EWCE 203: Geology and Geomorphology

Geology

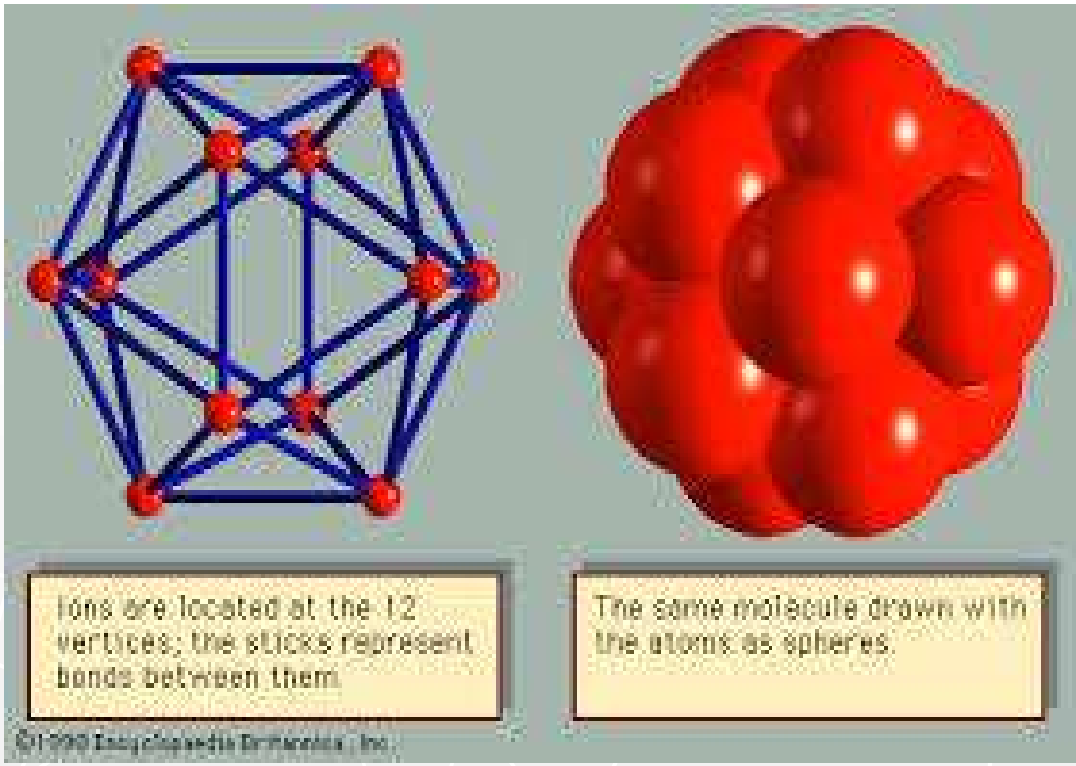
Previous Class: GTS

We will discuss today:

Minerals

- **Definition**
- Fundamental characteristics
- Other physical characteristics
- Some properties unique to some minerals.

Minerals



Definition:

A mineral is a

-naturally occurring,

-inorganic,

-solid.

-element or compound of elements,

-with definite chemical composition and a **regular crystalline structure.**

Minerals

Identifying Characteristics of Minerals:

- Fundamental Characteristics
- Other Physical Characteristics

Minerals

Fundamental Characteristics of Minerals:

Two fundamental characteristics of mineral that together distinguish it from other minerals are:

