Minerals: Building Blocks of Rocks

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Reading Assignment

- Chapter 2 – Matter and Minerals
- Write down answers to the Concept Check questions at the end of each section.,

Learning Objectives

- https://macearthscience.weebly.com/31-minerals.html

2.1 Minerals: the building blocks of rocks

- Definition of a mineral
  - Natural
  - Inorganic
  - Solid
  - Possess an orderly internal structure of atoms
  - Have a definite chemical composition
- Mineraloid - lacks an orderly internal structure
  - e.g. : opal, amber, obsidian

This is a mineral:

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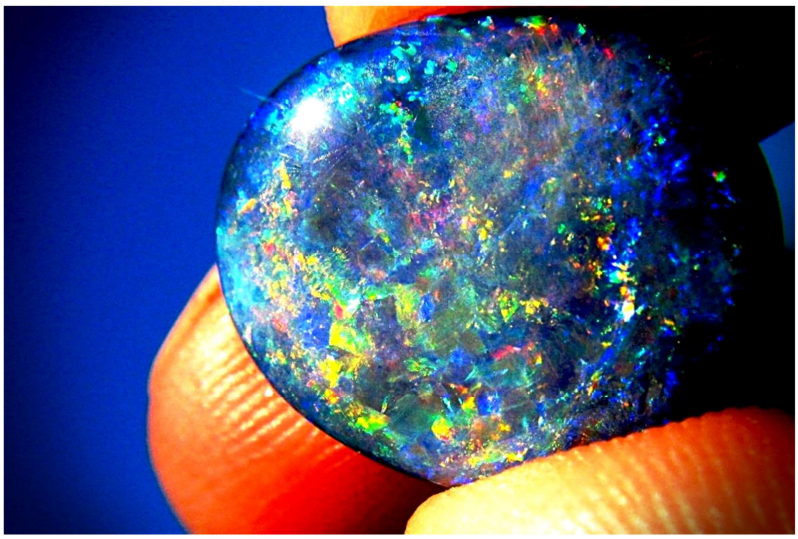
- It's a quartz crystal and it is Naturally occurring, Inorganic (not living), Solid, Possess an orderly internal structure of atoms, and has a definite chemical composition

This is a mineraloid:



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- This is Opal (pretty, no?) and it lacks a definite internal structure.

This is a rock.

These are minerals

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- Granite is a rock and is an aggregate of different minerals including the ones shown. Can also contain mica and some other minerals.

- Slides removed.

What happens if I cut this in half?

- Again?
- Again?
- Again?
- Again?
- Again?
- Again?
- Again?
- Again?

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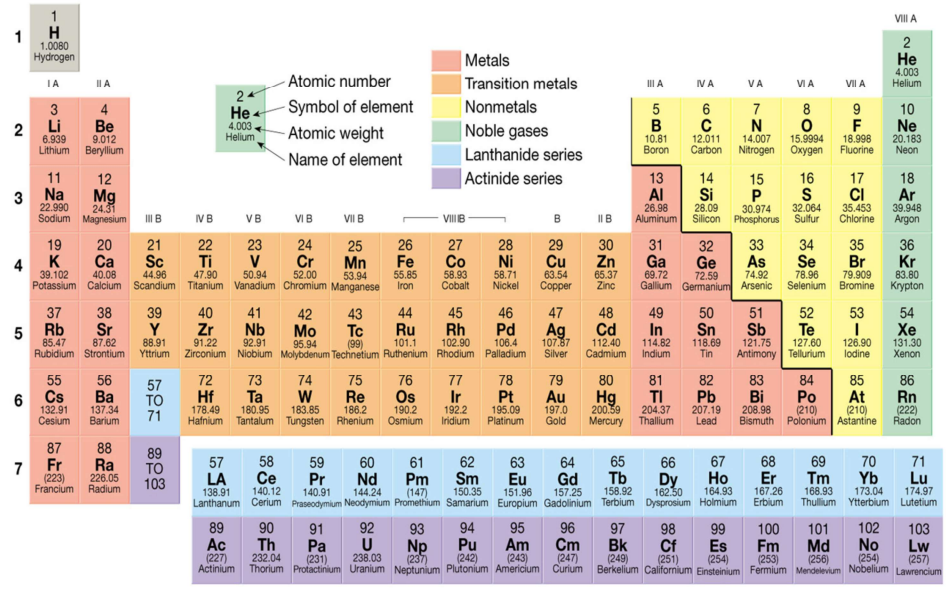
I wind up with an ATOM!

