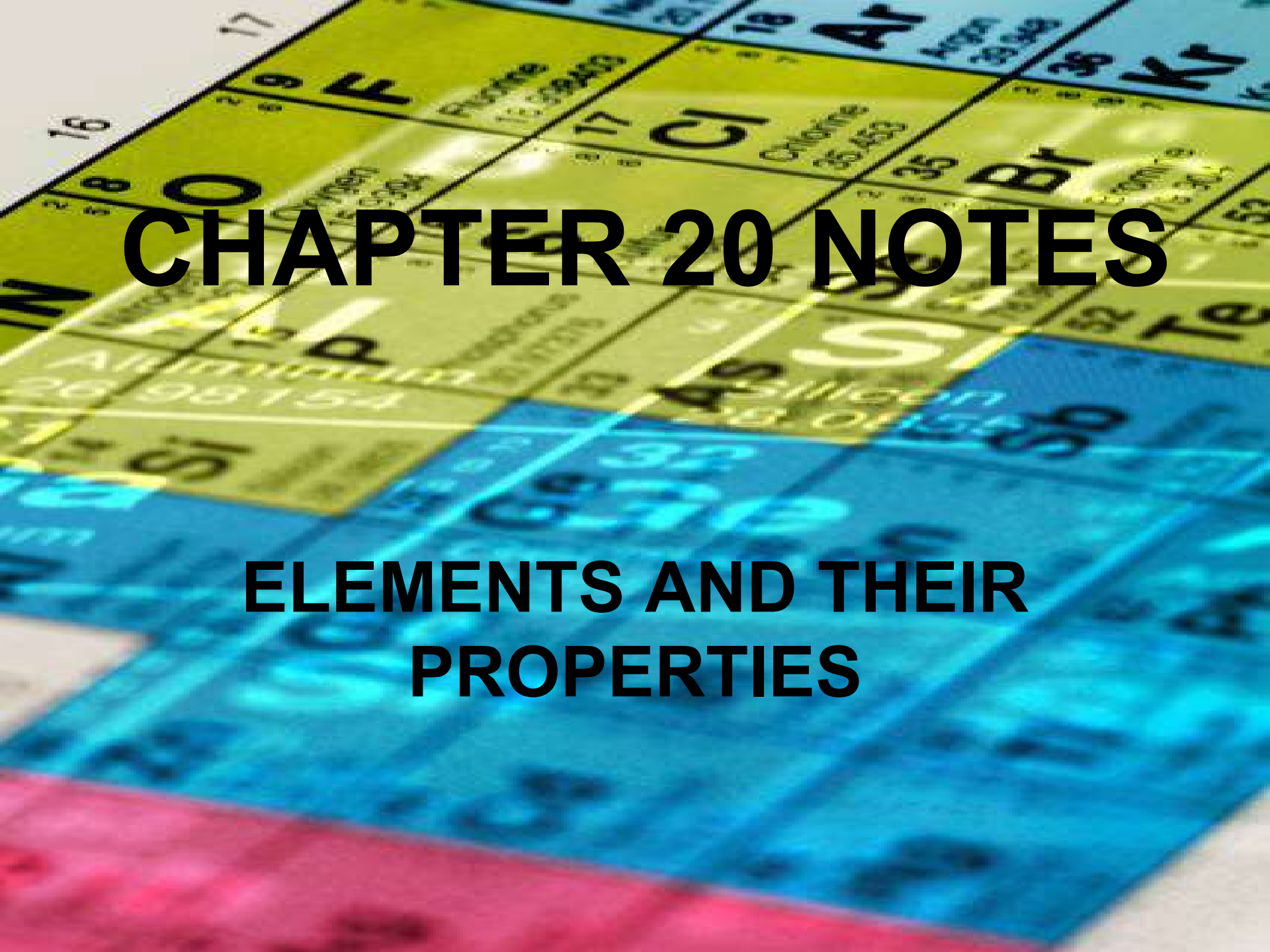