- **Chemical composition &**
- **Crystalline structure.**

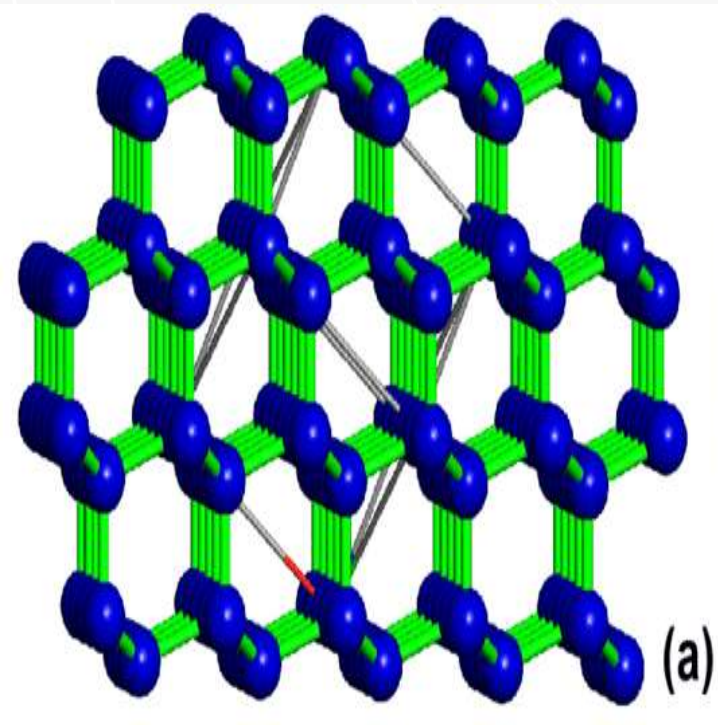
No two minerals are identical in both respect, though they may be same in one.

Chemical Composition

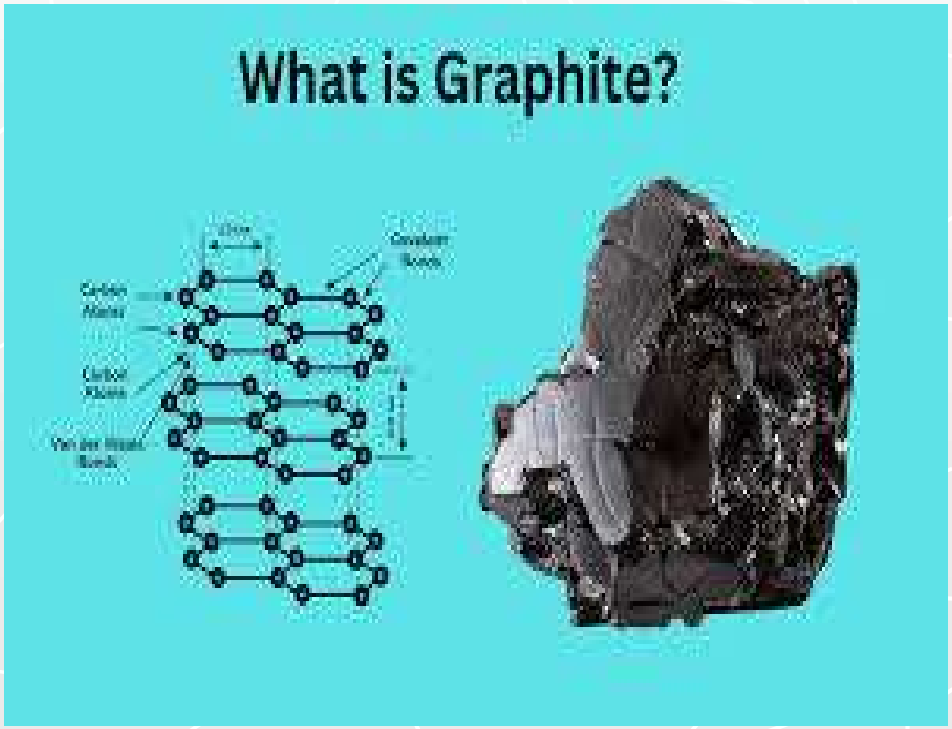
Diamond and **Graphite:**

- **Composition: Chemically same**, both are made of **pure carbon**.

- **Crystalline Structure: Physical properties vastly varies** due to **differences in their internal crystalline structure.**







