

Mineral Properties and Identification



Introductory Geology Lab – GEOL 101

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http://www.rockhounds.com/rockshop/mineral_id/index.html

MINERAL INQUIRY

I. What are Minerals?

- ✓ How do minerals form?
- ✓ Where are minerals found?
- ✓ What types of minerals are there?
- ✓ The common rock-forming minerals?



II. The Physical Properties of Minerals

- ✓ The most important properties?
- ✓ How do you determine these properties?

III. Determining the Identify of a Mineral

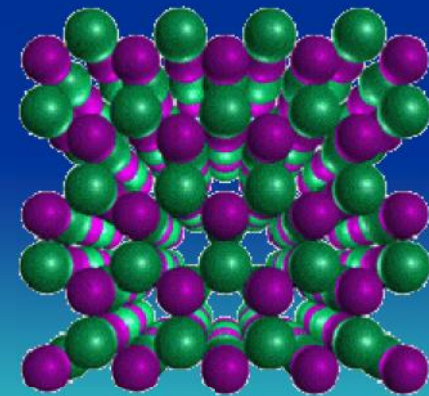
What are Minerals?

Definition: any *naturally-occurring*, homogeneous solid that has a distinctive internal *crystalline* structure, a *definite chemical composition* and a set of *unique physical properties*. Minerals are usually *formed by inorganic processes*.



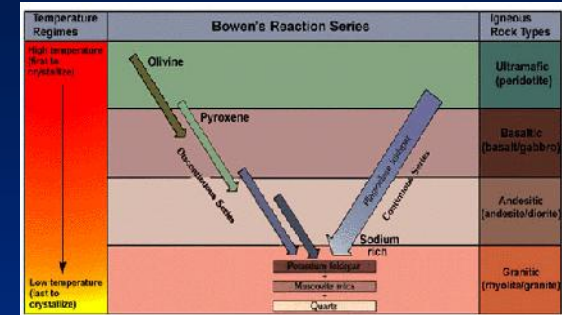
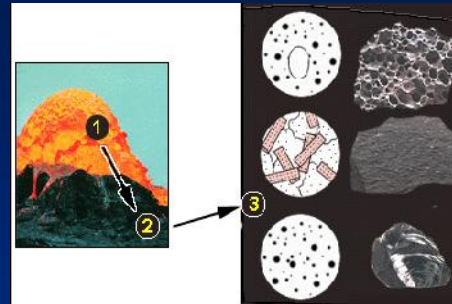
What Makes Each Mineral Unique?

A mineral's *crystal structure* and *chemical composition* together determine the mineral's *unique physical properties*



How do Minerals Form?

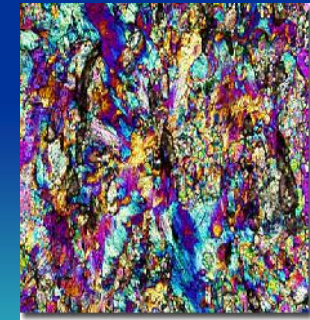
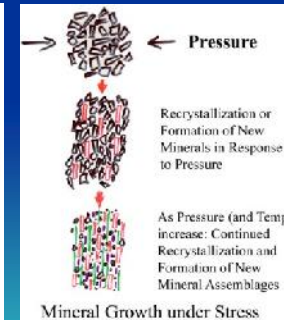
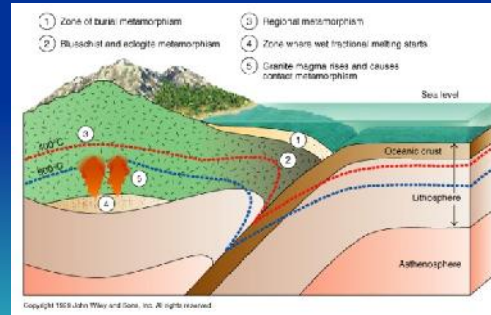
1) Crystallization from a cooling magma or lava



