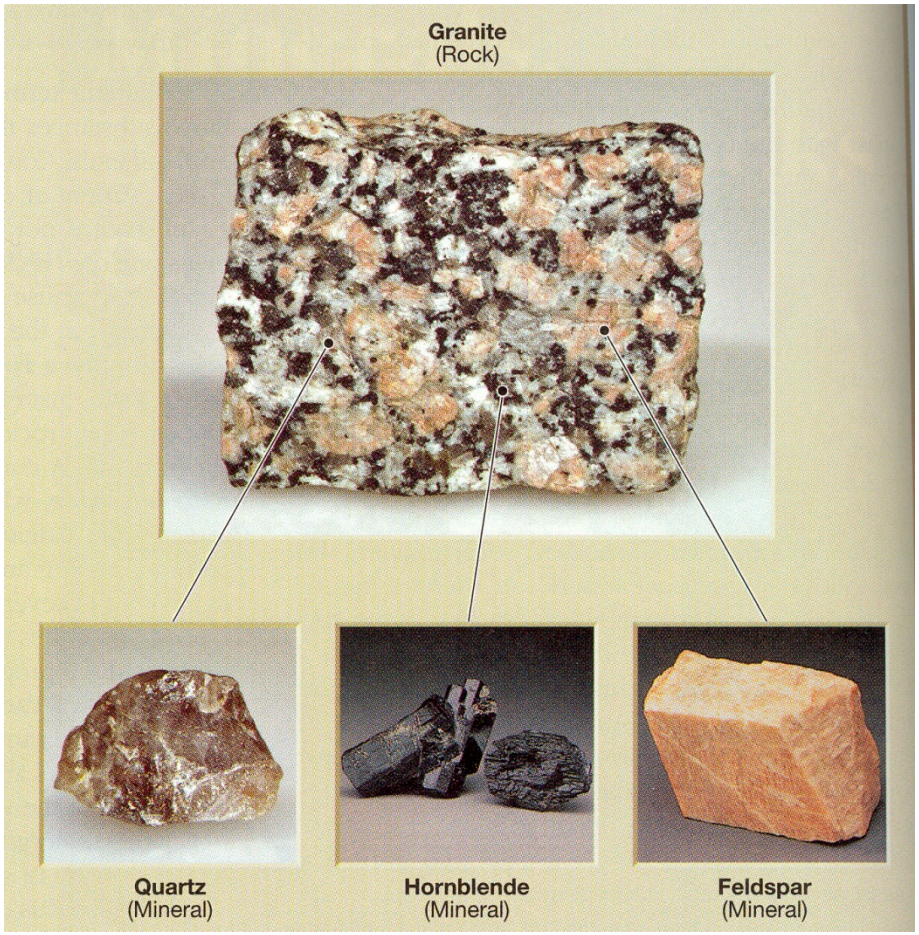
What is a mineral?

- A mineral is a naturally occurring inorganic solid with a definite internal ordered structure.
- It should have a definite chemical composition or range of compositions.

Minerals form rocks

- Granite made of 3 minerals

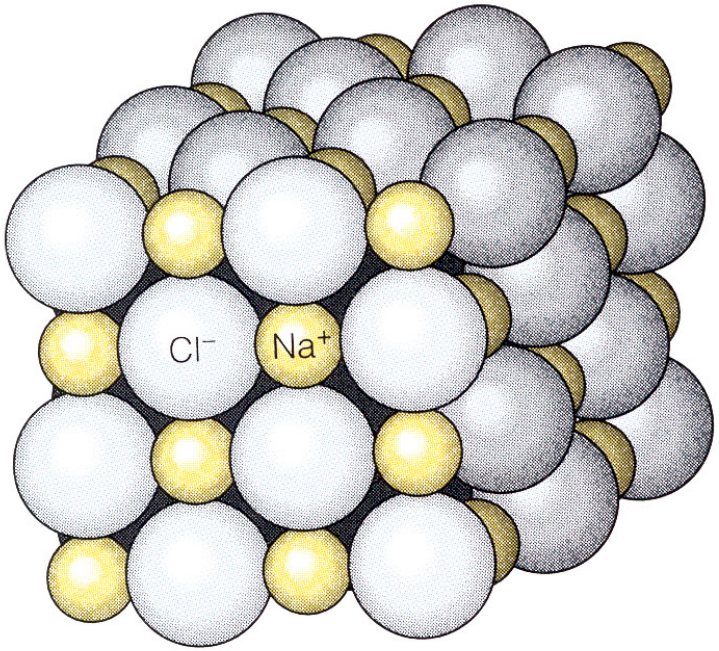


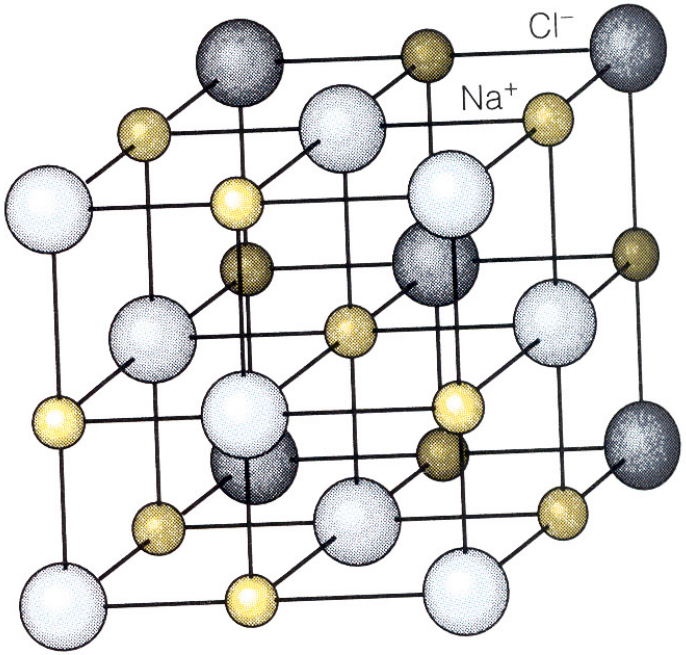
Minerals are all around us.

