Periodic Trends

Chemistry

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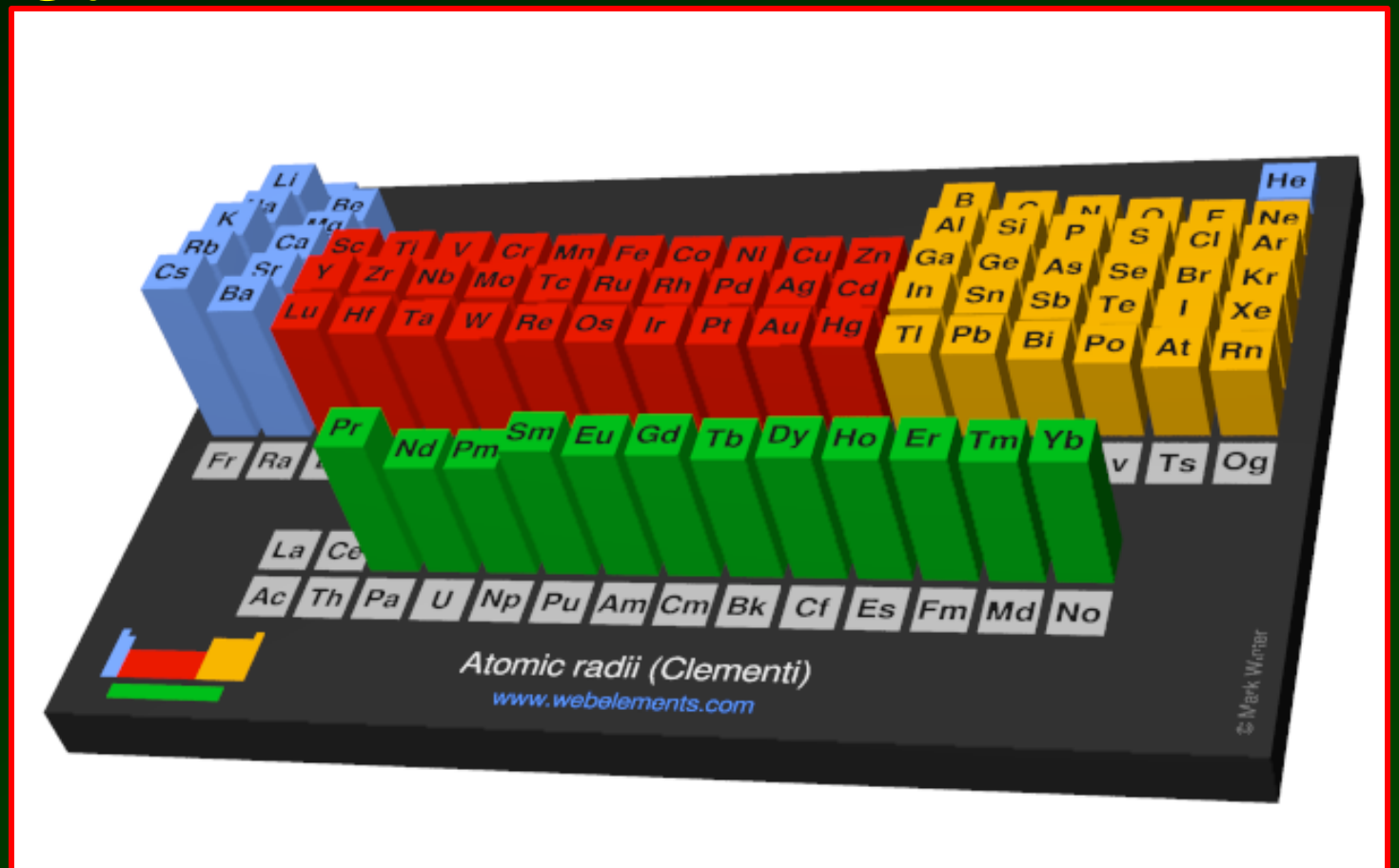
By end of this lesson I can…

- AS3: calculate the charge of an element in order write an ion.
- AS4: use the atomic number and atomic mass number of an isotope, to draw and label a model of the isotope's atomic structure.
- AS7: use the periodic table to find elements based on their properties, explain their positions and show trends that explain how and why elements will form bonds.

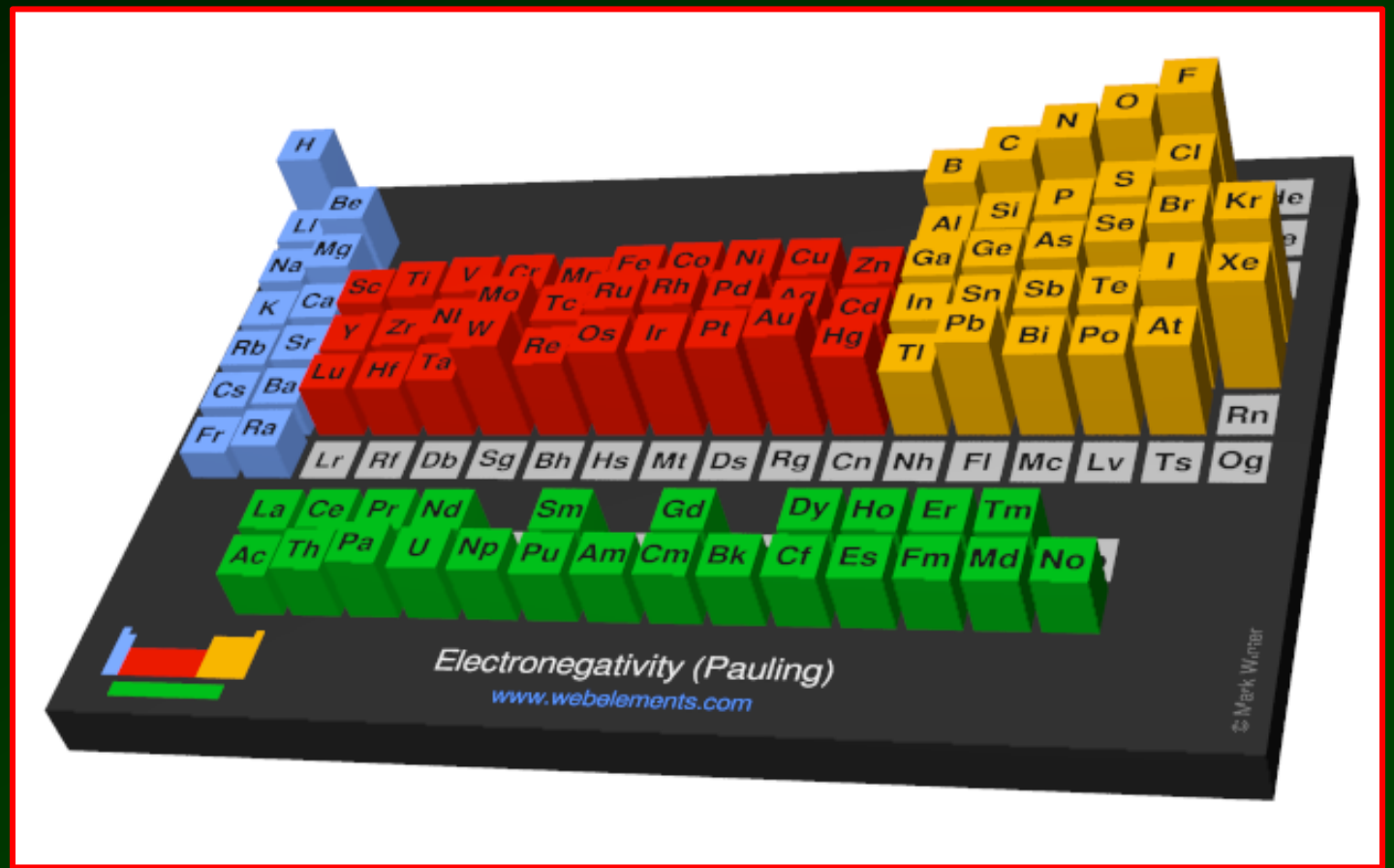
Periodic Trends

- **Atomic Radii:** The distance from the center of the nucleus to the outer e^-.