2) Crystallization from aqueous solutions



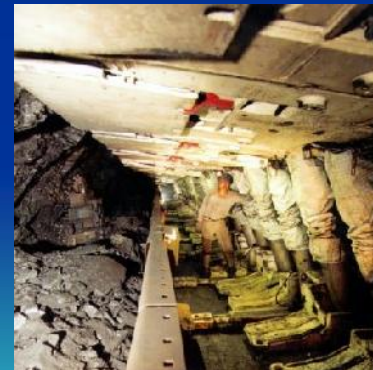
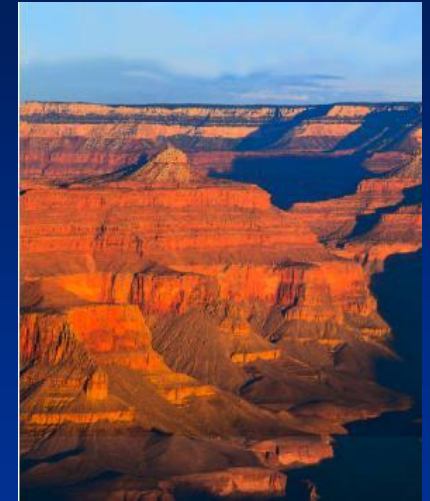
3) Crystallization from preexisting minerals



Where are Minerals Found?

Short Answer = Everywhere!