2.2 Composition and structure of minerals

- Elements
  - Basic building blocks of minerals
  - (well, of everything really…)
- Atoms
  - Smallest particles of matter that…
  - Have all the characteristics of an element

Periodic table of the Elements



How atoms are constructed

- Nucleus – central part of an atom that contains
  - Protons – positive electrical charges
  - Neutrons – neutral electrical charges
- Energy levels, or shells
  - Surround nucleus
  - Contain electrons – negative electrical charges

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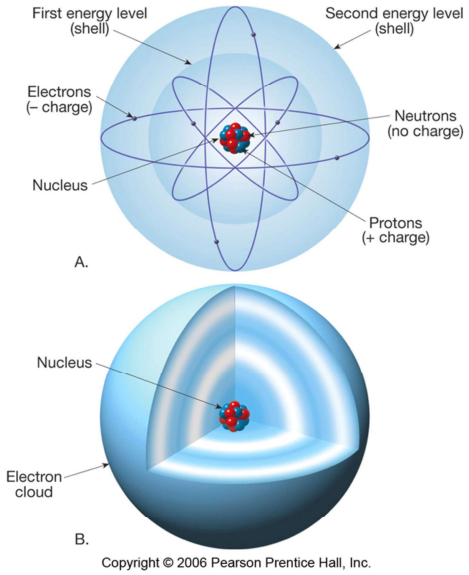
This is a review of basic chemistry.

Simplified view of the atom



How atoms are constructed

- Atomic number
  - the number of protons in an atom's nucleus
- Bonding of atoms
  - Forms a compound with two or more elements
  - Ions are atoms that gain or lose electrons
- Isotopes
  - Have varying number of neutrons

How atoms are constructed

- Isotopes
  - Have different mass numbers – the sum of the neutrons plus protons
  - Many isotopes are radioactive and emit energy and particles

2.4 Properties of Minerals

- Physical properties of minerals
  - Crystal form
  - Luster
  - Color
  - Streak
  - Hardness
  - Cleavage

The mineral quartz often exhibits good crystal form

A.

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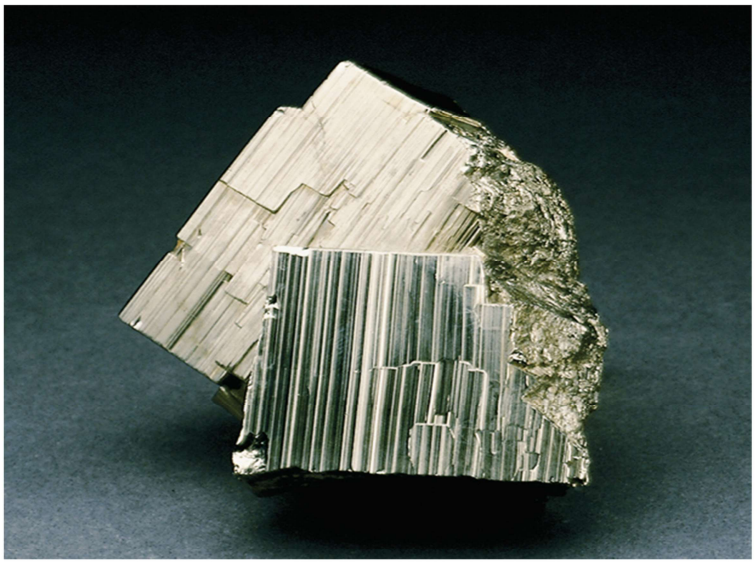
Pyrite (fool's gold, FeS_2) displays metallic luster



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- It looks like C3PO from Star Wars.