Periodic Trends

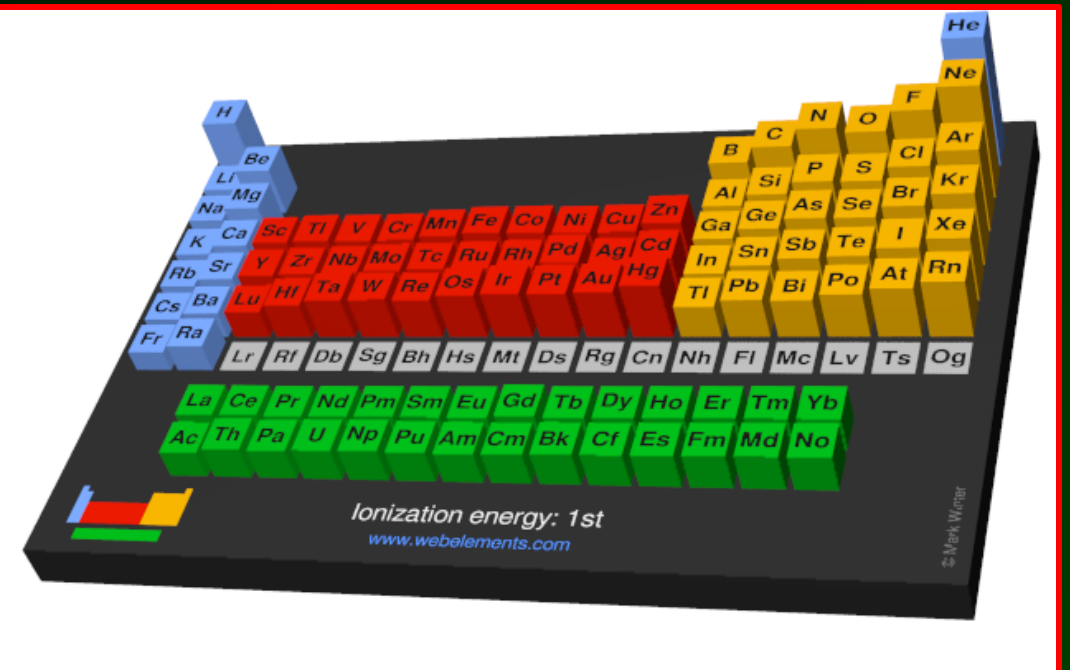
- **Electronegativity:** The power of an atom when in a molecule to attract electron's to itself.

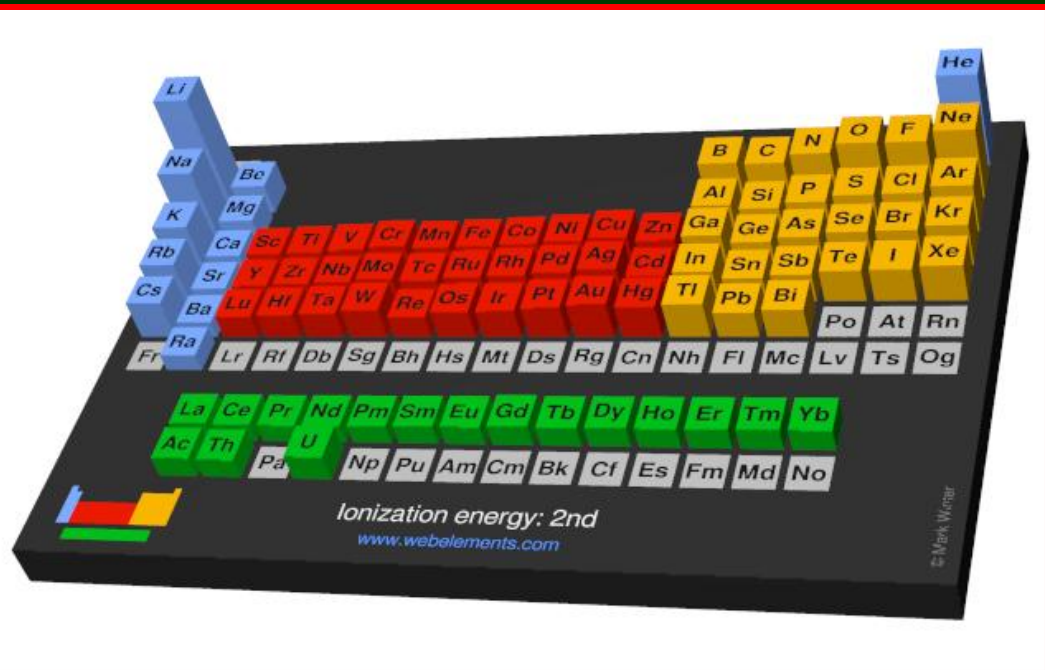


Periodic Trends

- **Ionization Energy:** The amount of energy needed to remove an e^-. (In Joules)
  - Removing more e^- increases the IE level…

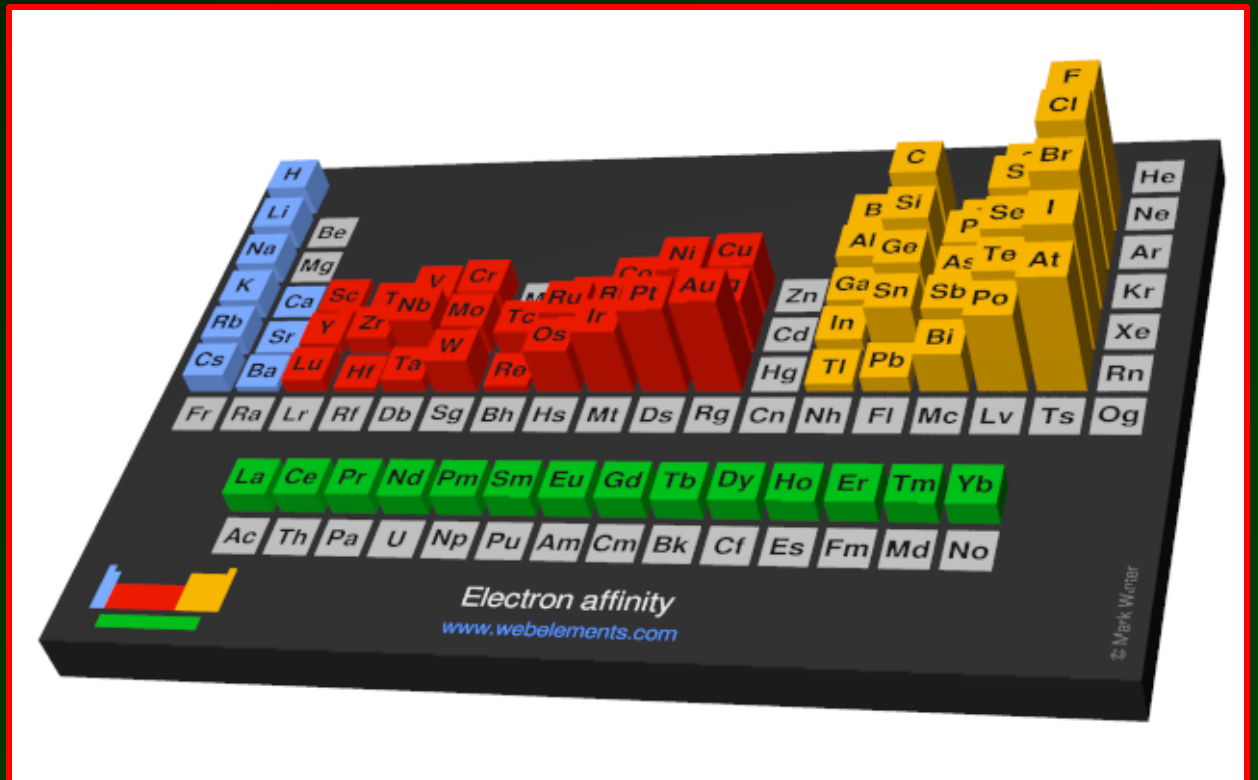
  (Sulfur: 1st IE: 999-J, 2nd IE: 2260-J)