- 1) Igneous Rocks
- 2) Sedimentary Rocks
- 3) Metamorphic Rocks
- 4) Sediment



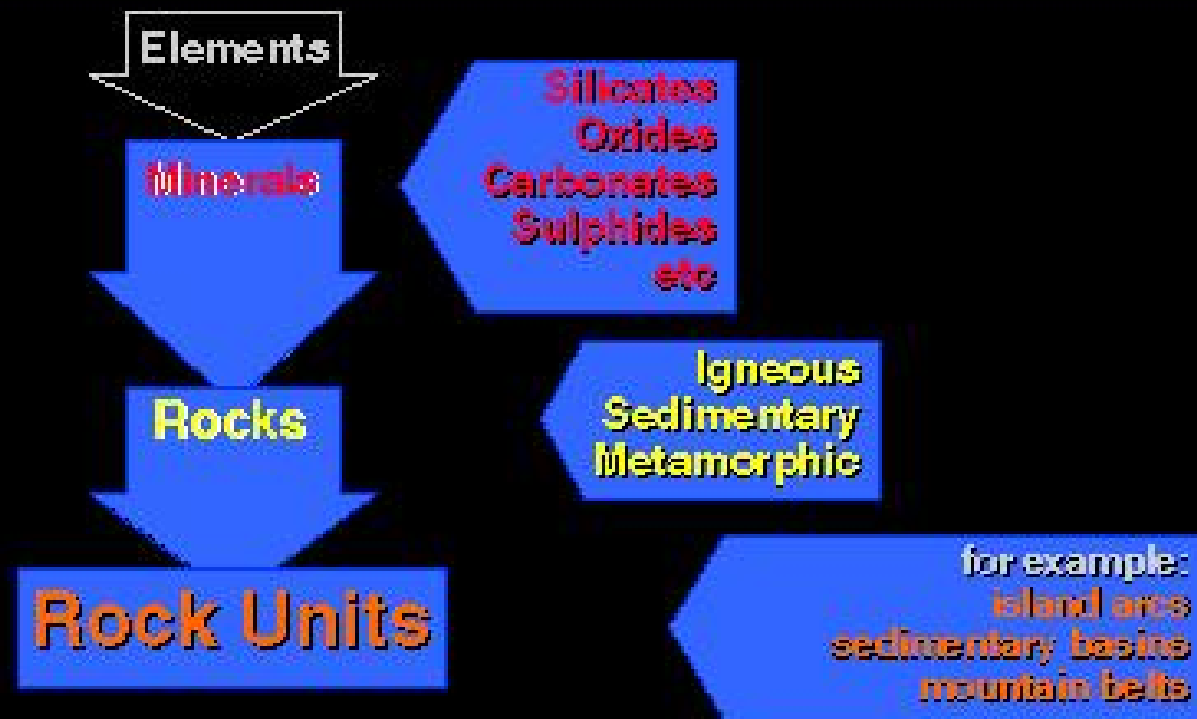
Various Types of Minerals

- ✓ Over 4000 Species
- ✓ Grouped into Categories
- ✓ Silicate group is by far the largest and most important mineral group
- ✓ Only about 20 minerals make up 95%+ of all rocks
- ✓ Minerals are identified by their Chemical and Physical Properties



Common Rock-Forming Minerals

Earth Materials

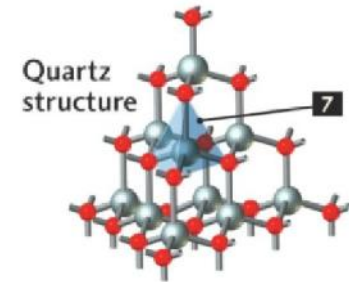
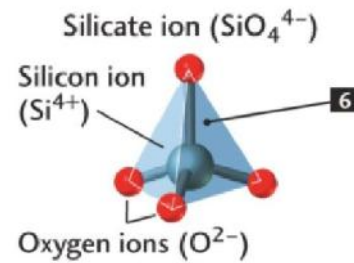


Common Rock-Forming Minerals

Rock-Forming Minerals

- ◆ Clay
- ◆ Quartz
- ◆ Calcite
- ◆ Olivine
- ◆ Dolomite
- ◆ Pyroxene
- ◆ Amphibole
- ◆ Biotite, Muscovite Micas
- ◆ Orthoclase, Plagioclase Feldspars

Although there are very many rock types, they are mainly built from one or more of 11 rock-forming minerals. Others are uncommon to rare.