Diamond

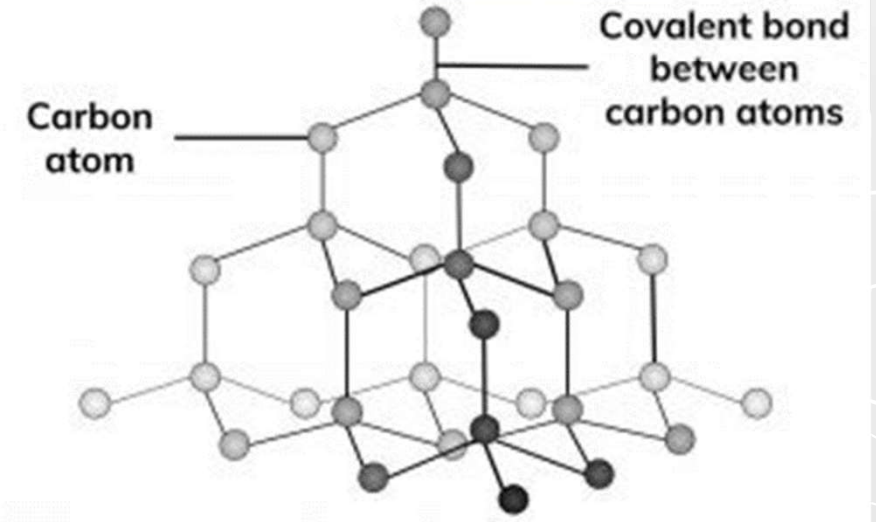
Graphite

Minerals

Diamond:

- Each C atom is **firmly bonded to every adjacent carbon atom in every direction** by **covalent bond**.
- **Clear, colorless and very hard**.
- Jewelers can **cut** into beautiful gemstone.



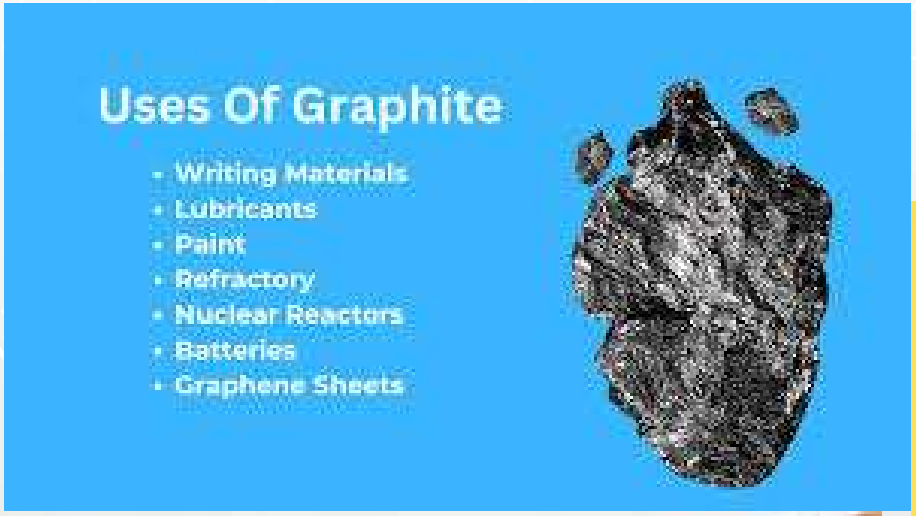




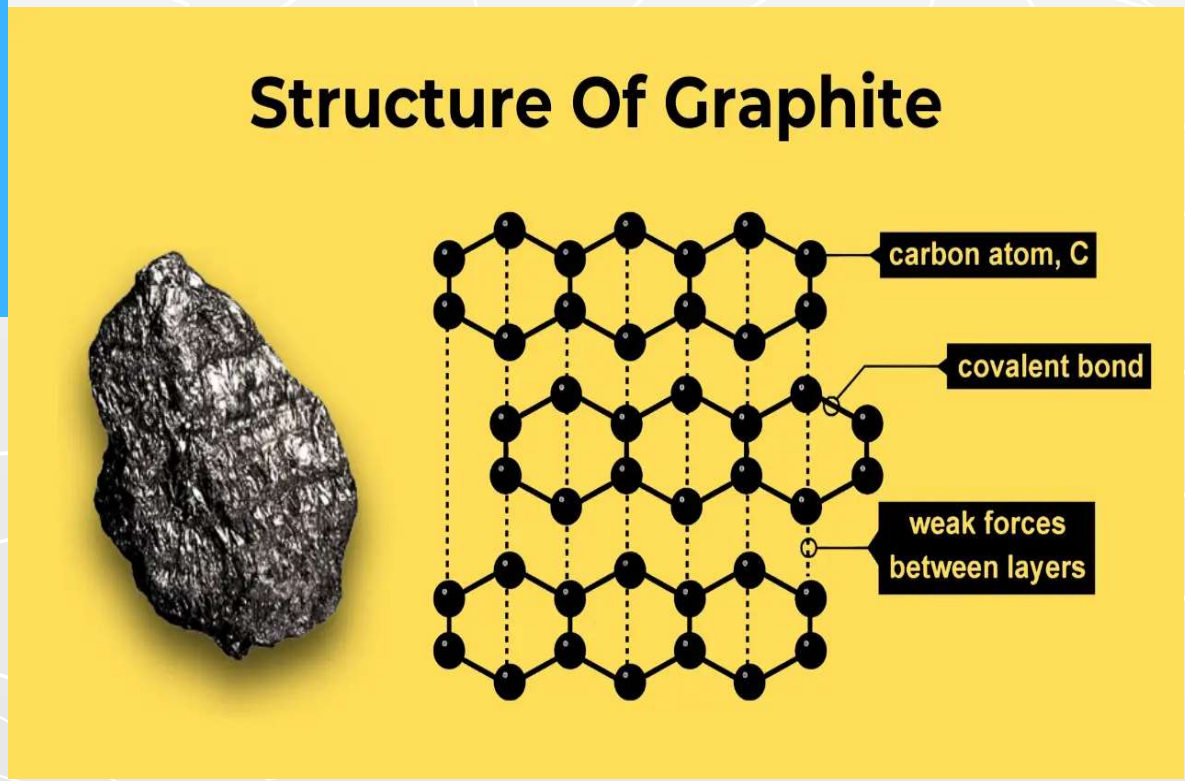
Koh-i-Noor Diamond is a 186 carat diamond