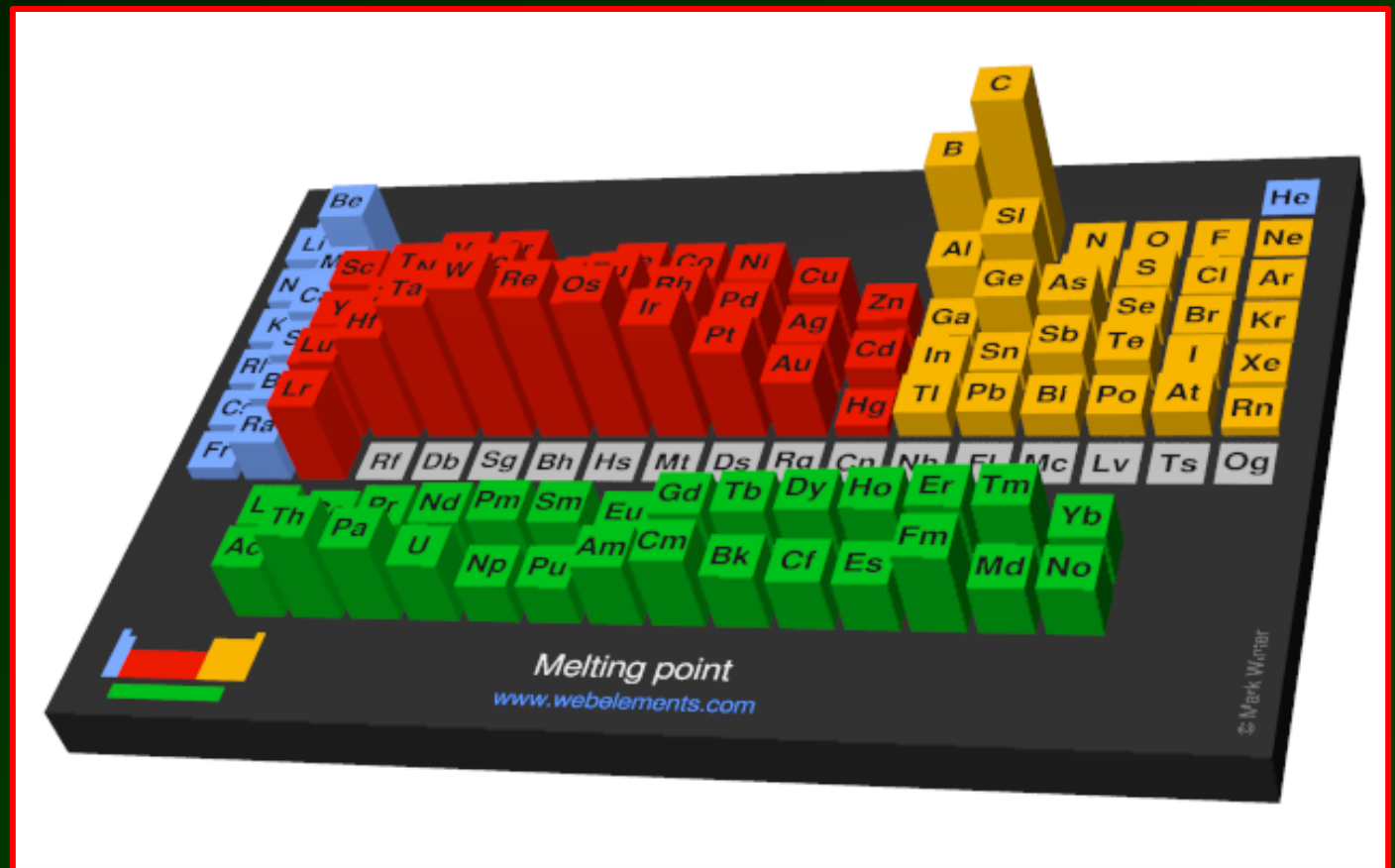
Periodic Trends

- **Electron Affinity:** The amount of energy released by adding an e^-. (In Joules)
  - This is for neutral elements becoming ions.



Periodic Trends

- **Melting Point:** Temperature at which the solid and liquid forms of a pure substance can exist in equilibrium