Isolated tetrahedra



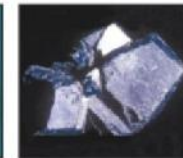
Olivine

Single chains



Pyroxene

Double chains



Amphibole

Sheet



Muscovite

Framework



Feldspar

Common Silicate Mineral Groups

1) Tetrasilicates

- ✓ Olivine and Quartz

2) Pyroxenes

- ✓ Augite most common

3) Amphiboles





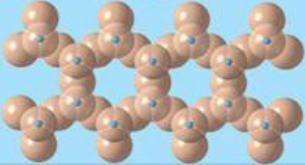

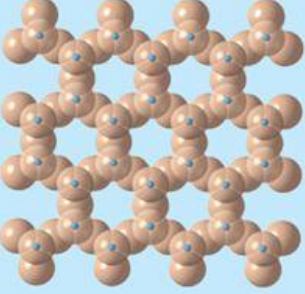






- ✓ Hornblende most common

4) Phyllosilicates

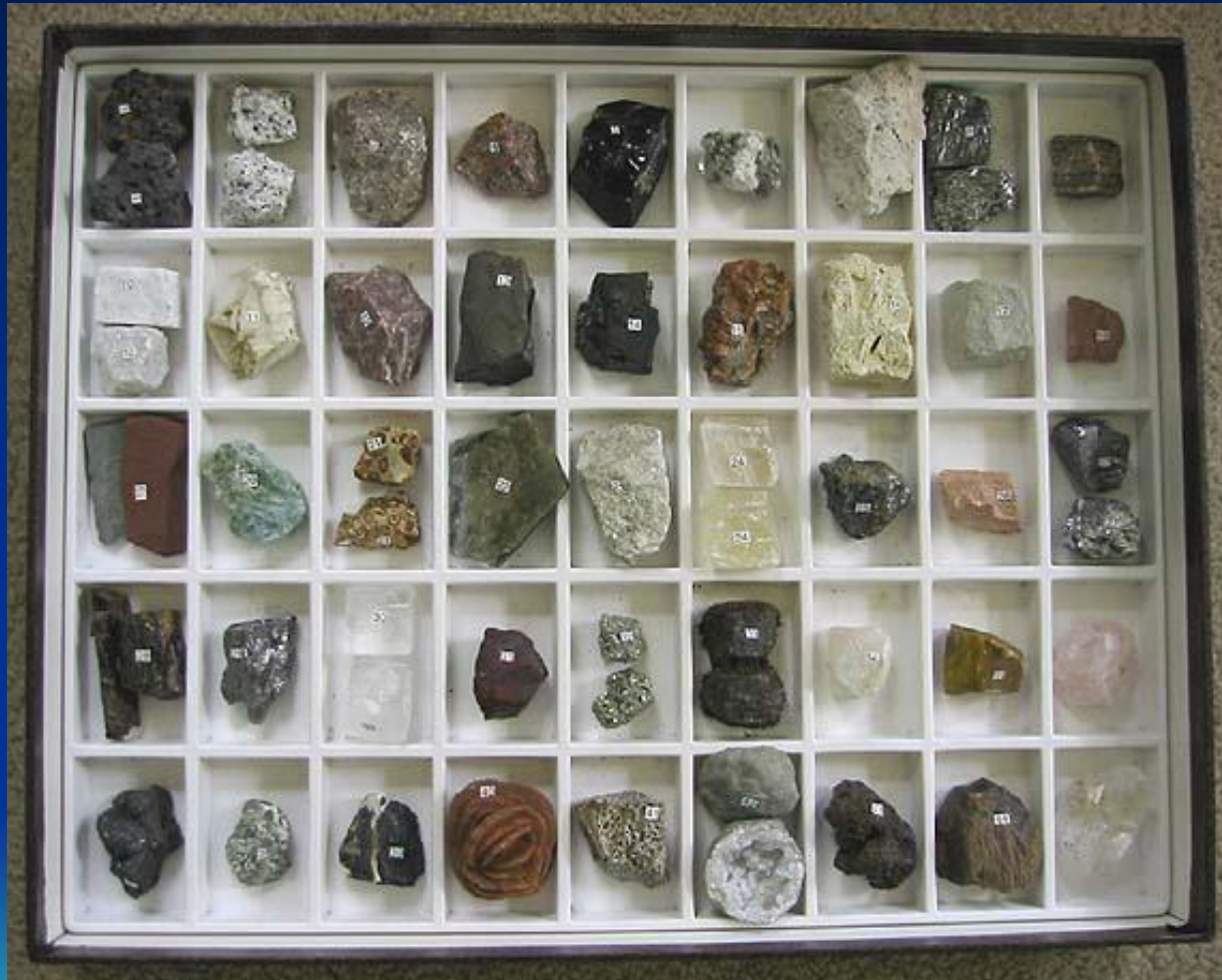
- ✓ Micas and Clays

5) Feldspars

- ✓ K-feldspar and Plagioclase

Mineral/Formula	Cleavage	Silicate Structure	Example
Olivine group (Mg, Fe) ₂ SiO ₄	None	Independent tetrahedron 	 Olivine
Pyroxene group (Augite) (Mg, Fe)SiO ₃	Two planes at right angles	Single chains 	 Augite
Amphibole group (Hornblende) Ca ₂ (Fe, Mg) ₅ Si ₈ O ₂₂ (OH) ₂	Two planes at 60° and 120°	Double chains 	 Hornblende
Micas	One plane	Sheets 	Biotite K(Mg, Fe) ₃ AlSi ₃ O ₁₀ (OH) ₂  Biotite
			Muscovite KAl ₂ (AlSi ₃ O ₁₀)(OH) ₂  Muscovite
Feldspars	Two planes at 90°	Three-dimensional networks 	Potassium feldspar (Orthoclase) KAlSi ₃ O ₈  Potassium feldspar
			Plagioclase feldspar (Ca, Na)AlSi ₃ O ₈  Quartz
Quartz SiO ₂	None		 Quartz

