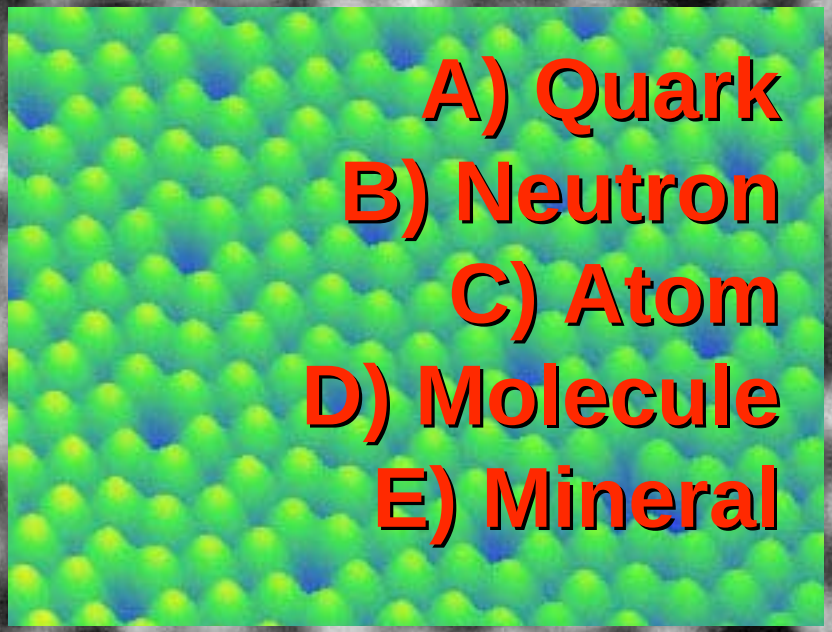
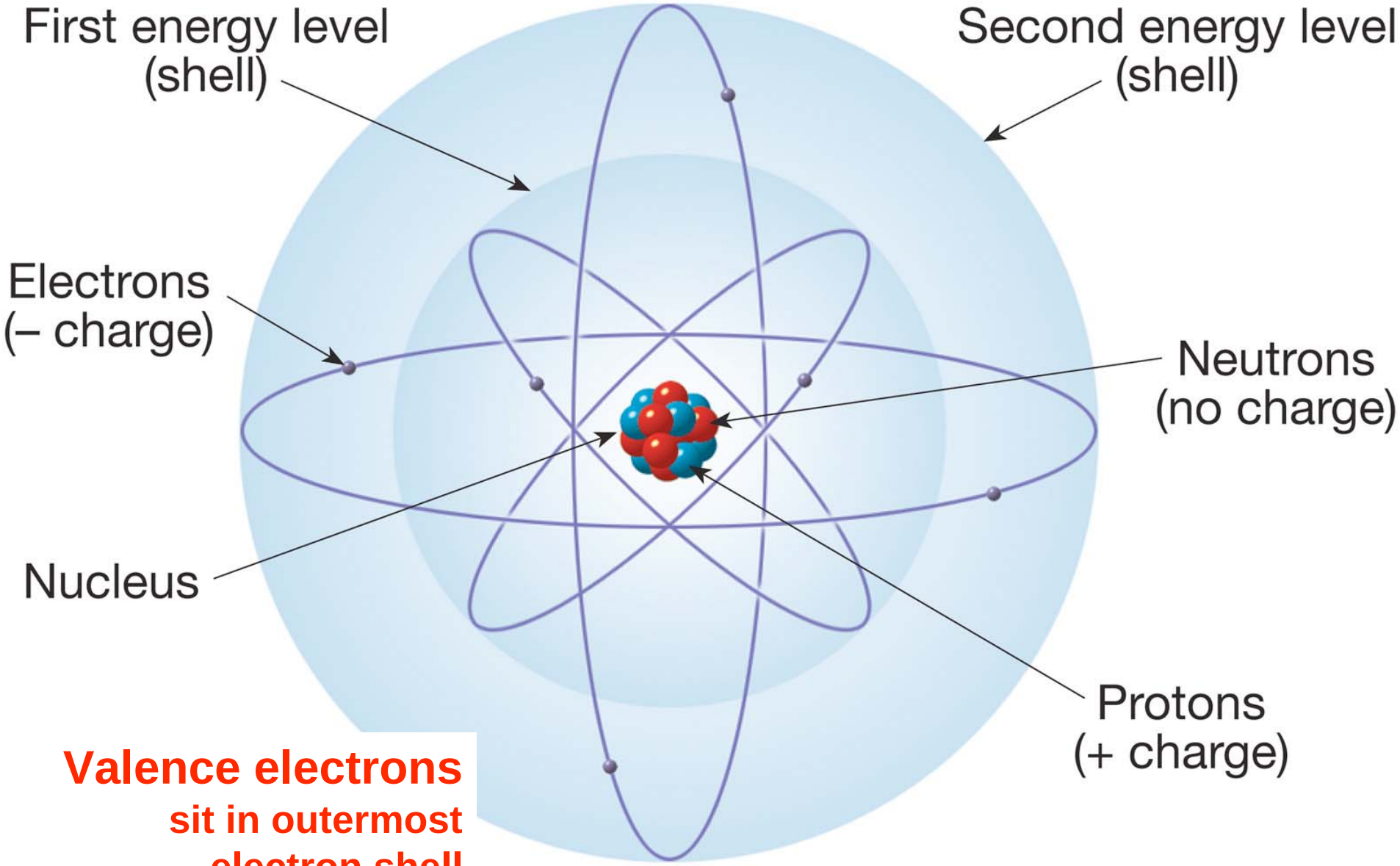
Smallest possible particle of a chemical element that retains that element's chemical properties?



A) Quark
B) Neutron
C) Atom
D) Molecule
E) Mineral

smallest possible particle of a chemical element that retains its chemical properties = ATOM



Valence electrons
sit in outermost electron shell

particle { **smallest possible particle of a chemical element that retains that element's chemical properties**

=

ATOM

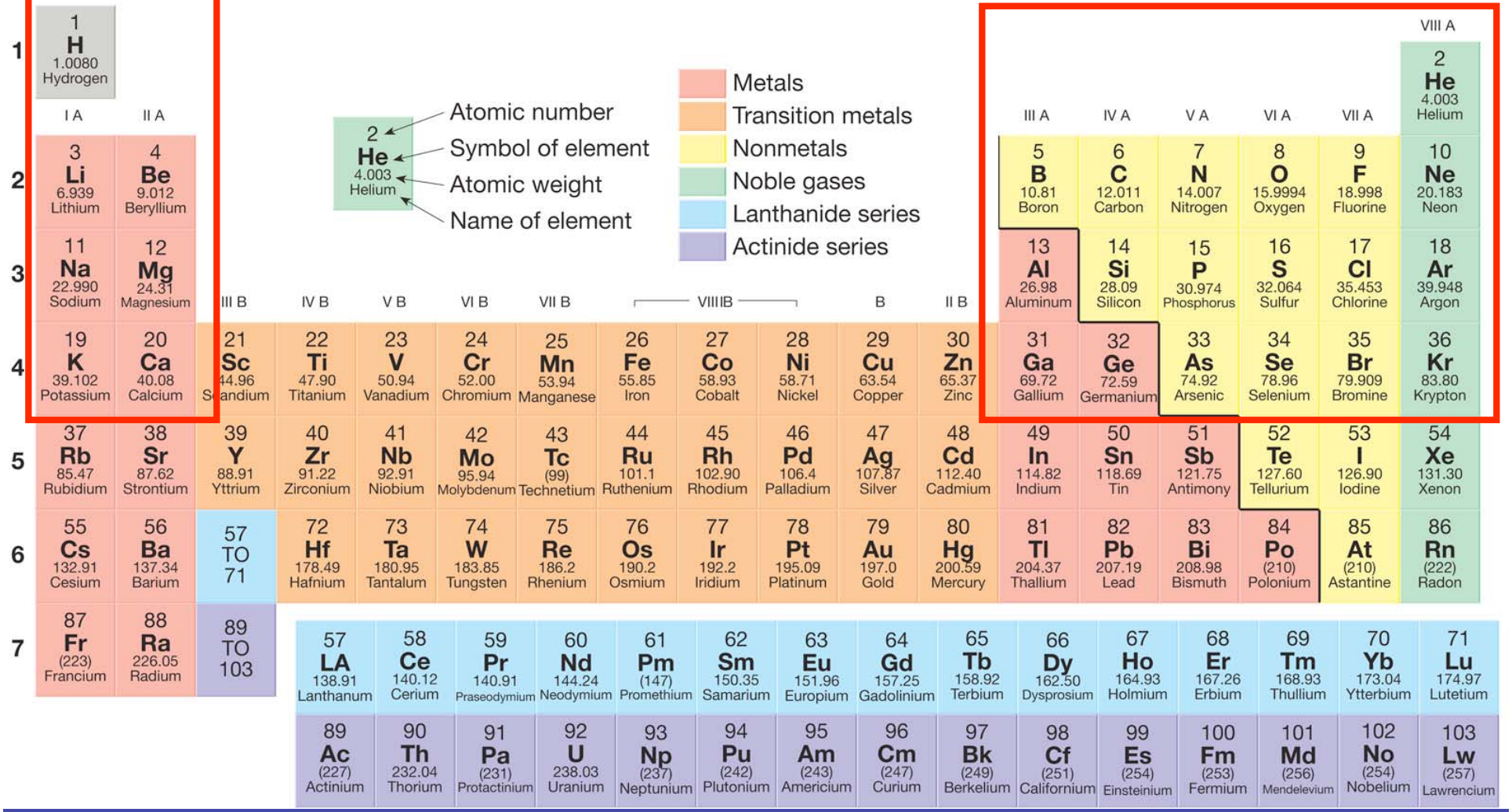
substance { **a substance that cannot be decomposed or transformed into other chemical substances by ordinary chemical processes**

=

?

