Observe the items in all 24 squares below in terms of similar characteristics.

Fill in the columns and rows (for the chart you copied) based on a recognizable & sensible pattern of the items. The 2nd row is the category of food.

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| Radio | Microwave | Infrared | Visible ROY | Visible GBIV | Ultraviolet | x-rays | gamma |
| Meat |  |  |  |  |  |  |  |
|  |  |  |  |  |  |  |  |
|  |  |  |  |  |  |  |  |
|  |  |  |  |  |  |  |  |

What guidelines did you use to make your Periodic Table of Foods? How did you determine “Groups”?

How did you determine “Periods” or “Rows”?

How was the periodic table developed and how is it arranged?

Searching for an Organizing Principle

D\_\_\_\_\_

* In 1829, a German chemist, J. W. Dobereiner, published a classification system. He grouped known elements into \_\_\_\_\_, sets of \_\_\_\_\_ elements with \_\_\_\_\_ properties.
* One triad consisted of chlorine, bromine, and iodine. They each look different, but have very similar chemical \_\_\_\_\_.

Dobereiner’s Triads

* When the \_\_\_ elements in a triad are put in the order of their atomic \_\_\_\_\_, the difference in mass between the first and second elements is about the same as the difference in mass between the second and third elements.

N\_\_\_\_\_’s Law of \_\_\_\_\_ - John Newlands (1865)

* He arranged the Periodic Table according to \_\_\_\_\_ atomic \_\_\_\_\_.
* He established the “Law of \_\_\_\_\_” 🡪 noticing a repeating pattern of \_\_\_\_\_ properties every \_\_\_\_\_ elements on the Periodic table.

M\_\_\_\_\_’s Periodic Table

* In 1869, the Russian chemist Dmitri Mendeleev produced the \_\_\_\_\_ orderly arrangement, or periodic table, of all \_\_\_ elements known at the time.
* Mendeleev wrote the \_\_\_\_\_ for each element, along with the \_\_\_\_\_ and \_\_\_\_\_ properties.
* Mendeleev arranged the elements in order of \_\_\_\_\_ atomic \_\_\_\_\_.
* Mendeleev noticed that \_\_\_\_\_ properties of elements occurred after “\_\_\_\_\_” of varying lengths (rows on Periodic Table).
* He established “\_\_\_\_\_” or “\_\_\_\_\_” (*columns*) on the Periodic Table, possessing \_\_\_\_\_ chemical \_\_\_\_\_.
* Mendeleev predicted properties and masses of \_\_\_\_\_ elements that he knew existed. (e.g. scandium, gallium, germanium).
* Mendeleev could \_\_\_\_\_ account for Iodine whose atomic mass was less than Tellurium, but whose chemical properties belonged with Br and Cl’s group .

The Modern Periodic Table

Henry \_\_\_\_\_ (1887-1915)

* Revised the periodic table to the \_\_\_\_\_ version.
* Arranged all the elements in order of \_\_\_\_\_ atomic \_\_\_\_\_.
* Accounted for variations resulting from \_\_\_\_\_.

The Modern Periodic Table

* The periodic table of elements is an organized display of the chemical elements.
* In order of \_\_\_\_\_ atomic \_\_\_\_\_ (\_\_\_\_\_)
* Similarities in chemical \_\_\_\_\_
* Similarities in \_\_\_\_\_ \_\_\_\_\_

Metals, Nonmetals, and Metalloids

M\_\_\_\_\_

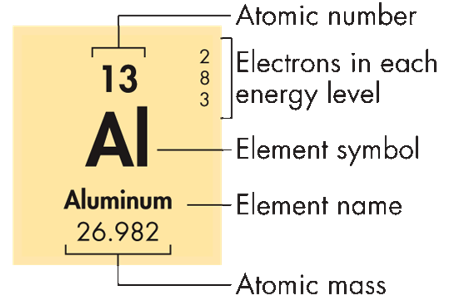
* As one goes \_\_\_\_\_ a \_\_\_\_\_, the properties of elements become less \_\_\_\_\_ and more nonmetallic. About \_\_\_% of the elements are \_\_\_\_\_.
* Good \_\_\_\_\_ of heat and electric current.
* High \_\_\_\_\_, or sheen … ability to \_\_\_\_\_ light.
* \_\_\_\_\_ at room temperature, except for mercury (Hg).
* \_\_\_\_\_, can be drawn into \_\_\_\_\_.
* \_\_\_\_\_, can be \_\_\_\_\_ into thin sheets without breaking.
* Hard & \_\_\_\_\_

\_\_\_\_\_

* Tend to have properties \_\_\_\_\_ of metals.
* Usually \_\_\_\_\_ conductors & \_\_\_\_\_.