- An example of a mineral would be halite--also known as salt. It is composed of Na^+ and Cl^- in equal amounts and has a cubic structure.

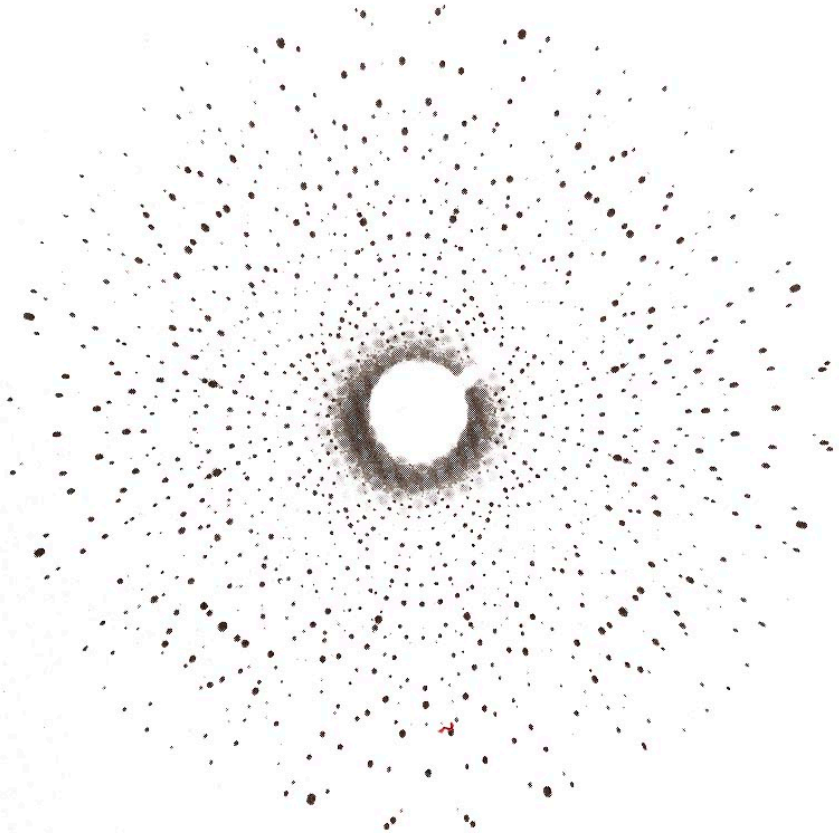
Minerals

- Definite arrangement of atoms in space





X-ray pattern of a mineral



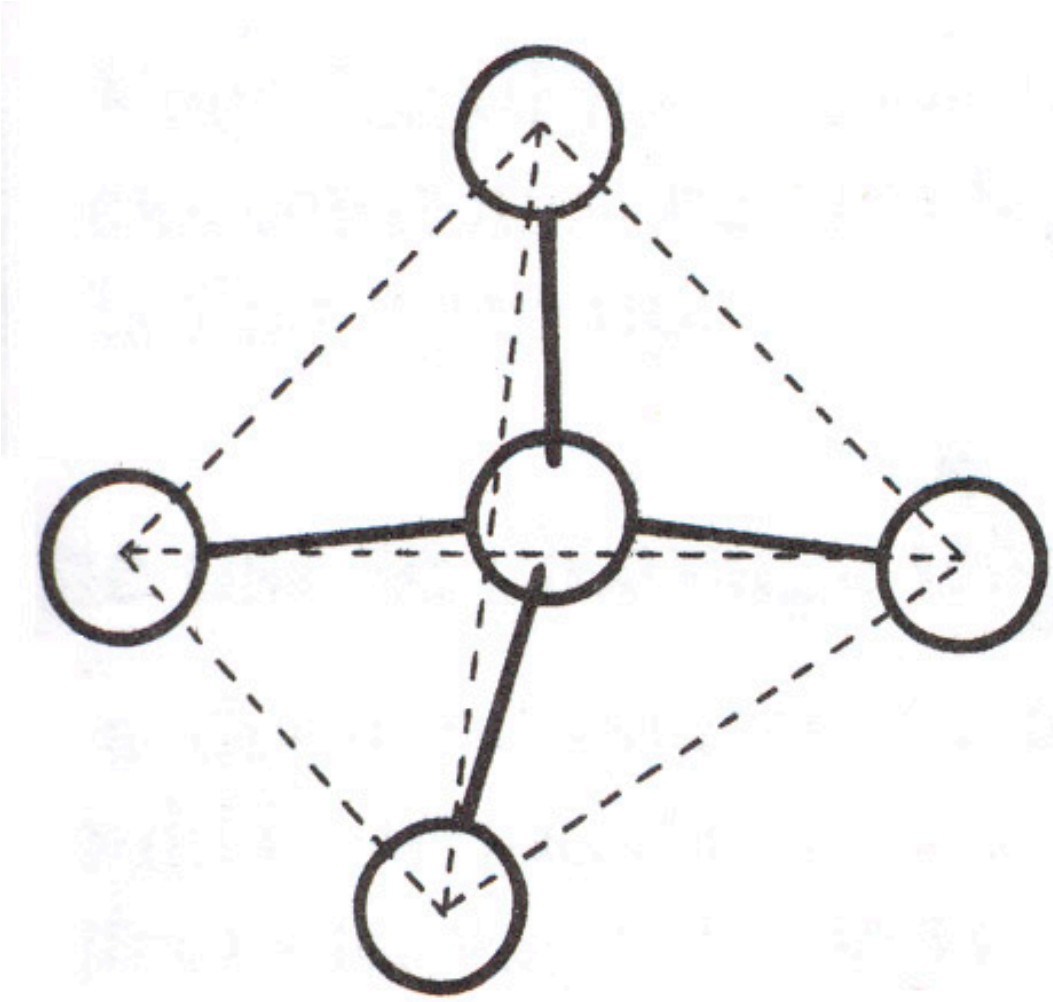
Definite composition

- NaCl = Halite
- One sodium for each Chlorine

Halite (common table salt)

Diamond structure

tetrahedron



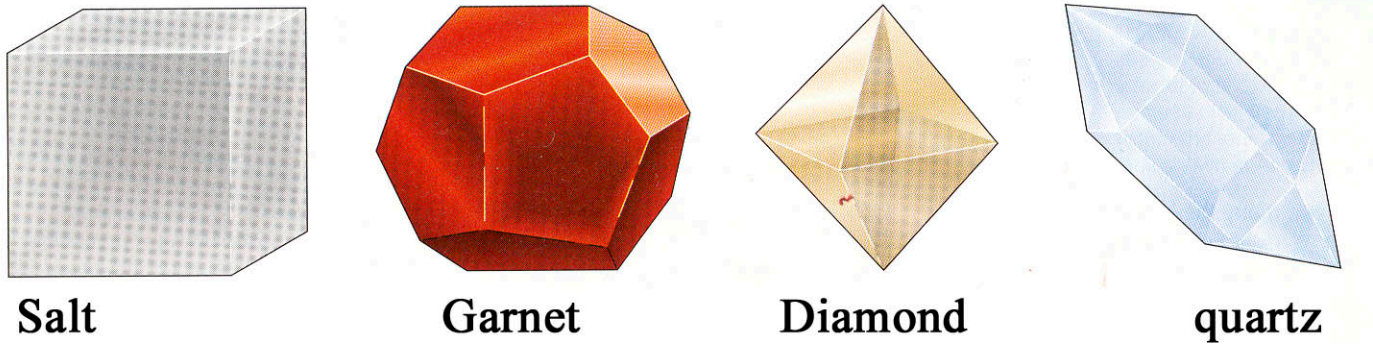
Physical properties of minerals

- Physical properties of minerals are a result of the minerals chemical composition and how the atoms are arranged (bonded together).

- No two minerals have the exact same physical properties, bonding, & chemical composition.

Crystal shape

- Due to the atomic arrangement of the mineral



- As minerals grow they take on characteristic shapes

Hardness

- Hardness is directly related to chemical bonding.
- A scale hardness called Mohs Scale of relative hardness (“Scratchability”)

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

Hardness (cont…)

Friedrich Mohs based his scale on what mineral could scratch what other mineral.

We can use a simplified scale

- skin = 1.5 (talcum is softer)