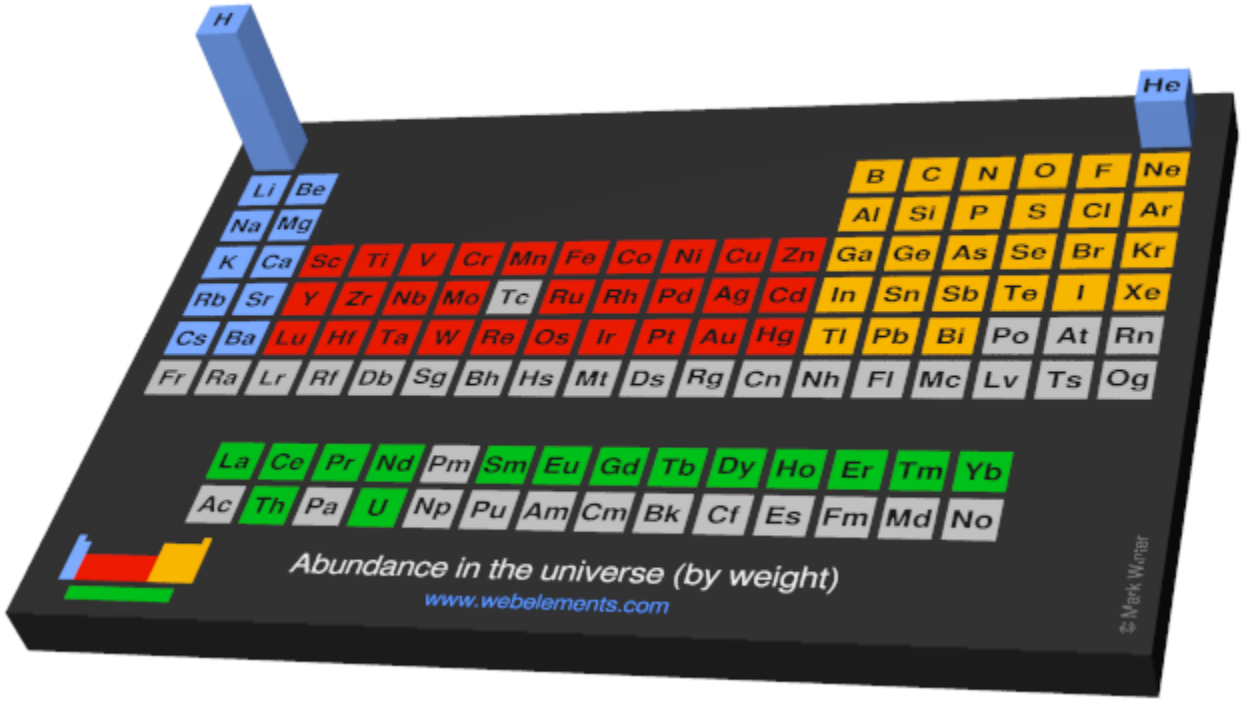


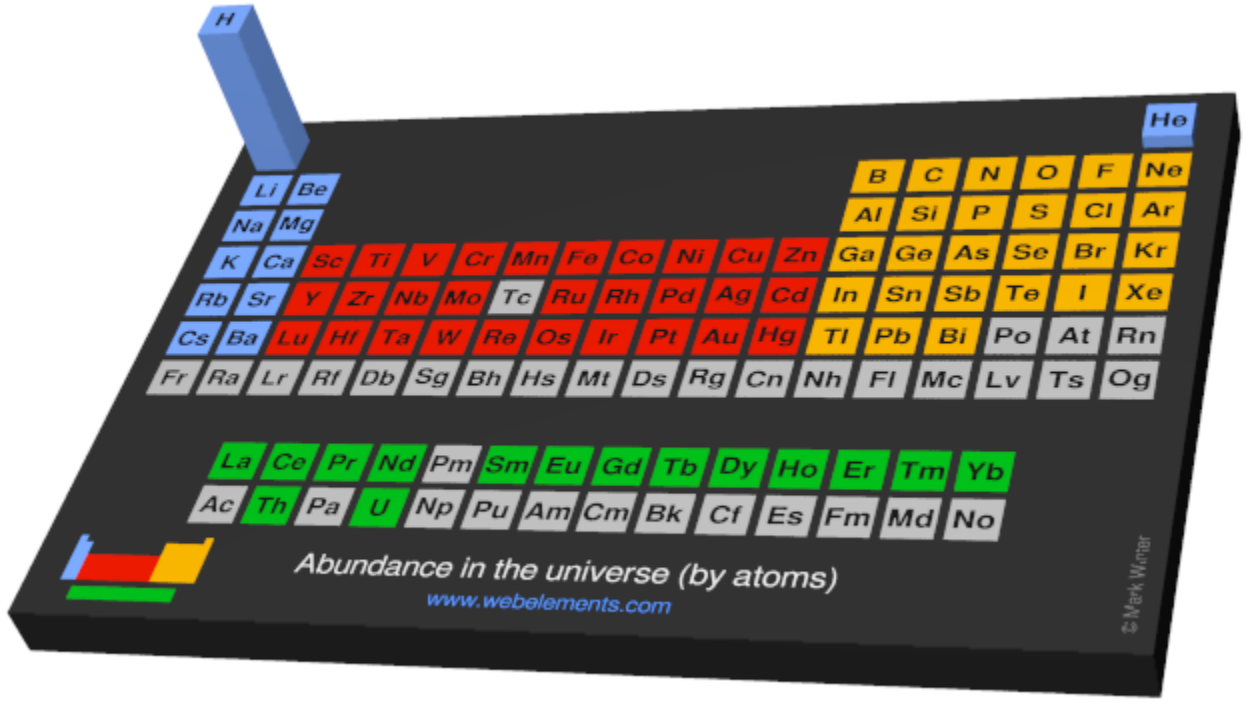
All in the Family

Review

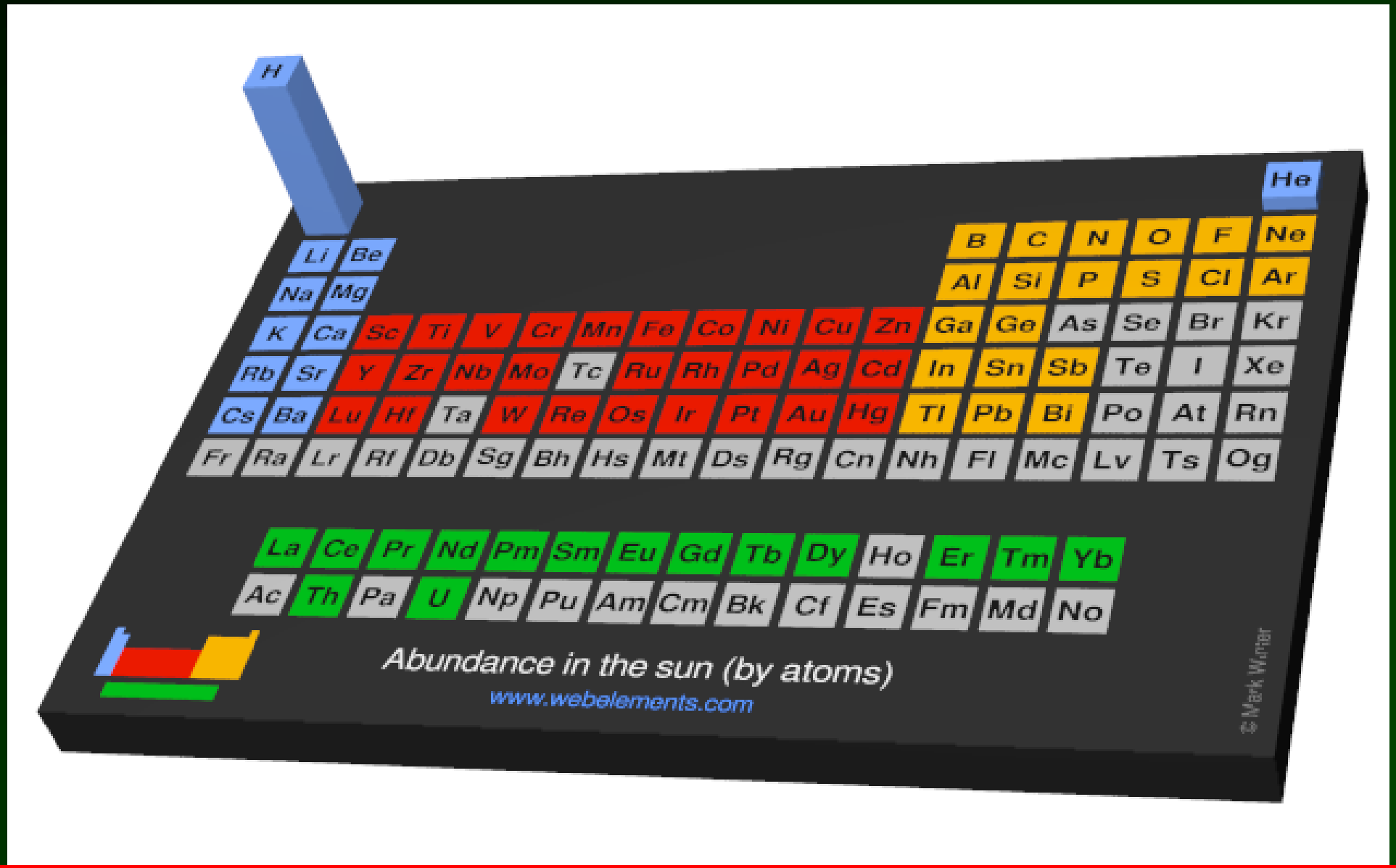
- Families/Groups are the up and down columns on the periodic table.
- While each element is unique in its own way, but much like real life families, elements have similar properties if they share a column.