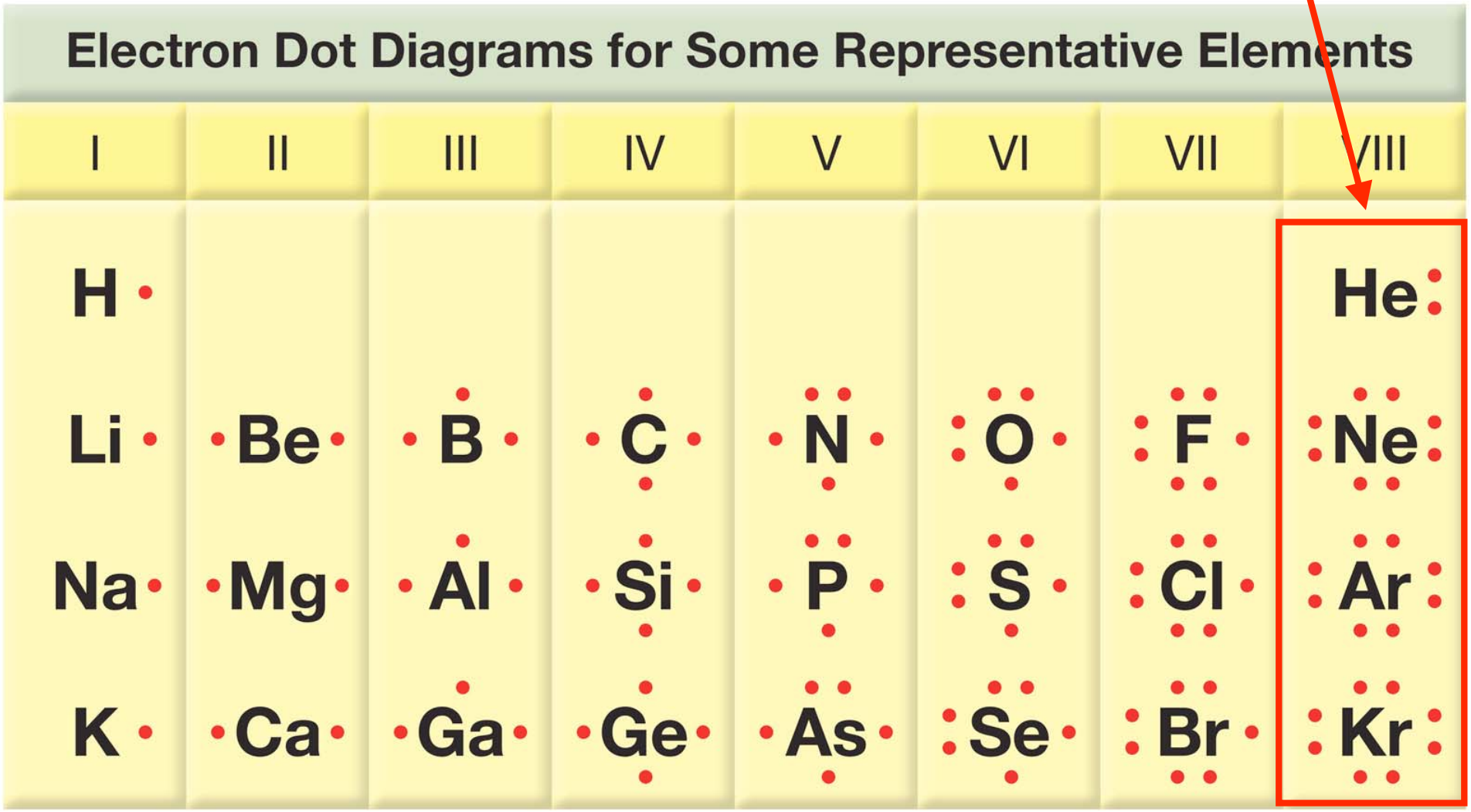
Which of these elements are the most STABLE?

A **B** **C** **D**



Periodic Table first created in 1869 by the Russian chemist Dmitri Mendeleev

stable configuration:
valence shell contains maximum electrons - noble gases

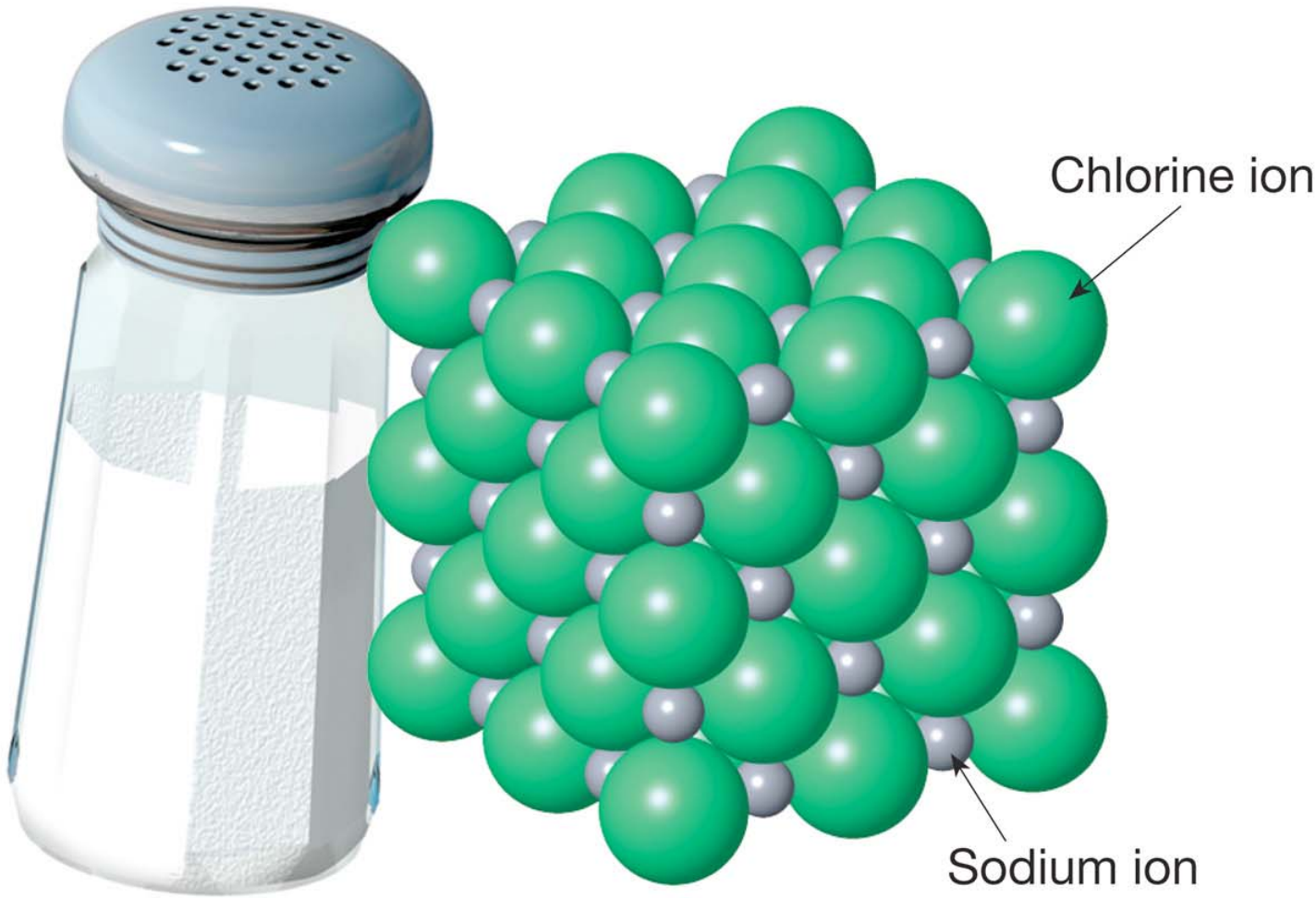


how do <u>other</u> elements <u>gain</u> stability?

A.



B.