- finger nail = 2-2.5
- penny is about 3 (calcite)
- glass = 5.5
- piece of hard steel = 6.5
- Porcelain = 6.5

TENACITY

The resistance that a mineral offers to breaking, crushing, bending, etc. The following terms are used to describe tenacity in minerals:

- 1. *Brittle.* A mineral that breaks or powders easily.
- *2. Malleable.* A mineral that can be hammered out into thin sheets.
- *3. Sectile.* A mineral that can be cut into thin shavings with a knife.
- *4. Ductile.* A mineral that can be drawn into wire.
- *5. Flexible.* A mineral that bends but does not resume its original shape when the pressure is released.
- *6. Elastic.* A mineral that, after being bent, will resume its original position upon the release of the pressure.

Streak

- **Streak** is the color of the mineral when it is powdered using a porcelain tile. Fool's gold is black. Real gold is gold.

Streak

- **Streak** is the color powdered mineral. A porcelain tile is used. Fool's gold is black. Real gold is gold.

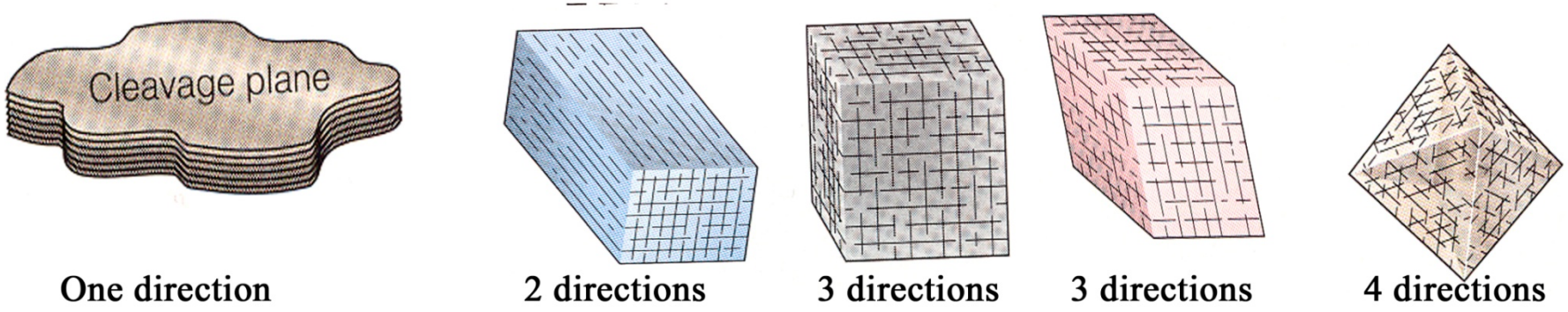
Cleavage and Fracture

- **Cleavage** is the property that some minerals have of splitting along planes of natural weakness in the crystal structure.

