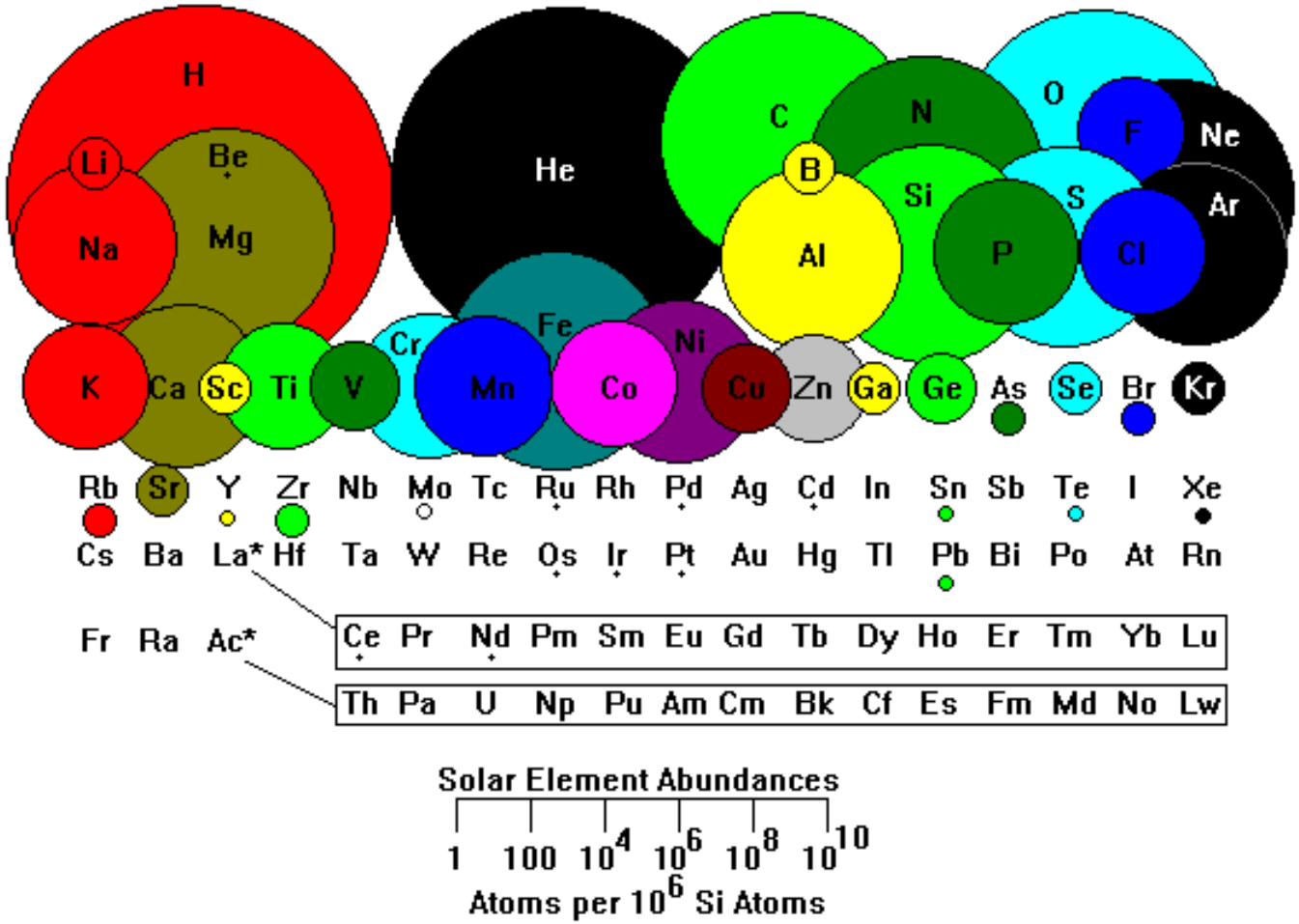
Minerals

Essential Points

1. Chemical elements form in stars
2. Atoms bond by sharing electrons
3. Minerals are classified by their chemistry
4. Minerals can be identified by their physical properties = atomic structure
5. Silicates are the most important mineral group
6. Crystals are determined by mathematical rules called symmetry

Composition of the Sun

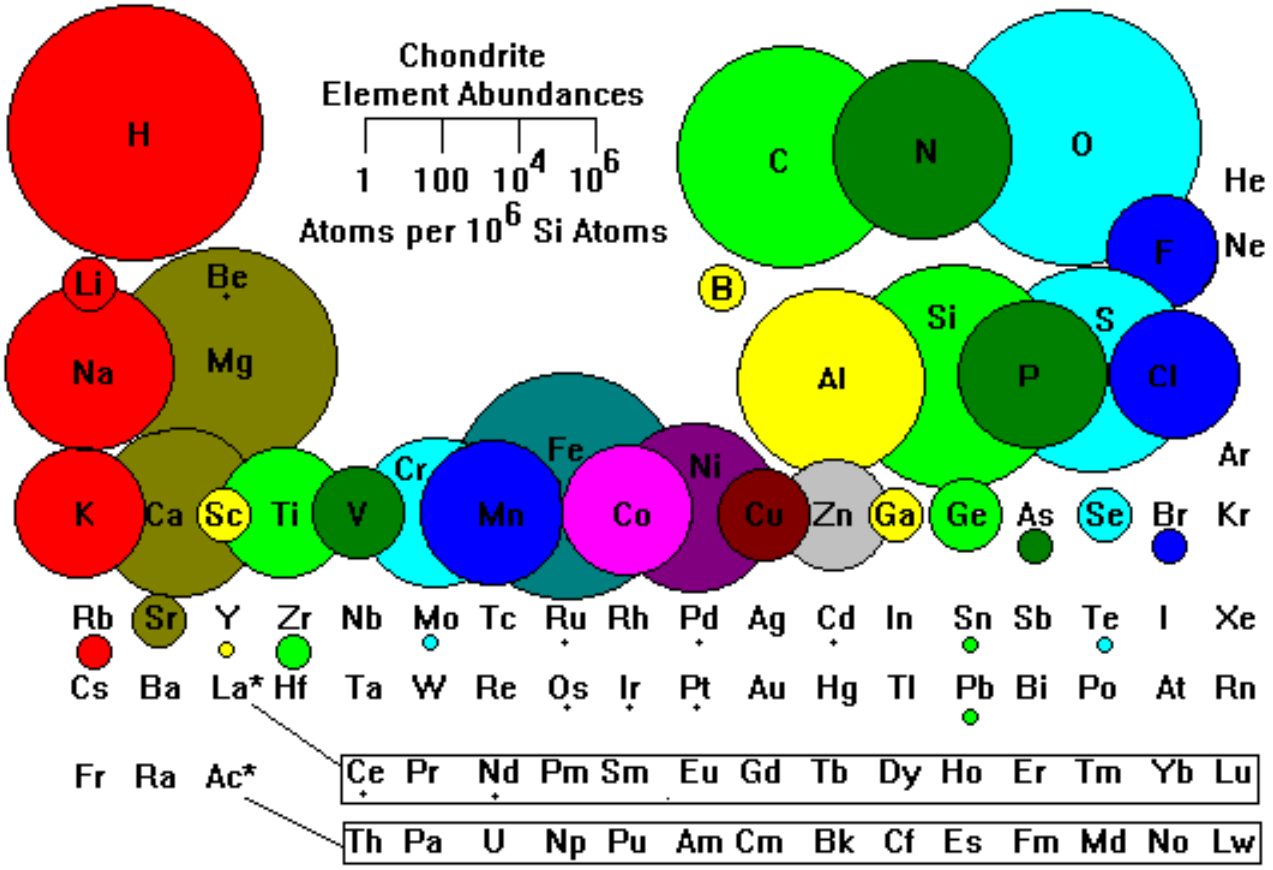


1. Chemical elements form in stars

What are Planets Made of?