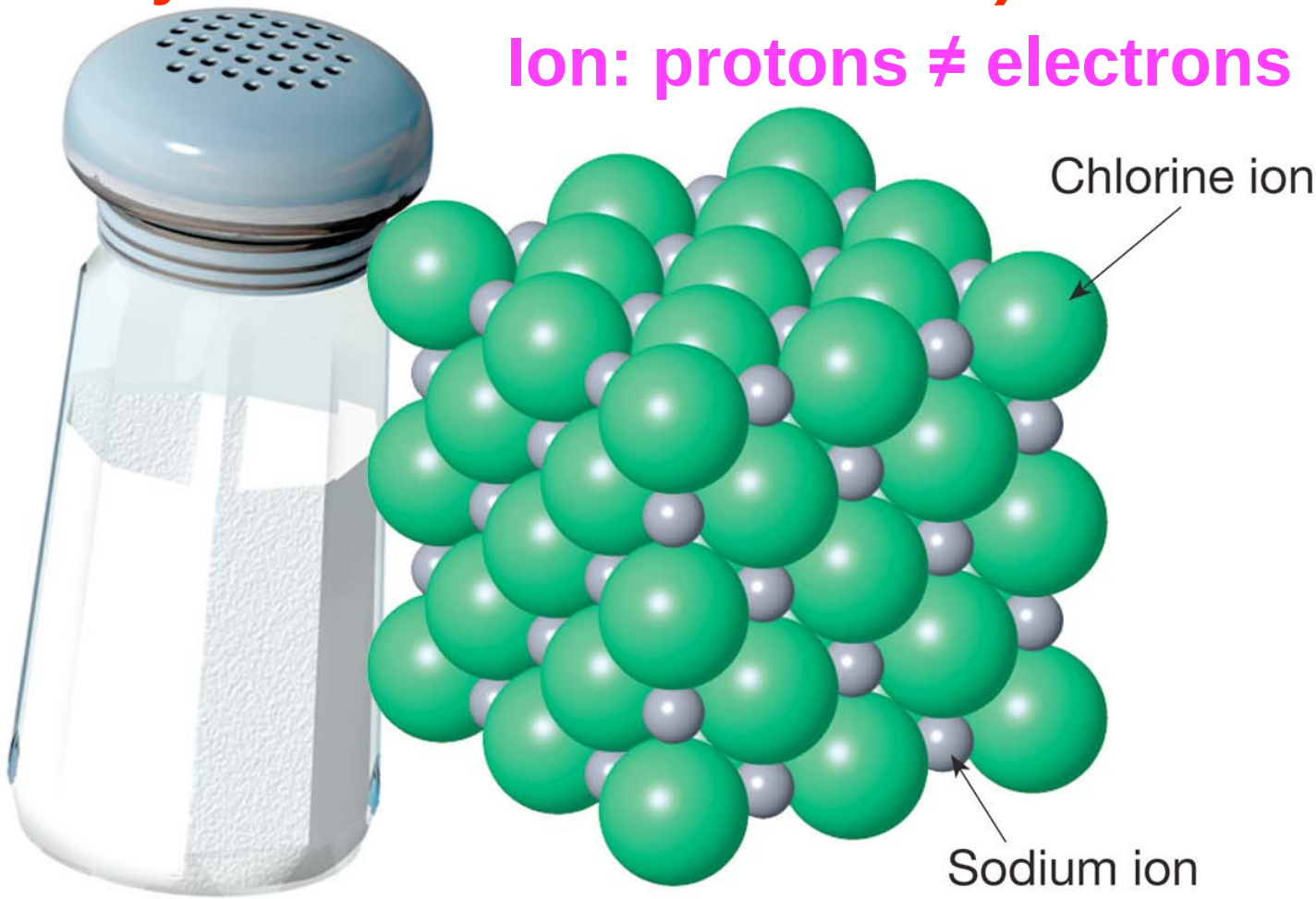
A.



<u>Ionic bond</u>: electrons transferred (usually from metal to non-metal)

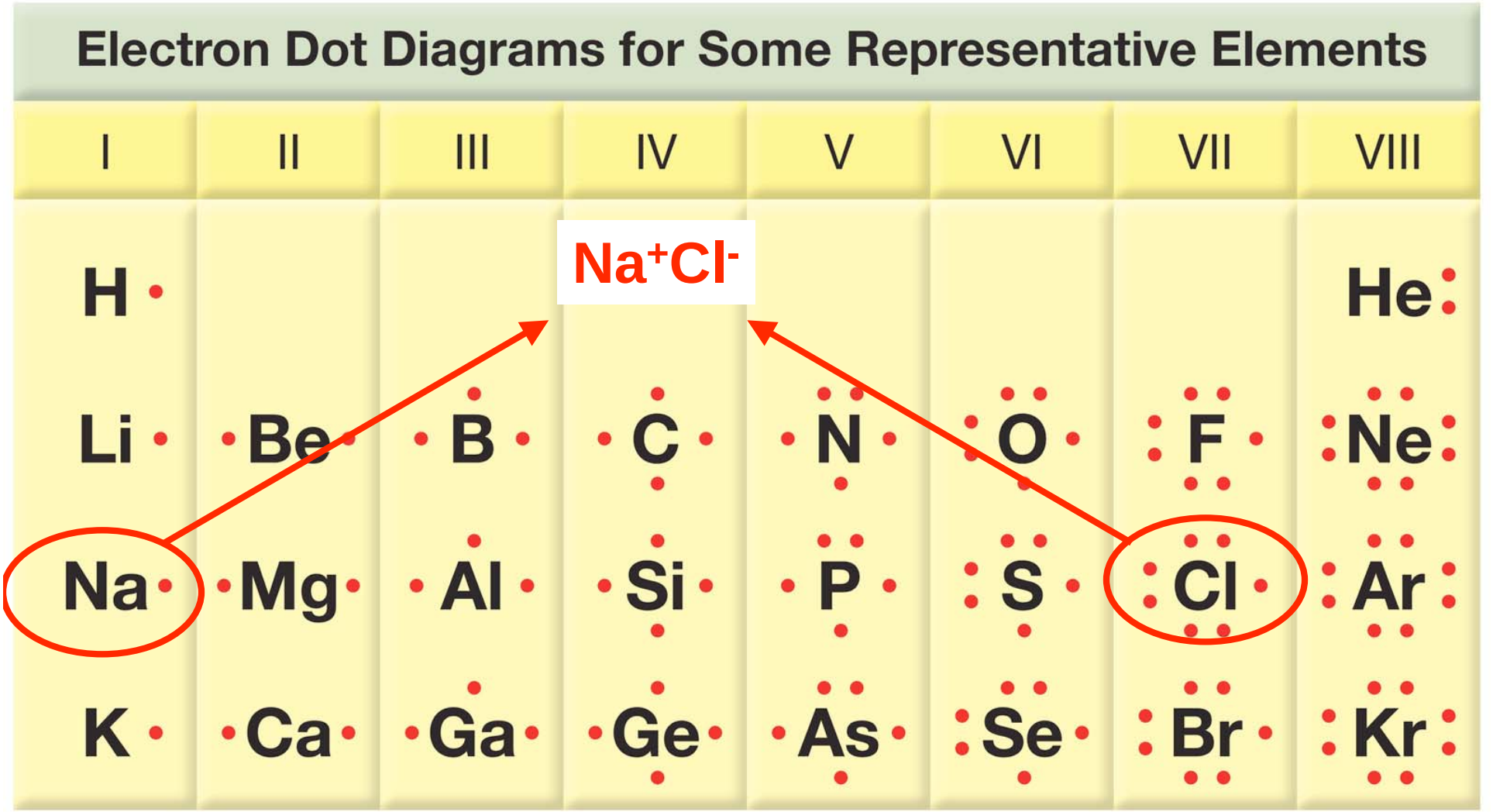
Ion: protons ≠ electrons

B.



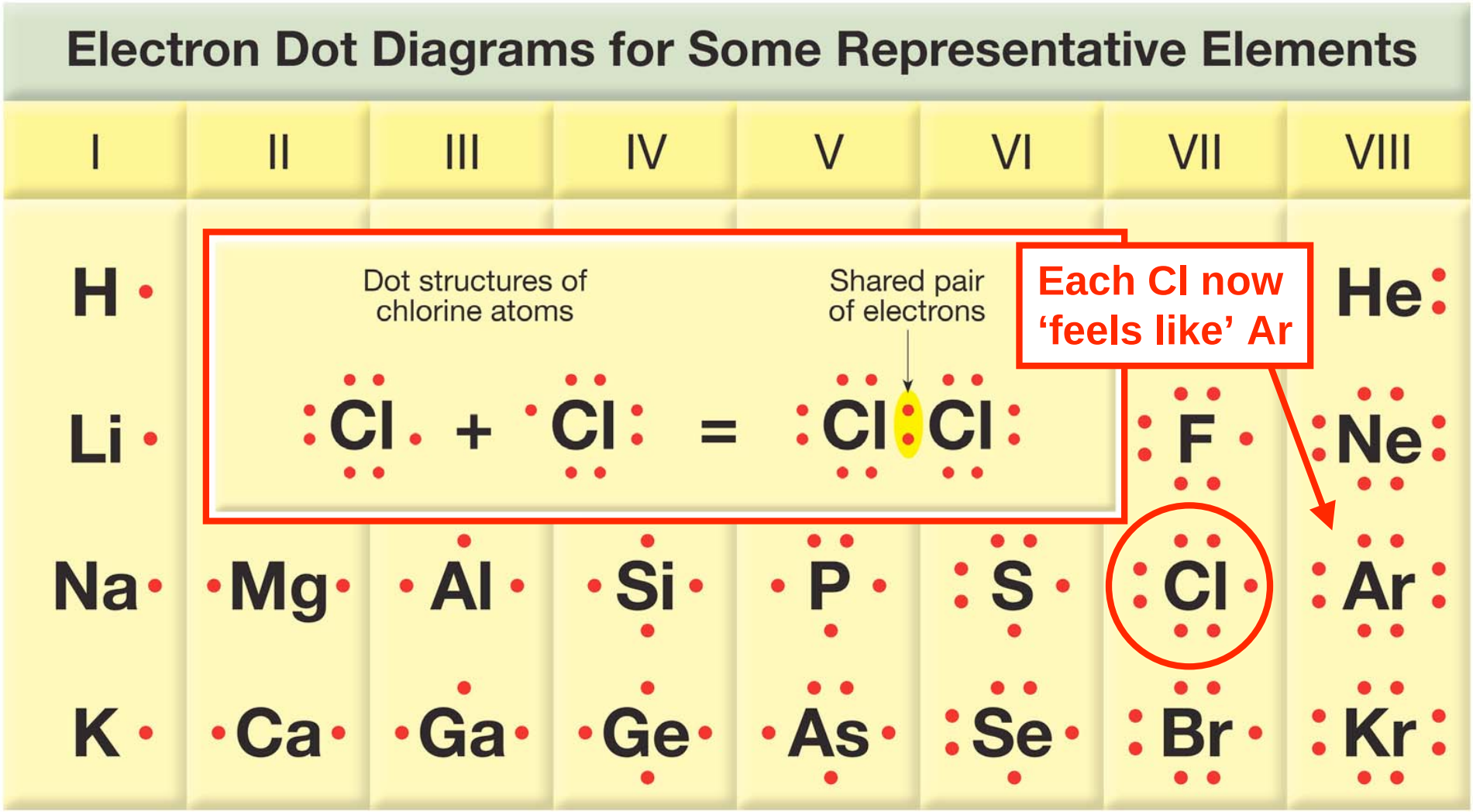
stable configuration: valence shell contains maximum electrons