\_\_\_\_\_

* “\_\_\_\_\_ Elements” that sometimes behave like metals.
* Under other conditions, they may behave like nonmetals.
* \_\_\_\_\_ is also present as the compound silicon dioxide in glass items and the earth’s crust (*silica*).



Information for Each Element

Each element’s entry on the periodic table shows:

* Chemical \_\_\_\_\_
* Element name
* Atomic \_\_\_\_\_
* Average atomic \_\_\_\_\_
* \_\_\_\_\_ \_\_\_\_\_

\_\_\_\_\_ Law

* When elements are arranged in order of \_\_\_\_\_ atomic \_\_\_\_\_, there is a periodic pattern in their physical and chemical \_\_\_\_\_.

\_\_\_\_\_ - \_\_\_\_\_ rows on the periodic table

* + Indicate \_\_\_\_\_ energy \_\_\_\_\_ of \_\_\_\_\_ electrons (Quantum number 1, \_\_\_).
  + Atomic \_\_\_\_\_ increases from \_\_\_\_\_ to right across the period.
  + In each period the number of \_\_\_\_\_ electrons \_\_\_\_\_ from left to right.
  + Chemical \_\_\_\_\_ \_\_\_\_\_ systematically across the periodic table.

\_\_\_\_\_: \_\_\_\_\_ or “\_\_\_\_\_ " on the periodic table

* Elements within a group have the \_\_\_\_\_ chemical properties
* Groups contain the same number of electrons in outermost level (\_\_\_\_\_ electrons), which explains why groups have the same properties
* “\_\_\_” groups 🡪 \_\_\_\_\_ filling s and p \_\_\_\_\_ orbitals

“Magic number is “\_\_\_” … \_\_2 + \_\_6

\_\_\_\_\_ Metals (Group IA) … s1

* Group 1 or \_\_\_\_\_
* Easily \_\_\_\_\_ an electron to form a \_\_\_ \_\_\_\_\_ *in order to gain* \_\_\_\_\_ *electron configuration*
* Typical properties:
  + Silver in color
  + Soft (can be cut with a knife)
  + Highly \_\_\_\_\_ with oxygen and water
  + Able to oxidize in air

“Magic number is “8” … s2 + p6 … Is it easier for the metals to \_\_\_\_\_ \_\_\_ electrons to make \_\_\_ or to lose \_\_\_ electron to have a \_\_\_\_\_ valence in the next lowest energy \_\_\_\_\_?

11Na23 neutral cation

+11 p +11 p

-11 e - e

0 +1 charge

\_\_\_\_\_ \_\_\_\_\_ Metals (Group IIA) … s2

* Group 2 or \_\_\_\_\_
* \_\_\_\_\_ two electrons to form a \_\_\_ \_\_\_\_\_ *in order to gain ideal electron configuration*
* Typical properties:
  + Silver in color
  + More brittle than alkali metals
  + Somewhat reactive
  + Low in density, with low melting and boiling points

“Magic number is “8” … s2 + p6

Is it easier for the metals to gain \_\_\_ electrons to make \_\_\_ or to lose \_\_\_ electron to have a full \_\_\_\_\_ in the next lowest energy level?

12Mg24 neutral cation

+12 p +12 p

-12 e - e

0 +2 charge

\_\_\_\_\_ Metals (B Groups)

* Characterized by the presence of electrons in \_\_\_ orbitals … E.g. C\_\_\_\_\_, silver, gold, iron
* Form \_\_\_\_\_ compounds
* May have unusual properties:
  + Magnetism
  + High conductivity

\_\_\_\_\_ Transition Metals (\_\_\_ Groups) … also called \_\_\_\_\_ -earth elements.