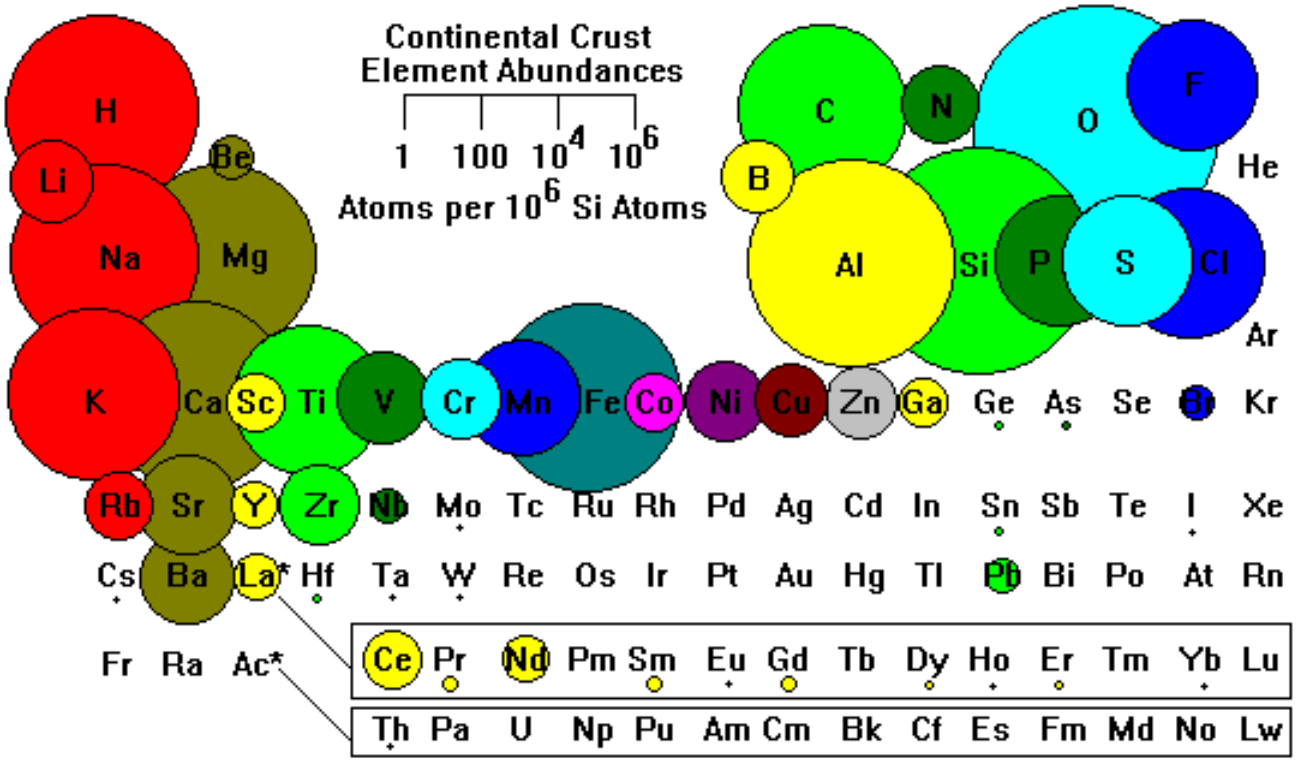
- Same material as Sun
- Minus the elements that remain mostly in gases
- We find this pattern in a certain class of meteorites

Chondrites



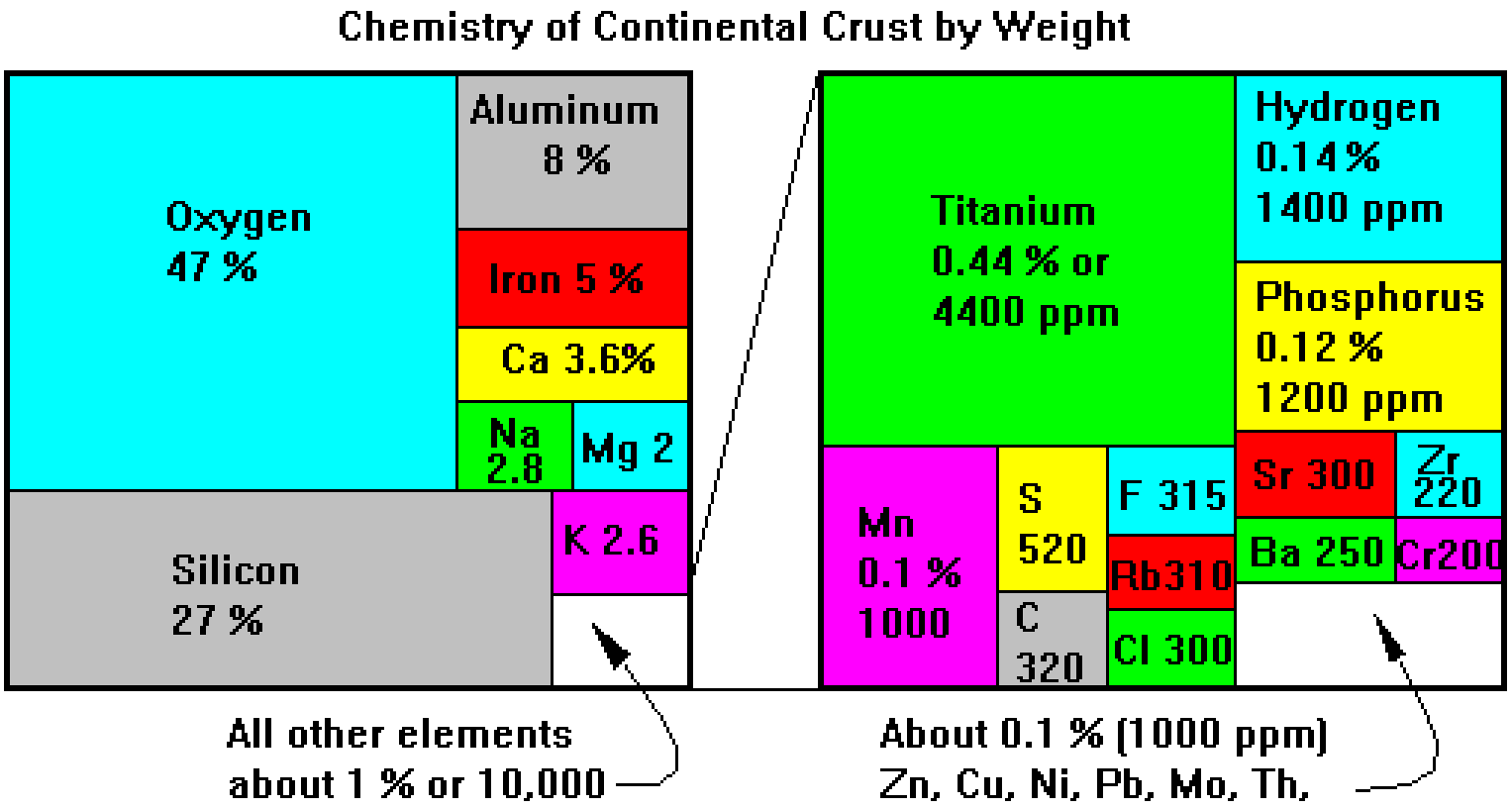
1. Chemical elements form in stars

The Earth's Crust looks Very Different



1. Chemical elements form in stars

Composition of the Crust



1. Chemical elements form in stars

Minerals are the Chemicals that make up the Earth

- Naturally Occurring
- Inorganic
- Chemical Compounds

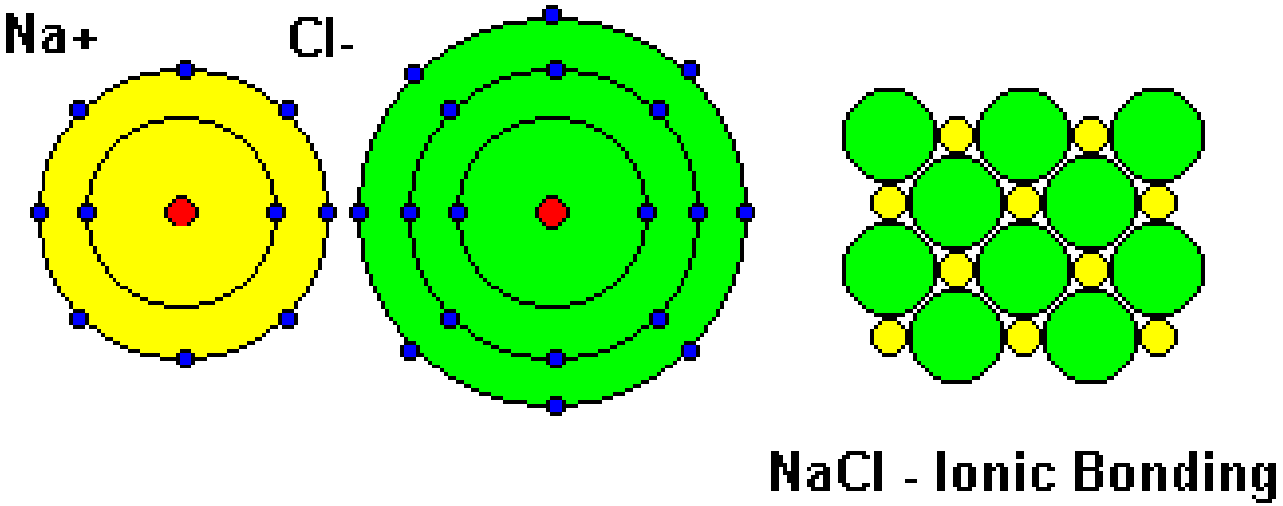
- About 5000 Known
- 200 Common
- 20 Rock-Forming

