑ Examples: Carbon, oxygen, fluorine, and chlorine
  - ❑ One Exception: Hydrogen (H) – behaves mostly as a nonmetal even though it is located in the top left corner of the periodic table.

# CHEMICAL FAMILIES

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- ❑ **CHEMICAL FAMILIES** – are groups of elements in the same vertical column of the periodic table.
- ❑ They have similar physical and chemical properties.



# Period

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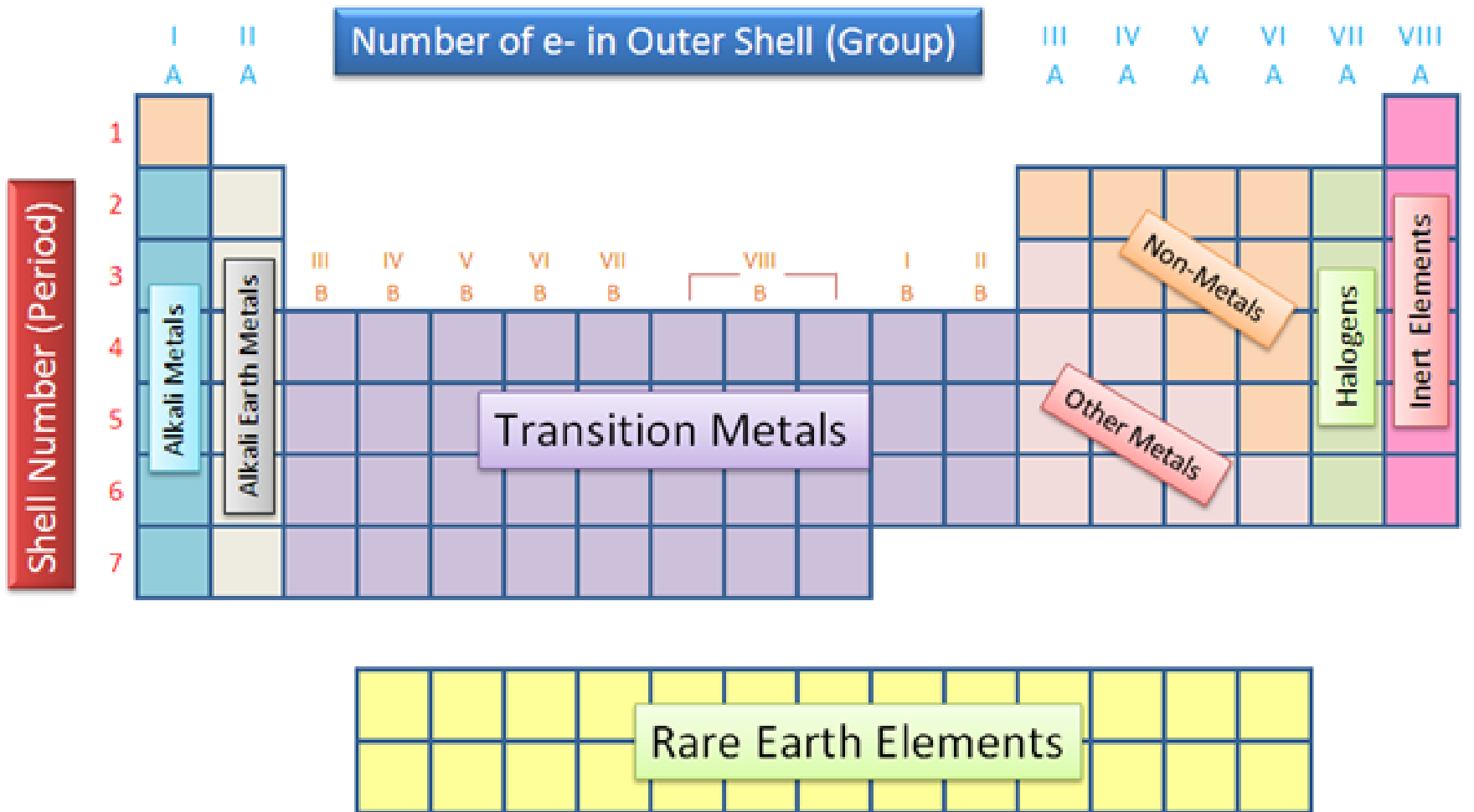
- A **period** is a horizontal row of elements whose properties gradually change from metallic to nonmetallic from left to right along the row.