The Universe

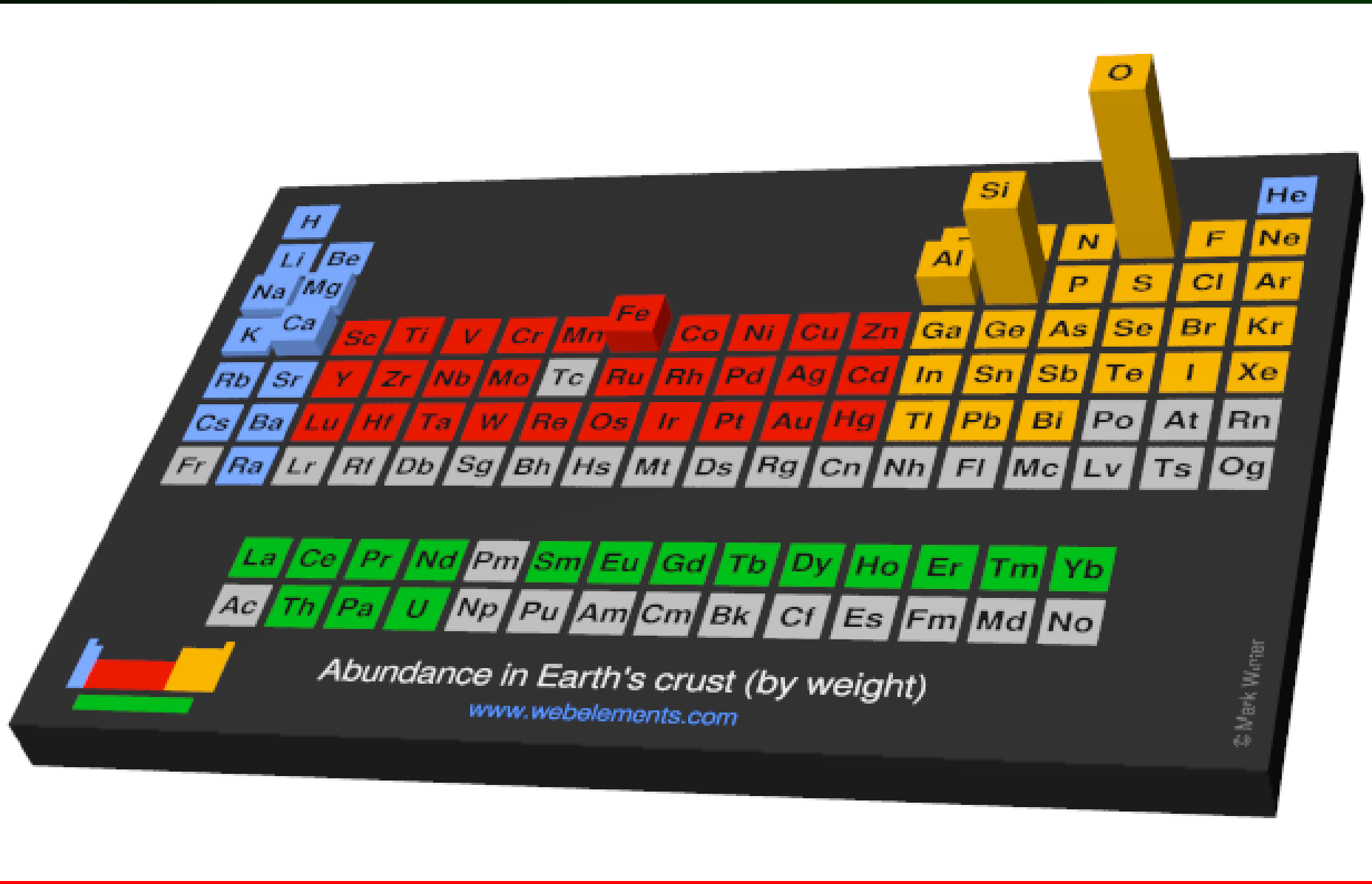




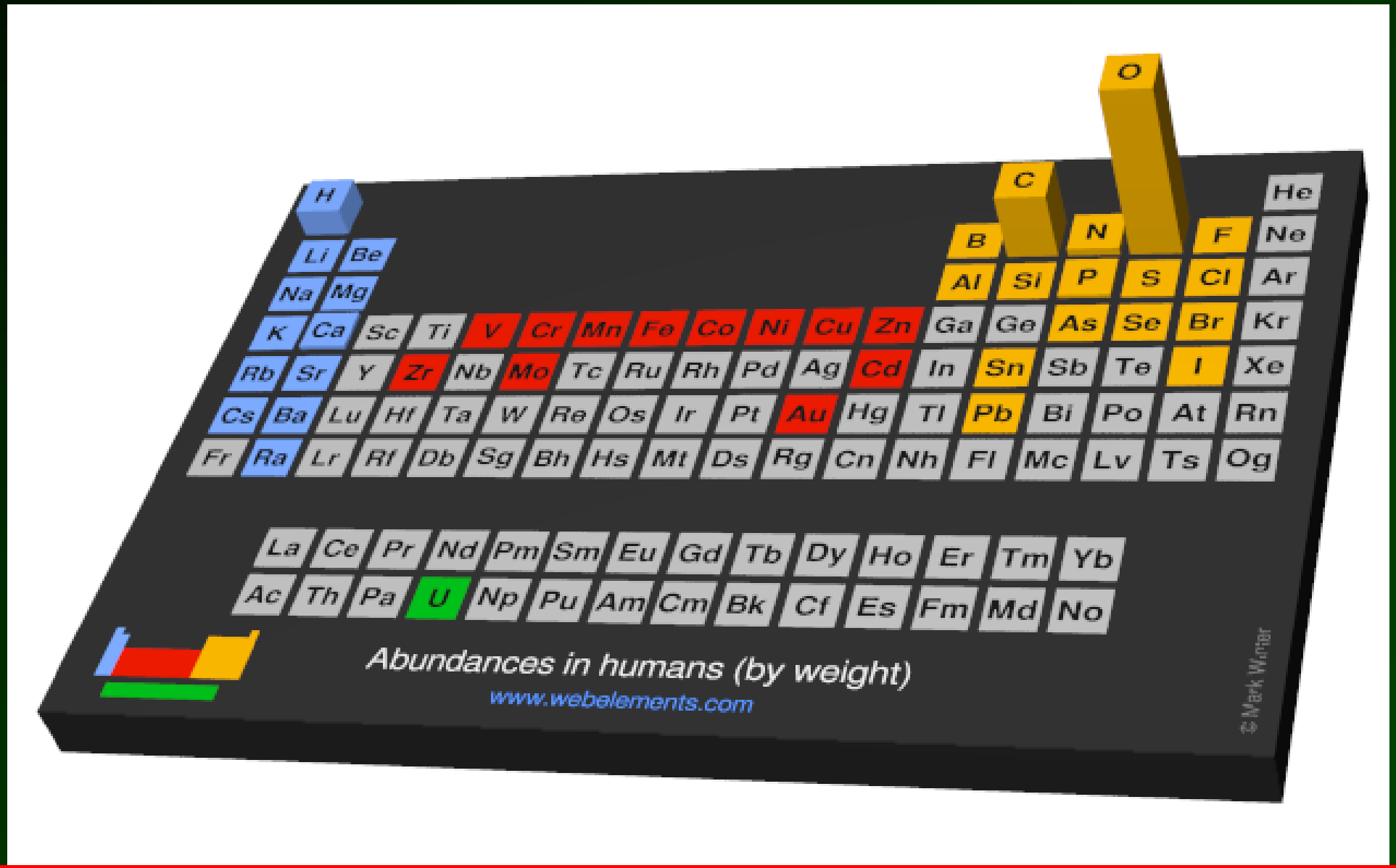
Mass Abundance: The Sun



Mass Abundance: Earth



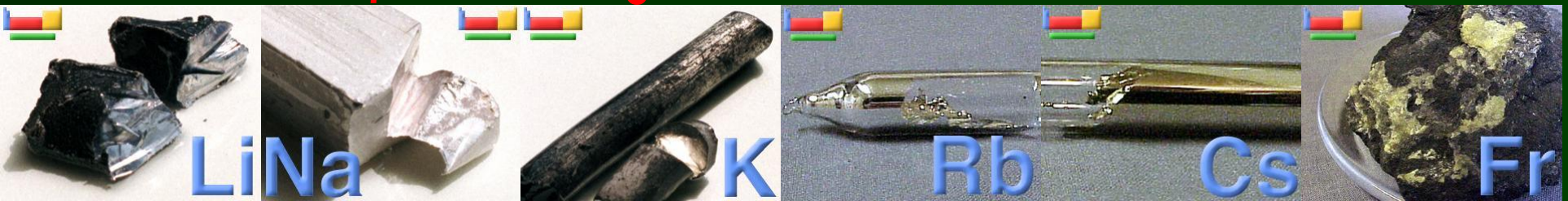
Mass Abundance: Life



1 Alkali Metals

- Arabic: From Ashes (Na/K are present in ash.)
- Form X^+ Ions: very reactive family.
- Shiny, malleable, ductile, oxidize.
  - Oxidize: Surfaces exposed to Oxygen quickly tarnish.
- Can be cut with a knife.
- Will react explosively with water.
- Bond easily with the Halogens (Family 7).
- Not found in pure form in nature.

7th 8th



2 Alkaline Earth Metals

- Middle Ages defined an earth as something which can not be burned.
- Form X^{2+} Ions: very reactive family.
- Shiny, malleable, ductile, oxidize.