1. **ionic bonding…electron transfer**
2. **_____**



stable configuration: valence shell contains maximum electrons

2. covalent bonding…electron sharing



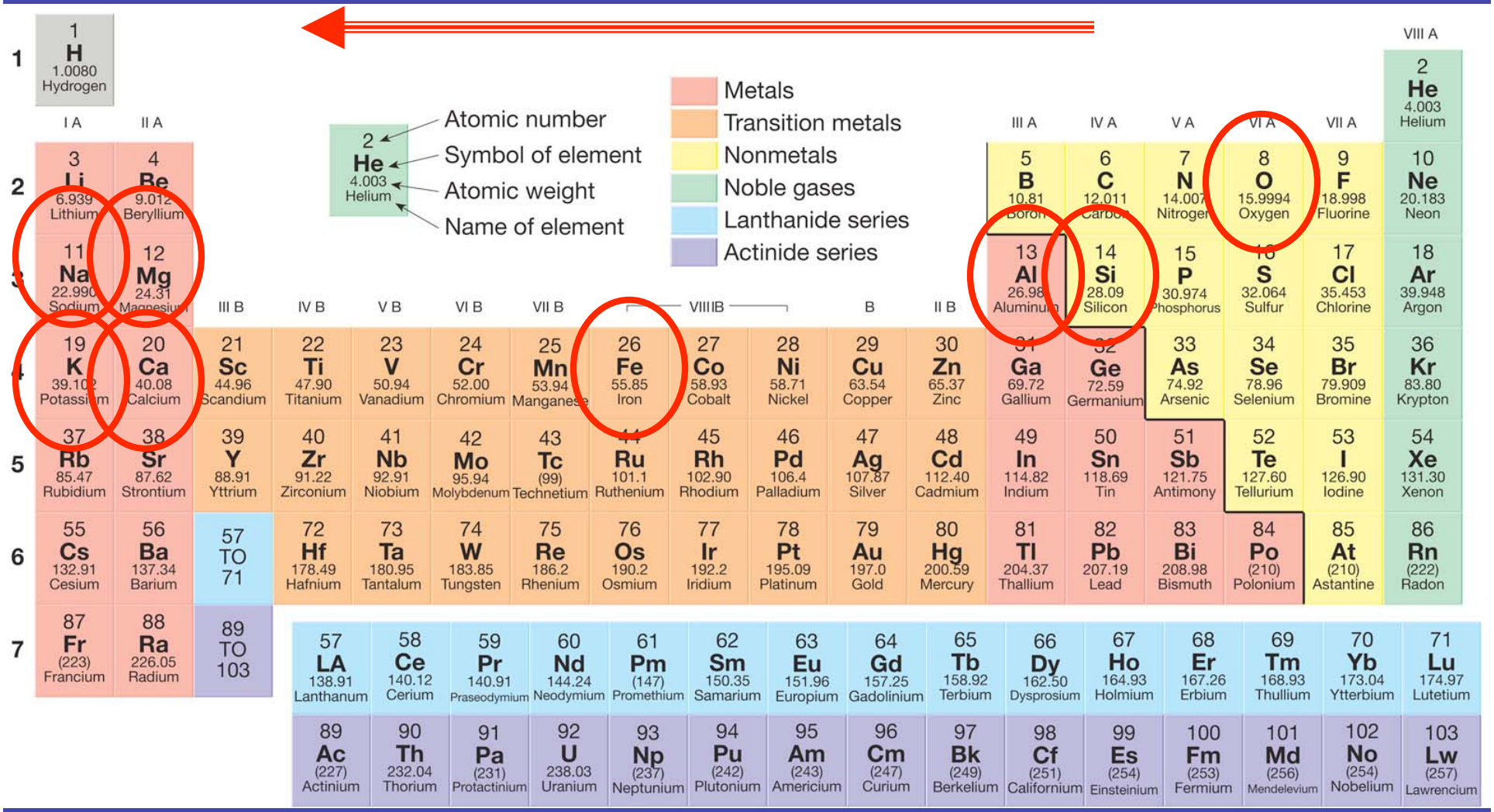
Take-home message:

Most of Earth's elements PREFER (chemically) to exist in combination with other elements

~

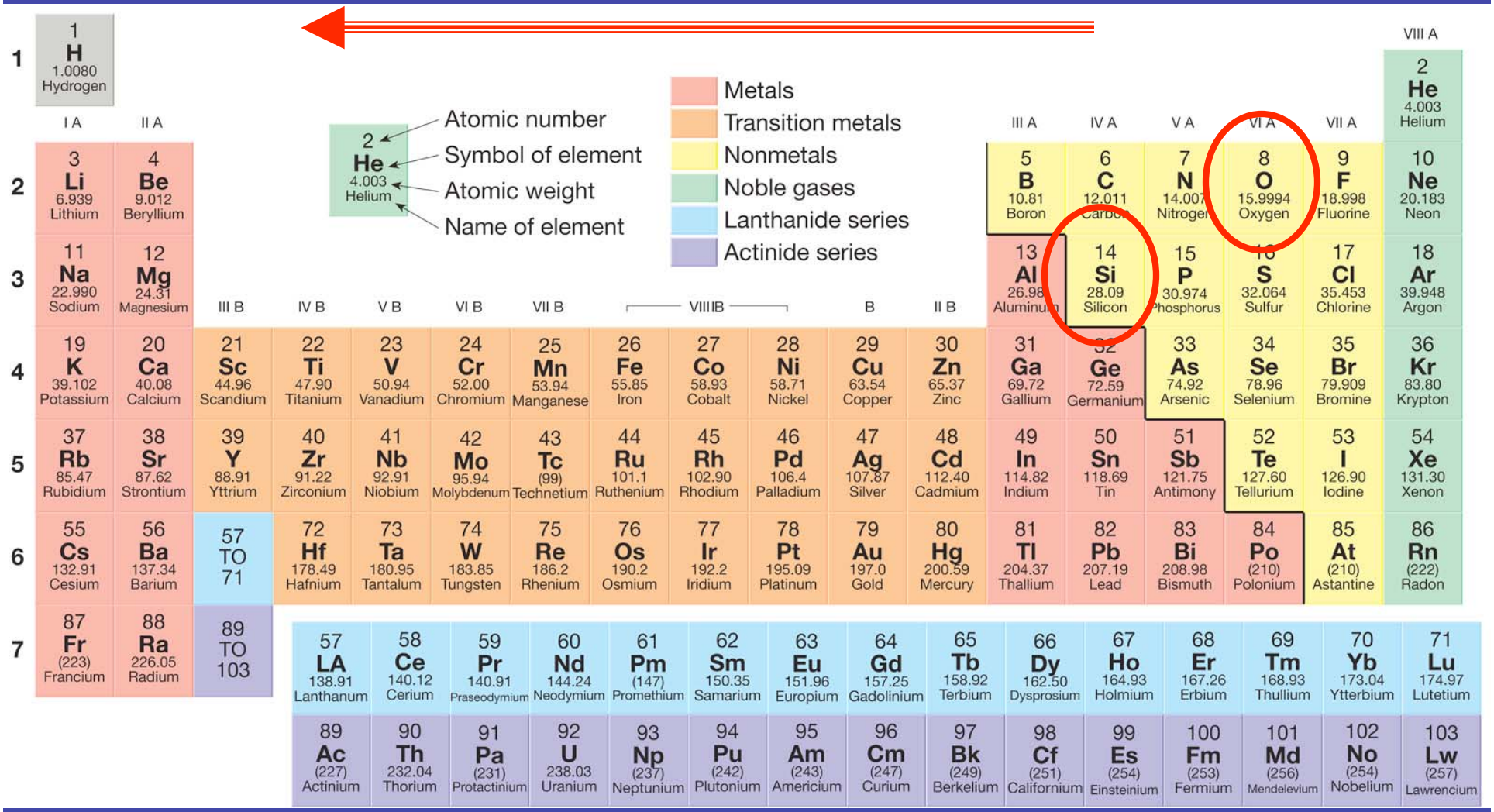
accomplished via electrostatic bonding
(ionic, covalent, and many other types)

less abundant most abundant



What is most common mineral group going to be made up of?

less abundant most abundant



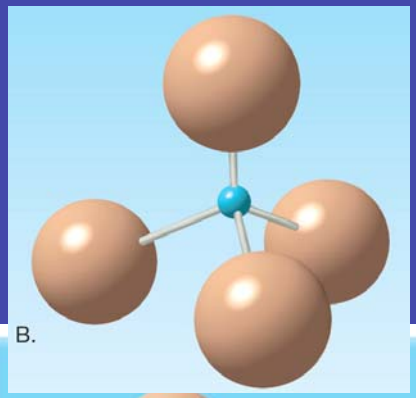
What is most common mineral group going to be made of?