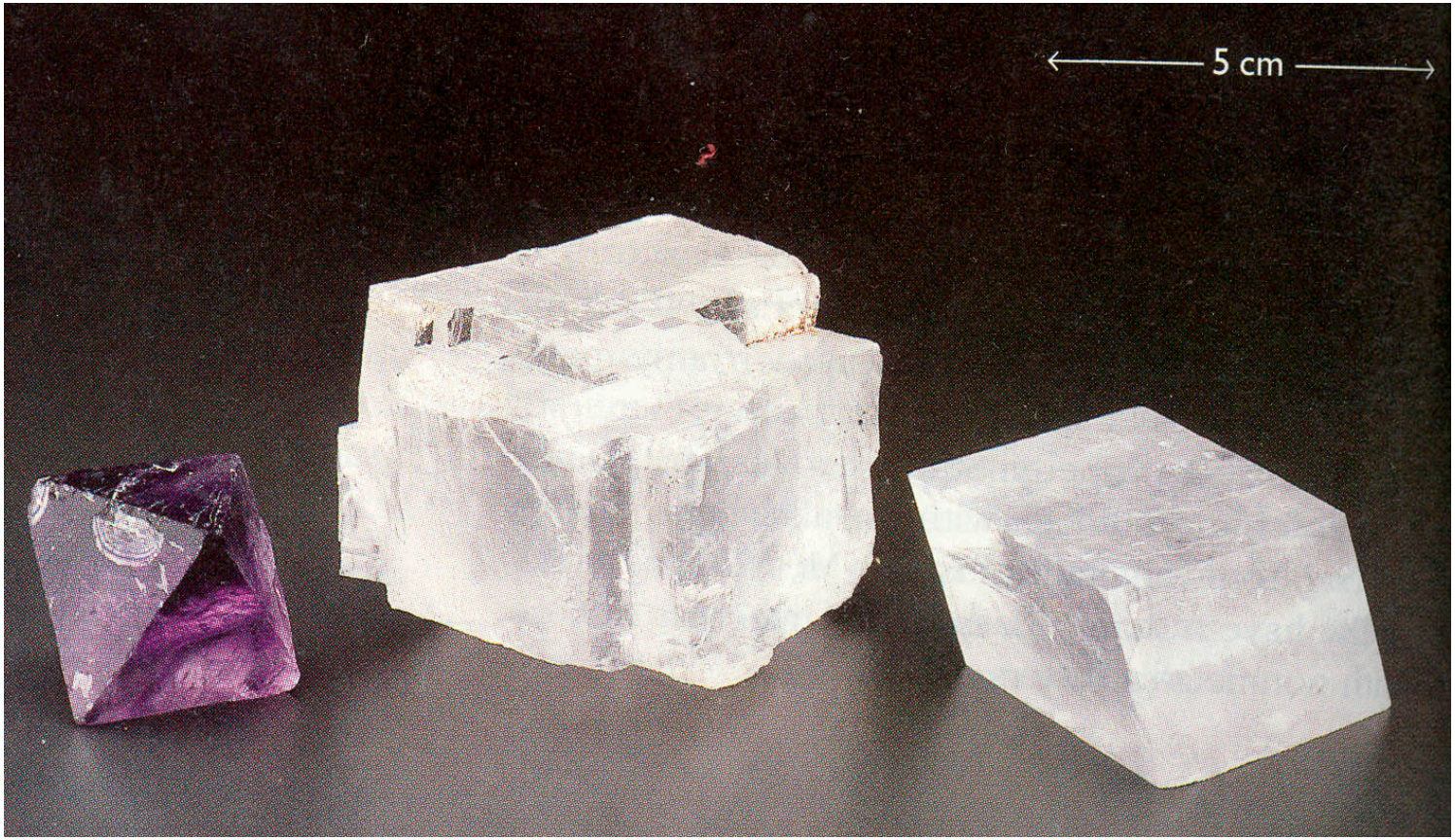
- Minerals can also fracture if they have no strong preferred plane of weakness. A term Conchoidal fracture is used and you have all seen this in shards of broken glass.