Graphite:

- Carbon atoms **are bonded strongly in two directions** into sheets but sheets are **only weakly held together in 3rd direction**.
- **Black, opaque and soft.**
- Sheets of carbon atoms tend to **slide past as weak bonds** between them are broken.







Minerals

Crystalline Structure:

- Defined as **the particular repeating arrangement of atoms (molecules or ions) throughout a crystal**.

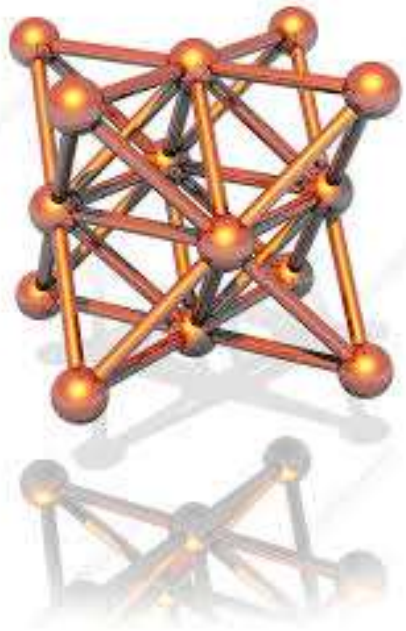
- **Crystal**: A piece of a homogeneous solid substance having a **natural geometrically regular form** with symmetrically arranged plane faces.

- But many **mineral share similar crystal form** and **same mineral may show different external forms** though it **always have the same internal structure.**