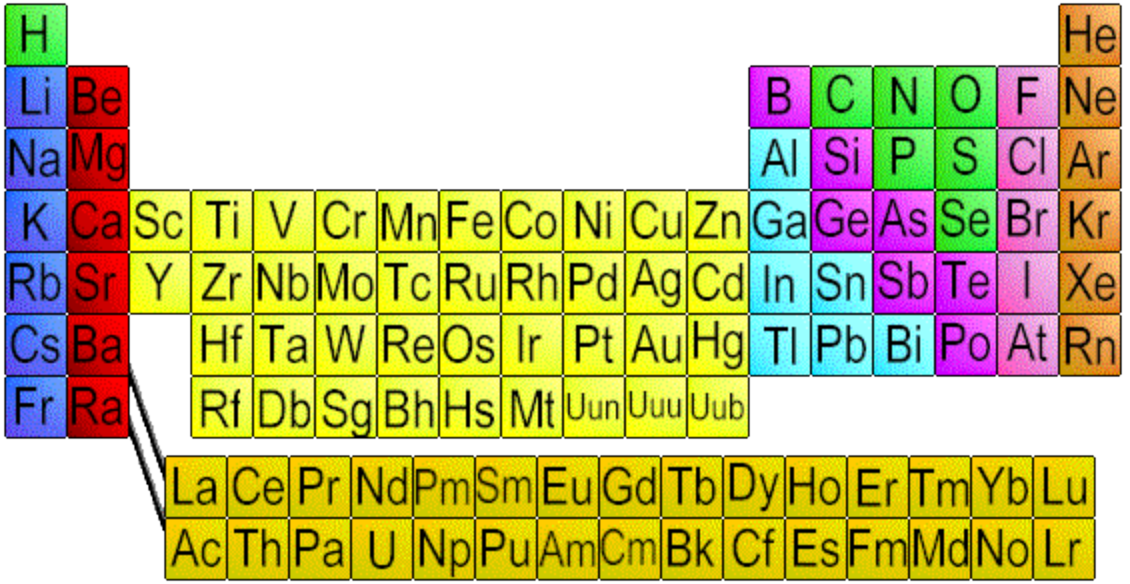