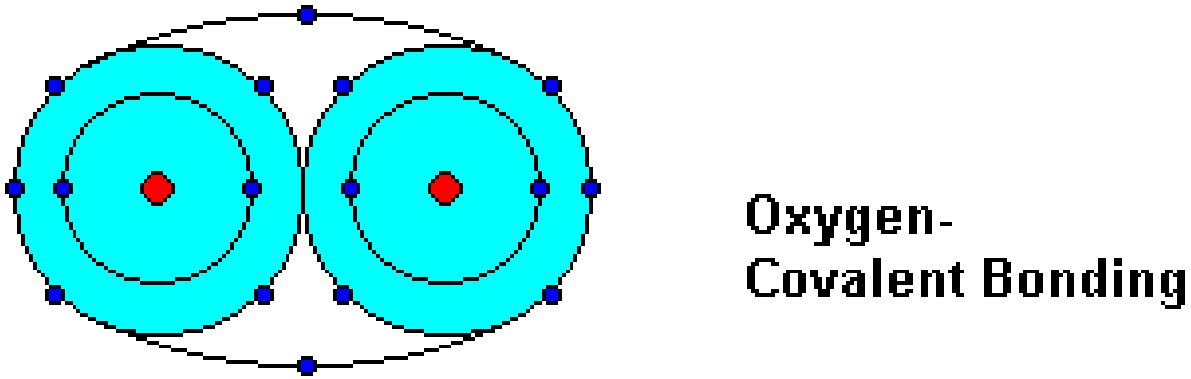
Atomic Bonding

1. Atoms Gain or Lose Electrons
2. Electrical Neutrality
- (+) and (-) Cancel Out
3. Bonding (Satisfy 1 & 2)
- Ionic (NaCl)
- Covalent (O_2)
- Metallic (Cu, Al, Fe)
- Hydrogen (in water)

2. Atoms bond by sharing electrons

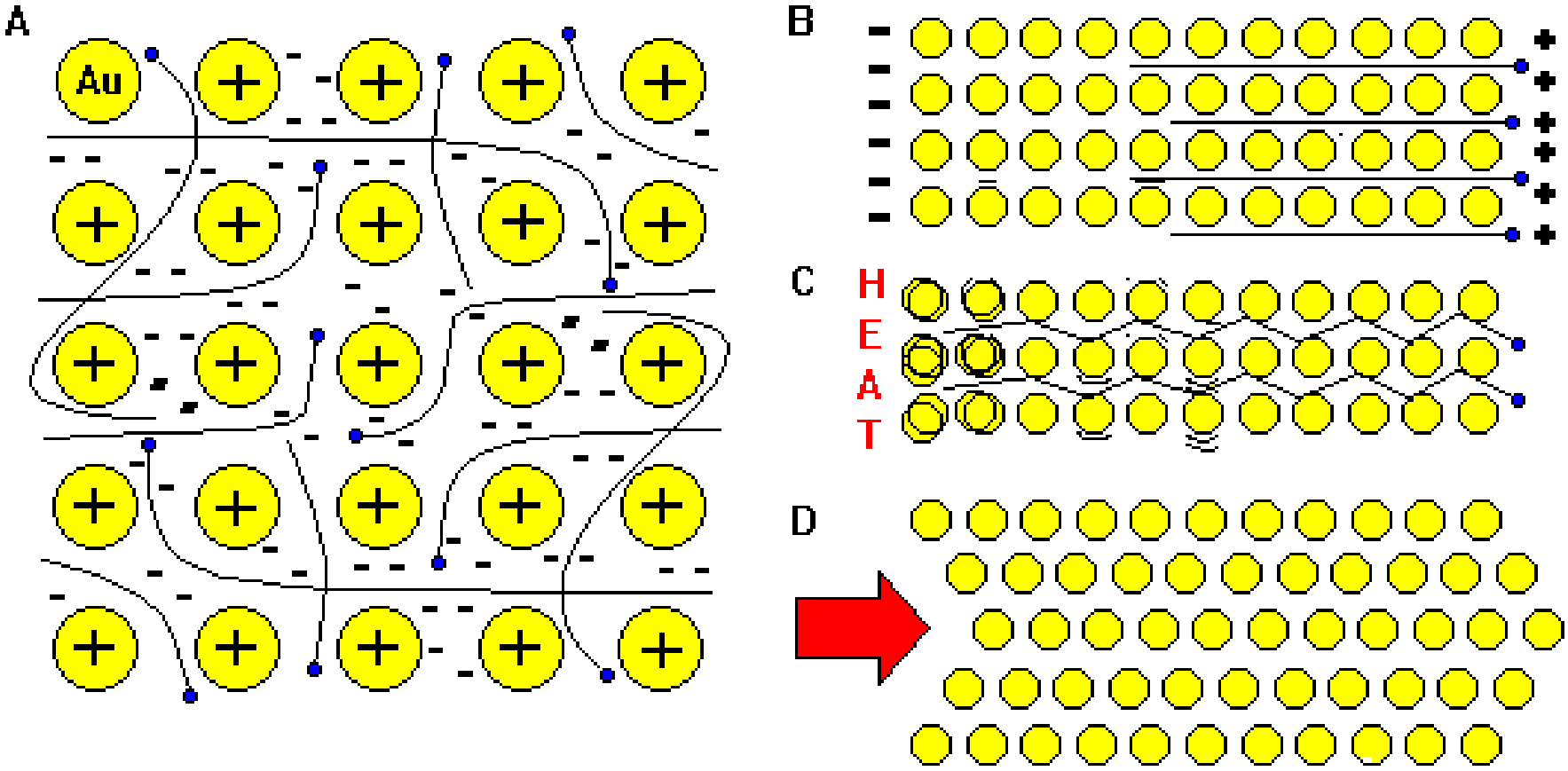
Ionic and Covalent Bonding





2. Atoms bond by sharing electrons

Metallic Bonding



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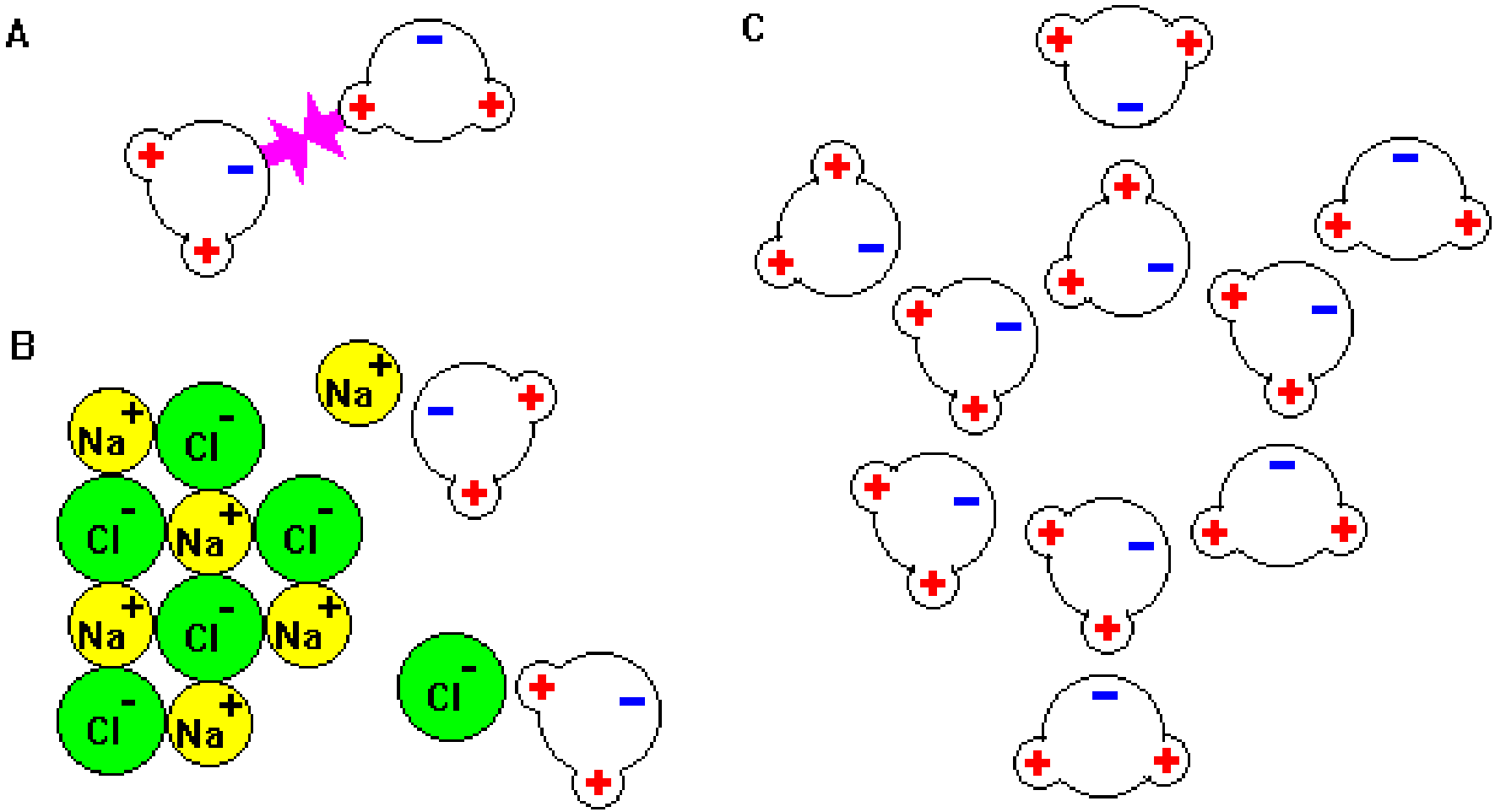
Hydrogen Bonding