Copper as crystal form

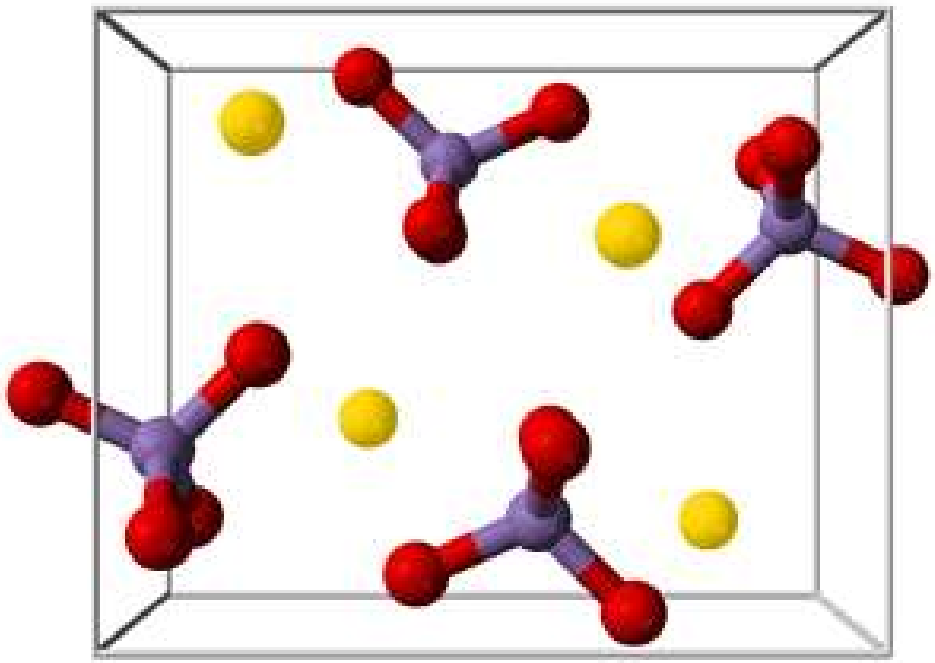


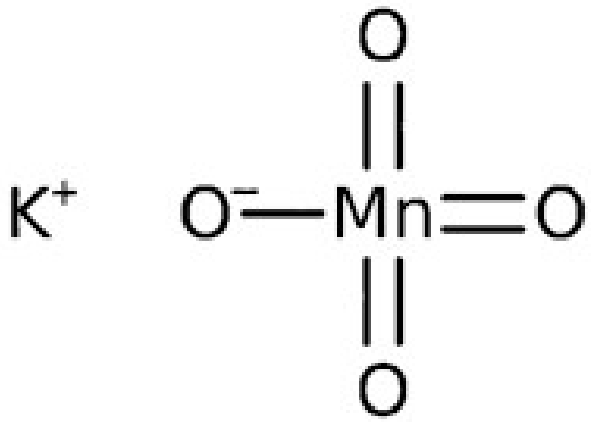




Crystal Shape









Other Characteristics of Minerals:

Color:

- Color is the **result of our brain's interpretation of the dominant wavelength of light**.

- Minerals are colored because **certain wavelengths of incident light are absorbed, and**

- Color we perceive is produced by the remaining wavelengths **that were not absorbed**.



Minerals

Color (cont..):

- **Variation in color is common** specially when the **pure mineral is light color or colorless.**

Example:

Quartz

- Hard crystalline mineral composed of silica (SiO_2).
- **Colorless in pure form.**
- May occur in other colors like **rose, pink, golden yellow, smoky brown, purple, milky white.**
- So, **quartz cannot always be recognized by its color**.

Minerals

Example:

Quartz







Minerals

Example:

Corundum

- **Crystalline form of (Al_2O_3).**
- **Colorless in its pure form**.
- **Quite hard** which makes it an **abrasive**, use on grit of sand paper.
- Impurities disguise it by changing color and **transform into highly prized gemstone.**

Minerals

Corundum







- **Ruby**: **deep bluish red gem** due impurities **chromium**.
- **Sapphire**: **tinted blue** due to **impurities iron & titanium**.

Minerals

Streak:

- Color of a mineral in **powdered form**.
- **Form when mineral is scratched** across by a piece of un-glazed tile, called streak plate.
- Quite **different from** **the color of the bulk sample**.
- **More consistent** for a single mineral.
- Tile is **not always handy**, and some **mineral are too valuable to scarp.**

Streak:



Minerals

Hardness:

- **Easily measured physical property** that **can help to identify mineral.**
- **Ability of mineral to resist scratching**.
- Does **not uniquely identify minerals**.

Measurement:

- Measured on **Mohs Hardness Scale.**
- **Ten minerals** are arranged in order of hardness.

Minerals

Hardness:

Measurement:



Minerals

Haw to Identify Hardness?

- **Unknown minerals are assigned a hardness number** on the basis of **which minerals they can scratch** and which minerals scratch them.
- A mineral that **scratches gypsum and is scratched by calcite**, is assigned a hardness **of 2.5**.
- **Diamond is the hardest** and **Corundum is the second hardest** minerals, can identify hardness of hard mineral.
- But thousands of softer minerals have **particular hardness like many minerals have particular color**.

Minerals

Why it is Important to Know the Hardness of Metals

- **German geologist Friedrich Mohs** devised the scale of hardness that we use today.
- Help you **determine which jewelry will be more durable** just by knowing the metal it is made of.
- Can be useful when you are **shopping and debating** between pieces of jewelry made from different metals.
- Mohs scale diamond has the top rating of 10, **gold and silver 2.5-3.0** and a fingernail 2.0-2.5.