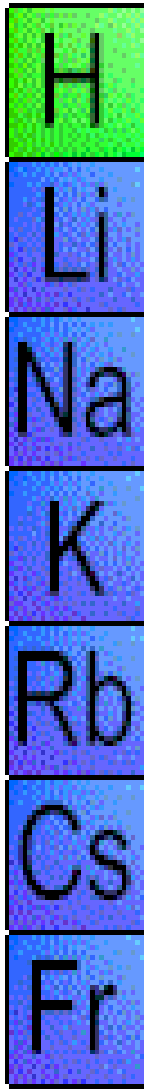
CHAPTER 20 NOTES

ELEMENTS AND THEIR PROPERTIES

PROPERTIES OF METALS



- Left of the stair-step line
- Good conductors of heat & electricity
- All but one are solid at room temperature
- Reflect light (**LUSTER**)
- **MALLEABLE** – can be hammered or beaten into sheets
- **DUCTILE** – can be drawn into wires

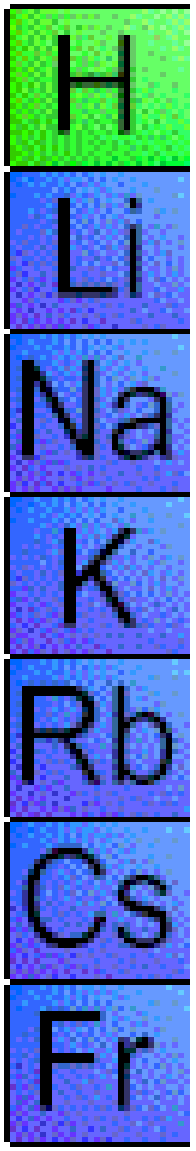


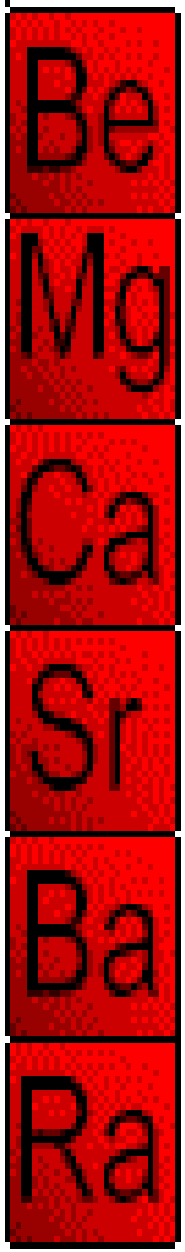
ALKALI METALS

- Softer than most other metals
- Most reactive of all metals
- React rapidly – often violently – with oxygen and water
- Don’t occur in nature in elemental form and are stored in substances that are unreactive, such as oil
- Have one valence electron, therefore, become positively charged in a compound

USES OF ALKALI METALS

- Potassium and sodium compounds help keep you healthy
- Lithium compounds treat bipolar disorders
- Photocells depend on Rubibium or Cesium compounds
- Francium is extremely rare and radioactive





ALKALINE EARTH METALS

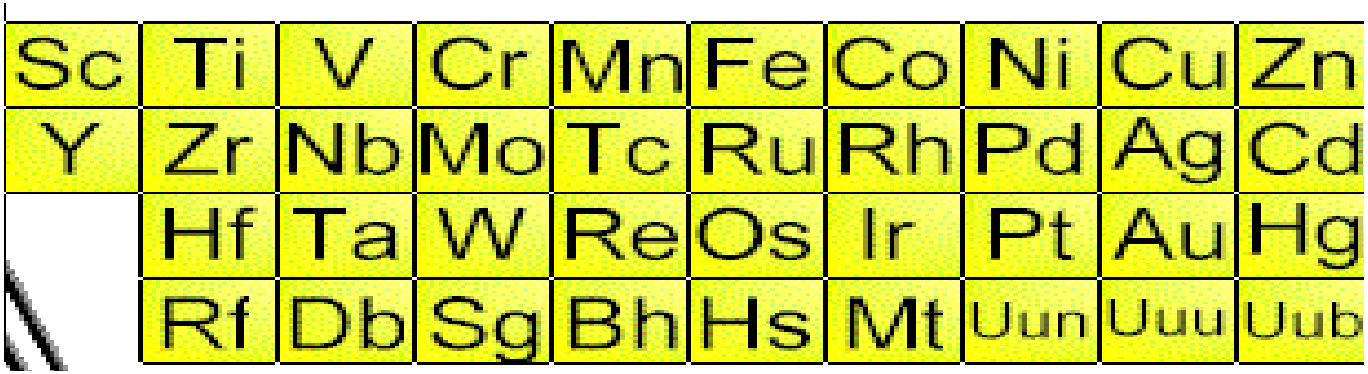
- Combine readily so are not found free in nature
- 2 valence electrons, therefore, become positively charged in a compound
- Mg produces white color in fireworks
- Mg is light so it is used in cars, planes, and spacecraft; used in household ladders, baseball/softball bats
- Mg compound, chlorophyll, enable plants to make foods

ALKALINE EARTH METALS

- Calcium (Ca) used in marble statues, countertops, vitamins
- Barium (Ba) – $BaSO_4$ used to diagnose digestive disorders because it absorbs X-ray radiation.
- Radium (Ra) is radioactive and found associated with Uranium.