Cleavage

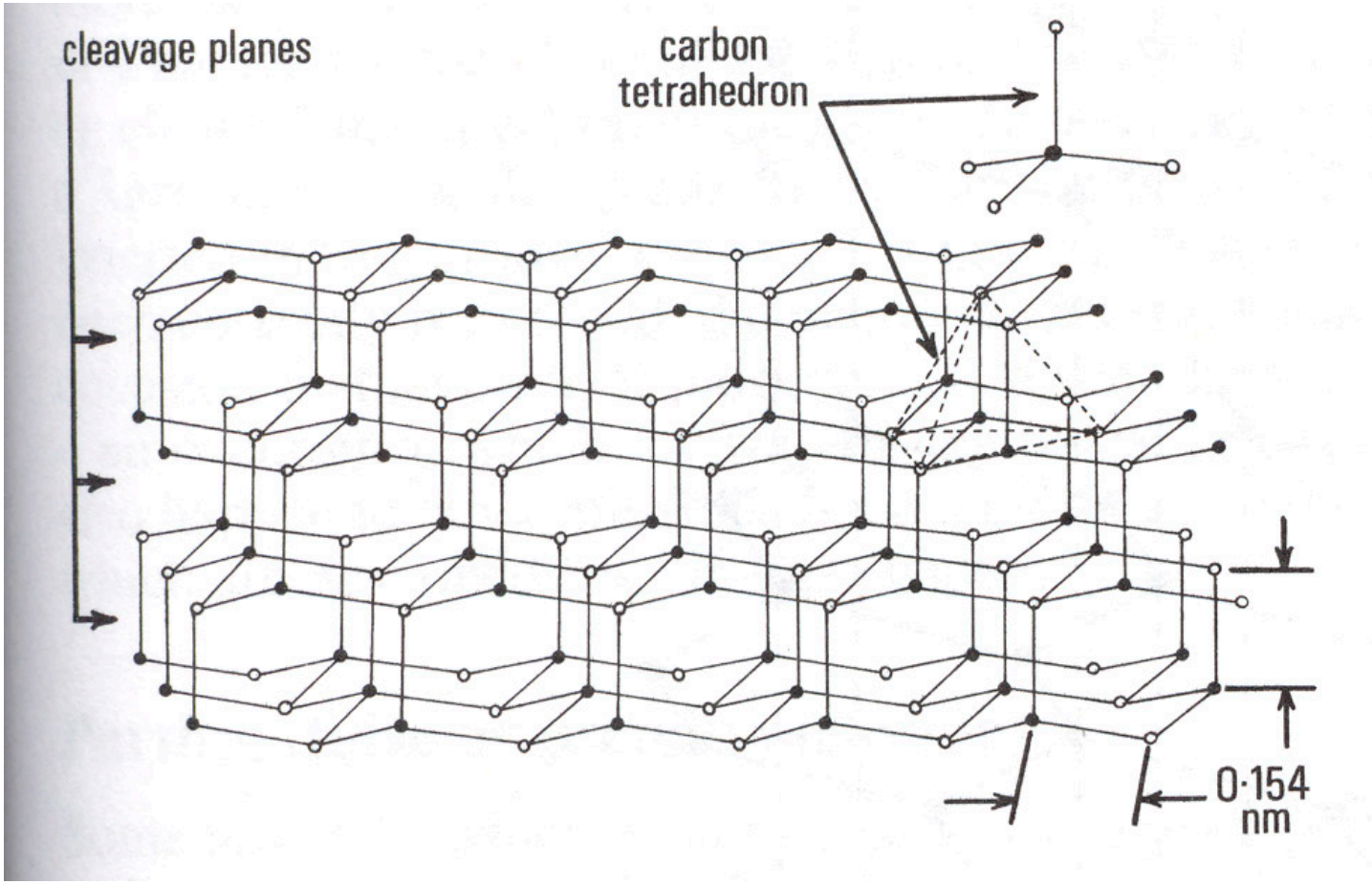
- Examples of cleavage of minerals



- Mica feldspar halite calcite diamond


5 cm

Cleavage in Diamond



Luster

- The appearance of a mineral in reflected light.
- Several specific terms are used, but it is still somewhat subjective unless the person is trained in the laboratory with examples.

Luster (cont…)

- **Metallic**--The type of very high luster associated with metals (e.g. gold, silver, platinum) and seen in some metallic compounds (e.g. pyrites [fool's gold])

- **Adamantine**--The high surface polish achieved with diamond (zircon classified as 'sub-adamantine')

- **Vitreous**--A glass-like luster typical of the majority of gemstones (ex. quartz, sapphire, emerald, etc.)

- Resinous --The more subdued polish as seen in amber
- Waxy--The almost matte surface typical of turquoise and jadeite
- Greasy--The appearance of soapstone and nephrite (jade)
- Pearly--The luster seen in mother-of-pearl
- Silky--A fibrous luster typical of satin spar and ulexite

Table 8.2 p. 76 of Read

Fluorescence

- How a mineral looks when viewed in the dark using ultraviolet light (UV) which can excite fluorescence

- 2 types of UV exist: short wave (SW) and long-wave (LW) UV (p. 133-135 of P.G. Read)

- SW can be dangerous to your eyes and skin!