- Denser than the Alkali metals.
- Reacts explosively with water.
- Bond easily with Chalcogens (6).

6th 5th

Transition Metals

- Useful in living organisms and structurally strong. Form many alloys.
- Individual properties vary from family to family.
- Mostly shiny, ductile, malleable.
- High Densities.

4th 10th 25th 64th 71st

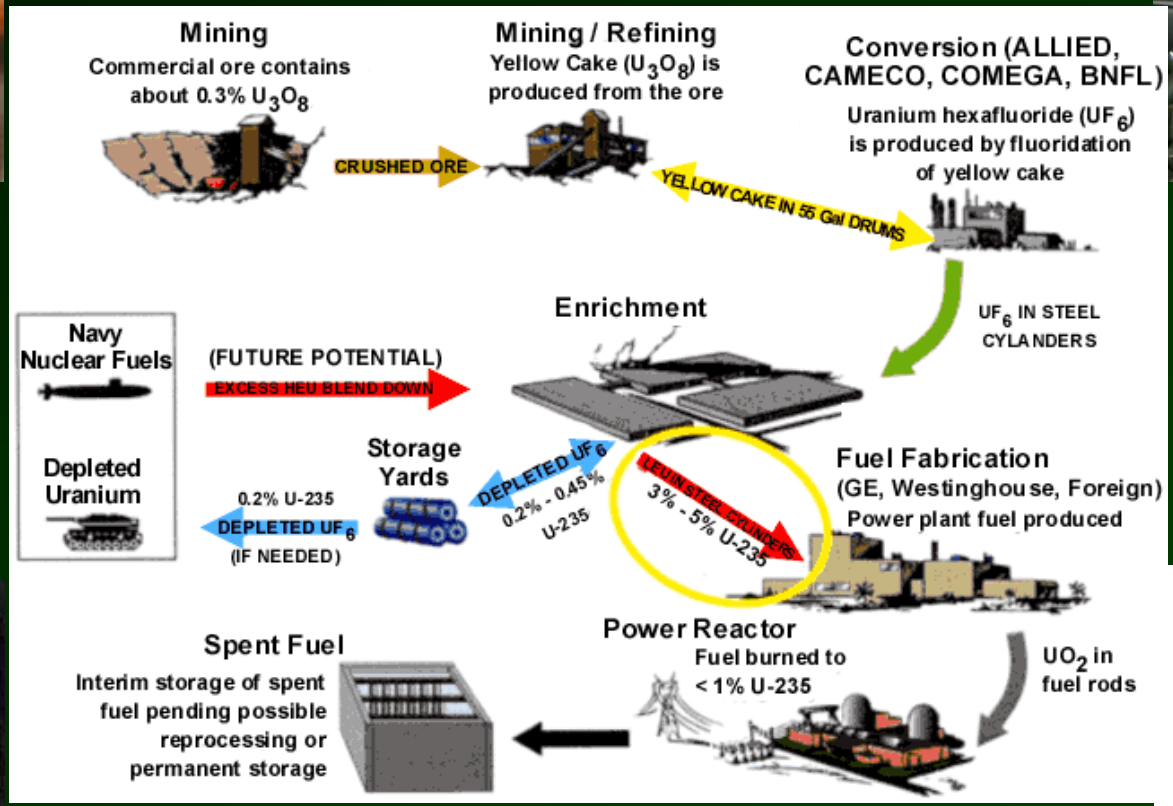
Inner Transition Metals

- It is unsure where they are to be placed, after family 2, or after La and Ac.
- Lanthanides: Form 3+ ions, soft, silvery, tarnish, too reactive to be structural. They are difficult to separate and are found together.
- Actinides: Radioactive, Th and U are the only ones that are readily available in nature.