- Ra was once used to treat cancers

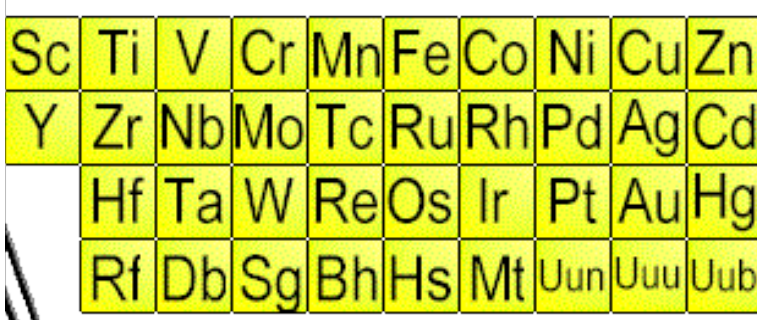
TRANSITION ELEMENTS



Sc	Ti	V	Cr	Mn	Fe	Co	Ni	Cu	Zn
Y	Zr	Nb	Mo	Tc	Ru	Rh	Pd	Ag	Cd
	Hf	Ta	W	Re	Os	Ir	Pt	Au	Hg
	Rf	Db	Sg	Bh	Hs	Mt	Uun	Uuu	Uub

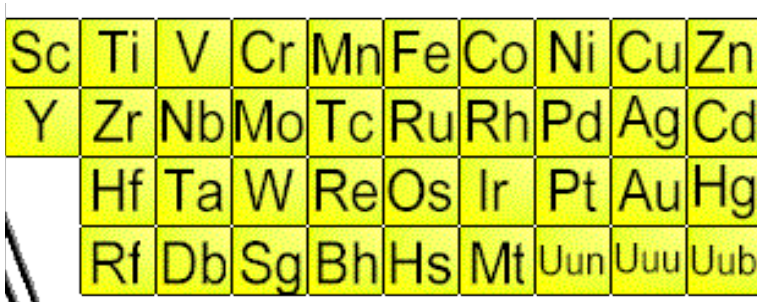
- Groups 3-12
- Called transition because they are considered to be in “transition” between Groups 1 & 2 and Groups 13 through 18.
- Occur in nature as uncombined elements
- Often form colored compounds

USES OF TRANSTION ELEMENTS



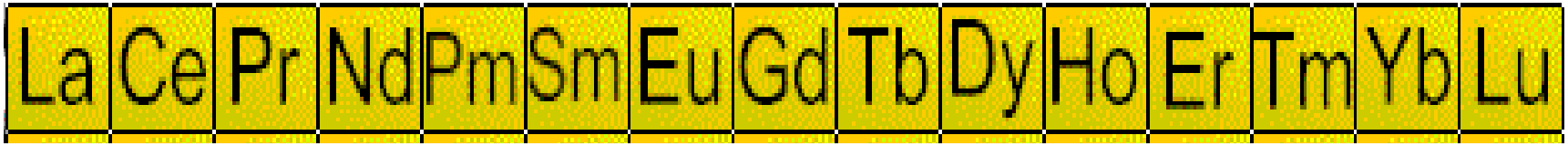
- Iron (Fe), Cobalt (Co), Nickel (Ni) known as "Iron Triad" – used to create steel
- Fe – main component of steel, most widely used of all metals, 2nd most abundant metallic element in Earth's crust (Al is 1st)
- Copper (Cu), Silver (Ag), Gold (Au) – found as free elements in nature, once used to make coins
- Cu used in wiring
- Silver Iodide & Silver Bromide used in photographic paper
- Ag & Au used to make jewelry

USES OF TRANSITION ELEMENTS



- Zinc (Zn) combines with Oxygen in the air to form a thin, protective coating of Zinc Oxide on its surface.
- Zn and Cadmium (Cd) used to coat other metals because of protective quality.
- Cd used in rechargeable batteries
- Mercury (Hg) silvery, liquid metal – used in thermometers, thermostats, switches, batteries.
- Hg is poisonous and can accumulate in the body. People have died of Hg poisoning after eating fish that lived in Hg-contaminated water.