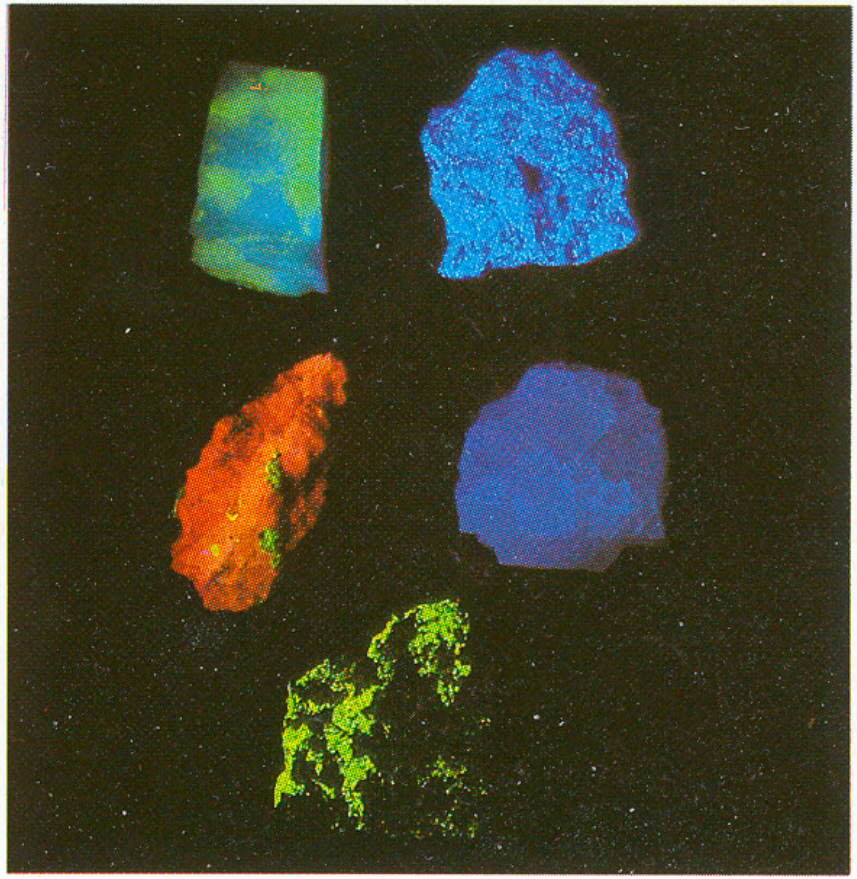
Fluorescence (cont…)

- The energy used to excite fluorescence can also stimulate a mineral to phosphoresce.

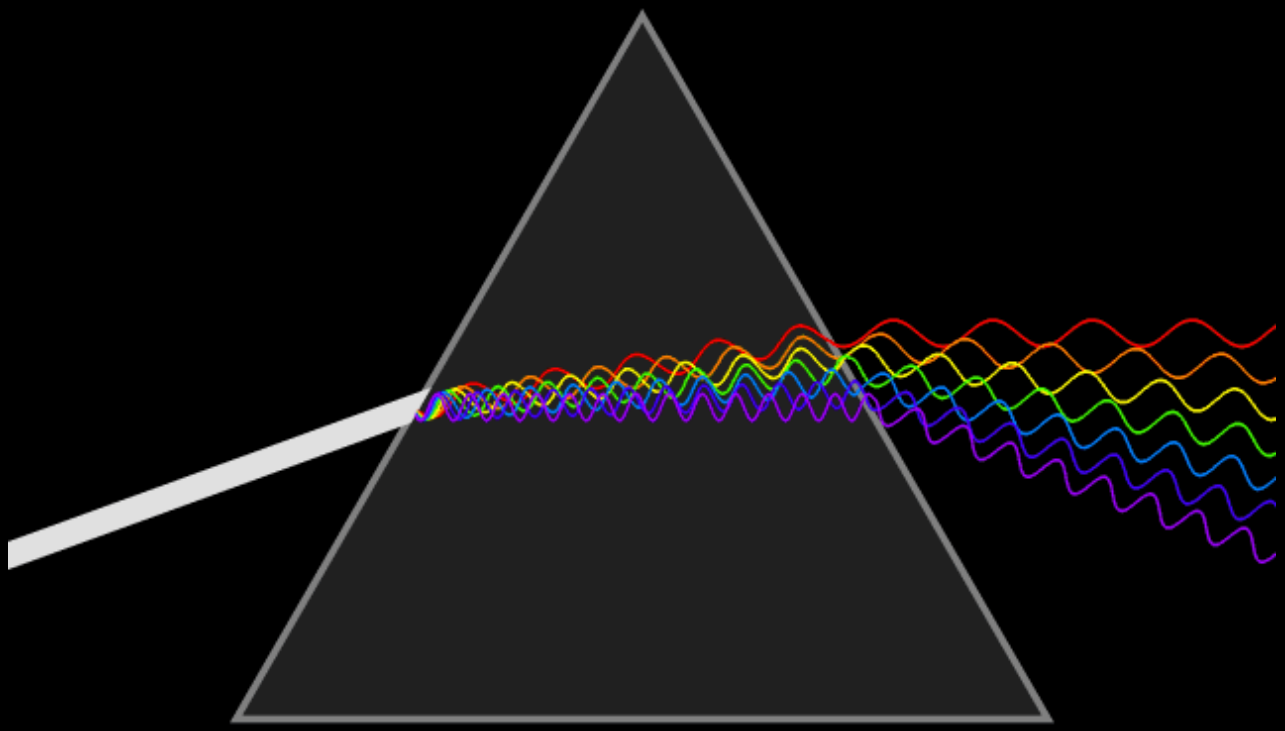
- Phosphorescence is the continued glow (emission of light) after the exciting source is turned off, for example in a luminous watch face.