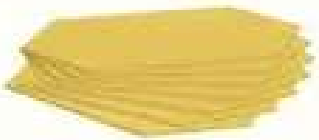
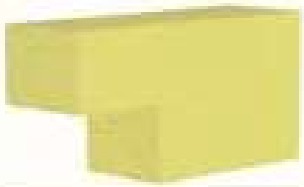
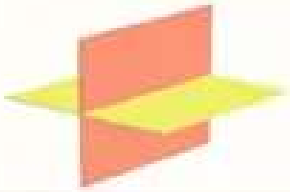
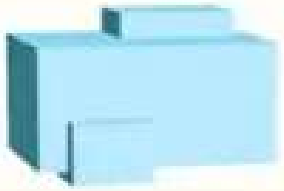
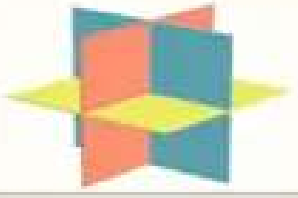
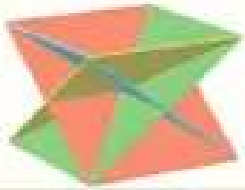
Cleavage:

- Cleavage is a mineral's **tendency to b**reak along specific internal planes, or cleavage planes, when struck with a hammer.

- **Cleavage planes** are smooth, two-dimensional surfaces that are caused by the alignment of weaker bonds between atoms in the crystal lattice.

- External form of crystals may be **related to their internal structure**.



Number of Cleavage Directions	Shape	Sketch	Directions of Cleavage	Sample
1	Flat sheets			 Muscovite
2 at 90°	Elongated form with rectangle cross section (prism)			 Feldspar
2 not at 90°	Elongated form with parallelogram cross section (prism)			 Hornblende
3 at 90°	Cube			 Halite
3 not at 90°	Rhombohedron			 Calcite
4	Octahedron			 Fluorite

- A **cleavage direction will show up** as a smooth, shiny, evenly bright shinning of light reflected by one set of parallel surfaces on the mineral.

- Mica has cleavage in **one direction** **and** **forms sheets**.

- **Mica is a group of minerals** that have a layered structure and can be split into thin, flexible sheets.





Minerals can cleave into polygons.

- Diamond forms **octahedrons**.

One reason **gemstones are beautiful** is that the **cleavage planes make an attractive crystal shape with smooth faces.**



Diamond shows its octahedral cleavage.

Minerals

What happens when minerals are struck?

- Minerals break in distinct way.

Fracture:

- Some minerals may simply **crumble** in **irregular surface.**

- **Break more or less random pattern** with no smooth planar surfaces.



Fracture (cont..):

Break in a mineral that **is not along a cleavage plane.**

Fracture is not always the same in the same mineral because fracture is not determined by the structure of the mineral.