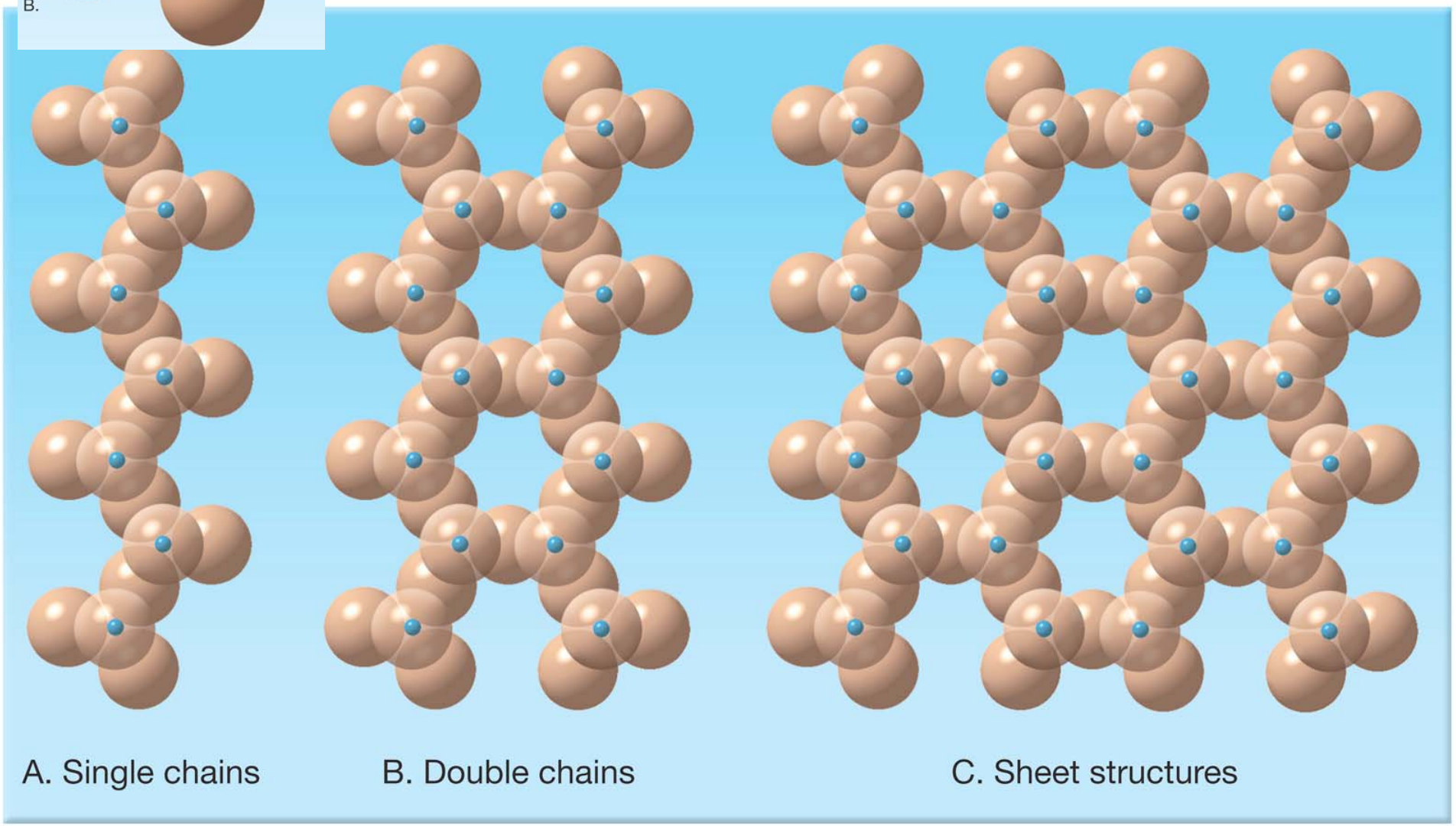
Oxygen, Silica – Silicates (90% of Earth's crust)

Ratio of oxygen to silica changes

4:1, 3:1, (2:1)

% silica controls physical properties of magma





Mineral/Formula	Cleavage	Silicate Structure	Example
Oceanic crust - dense			
Olivine $(Mg, Fe)_2SiO_4$	None	Single tetrahedron	Olivine
Pyroxene group (Augite) $(Mg,Fe)SiO_3$	Two planes at right angles	Single chains	Augite
Amphibole group (Hornblende) $Ca_2(Fe,Mg)_5Si_8O_{22}(OH)_2$	Two planes at 60° and 120°	Double chains	Hornblend
Micas: Biotite $K(Mg,Fe)_3AlSi_3O_{10}(OH)_2$	One plane	Sheets	Biotite
Micas: Muscovite $KAl_2(AlSi_3O_{10})(OH)_2$	One plane	Sheets	Muscovite
Feldspars: Potassium feldspar (Orthoclase) $KAlSi_3O_8$	Two planes at 90°	Three-dimensional networks	Potassium feldspar
Feldspars: Plagioclase feldspar $(Ca,Na)AlSi_3O_8$	Two planes at 90°	Three-dimensional networks	
Quartz SiO_2	None	Three-dimensional networks	Quartz
Continental crust - light			