Color

- Color can be unreliable due to variations.

A. Fluorite

B. Quartz

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- Notice the crystal structure of fluorite is the same regardless of the color of the sample. The color variations are due to impurities found in each sample.

Streak

Although the color of a mineral is not always helpful in identification, the streak, which is the color of the powdered mineral, can be very useful.

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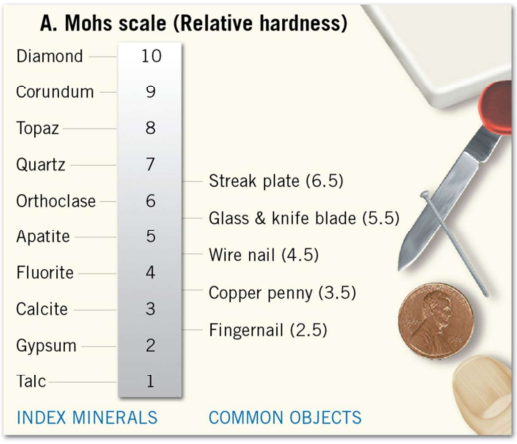
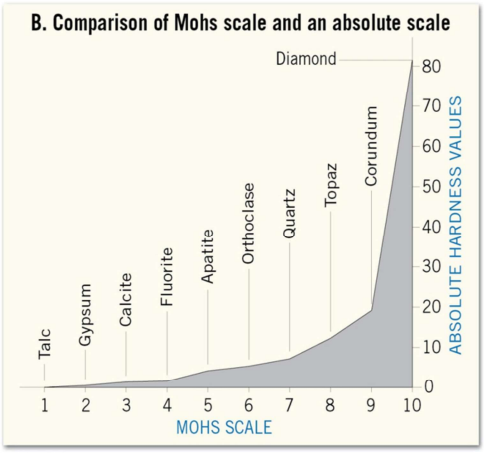
- Streak is much more reliable than color.

Hardness: Mohs Scale





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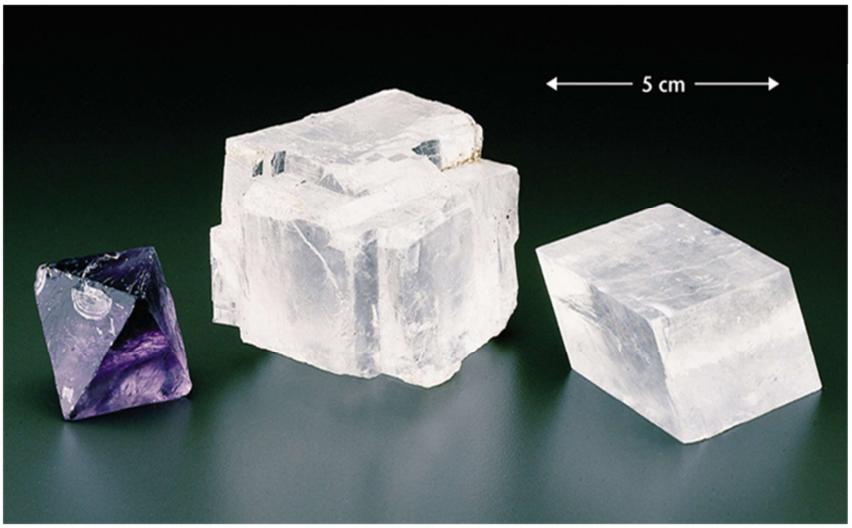
Three examples of perfect cleavage – fluorite, halite, and calcite



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- Cleavage means that the mineral tends to break or "cleave" along certain planes.