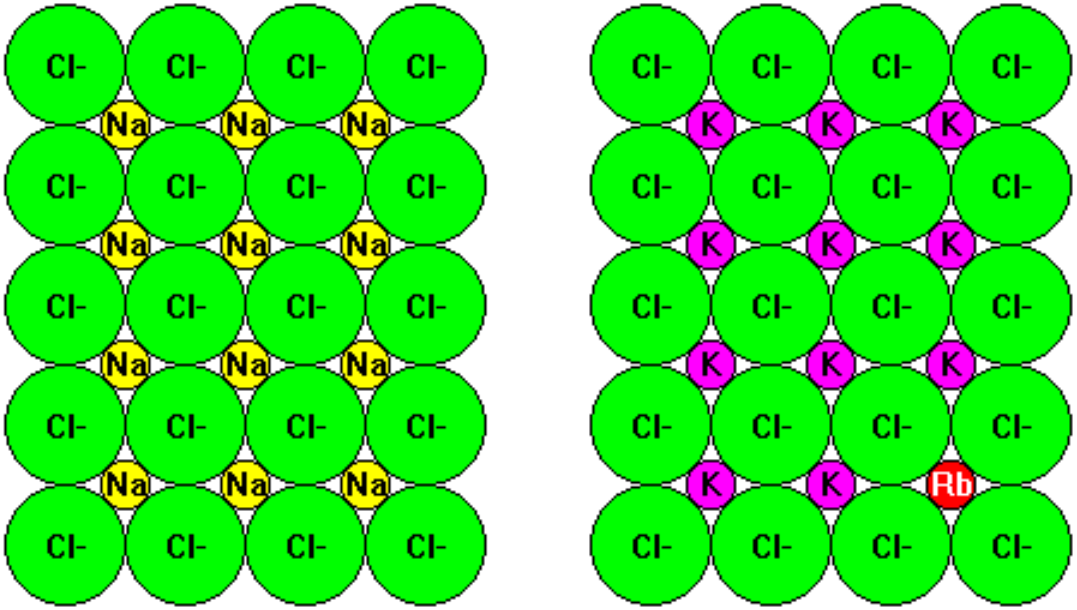
2. Atoms bond by sharing electrons

Summary of Bonding

- Ionic bonding holds rocks and minerals together
- Covalent bonding holds people and other organisms together
- Metallic bonding holds civilization together
- Hydrogen bonding gives water its heat-retaining and solvent properties

4. Lattices

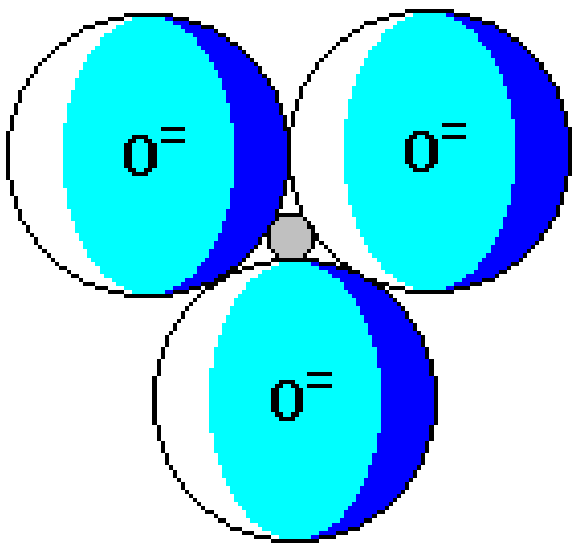
- Atoms in crystals form a repeating pattern called a Lattice



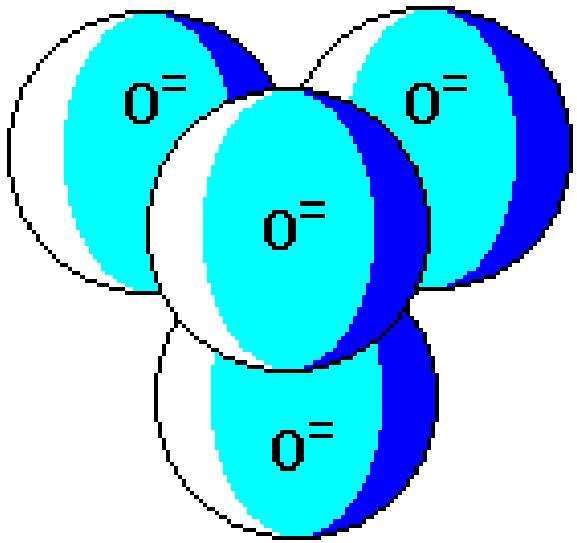
2. Atoms bond by sharing electrons

5. Complex Ions

- Many minerals contain groups of atoms that behave as single units



Carbonate CO_3^{-2}



Sulfate SO_4^{-2}

Silicate SiO_4^{-4}

2. Atoms bond by sharing electrons

Identifying Minerals

- Color: very variable, complex causes
- Hardness: strength of atomic bonds
- Density: mass and spacing of atoms
- Luster: how electrons interact with light
- Cleavage: weak atomic planes
- Crystal Form: extremely useful but not for beginners
- Other properties distinctive at times

4. Minerals can be identified by their physical properties = atomic structure

Hardness

- Resistance to Scratching
- Directly related to relative strength of atomic bonds
- Scratch Test (Mohs)

1. Talc
2. Gypsum
3. Calcite
4. Fluorite
5. Apatite
6. Feldspar
7. Quartz
8. Topaz
9. Corundum
10. Diamond

Density

- Directly related to masses of component atoms and their spacing
- Usually very consistent

Ice:	0.92
Water:	1.00
Halite:	2.18
Quartz:	2.65
Pyrite, Hematite, Magnetite:	5.0
Galena:	7.5
Gold:	19.3
Platinum:	21.4
Iridium: (densest material on Earth)	22.4

4. Minerals can be identified by their physical properties = atomic structure

MAJOR MINERAL SUITES

Elements

Metallic:Au, Ag, Cu

- *Not* Al, Pb, Zn, Fe, etc.

Nonmetallic: C - Diamond, Graphite

- Sulfur

4. Minerals can be identified by their physical properties = atomic structure

Copper Nugget

Sulfides: Dense, Usually Metallic
Many Major Ores

- Major Cause of Acid Rain

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Carbonates

- Principal Components of limestone and dolostone
- Storehouse for CO_2
- Major regulator of climate