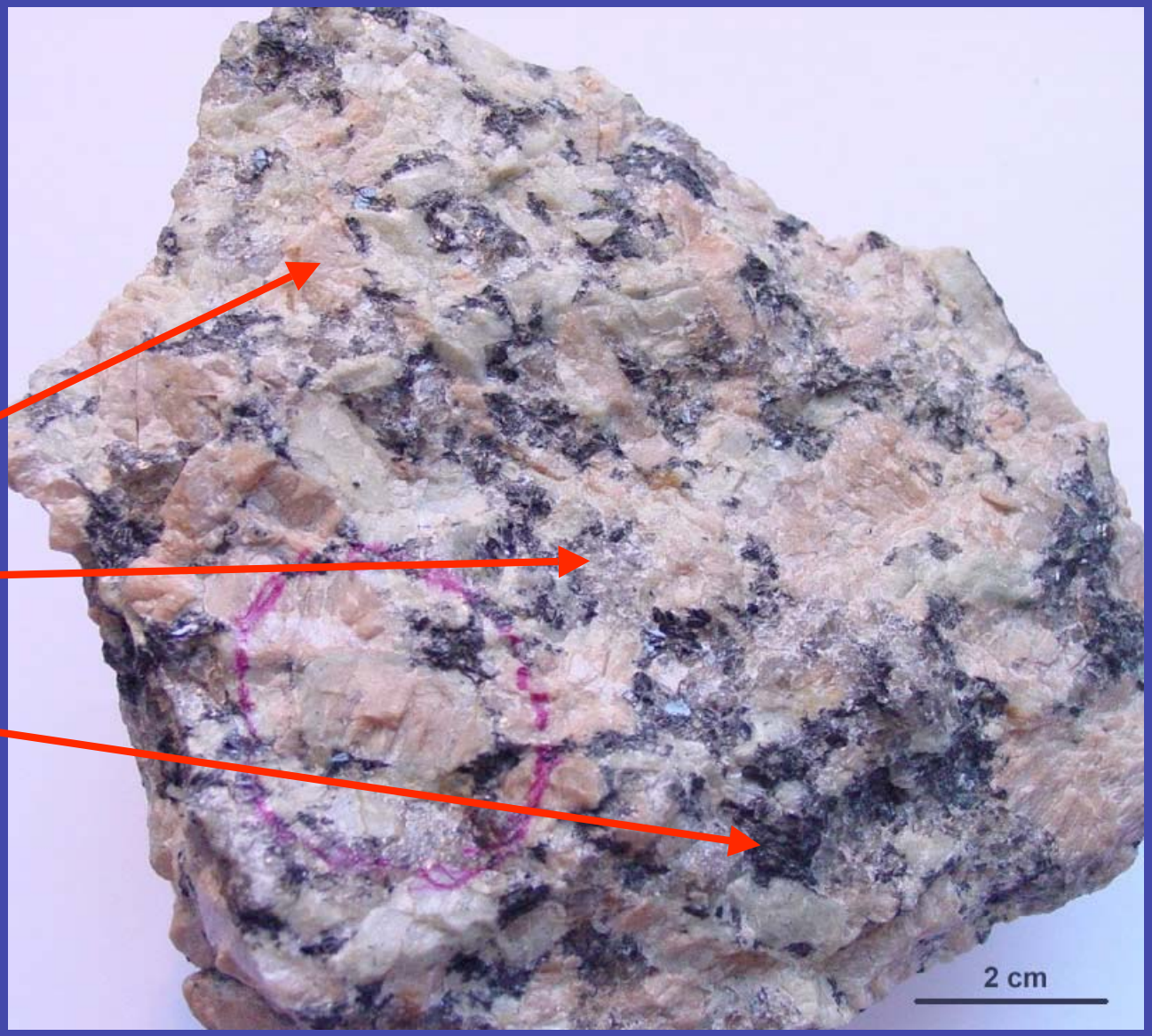



2 cm

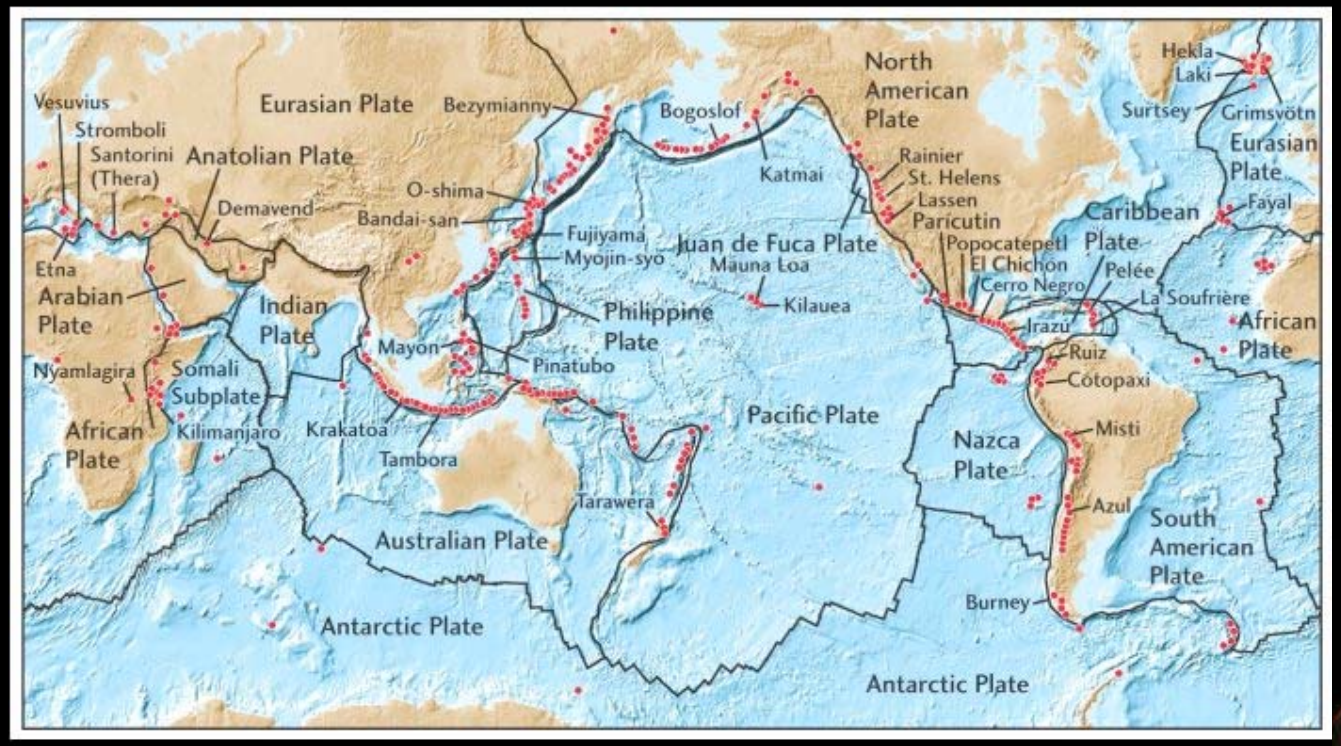


Granite

most common rock in continental crust



The World's Active Volcanoes



Silicates have volcanic origin

Plate tectonics controls lava chemistry



Summary

Silicates: 90% of Earth's Crust, volcanic origin

1) Continental crust

- **High silica, low density**
- **Granite most common rock**
  - **Feldspars and quartz most common minerals (light silicates)**

2) Oceanic crust

- **Lower silica, higher density**
- **Basalt most common rock**
  - **Olivine and pyroxene most common minerals (dark silicates)**

Non-silicates (<10%): Halides, Sulfates, Carbonates


gypsum


zinc

limestone




Great
Salt
Lake
OR
ID
CA
NV
Salt Lake
City
Bonneville
Salt Flats
UT
AZ

Salt flats







Gypsum $CaSO_4 \cdot 2H_2O$



Examples of Halides - Evaporites









Seawater 100%



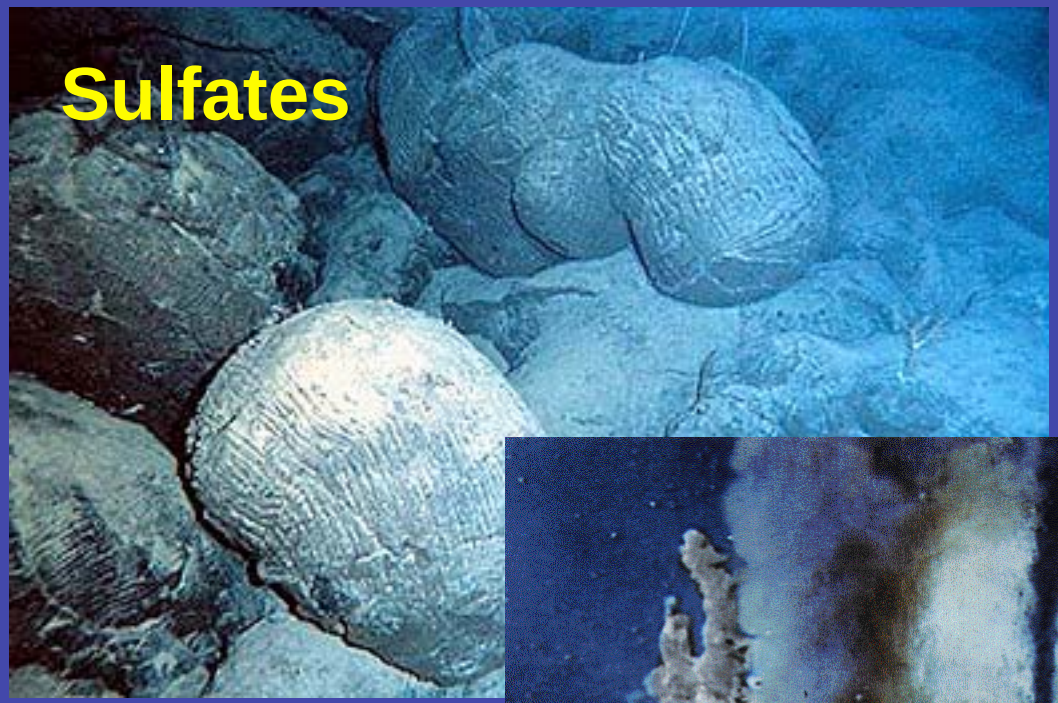
Gypsum 25-30%



Halite 10%



Sylvite <10%



Before





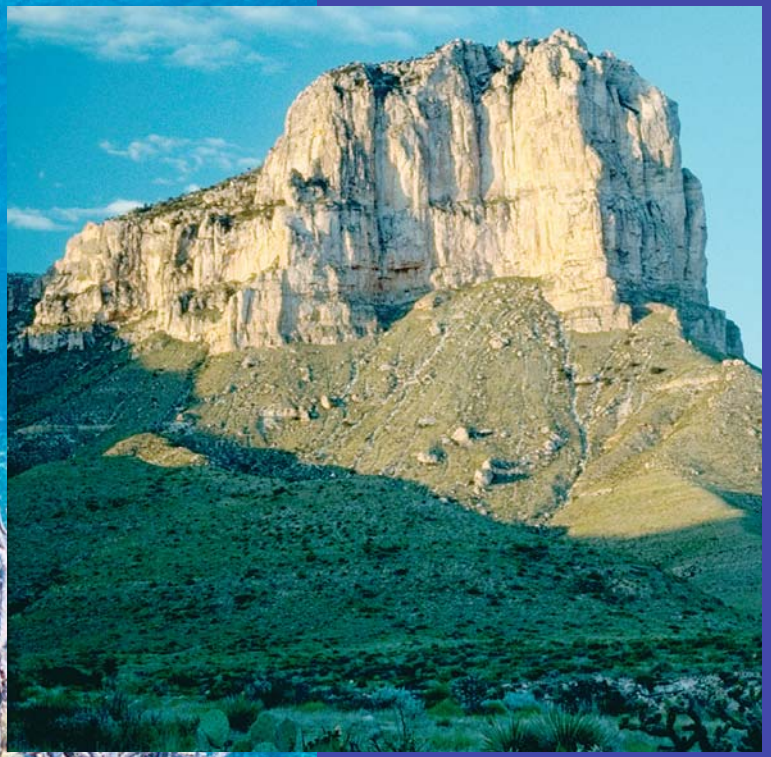
After

Where do you find these?



200,000 tons from 3,500-1,200 BC !