Fluorescence

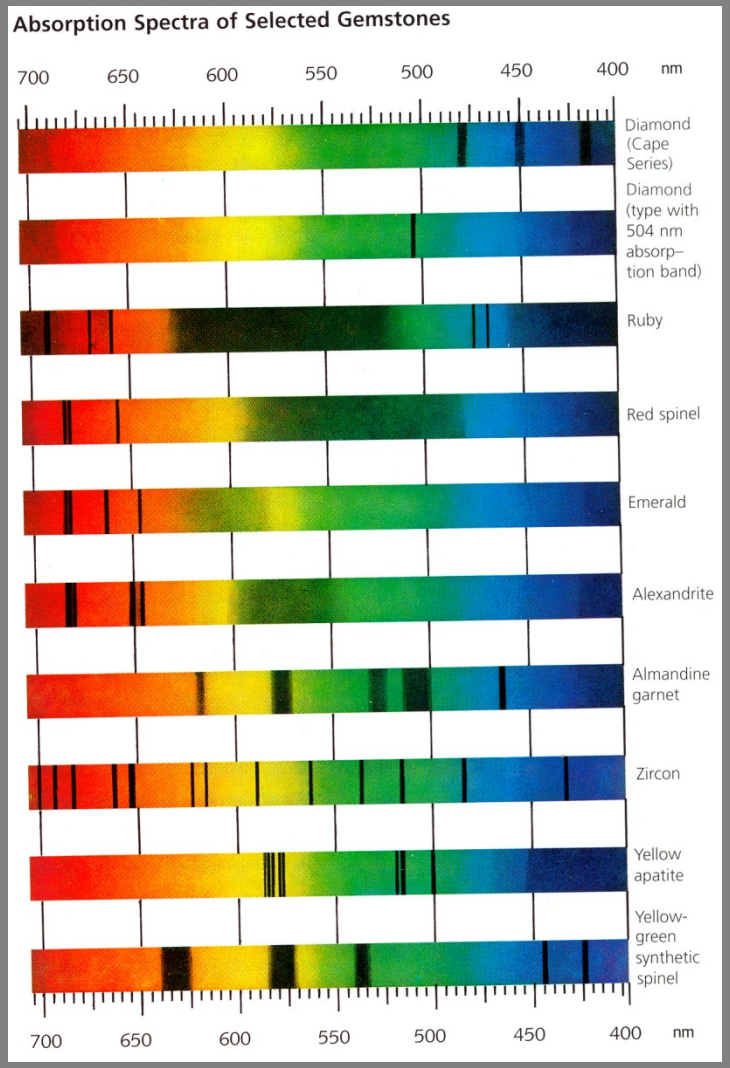
aragonite, calcite; center, fluorite, halite; bottom, willemite.



Dispersion of light in a prism



Spectra as seen with a spectroscope



Specific Gravity

Specific gravity(G) = *density* is a number that expresses the ratio between the weight of a substance and the weight of an equal volume of water at 4°C. Thus a mineral with a specific gravity of 2, weighs twice as much as the same volume of water. The specific gravity of a mineral is frequently an important aid in its identification, particularly in working with fine crystals or gemstones, when other tests would injure the specimens.

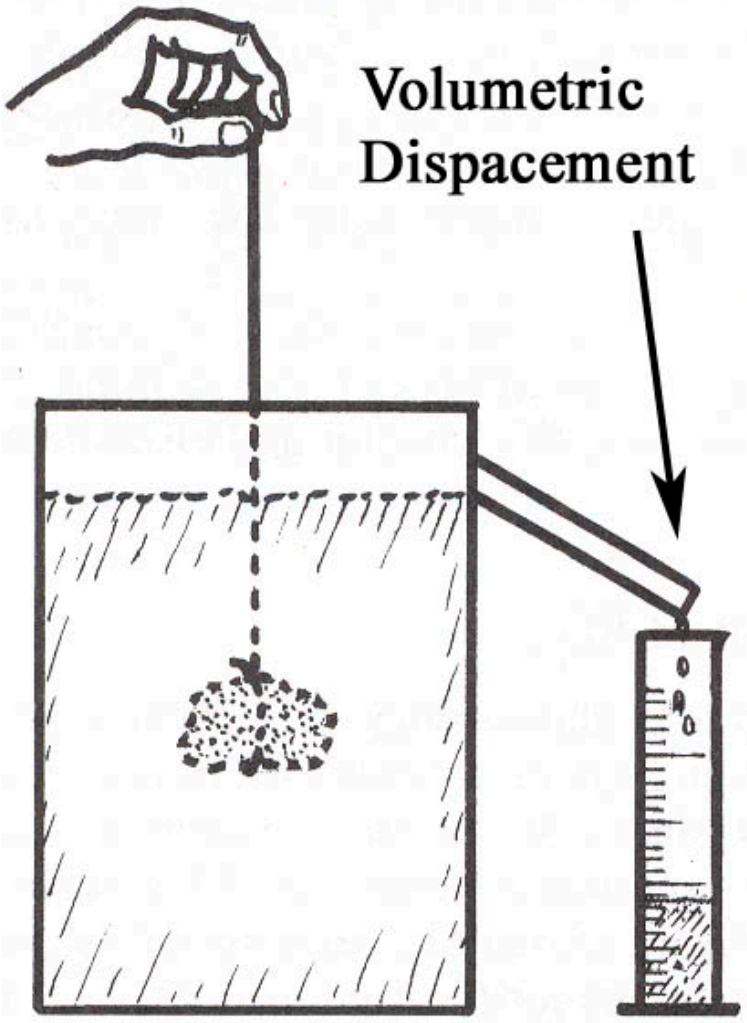
Calculation of specific gravity

$$\text{SG of gem} = \frac{\text{weight of gem}}{\text{weight of displaced water}} = \frac{W1}{A - B}$$