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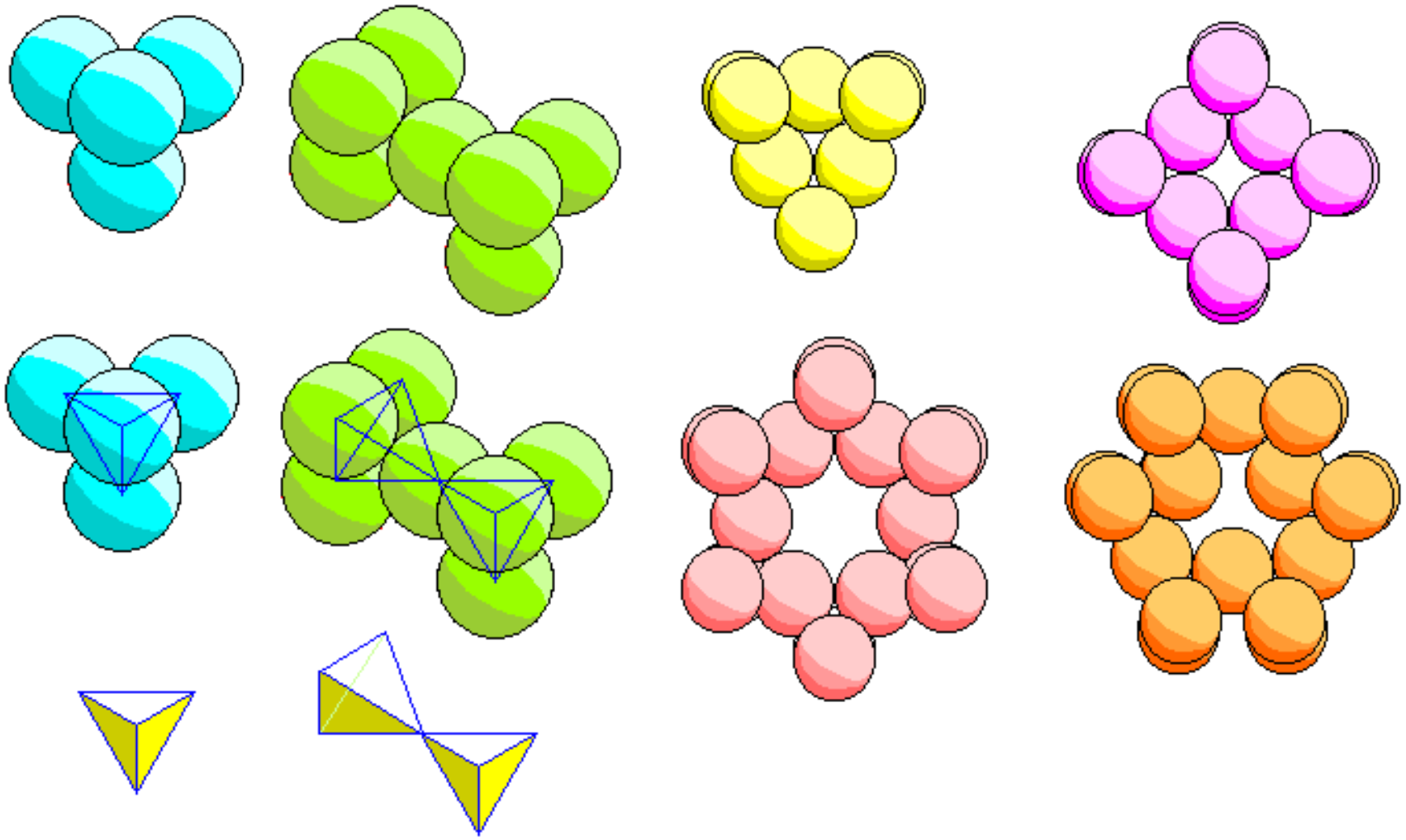
Oxide: Hematite

4. Minerals can be identified by their physical properties = atomic structure

MOST IMPORTANT MINERAL SUITE:
The Silicate Minerals

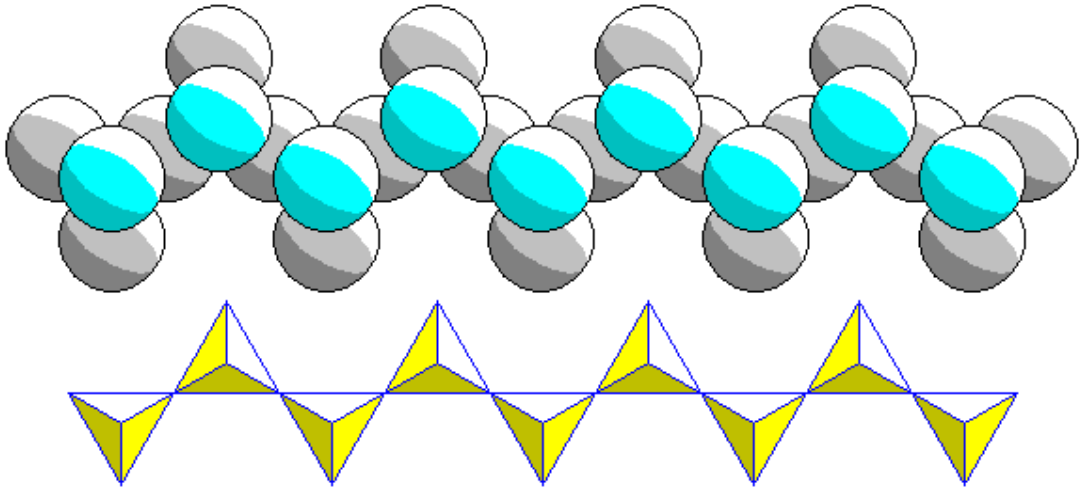
- Si + O = 75% of Crust
- Silicates make up 95% + of all Rocks
- SiO_4: -4 charge
- Link Corner-To-Corner by Sharing Oxygen atoms

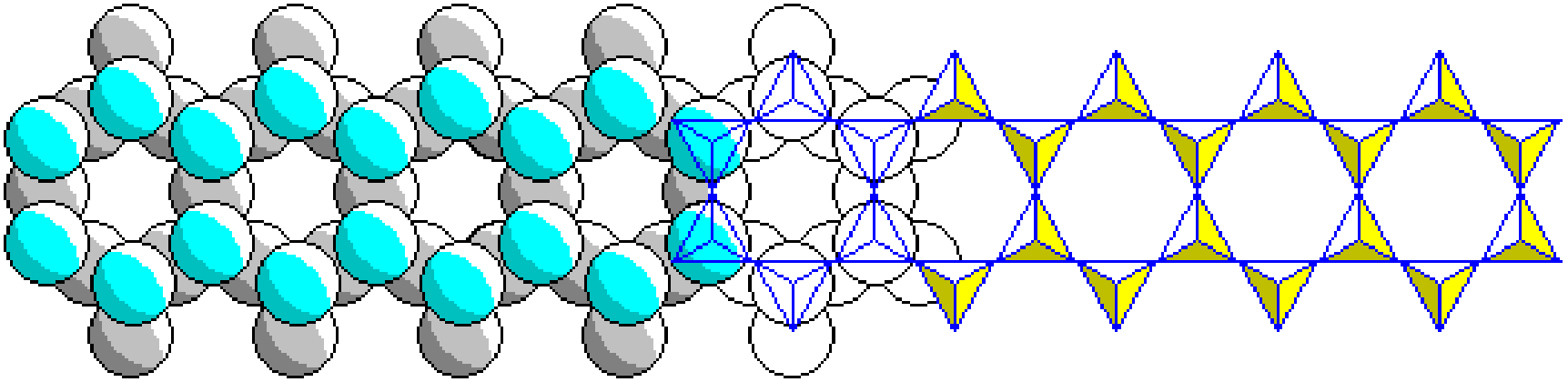
Silicate Structures



5. Silicates are the most important mineral group

Chain Silicates





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Asbestos

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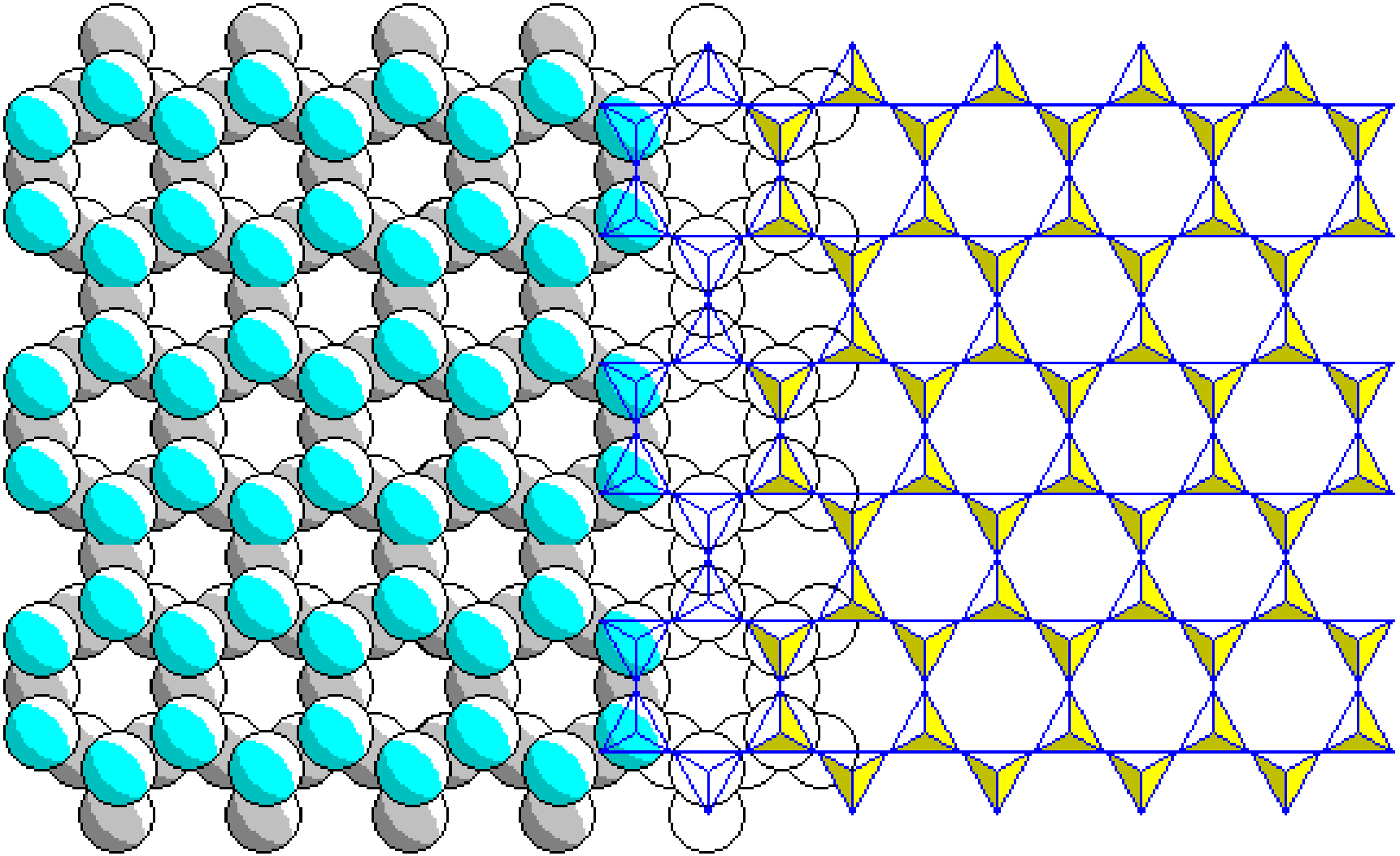
Sheet Silicates