# Group of One

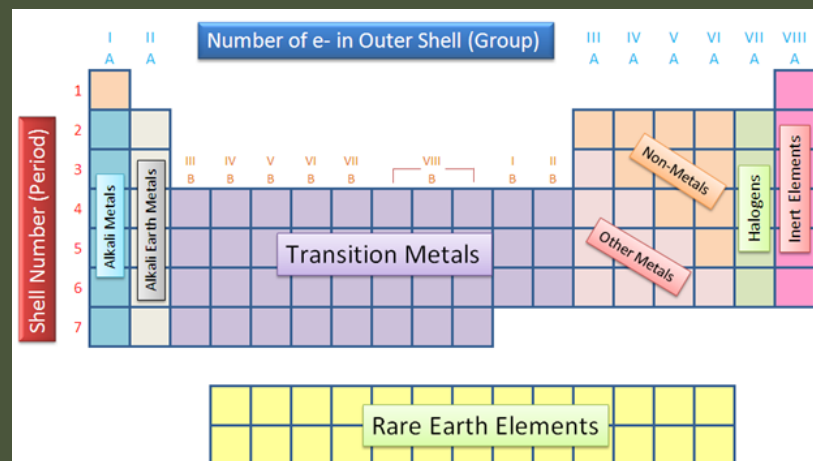
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- Hydrogen is a unique element.
- It's most common isotope has only a single proton and no neutron in its nucleus.
- Hydrogen doesn't have much in common with the alkali metals. It's a colorless, odorless, tasteless, highly flammable gas.
- Almost all of Earth's hydrogen exists in combination with other elements. Its reactivity is too great for it to exist in the atmosphere as a free element.



# ALKALI METALS

- Are the family of elements in Group 1.
- They are soft, silver-colored metals that react violently with water to form basic solutions.
- Therefore very soluble in water
- EXAMPLES: lithium, sodium, potassium



# ALKALINE EARTH METALS

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- Are the family of elements in Group 2.
- They are light, reactive metals that form oxide coatings when exposed to air.
- Often insoluble in water.
- Also shiny, silvery metals.
- EXAMPLES: magnesium, calcium, strontium, and barium (and radium).



**Magnesium**



**Beryllium**



**Calcium**



**Strontium**



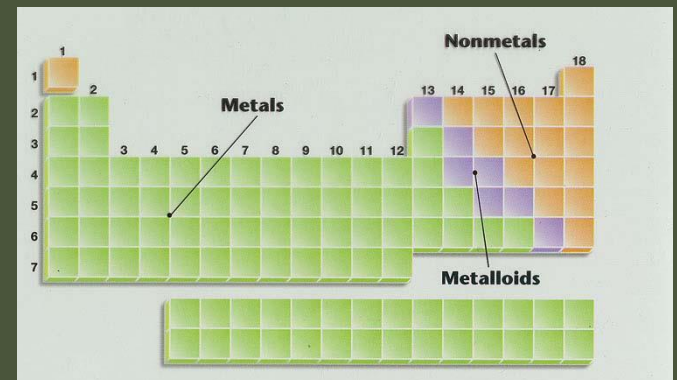
**Barium**



**Radium**

# Metalloids

- The staircase
- Elements that possess both metallic and non-metallic properties. Found on both sides of the zigzag line that divides the metals from the non-metals.
- Ex. boron (B), silicon (Si), germanium (Ge), arsenic, antimony, tellurium, polonium.