p. 58

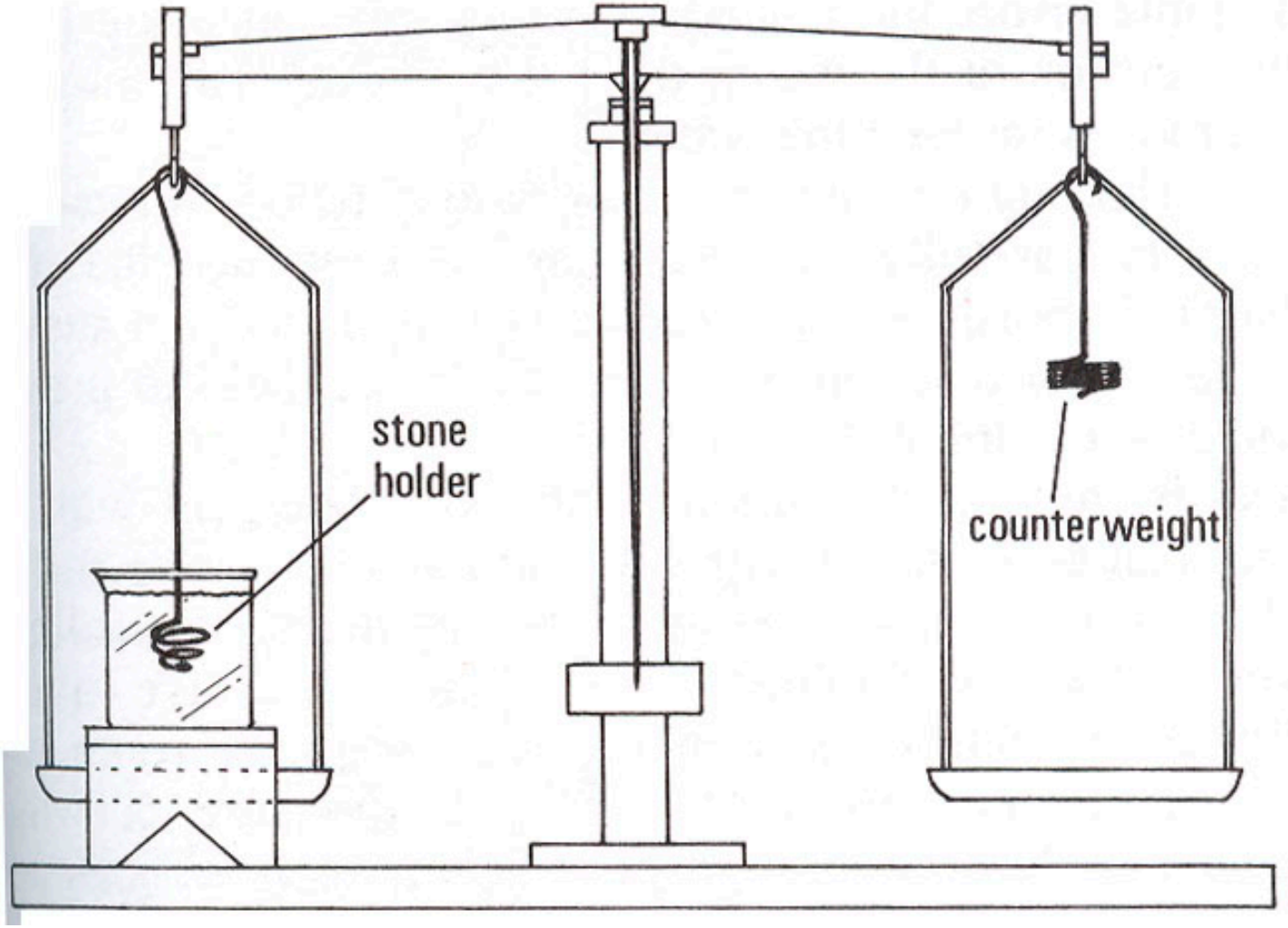
By convention 1 gram of water has a volume of 1 milliliter (1cc) at 4°C

Specific Gravity



Page 56

Hydrostatic method of SG Determination



2. Cleavage not prominent

Color	G.	H.	Remarks	Name, Composition, Crystal System
Colorless, white, smoky, Variously colored	2.65	7	Crystals usually show horizontally striated prism with rhombohedral terminations.	**QUARTZ** SiO_2 Rhombohedral
Colorless, white, pale yellow	2.97 to 3.02	7	In prismatic crystals resembling topaz but distinguished by lack of good cleavage. Also in irregular masses and indistinct crystals. A rare mineral.	Danburite $Ca(B_2Si_2O_8)$ Orthorhombic
White, colorless	2.97 to 3.0	$7\frac{1}{2}$–8	In small rhombohedral crystals. A rare mineral.	Phenacite $Be_2(SiO_4)$ Rhombohedral
White and almost any color	3.95 to 4.1	9	Luster adamantine to vitreous. Parting fragments may appear nearly cubic. In rude barrel-shaped crystals.	**CORUNDUM** Al_2O_3 Rhombohedral
Red, black, blue, green, brown	3.6 to 4.0	8	In octahedrons; twinning common. Associated with crystalline limestones.	**SPINEL** $MgAl_2O_4$ Isometric
Bluish green, yellow, pink, colorless	2.75 to 2.8	$7\frac{1}{2}$–8	Commonly in hexagonal prisms terminated by the base; pyramid faces are rare. Crystals large in places. Poor basal cleavage.	**BERYL** $Be_3Al_2(Si_6O_{18})$ Hexagonal
Yellowish to emerald-green	3.65 to 3.8	$8\frac{1}{2}$	In tabular crystals frequently in pseudohexagonal twins. Found in pegmatites.	CHRYSOBERYL $BeAl_2O_4$ Orthorhombic
Green, brown, blue, red, pink, black	3.0 to 3.25	7–$7\frac{1}{2}$	In slender prismatic crystals with triangular cross section. Found usually in pegmatites. Black most common, other colors associated with lithium minerals.	**TOURMALINE** Rhombohedral