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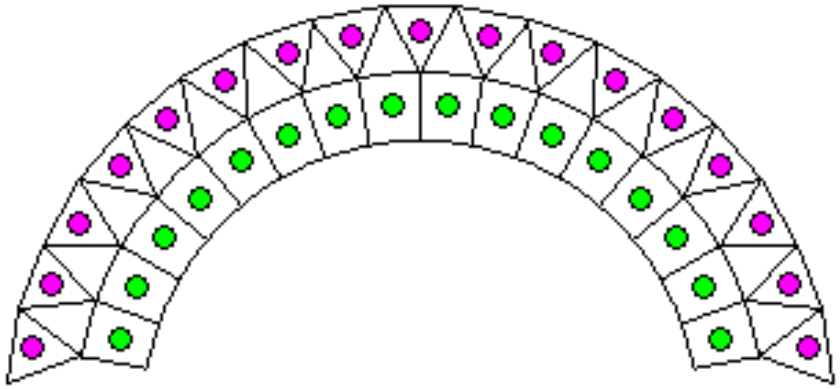
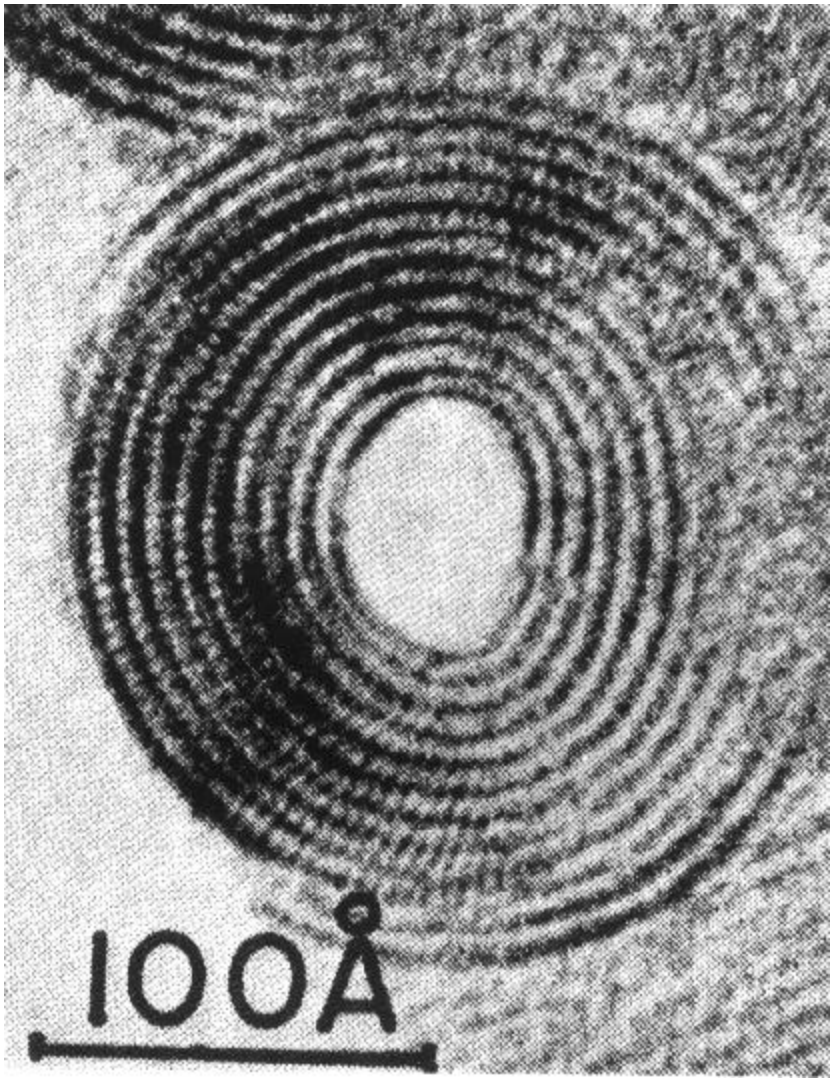
One Type of Asbestos





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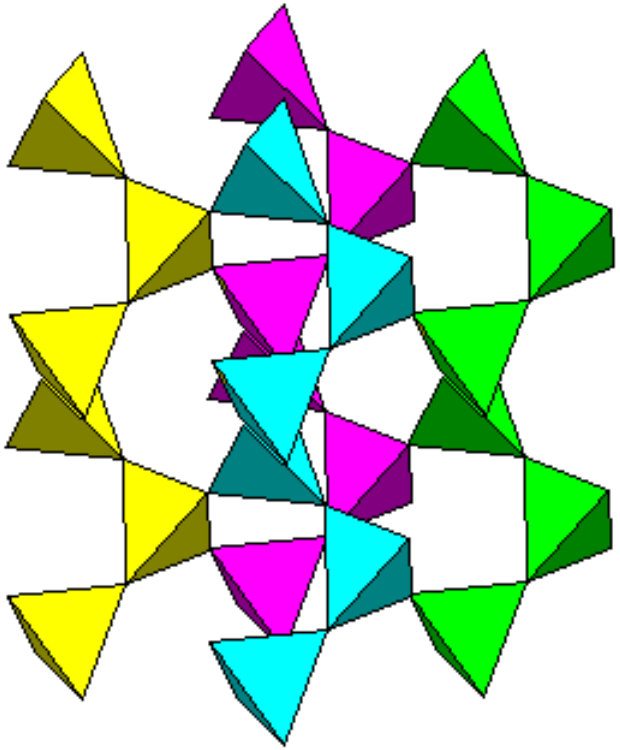
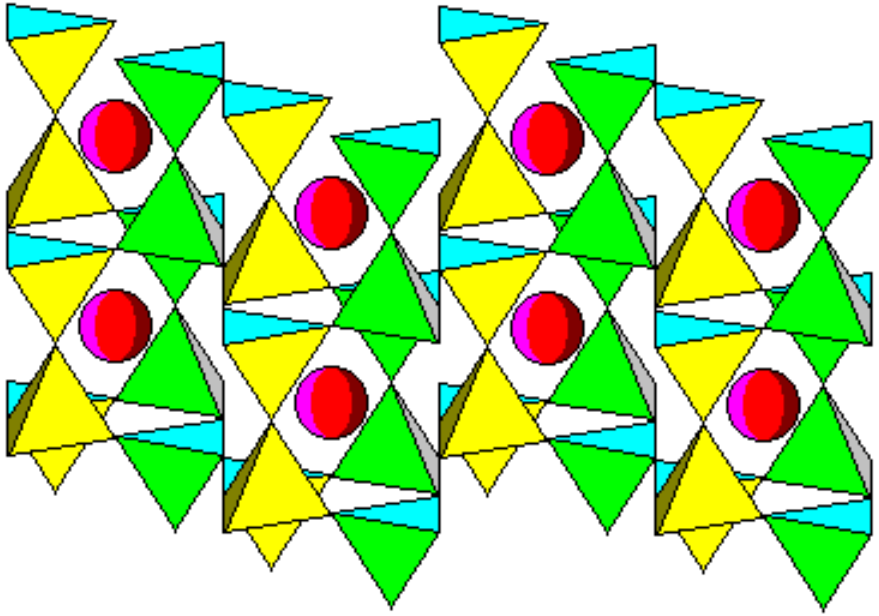
Silicates