* Characterized by the presence of electrons in \_\_\_ orbitals
* L\_\_\_\_\_: *elements 57-71*
* A\_\_\_\_\_: *elements 89-103*
* Radioactive (e.g. U-92)
* Present in only trace amounts on Earth

\_\_\_\_\_ (Group VIIA) … s2 p5

* Group 17 or \_\_\_\_\_
* Easily \_\_\_\_\_ an electron to form a \_\_\_ \_\_\_\_\_ *in order to gain ideal electron configuration*
* Typical properties
  + Highly \_\_\_\_\_ with metals
  + Toxic to organisms
  + Most occur as diatomic molecules (F2, Cl2, Br2, I2)
  + React with metals to form salts

“Magic number is “8” … s2 + p6 … Is it easier for the \_\_\_\_\_ -metal to \_\_\_\_\_ \_\_\_ electron to make 8 or to lose \_\_\_ electrons to have a full valence in the energy level?

17Cl35 neutral anion

+17 p +17 p

-17 e - e

0 -1 charge

\_\_\_\_\_ Gases (Group VIIIA) … s2 p6

* Group 18 or \_\_\_\_\_
* Inert gases (nonreactive)  *have ideal electron configuration*
* Typical properties
  + Odorless and tasteless
  + Nonreactive and nonflammable
  + Have extremely low boiling points (i.e. \_\_\_\_\_)
  + Produce characteristic colors when excited electrically

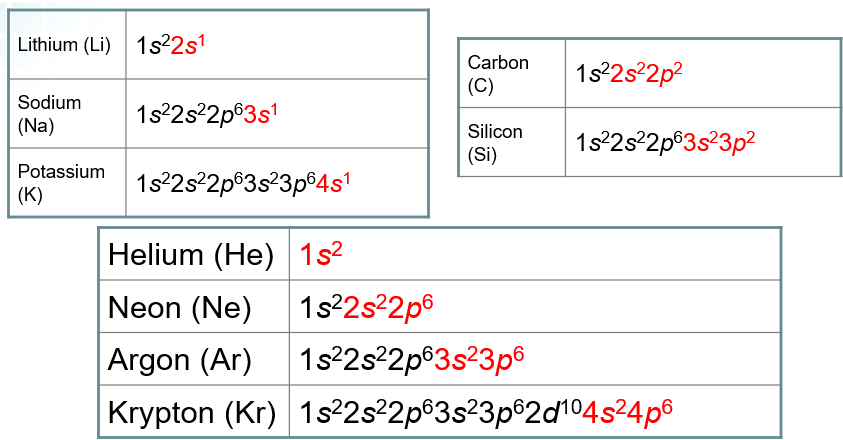
\_\_\_\_\_ Rule – Stability of Atoms When Bonding

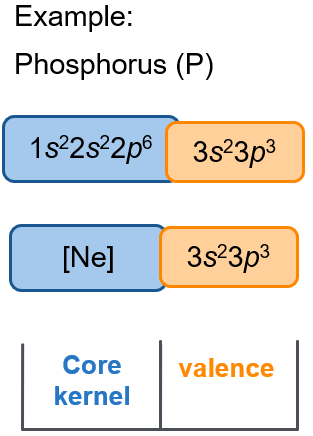
* The \_\_\_\_\_ of an atom is associated with electron configuration:
* The \_\_\_\_\_ number of \_\_\_\_\_ in outer level is \_\_\_e-  [ *s* orbital holds up to \_\_\_ e-, *p* orbitals hold up to \_\_\_ e-  ]
* 8e- represents a very stable arrangement (noble gas configuration)
* Helium (2He4) has only \_\_\_e- but a complete outer shell.
* Atoms tend to combine with other atoms in such a way that each atom has \_\_\_\_\_ electrons in its \_\_\_\_\_ shell, giving it the same electron configuration as a \_\_\_\_\_ gas.

Electron Configurations in Groups

\_\_\_\_\_ Electrons

* The number of electrons in the \_\_\_\_\_ occupied \_\_\_\_\_ \_\_\_\_\_ (n) level (\_\_\_\_\_ electrons.)