INNER TRANSITION METALS

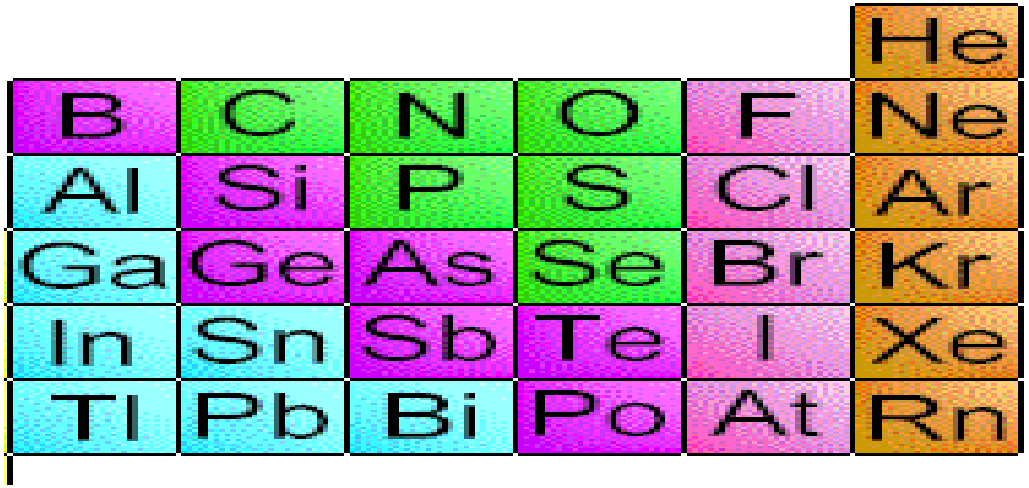


- Lathanides –
- Lanthanum, Cerium, Praseodymium, and Samarium are used with Carbon to make a compound that is used extensively by the motion picture industry.
- Europium, Gadolinium, and Terbium are used to produce colors on TV screen

INNER TRANSITION METALS

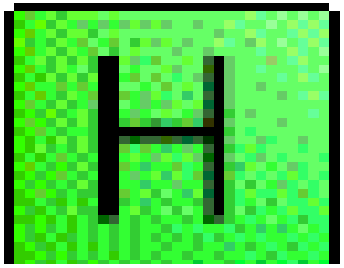
- Actinides – all are radioactive & unstable
- Thorium used in making glass for camera lenses
- Uranium used in nuclear reactors & weapons. Best known is used as photographic toner

NONMETALS

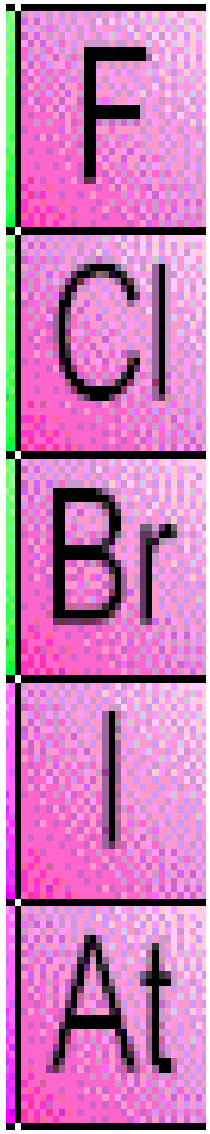


- Usually gases or brittle solids at room temp.
- Not malleable/ductile, do not conduct heat/electricity, not shiny
- Found at the right of the stair-step line
- Can form ionic and covalent bonds

HYDROGEN



- Most H on Earth found in the compound water
- Highly reactive
- Has 1 single electron which is shared in bonds
- H can gain an electron when it combines with Alkali and Alkaline Earth metals forming hydrides