Tectosilicates - Three-Dimensional Networks

- Quartz



Feldspars



Quartz

5. Silicates are the most important mineral group

Minerals in Granite

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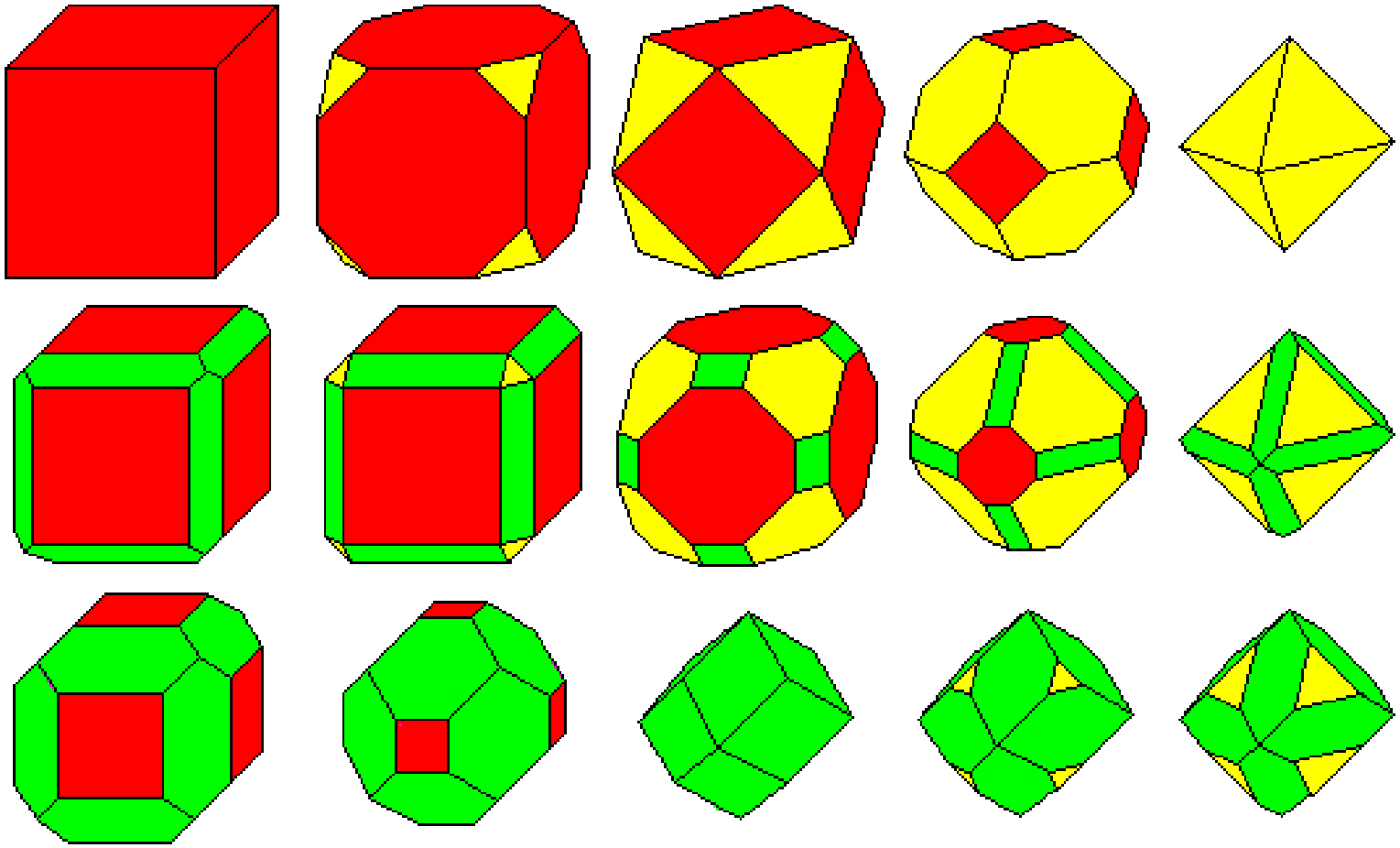
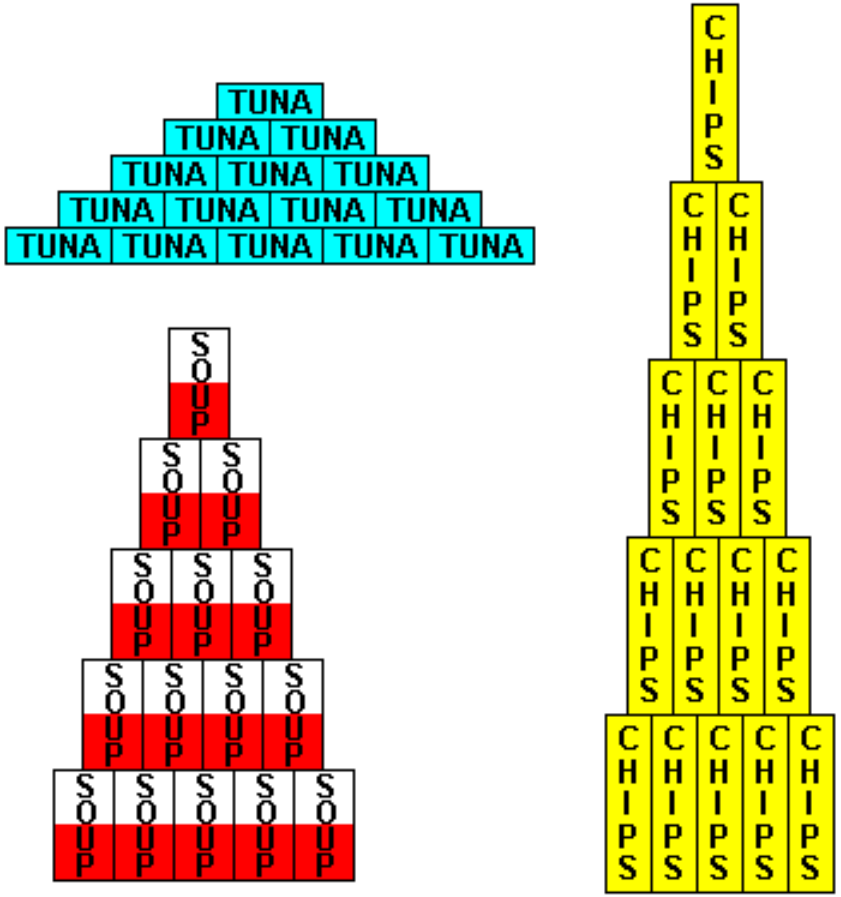
Making Sense of Crystals



6. Crystals are determined by mathematical rules called symmetry

The problem in Crystallography is to reason from the outward shape to the unit cell



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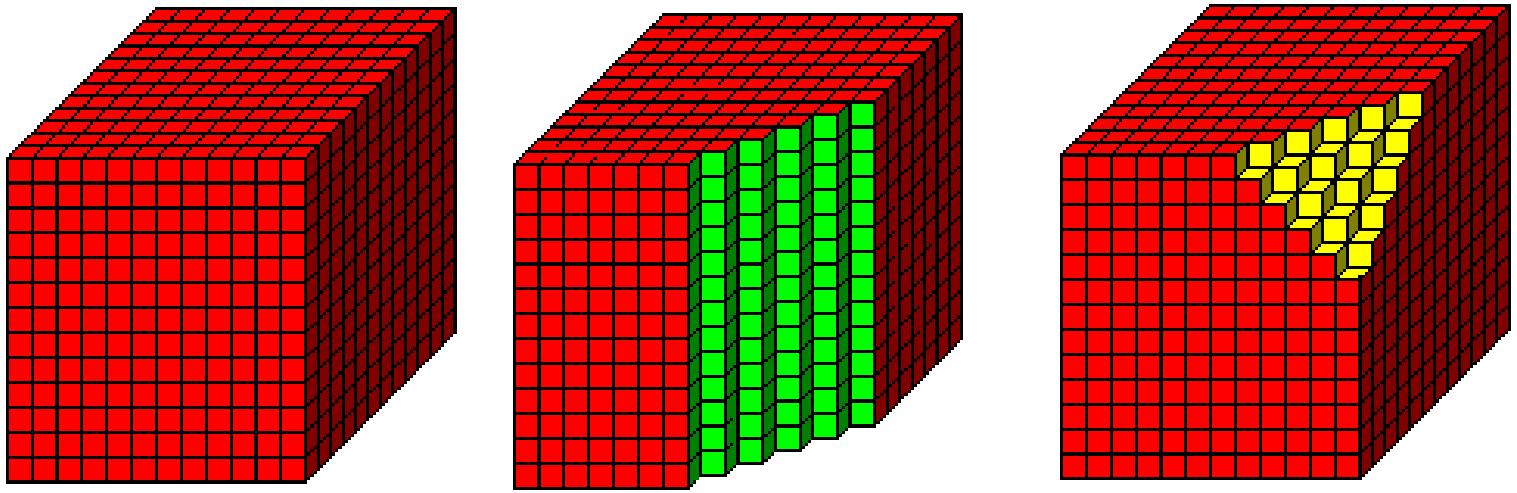
Stacking Cubes