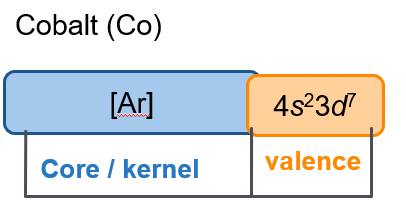


\_\_\_\_\_ & Valence Electrons in A Groups

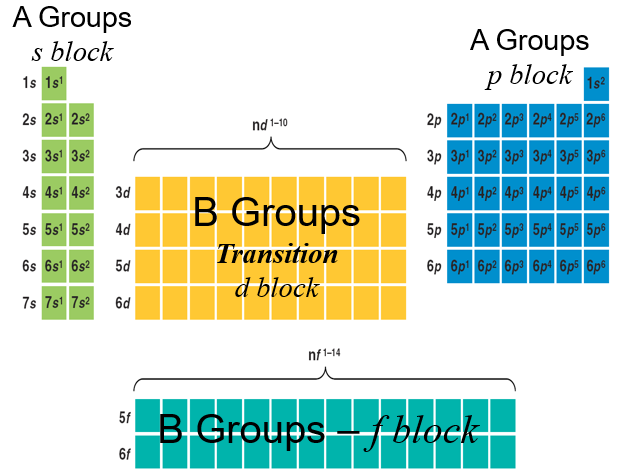
* Highest *n* orbitals = \_\_\_\_\_ electrons
* All other orbitals = \_\_\_\_\_ electrons (use [Ne])
* \_\_\_\_\_ number relates to the number of \_\_\_\_\_ electrons
* \_\_\_\_\_ gases (group VIII or 18): \_\_\_\_\_ valence shell

Kernel & Valence Electrons in B Groups

* Notice that valence electrons are still in the \_\_\_\_\_ “n” s and p orbitals
* Partially filled *\_\_\_* and *\_\_\_* orbitals = valence electrons



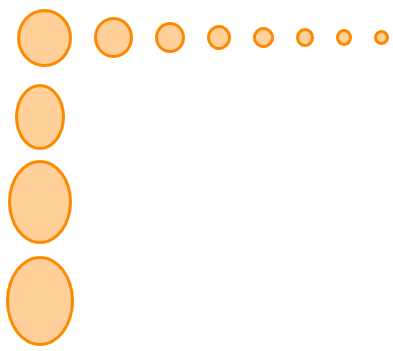
Group “A” & “B” Elements distinguished by sublevels



Periodic Trends

Atomic Radii

* This \_\_\_\_\_ is expressed as an atomic radius, and is one-half of the distance between the nuclei of two atoms of the same element when the atoms are joined. (picometers or 10-12 m)



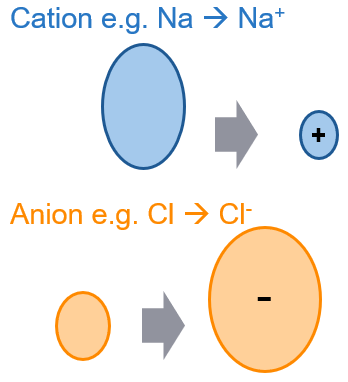
Trends in Atomic \_\_\_\_\_

* In general, atomic size \_\_\_\_\_ from \_\_\_\_\_ to right across a \_\_\_\_\_ & \_\_\_\_\_ going down a \_\_\_\_\_
* Electrons are added:
  + To the \_\_\_\_\_ energy level across a period (\_\_\_\_\_ nuclear charge draws them in)
    - E.g. using a larger magnet to pick up metals
  + To a \_\_\_\_\_ energy \_\_\_\_\_ down a \_\_\_\_\_ (the atom is much larger and electrons more energetic)
    - E.g. placing the electrons in a bigger room to accommodate the larger atom

The \_\_\_\_\_ Effect

* The increase in the number of occupied orbitals \_\_\_\_\_ \_\_\_\_\_ in the highest occupied energy level from the \_\_\_\_\_ of protons in the \_\_\_\_\_. (e.g. solar eclipse)

Trends of Ionic Radii



\_\_\_\_\_ radius is a measure of the size of an ion.

* \_\_\_\_\_ for \_\_\_\_\_ across a \_\_\_\_\_.
  + Groups 1A – 3A elements lose electrons to become cations.
* \_\_\_\_\_ for \_\_\_\_\_ across a \_\_\_\_\_.
  + Groups 4A – 8A elements gain electrons to become anions.
* \_\_\_\_\_ down a \_\_\_\_\_.