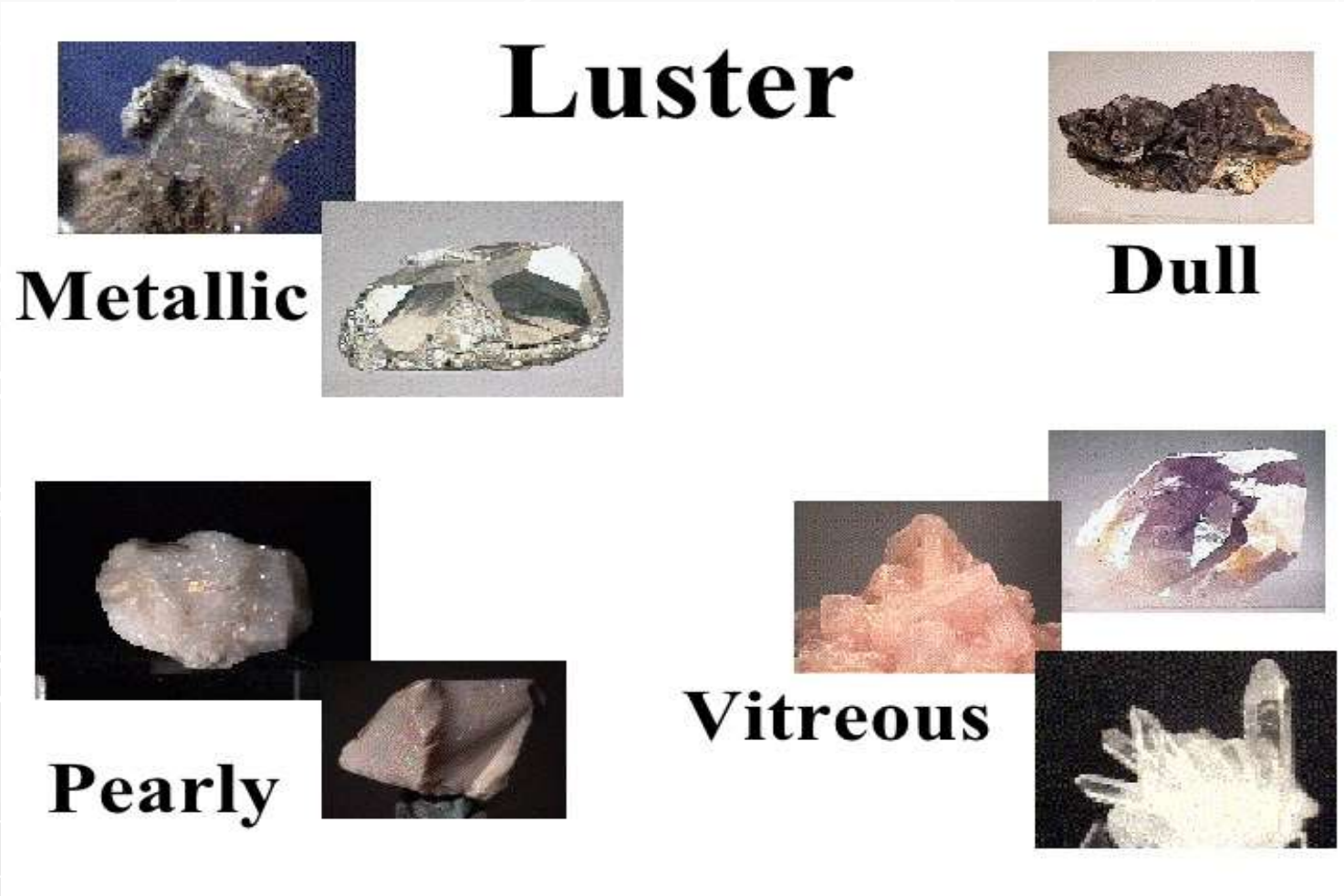
- **Metals** usually fracture into **jagged edges**.
- If a mineral **splinters like wood**, it may be **fibrous.**
- Some minerals, such as quartz, **form smooth curved surfaces** when they fracture.

Minerals

A number of Physical Properties may be individually common to many Minerals. These are:

Luster:

- Describe the **appearance of the surface**.
- May be **glassy**, **metallic**, greasy, earthy p**early, silky** etc.



Minerals

Density:

- Some minerals are **notably denser** than other.

