

Every subatomic particle has numerous measurable properties and roles.

particle	mass	charge	role
neutron	≈ 1	0	isotope
proton	≈ 1	+	type
electron	≈ 0	−	bonding

The nucleus of an atom contains protons and neutrons.
The atomic number = number of protons.
The atomic mass = number of protons + neutrons.

Atomic shorthand

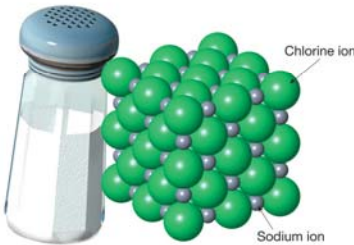
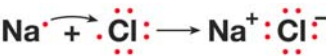


Atomic mass may be considered as:

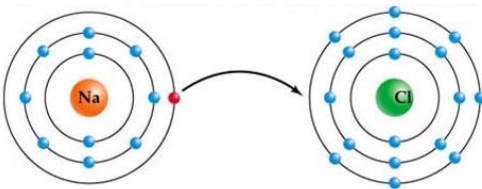
- 1) the total number of protons plus neutrons in one atom, or
- 2) the weight (in grams) of one mol of atoms (Avogadro’s number).

[Periodic Table](#)
[Brookhaven Labs](#)

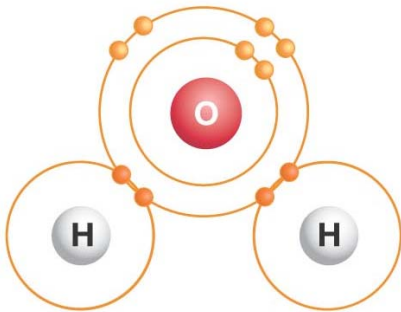
Ionic bonds transfer valence shell electrons from one atom to another atom.



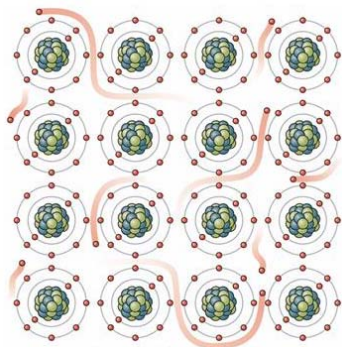
Electrons are transferred in ionic bonds.



Electrons are shared in covalent bonds.



Electrons roam in metallic bonds.



Pauling’s Rules describe atomic bonding, mineral symmetry, and mineral properties.

- Electrical neutrality of the mineral.
- Mutual repulsion of similar atoms.
- Atoms must fit together (radius ratio).



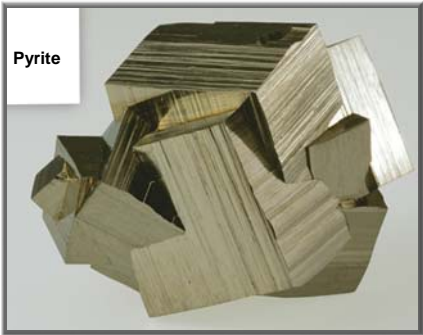
Linus Pauling

<http://www.bbc.co.uk/news/magazine-24563590>

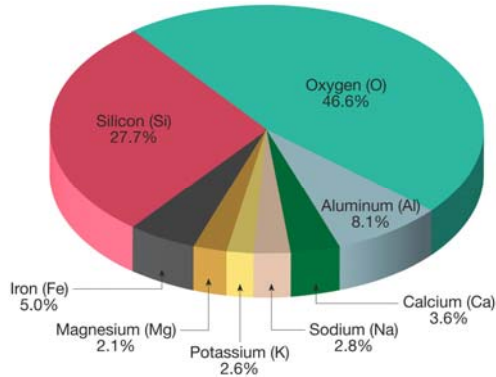
Minerals are naturally occurring inorganic solids with a repetitive internal structure.

Each mineral is characterized by:

- i) chemical composition and
- ii) internal structure.



The common elements in Earth’s crust bond together to make the common minerals.



The silica tetrahedron, SiO₄, is the building block for common minerals.