# HALOGENS

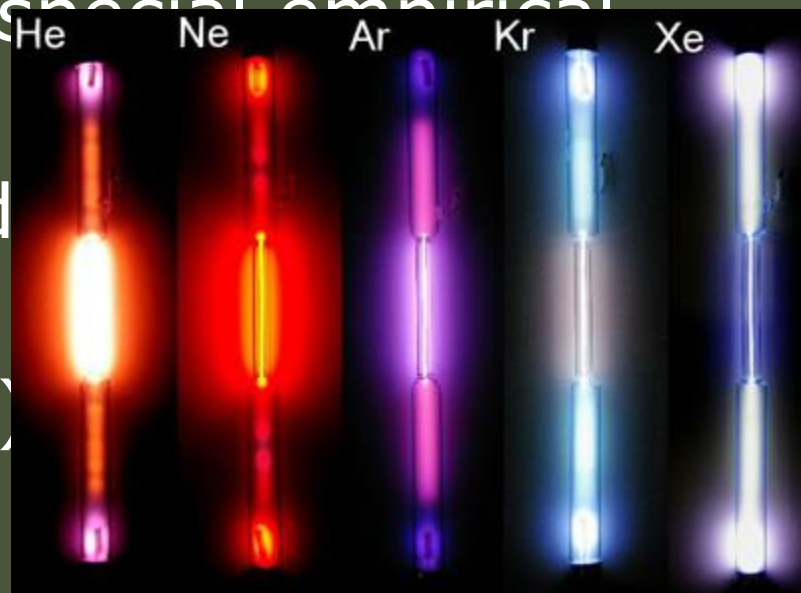
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- Are the elements in Group 17.
- They are extremely reactive, with fluorine being the most reactive.
- Nonmetallic elements are all poisonous elements that react readily with sodium and other alkali metals
- Second column from the right on the periodic table
- EXAMPLES: fluorine (F), chlorine (Cl), bromine (Br)

# NOBLE GASES

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- Are the elements in Group 18.
- They are located in the far right column.
- They are special because of their extremely low chemical reactivity.
- The noble gases are of special empirical and theoretical interest.
- Generally noble gases do not form compounds.
- EXAMPLES: Helium (He)



# REPRESENTATIVE ELEMENTS

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- Are the elements in Groups 1,2 and 13-18
- Of all the elements, the representative elements best follow the periodic law.
- The laws and theories presented in introductory chemistry courses are often restricted to these elements.

# TRANSITION ELEMENTS

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- Are elements in Groups 3 to 12.
- These elements exhibit a wide range of chemical and physical properties.

# Questions

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The following statements describe ~~metals EXCEPT:~~

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- Good conductors of heat
- Malleable and ductile
- Tend to gain electrons
- More reactive as you go down columns

- As you go down the group of metals they become more reactive
- Metals tend to lose electrons

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The following statement is TRUE  
about nonmetals:

- Located on the left hand side of the stair case
  - Shiny and lustrous
  - Occur mostly in a solid state
  - More reactive as you go up columns
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Group 1 on the Periodic Table is  
also known as:

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Alkali Earth Metals

Alkali Metals

Noble Gases

Halogens



Group 17 on the Periodic Table is  
also known as:

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Alkali Earth Metals

Alkali Metals

Noble Gases

Halogens

A bright yellow solid substance is ~~known to be an element. It is brittle~~ and will shatter if hit with a hammer. It is a poor conductor of both heat and electricity. The element is best called a(n):

Alkali metal

Metal

Nonmetal

Noble Gas.

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In the Periodic Table, elements with similar properties are grouped in :

Diagonal rows

Horizontal Rows

Periods

Vertical Columns

## State the Periodic Law:

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*“When elements are placed in increasing order of atomic number, patterns arise at regular intervals”*

# HOMework

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- Periodic Table Review sheet.
- Use page 184-185 and the Periodic table at the back of the book to complete the handout.



7. The Periodic table can also be divided into two sections. The groups 3-12 are known as the Transition elements and groups 1,2,13-18 are known as the Representative elements.
8. Why does it make sense that the metalloids are located between the metals and non-metals? Because they have characteristics of both metals and nonmetals
9. Use your Periodic table to complete the following table:

Element Name	Symbol	Group/ Family Number	Period Number	Metal, Non- metal or Metalloid	State of matter	Group/Family Name
chlorine	Cl	17	3	NM	G	Halogen
magnesium	Mg	2	3	M	S	Alkaline Earth
Helium	He	18	1	NM	G	Noble Gases
Nitrogen	N	15	2	NM	G	Representative
Iodine	I	17	5	NM	S	Halogen
Sodium	Na	1	3	M	S	alkali metal
Mercury	Hg	12	6	M	liquid	Transition
Silver	Ag	11	5	M	S	Transition
Silicon	Si	14	3	Metalloid	metalloid	Representative
potassium	K	1	4	M	S	Alkali