Carbonates

Former marine organisms

Non-silicates: Non-volcanic, commercially useful


Halide


Sulfate

Carbonate

Building blocks…

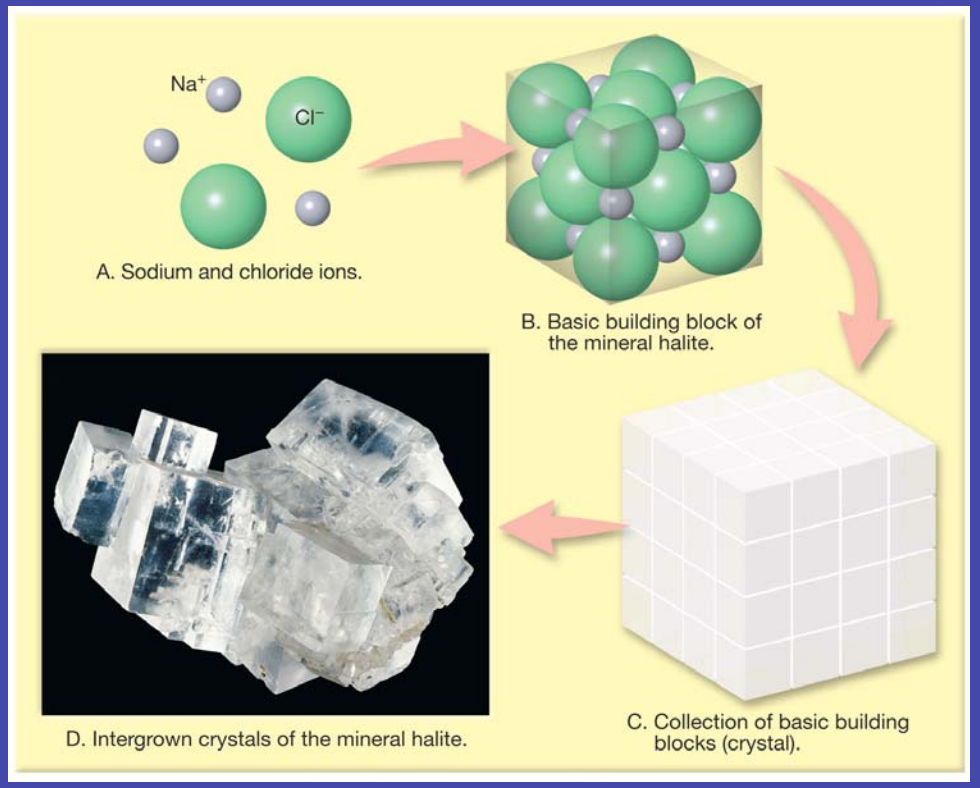
Made up of:	Description:
1. (Quarks, photons, neutrinos……	Subatomic)
2. Protons, neutrons, electrons……..	Atom
(Atoms: elements)	
3. Atom → molecule/compound……	Mineral

Increasing size, complexity

Geologists' definition of "mineral"…



1. Naturally occurring (no synthetics)
2. Solid substance (on Earth)
3. Orderly crystalline structure
4. Definite chemical composition
5. Generally inorganic



How do you identify a mineral?