Ions

* \_\_\_\_\_, such as Sodium \_\_\_\_\_ electrons when bonding, giving the sodium ion a net \_\_\_\_\_ charge (11 protons - 10 electrons). The positive ion is called a cation and is written as Na+. The \_\_\_\_\_ size is \_\_\_\_\_ than the atomic size.
* \_\_\_\_\_, such as chlorine, \_\_\_\_\_ electrons when bonding, producing an \_\_\_\_\_ (\_\_\_\_\_ ion): (+17 p – 18 e-). This is written: Cl-. The \_\_\_\_\_ size is \_\_\_\_\_ than the atomic size.
* In general, \_\_\_\_\_ tend to form \_\_\_\_\_. \_\_\_\_\_ tend to form \_\_\_\_\_.

\_\_\_\_\_ Energy

* The energy required to \_\_\_\_\_ an \_\_\_\_\_ from an atom.
* The tendency to \_\_\_\_\_ electrons is evidence of \_\_\_\_\_ character (*to gain ideal electron configuration*).
* Ionization energy \_\_\_\_\_ across a \_\_\_\_\_ & \_\_\_\_\_ down a \_\_\_\_\_.

Trends in Ionization Energy

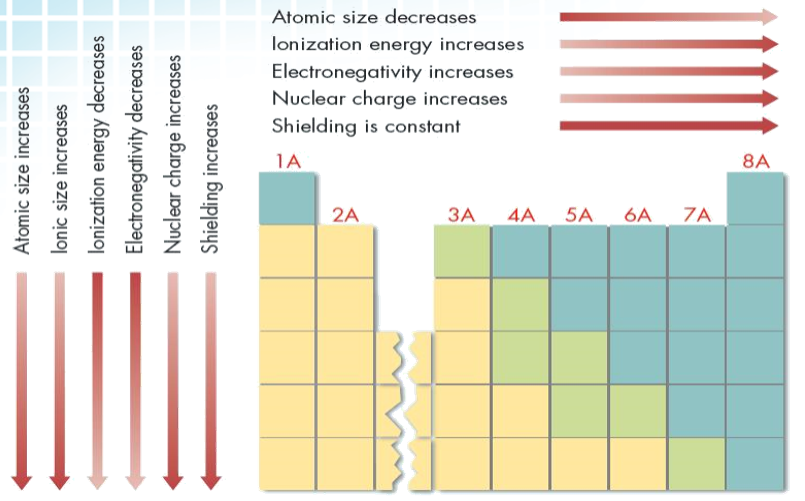
* \_\_\_\_\_ tend to \_\_\_\_\_ electrons, meaning it takes \_\_\_\_\_ energy (lower I.E.)
* \_\_\_\_\_ tend to \_\_\_\_\_ electrons, meaning it would require \_\_\_\_\_ energy (higher I.E.)

E\_\_\_\_\_

* The measure of the electron \_\_\_\_\_ power (electron \_\_\_\_\_) of an atom when it bonds with another atom (*to gain ideal electron configuration*).
* A property used to predict Bonding type during a reaction.
  + \_\_\_\_\_ along a \_\_\_\_\_ or row
  + \_\_\_\_\_ down a \_\_\_\_\_ or family

Trends in Electronegativity

* \_\_\_\_\_ do not “gain” electrons, meaning \_\_\_\_\_ electronegativity
* \_\_\_\_\_ DO gain electrons, meaning \_\_\_\_\_ electronegativity



SUMMARY

The Arrangement of the Periodic Table

* The periodic table contains a great deal of information on the elements.
* \_\_\_\_\_ refer to \_\_\_\_\_ rows of the periodic table.
* \_\_\_\_\_ or *families* refer to \_\_\_\_\_ \_\_\_\_\_ of the periodic table.
* Cells of the periodic table contain information such as the atomic \_\_\_\_\_, atomic \_\_\_\_\_, atomic \_\_\_\_\_, name of the \_\_\_\_\_, \_\_\_\_\_ configuration, and possible \_\_\_\_\_ numbers.
* Elements can be categorized broadly as \_\_\_\_\_, \_\_\_\_\_, or semimetals (\_\_\_\_\_).

Classifying the Elements

* Groups
* \_\_\_\_\_ metals: most reactive metals, soft, oxidize quickly
* \_\_\_\_\_ earth metals: not as reactive as alkali metals, brittle, shiny
* \_\_\_\_\_ metals: form colored compounds, good conductors of electricity
* \_\_\_\_\_: most reactive nonmetals
* \_\_\_\_\_ gases: lowest chemical reactivity, used in lighting
* \_\_\_\_\_ transition metals: radioactive, used in nuclear power plants