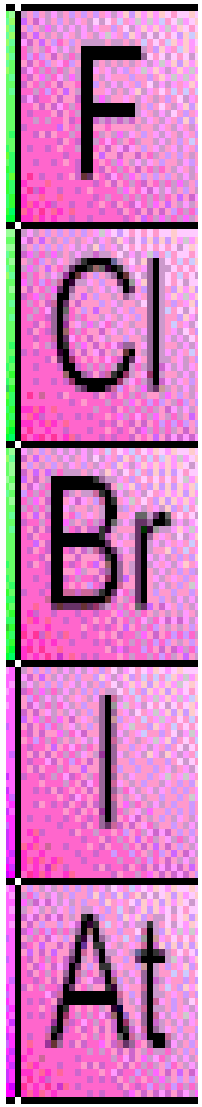


HALOGENS

- Very reactive
- 7 valence electrons so need only one to be stable
- Bromine & Iodine in small amounts in halogen lights
- Chlorine is greenish yellow and added to water to disinfect it

- Fluorine is the most chemically active of all elements. It is added to toothpastes and city water to prevent tooth decay. A compound of Fluorine is used to etch glass & frost the inner surfaces of lightbulbs

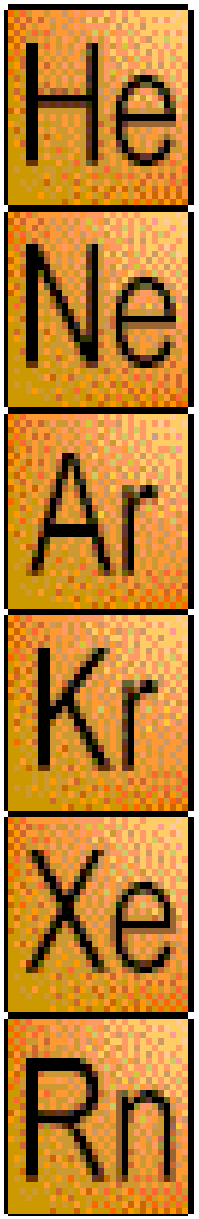
USES OF HALOGENS



- Cl – most abundant halogen is obtained from seawater, used to disinfect water, and in bleach
- Br – only nonmetal that is a liquid also extracted from seawater. Used as dyes in cosmetics
- I – shiny purple gray obtained from seawater. When heated I changes directly to a purple vapor. The process of a solid changing directly to a vapor without forming a liquid is sublimation. Used in your diet for producing thyroxin & prevent goiters
- At – radioactive & rare. No known use

NOBLE GASES

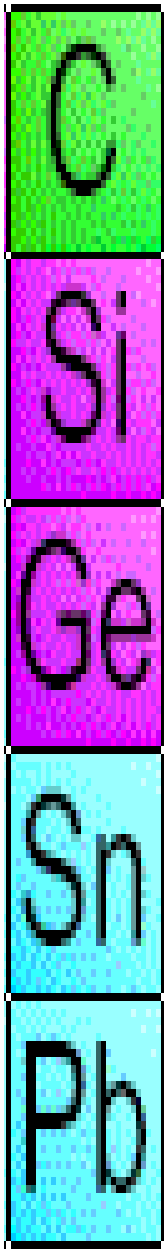
- Exist as isolated atoms
- Stable because outermost energy level is full
- No naturally occurring noble gas compounds are known
- He used in blimps & balloons
- Ne and Ar used in “neon” lights
- Ar & Kr used in lasers



BORON GROUP

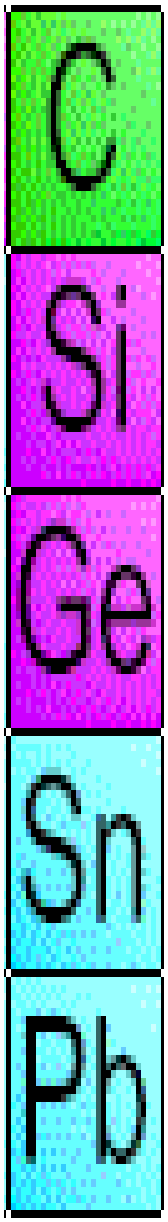
Boron – a metalloid found in borax and boric acid (a mild antiseptic)