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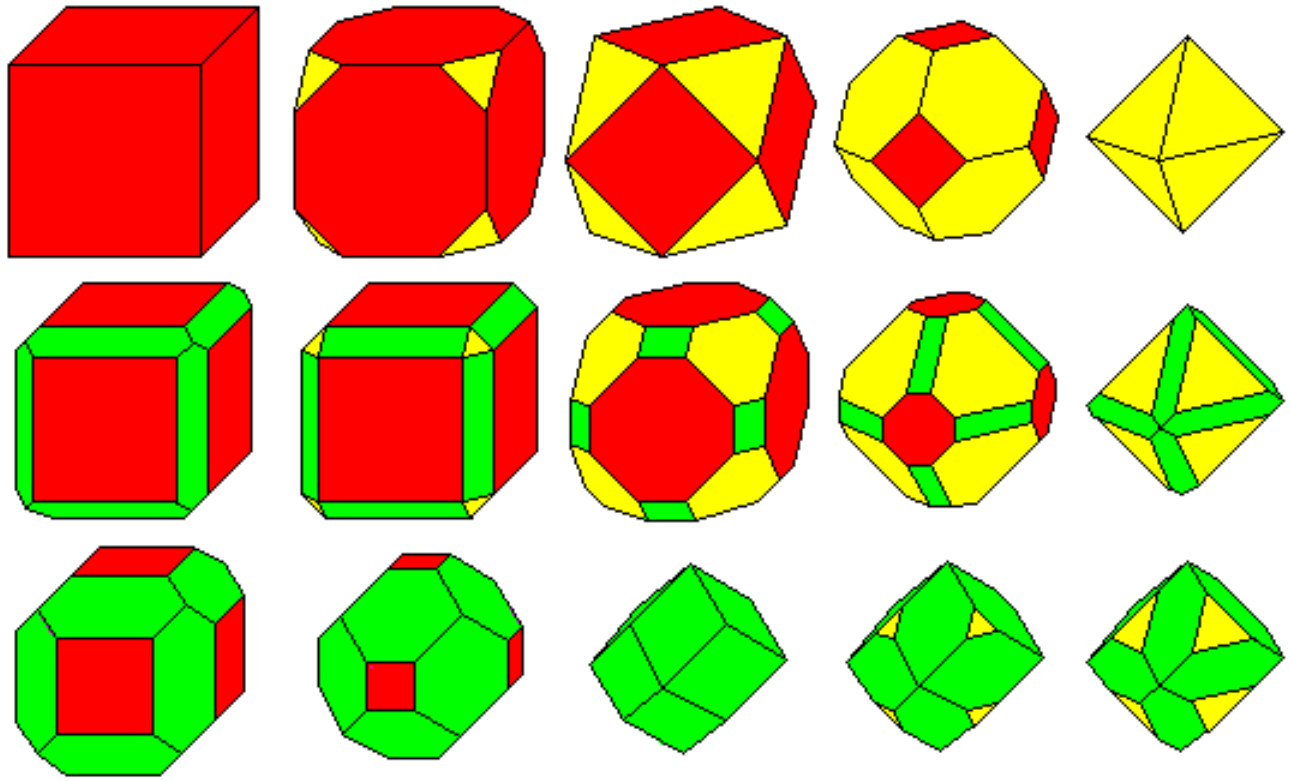
Some shapes that result from stacking cubes



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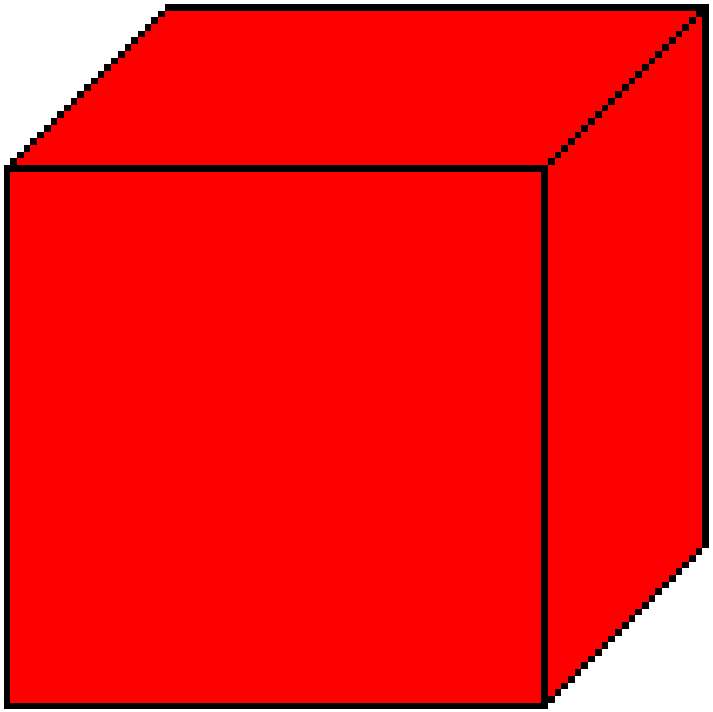

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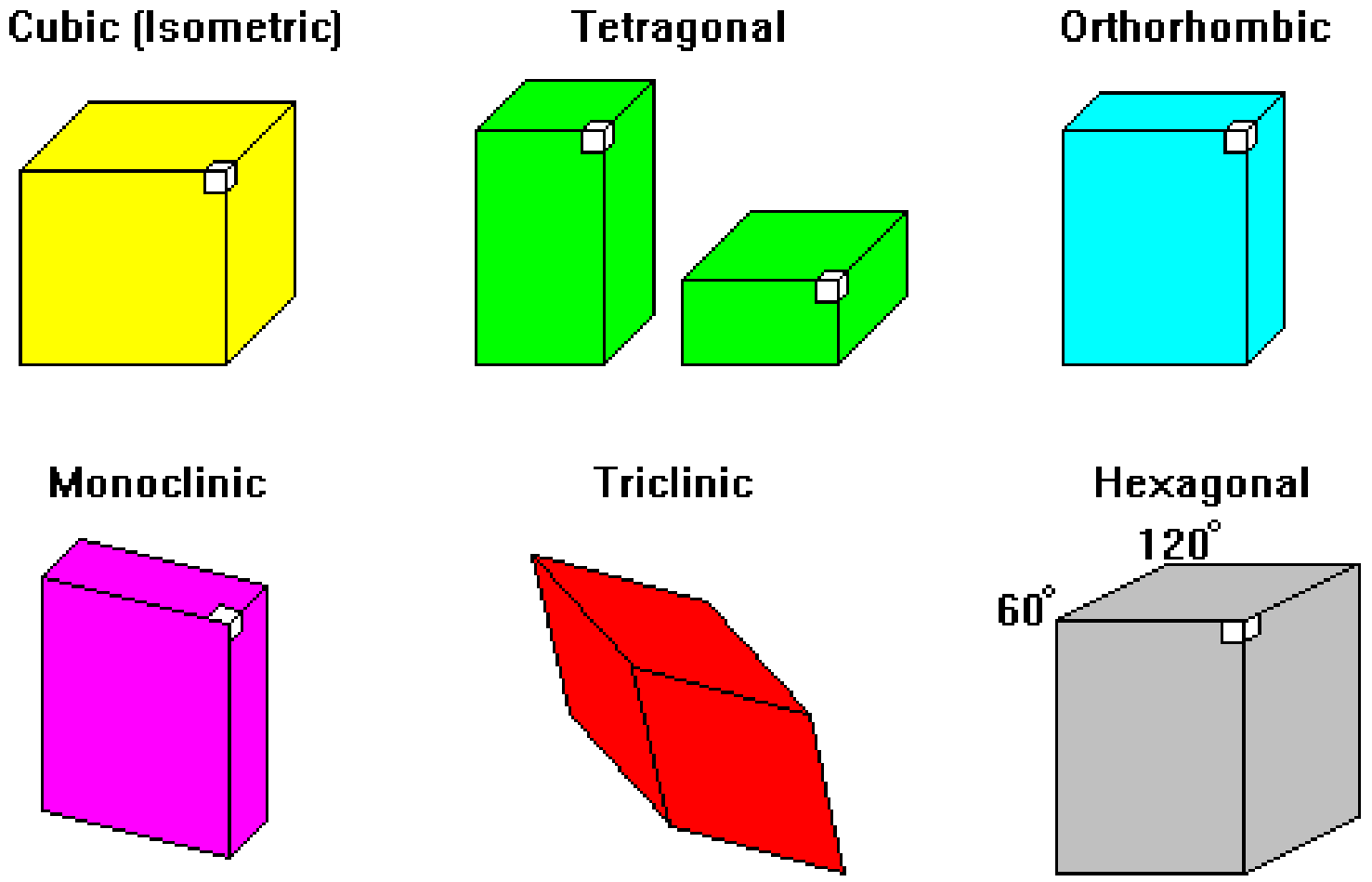
The Crystal Classes



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