Minerals

- Physical properties of minerals
  - Fracture
  - Specific gravity
  - Other properties
    - Taste
    - Smell
    - Elasticity
    - Malleability

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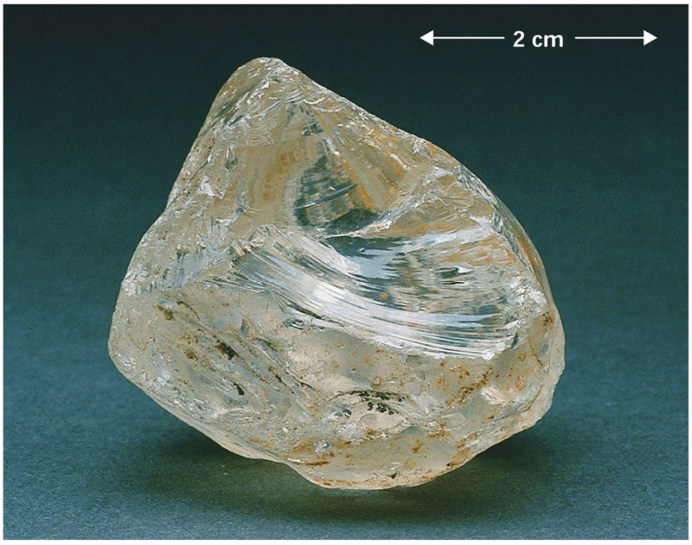
Fracture is the characteristic way a mineral breaks. The **difference between cleavage and fracture** is that **cleavage** is the break of a crystal face where a new crystal face is formed where the mineral broke, whereas **fracture** is the "chipping" of a mineral.

Specific gravity is basically how dense a substance is.

Elasticity is the ability of a material to "spring back" after stress is removed.

Malleability is how well a substance can be molded. Most metals are malleable.

Conchoidal fracture



Minerals

- Physical properties of minerals
  - Other properties
    - Feel
    - Magnetism
    - Double Refraction
    - Reaction to hydrochloric acid

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- Graphite has a "greasy" feel.
- Magnetite (a form of iron ore) is magnetic.
- **Double refraction**. Optical phenomenon exhibited on certain **minerals** where a light ray enters the crystal and splits up into two separate rays. Calcite does this.
- Carbonate minerals react with HCl.

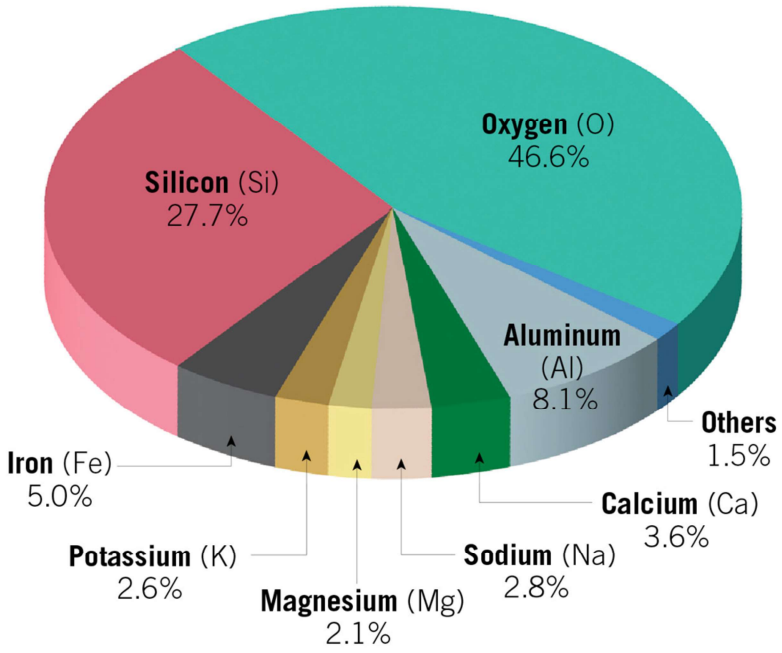
2.4 Check Questions

1. Define *luster*.
2. Why is color not always a useful property in mineral identification? Give an example of a mineral that supports your answer.
3. What differentiates cleavage from fracture?
4. What do we mean when we refer to a mineral's tenacity? List three terms that describe tenacity.
5. What simple chemical test is useful in the identification of the mineral calcite?