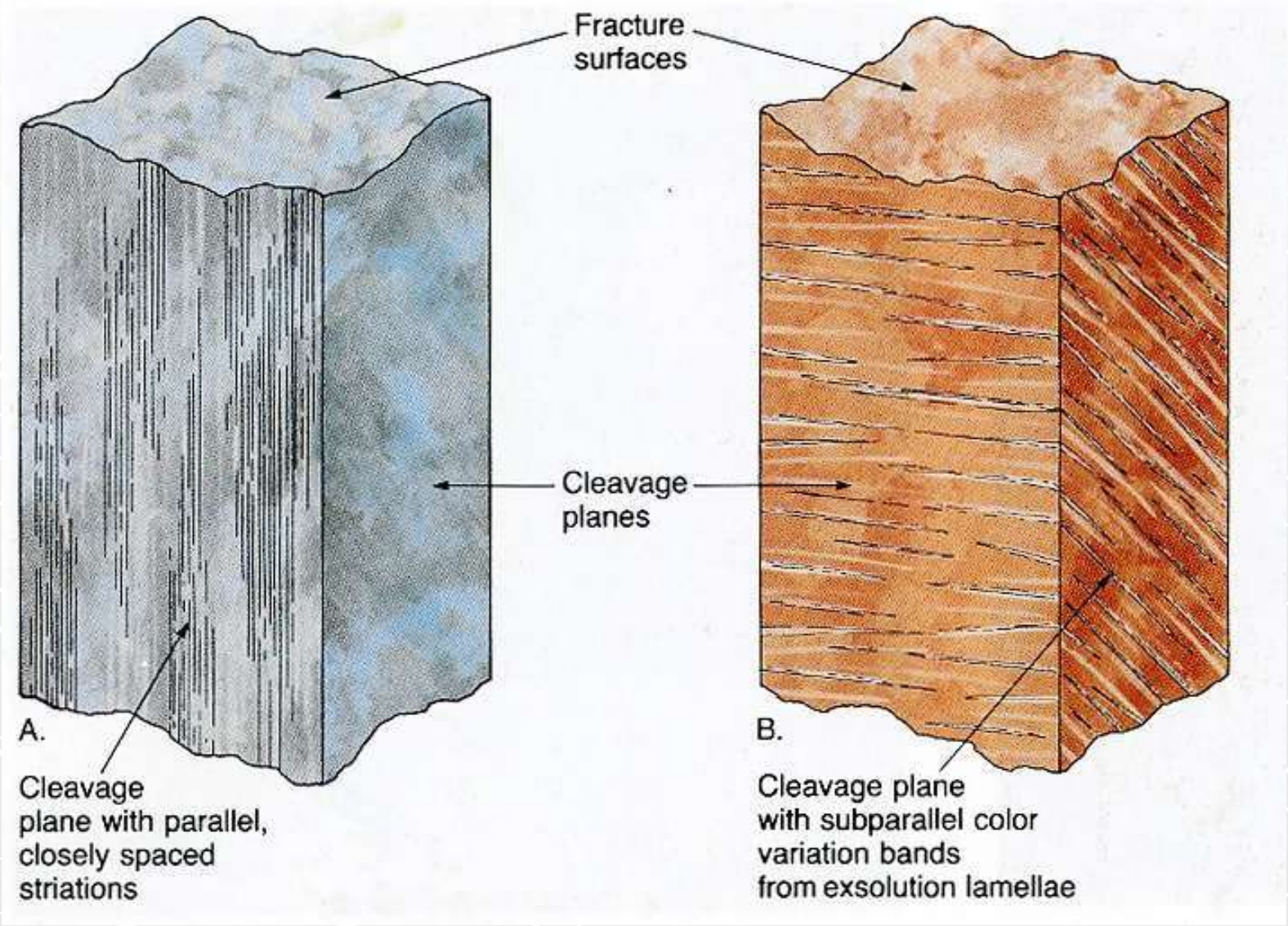
Magnetic:

- Some minerals are magnetic.

Question: Only be **considering non-unique properties** as color, hardness, cleavage, density and others, can a mineral be identified without complex instruments. Explain.

Striations:

Striations are the **narrow alternating grooves** or **furrows** and **ridges** or **color appearing as parallel lines** on some minerals



Striations (cont..):

- A few common minerals have **parallel, thread like lines or narrow bands** called striations running along the crystal faces or **cleavage surfaces.**
- These lines are clearly seen on the **crystal faces of Quartz and Pyrite.**
- This property is a **reflection of the internal arrangement of atoms** and the **conditions of growth** of the crystals.



Striation in Quartz



Striation in Pyrite

Other Identifying Characteristics

Effervescence

Some properties that only help to distinguish a small number of minerals, or even just a single mineral.

- An example of such a special property is the **effervescent reaction of calcite ($CaCO_3$)** to a weak solution of hydrochloric acid
- (5% **HCl**).
- Calcite **fizzes or effervesces** as the HCl solution dissolves it and creates CO_2 gas.
- **Calcite is easy to identify** even without testing the reaction to HCl, by its hardness, luster and cleavage.

Magnetism:

- **Another special property is magnetism.**
- Tested by seeing if a **small magnet responds to the mineral**.
- Most common mineral that is strongly magnetic is the mineral **magnetite.**

Some minerals have other unique properties, some of which are listed below:

Some minerals have unusual properties that can be used for identification.		
Property	Description	Example of Mineral
Fluorescence	Mineral glows under ultraviolet light	Fluorite
Magnetism	Mineral is attracted to a magnet	Magnetite
Radioactivity	Mineral gives off radiation that can be measured with Geiger counter	Uraninite
Reactivity	Bubbles form when mineral is exposed to a weak acid	Calcite
Smell	Some minerals have a distinctive smell	Sulfur (smells like rotten eggs)
Taste	Some minerals taste salty	Halite

We have discussed Today:

Minerals

- **Definition**
- Fundamental characteristics
- Other physical characteristics
- Some properties unique to some minerals.

Thanks