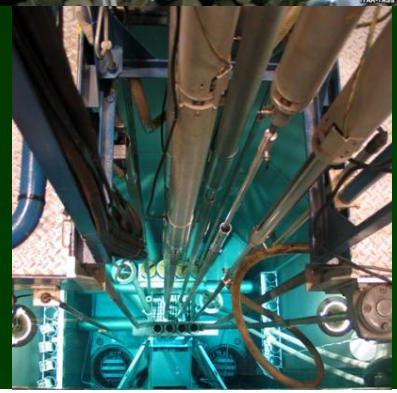
Uranium's Uses

Yellow Cake
U_3O_8

Depleted Uranium
DU_3O_2

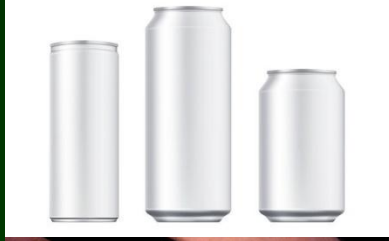


Fuel Pellet
UO_2



Fiestaware (Glaze)
UO_2

3 Boron

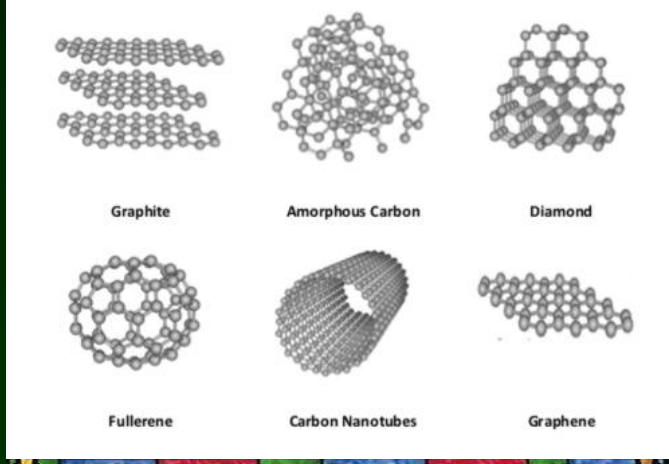


- Serve some biologic roles.
- Al- key element in this family.
  - Normally found as Si and O compounds.
  - Until late 1800's was costly due to separation process
    - Bayer Process much cheaper
  - Cheaper to recycle Aluminum rather than extract new Aluminum from bauxite (Al_2O_3).

3rd

4 Carbon

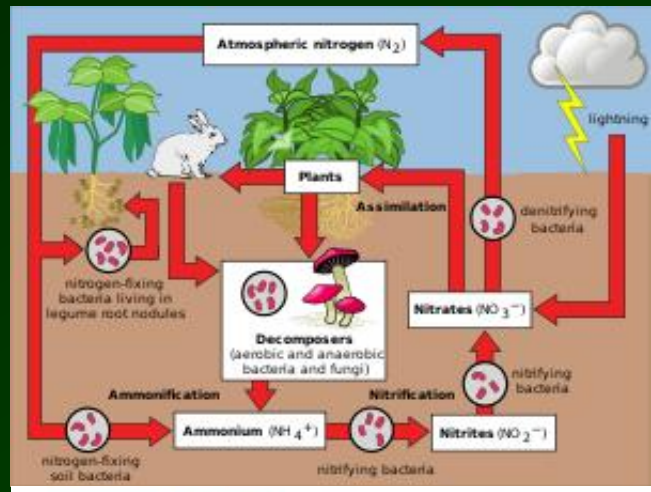
- This family is fairly unique.
  - C is non-metallic.
  - Si and Ge are mettaloids.
  - Sn and Pb (Toxic) are metals.
- 50% of Carbon is bonded in Limestone.
- H and C bond to form hydrocarbons.
  - Coal, Petroleum, Natural Gas, Waxes.

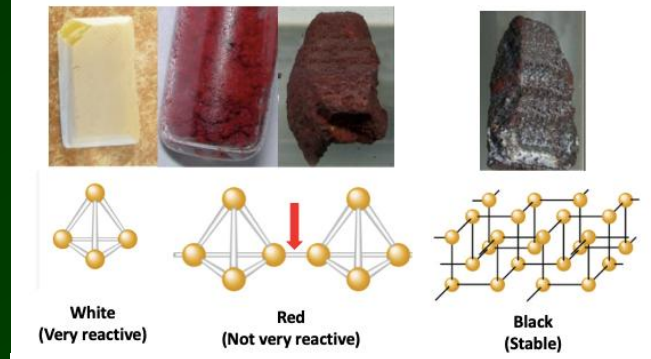


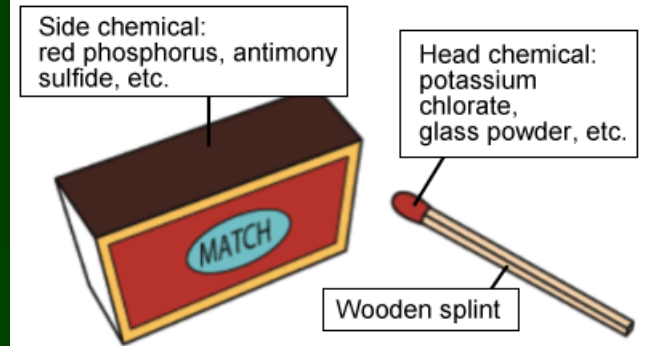
2nd

5 Pnictogen (Choke+Former)

- **This family is also fairly unique.**
  - **N and P are non-metallic.**
  - **As and Sb are mettaloids.**
  - **Bi is a metal.**
- **Almost all Nitrogen is in gas form (80% of air)**
  - **Most is not reactive; few living things use it directly.**
  - **Mainly used in fertilizers. NH_3 is Ammonia.**
- **P: Three forms. White spontaneously ignites.**
  - **H_3PO_4 diluted can add tartness to soda (Can leach Ca out of bones).**



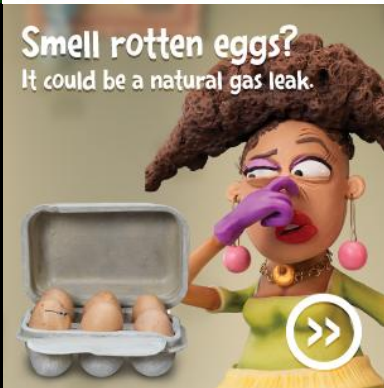




6 Chalcogen (Copper+Former)

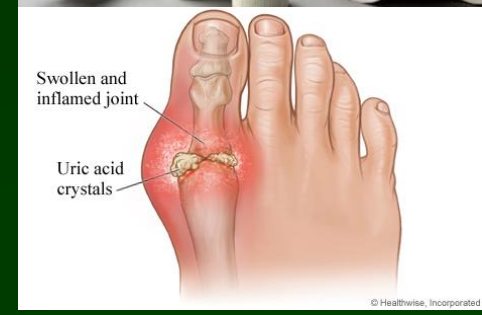
- Need two e^- to be complete: X^{2-}.
- O: Black sheep of family.
  - By mass 23% air, 89% water, 46% crust.
  - Pure O is in either O_2 or O_3 form. Elemental O found only in space (Reactive!)
- S: found bonded to Iron → FeS_2: Iron Pyrite.
  - Most S is manufactured to make H_2SO_4.
  - H_2S is added to Natural Gas as a warning by making it smell bad (rotten eggs).