2.5 Mineral Groups

- Eight elements compose most rock-forming minerals:
  - oxygen (O),
  - silicon (Si),
  - aluminum (Al)
  - iron (Fe)
  - calcium (Ca)
  - sodium (Na)
  - potassium (K)
  - magnesium (Mg)

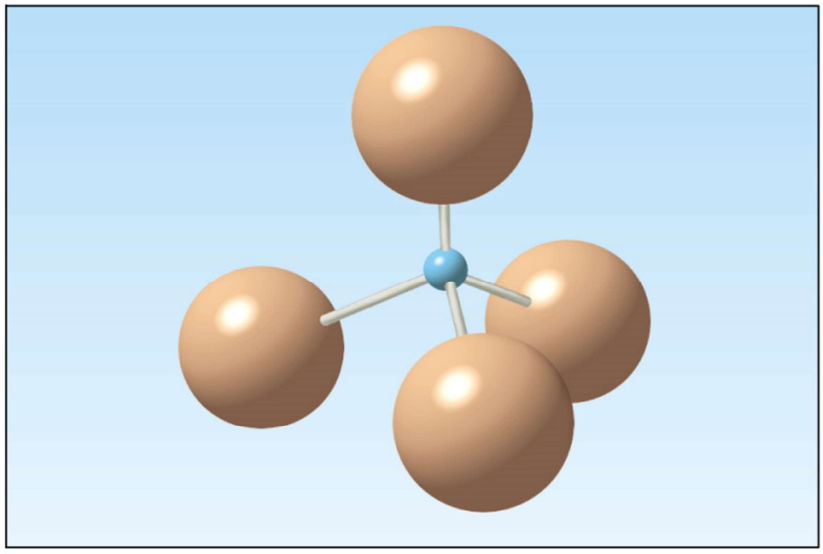
Composition of Continental Crust



Rock-forming silicates

- Most common mineral group
- Contain the silicon-oxygen tetrahedron (molecule)
  - Four oxygen atoms surrounding a much smaller silicon atom
  - Combines with other atoms to form the various silicate structures

The silicate $(SiO_4)^{-4}$ molecule



Important Silicate Minerals

Mineral/Formula	Cleavage	Silicate Structure	Example
Olivine group $(Mg, Fe)_2SiO_4$	None	Single tetrahedra	Olivine
Pyroxene group (Augite) $(Mg,Fe)SiO_3$	Two planes at 90°	Single chains	Augite
Amphibole group (Hornblende) $Ca_2(Fe,Mg)_5Si_8O_{22}(OH)_2$	Two planes at 60° and 120°	Double chains	Hornblende
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** $(Ca,Na)AlSi_3O_8$	Two planes at 90°	Three-dimensional networks	
Quartz SiO_2	None		Quartz

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Important non- Silicate Minerals

Natural Resources

- Renewable
  - Can be replenished in relatively short time spans
    - Corn, wind, water, etc.
- Nonrenewable
  - Earth has fixed quantities
    - Oil, aluminum, natural gas, coal

Minerals

- Mineral resources
  - Reserves are already identified deposits
  - Ores are useful metallic minerals that can be mined at a profit
  - Economic factors may change and influence a resource

An underground halite (salt) mine

Copper Mining

Turning Point slides removed

Check Questions

- Obsidian is a glass that formed when lava cools so quickly that the atoms to not have a chance to arrange themselves in crystals. Is obsidian a crystal? Explain your reasoning.

Virtual Mineral ID Activity

- https://www.wiley.com/college/strahler/0471669695/interactivities/flash/mineralogy/mineralogy.htm

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- Work this on your own!