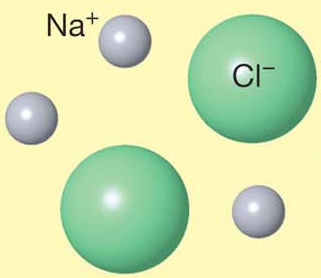
Physical properties of minerals

1. Crystal form
2. Luster
3. Color
4. Streak
5. Hardness
6. Cleavage
7. Fracture
8. Density/specific gravity
9. Other

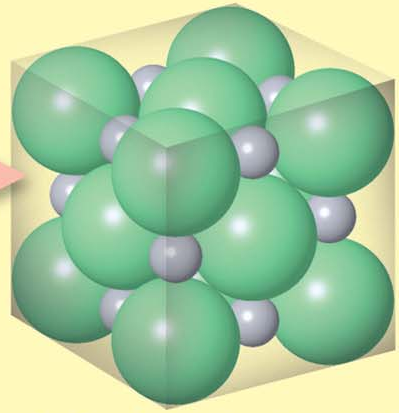
1. Crystal form……



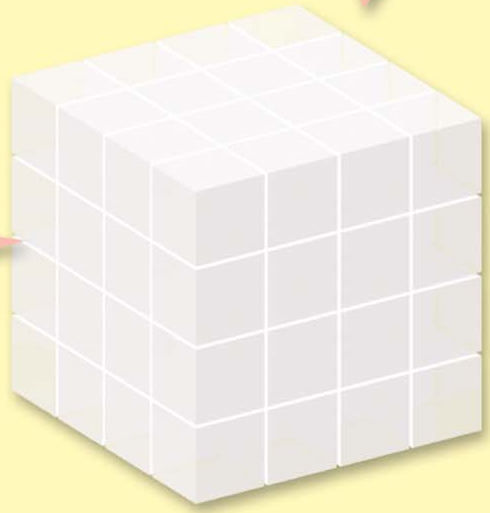




A. Sodium and chloride ions.



B. Basic building block of the mineral halite.



C. Collection of basic building blocks (crystal).



D. Intergrown crystals of the mineral halite.

2. Luster.....



3. Color.....



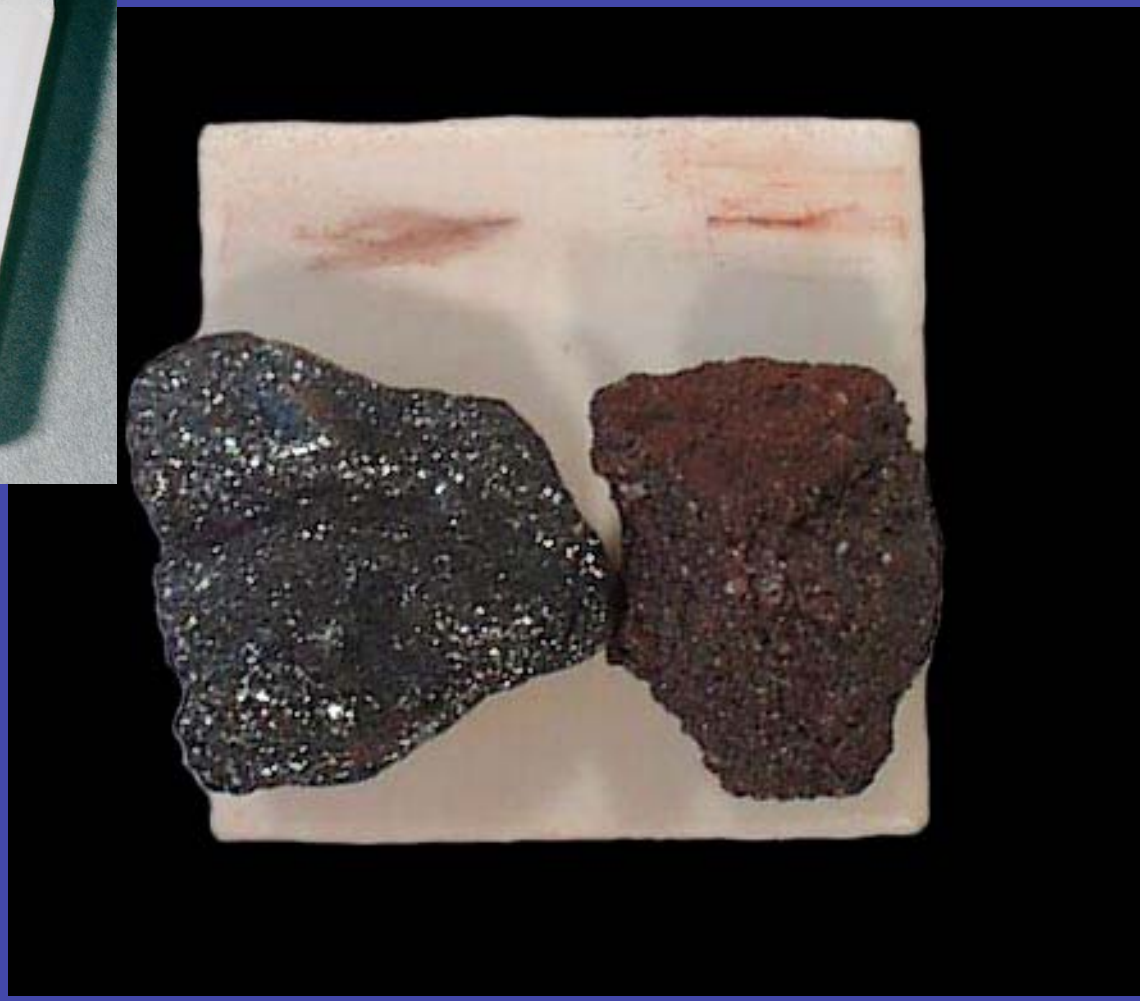






4. Streak.....



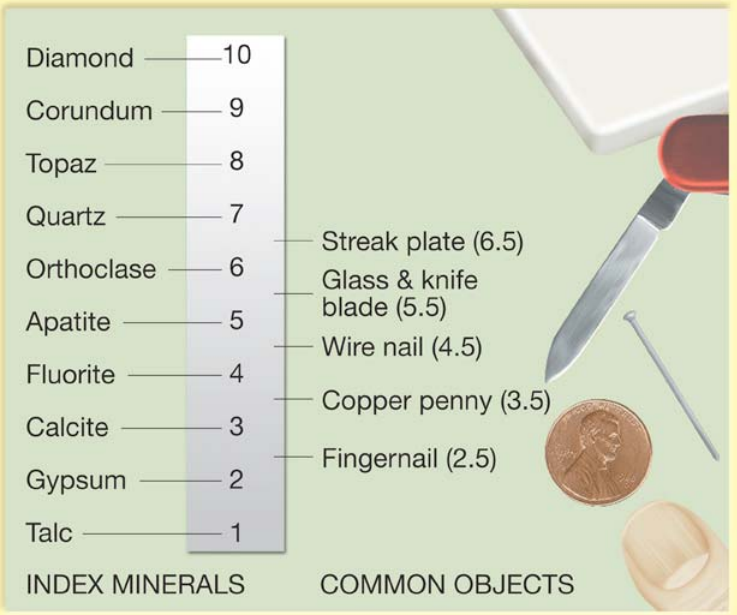


5. Hardness…

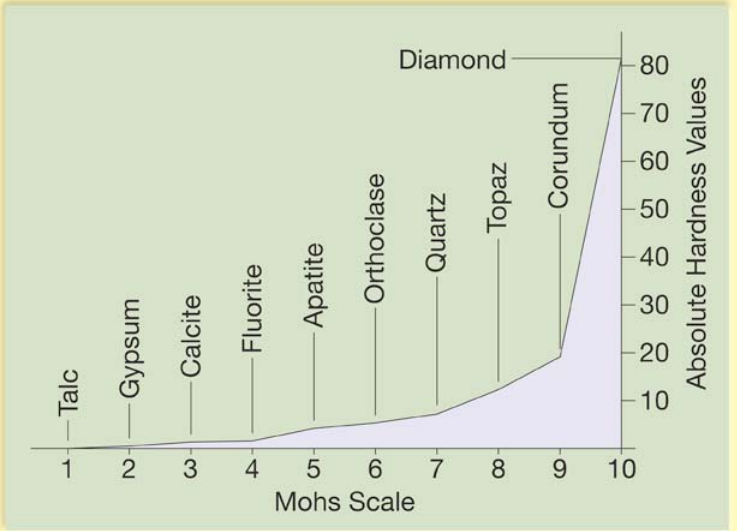




A. Mohs scale (Relative hardness)

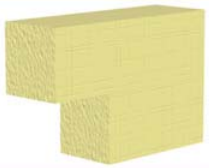
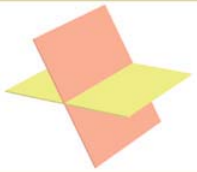
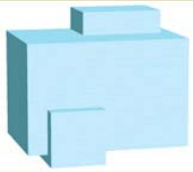


B. Comparison of Mohs scale and an absolute scale



6. Cleavage



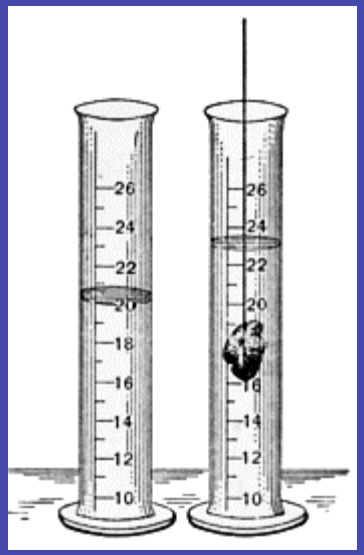
Number of Cleavage Directions	Shape	Sketch	Directions of Cleavage	Sample
1	Flat sheets			 Muscovite
	Elongated form with rectangle cross section (prism)			 Feldspar
	Elongated form with parallelogram cross section (prism)			 Hornblende
	Cube			 Halite
	Rhombohedron			 Calcite
4	Octahedron			 Fluorite

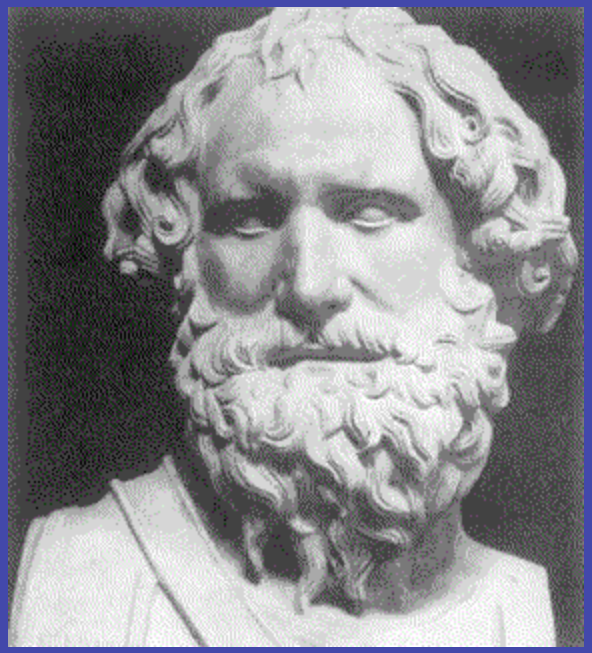
7. Fracture…





8. Specific gravity/density…





Asbestos = 2.45
Basalt = 3.01
Coral = 2.12
Granite = 2.69
Etc…

weight of mineral
vs.
weight of equal volume of water

9. Other…



Taste
Elasticity
Malleability
Feel (greasy, soapy)
Magnetism
Double refraction
Etc…

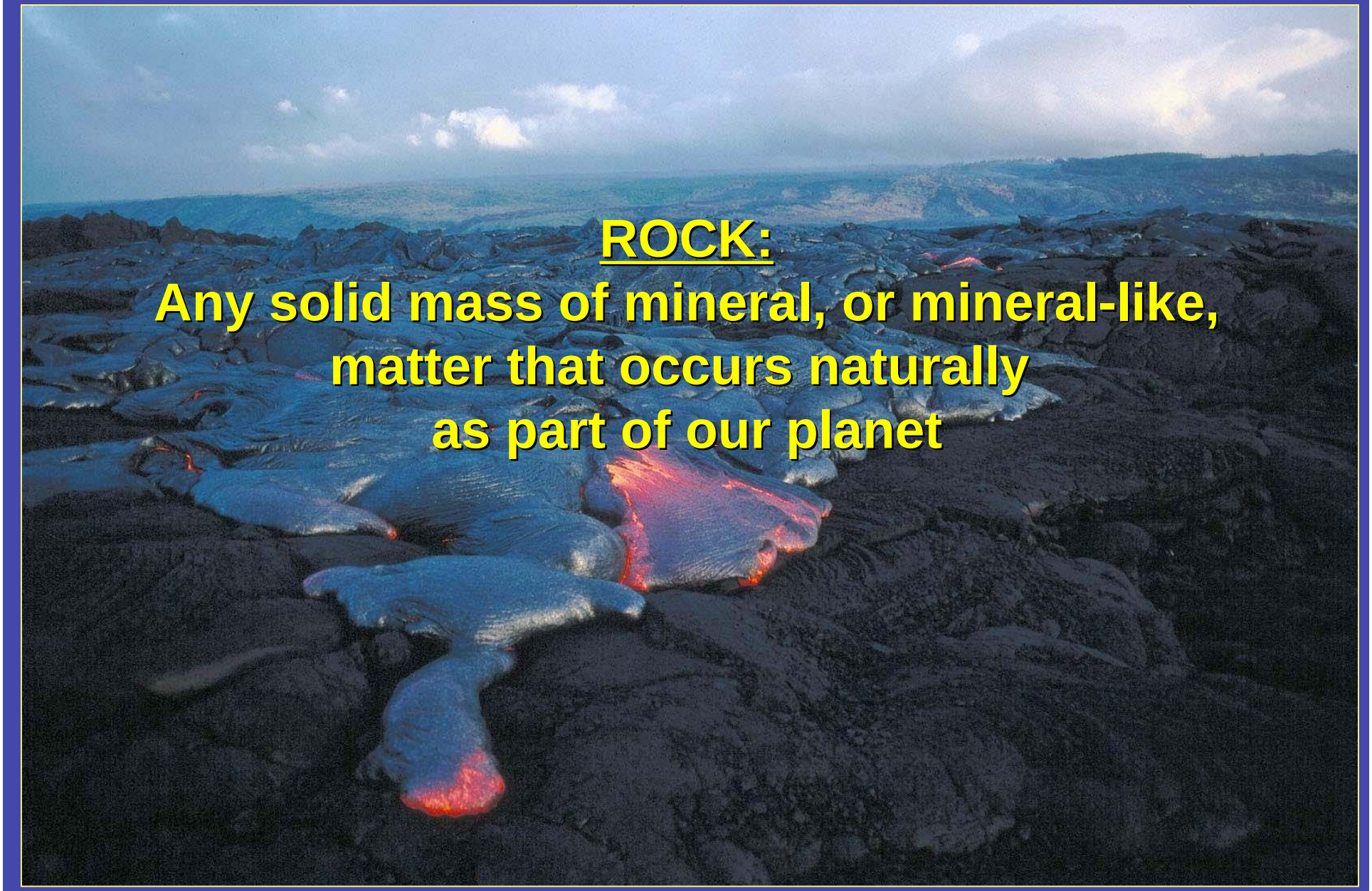
Take-home message:

Physical properties of minerals can be used in combination to determine mineral type

Building blocks…of ROCKS!

Made up of:	Description:
1. (Quarks, photons, neutrinos……	Subatomic)
2. Protons, neutrons, electrons……..	Atom
(Atoms: elements)	
3. Atom → molecule/compound……	Mineral
4. Minerals……..	Rock

Increasing size, complexity


ROCK:
Any solid mass of mineral, or mineral-like,
matter that occurs naturally
as part of our planet