Aluminum – most abundant metal in Earth's crust; used in soft-drink cans, foil wrap, cooking pans, and as siding. Also used in construction of planes



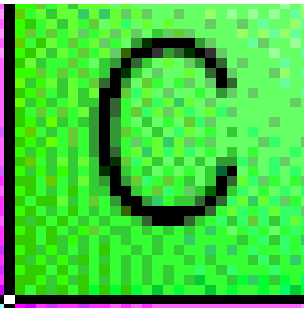
CARBON GROUP

- Carbon – 4 valence electrons
- C is a nonmetal, Si and Ge are metalloids; Sn and Pb are metals.
- C occurs as an element in coal & as a compound in oil, natural gas, and foods.
- C, in these materials can combine with O to produce CO_2 which is also used by plants.
- C compounds are essential to life
- All organic compounds contain C but not all carbon compounds are organic.



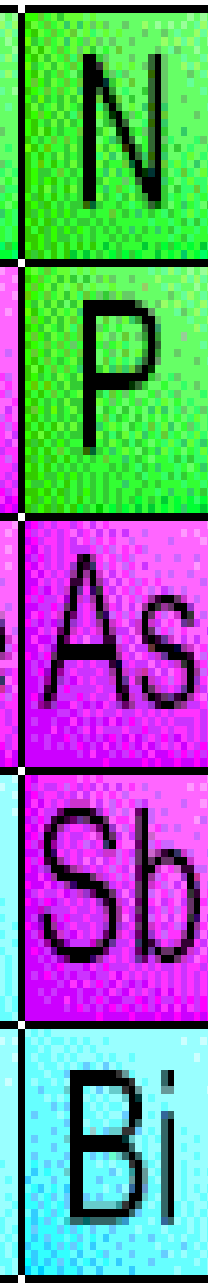
CARBON GROUP

- Si is 2nd only to O in abundance in Earth's crust
- Most Si is found in sand, & almost all rocks & soil
- Si occurs as two allotropes
- Si is main component in semiconductors
- Ge used with Si to make semiconductors
- Sn used to coat other metals to prevent corrosion, is also combined with other metals to produce bronze and pewter
- Pb once used in paints



ALLOTROPES OF CARBON

- Diamonds – C atom is bonded to 4 other C atoms at the corner points of a tetrahedron
- Graphite – black powder that is an excellent lubricant
- Buckminsterfullerene – informally called a buckyball – used to synthesize extremely thin, graphitelike tubes called nonotubes which may be used one day to make computers smaller and faster



NITROGEN GROUP

- Each element has 5 valence electrons so will form negative ions in an ionic bond
- N is used to make nitrates & ammonia both of which are used in fertilizer, it is the 4th most abundant element in the body
- P has 3 allotropes used for water softeners, fertilizers, match heads, & fine china
- Antimony (Sb) is a metalloid & is used with other metals to lower melting points
- Bismuth (Bi) is a metal & used to lower melting points & automatic fire-sprinkler heads

OXYGEN GROUP

- O exists in air as a diatomic molecule; used for respiration and to protect from Suns radiation
- S combines with metals to form sulfides that are used as pigments in paint
- Se (nonmetal) is needed in trace amounts in the diet, found in multivitamins but can be toxic if you get too much, also used in photocopiers

SYNTHETIC ELEMENTS

- Each synthetic element has more than 92 protons
- Neptunium disintegrates to form Plutonium
- Plutonium produced in control rods of nuclear reactors & used in bombs
- Americium produced from Plutonium. Used in home smoke detectors.
- Transuranium elements – are neither metals, nonmetals, or metalloids; some are in the actinide series & some are on the bottom row of the mains periodic table. They are all synthetic & unstable, and many disintegrate quickly