1st



7 Halogen (Salt+Former)

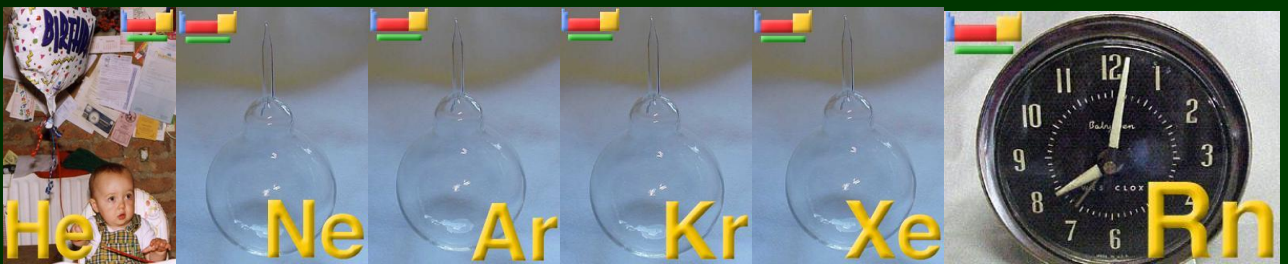
- Need one e^- to be complete; very unstable.
  - Each forms of Diatomic Molecules.
- F: Most reactive element. Very corrosive gas.
- Cl: Industrially useful halogen
  - Disinfects water and pools. Used in a bleach, and PVC.
- I: Prevents Gout and as an antiseptic.



8 Noble Gas

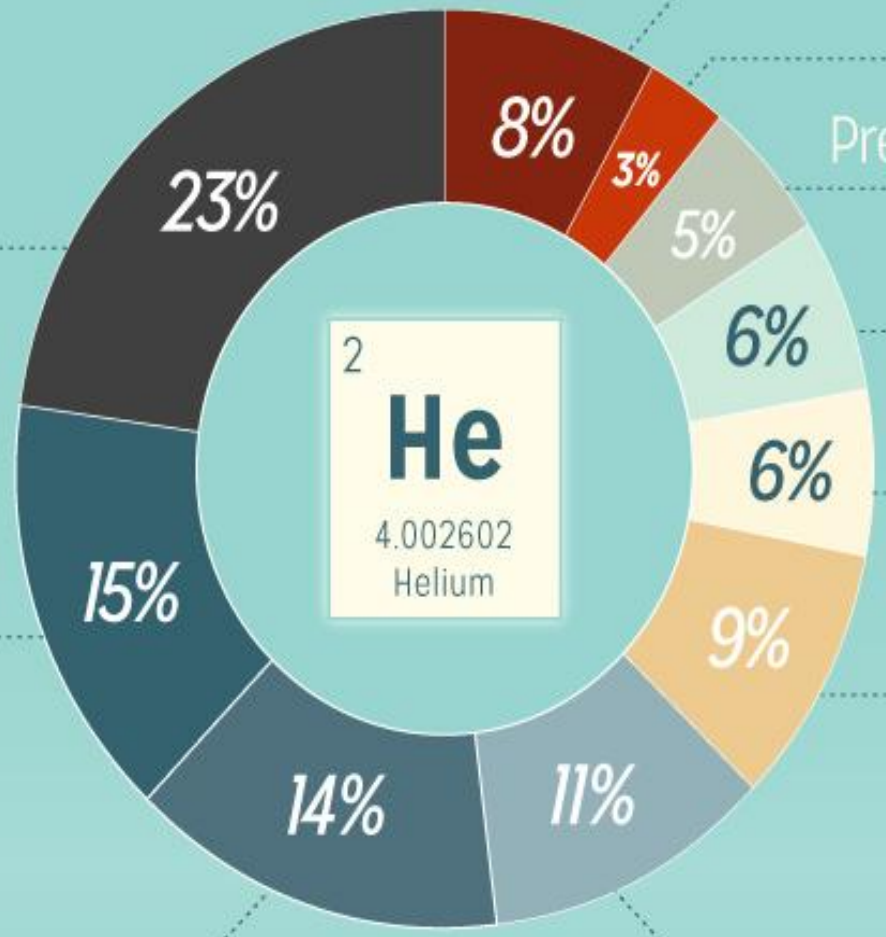
- Complete shells and ‘fairly’ non-reactive.
- Ar: The most abundant in family (1% Earths Air).
  - First to be discovered in 1849.
  - Used in welding and between windows.
- He: Most commercially important in family.
- Compounds like KrF_2, XeF_2, XeF_4, and XeF_6 exist.
- Rn radioactive and unstable
  - Natural decay: the gas enters cracked foundations.

Greek Roots.
He: Helios: Sun
Ne: Neos: New
Ar: Argos: Lazy
Kr: Kryptos: Hidden
Xe: Ksenos: Stranger
Rn: Radius: Ray



HELIUM USES

Global Share of Helium Applications



Other

Diving

Pressure & Purging

Analytical

Leak Detection

Welding

Optical Fiber

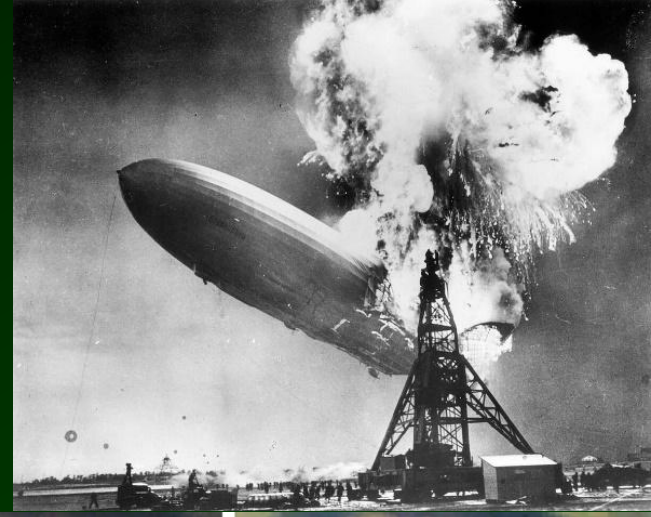
Electronics

Lifting

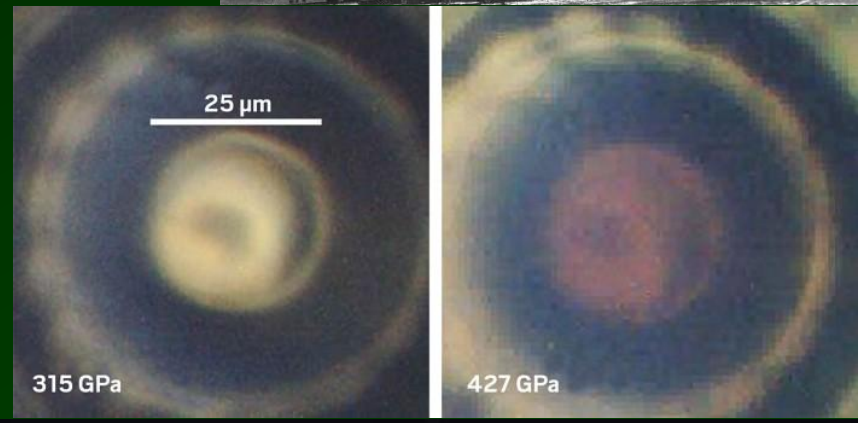
Cryogenics

Source USGS

On its own: Hydrogen



- Most abundant element in the universe.
  - Not proportionately abundant since it escapes Earth.
- Most bonded to Oxygen to form water.
- A precursor to being an Acid (H^+...)
- Large amounts are used to form organic compounds like methanol (racing fuel).



9th