Mineral and Rock Reference Samples



Common Rock-Forming Minerals

- 1) Plagioclase
- 2) K-Feldspar
- 3) Quartz
- 4) Muscovite
- 5) Calcite
- 6) Gypsum
- 7) Halite
- 8) Biotite
- 9) Hornblende
- 10) Pyroxene
- 11) Olivine
- 12) Tourmaline
- 13) Garnet
- 14) Magnetite
- 15) Hematite
- 16) Kaolin



Important Mineral ID Properties

- 1) Luster
- 2) Streak
- 3) Color
- 4) Hardness
- 5) Cleavage
- 6) Other properties
 - Reaction to acid
 - Magnetic
 - Taste



Mineral Luster

Defined: The quality of reflected light emitted by a mineral crystal

Luster can be divided into two useful categories:

- Metallic and Nonmetallic

Nonmetallic lusters can be further subdivided into:

- Glassy, Pearly, Waxy, and Dull

Luster is useful for mineral ID



- <http://cmssc.minotstateu.edu/Labs/web%20minerals/minerals%20lab.html>

Mineral Streak

Defined: The color of the crushed powder of a mineral left on a porcelain plate

✓ **Only** for determining the **metallic** minerals

✓ Only works if mineral has lower hardness than the streak plate



Mineral Color

Defined: The hue and shade of the reflected light emitted by a mineral crystal

Mineral color can be divided into two useful shade categories:

- Dark-colored and Light-colored

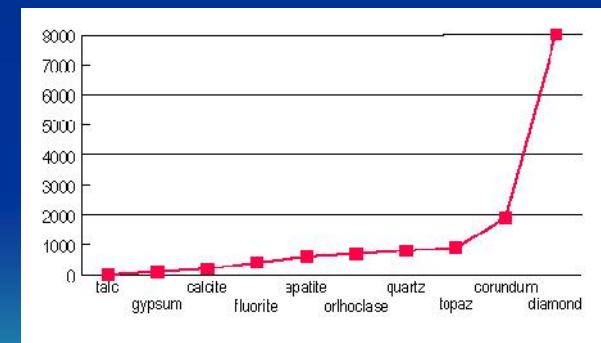
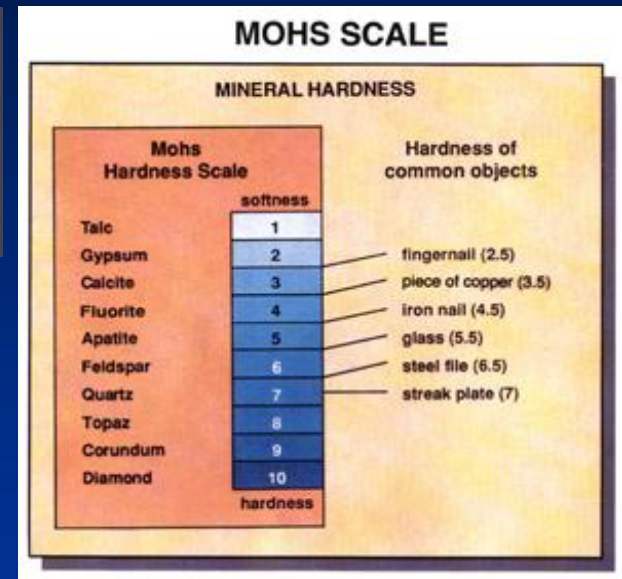
Color can also be divided into the hue categories:

- White, Gray, Black, Red, Orange, Yellow, Green, Blue, Purple, etc.
- Color is useful for mineral ID



Mineral Hardness

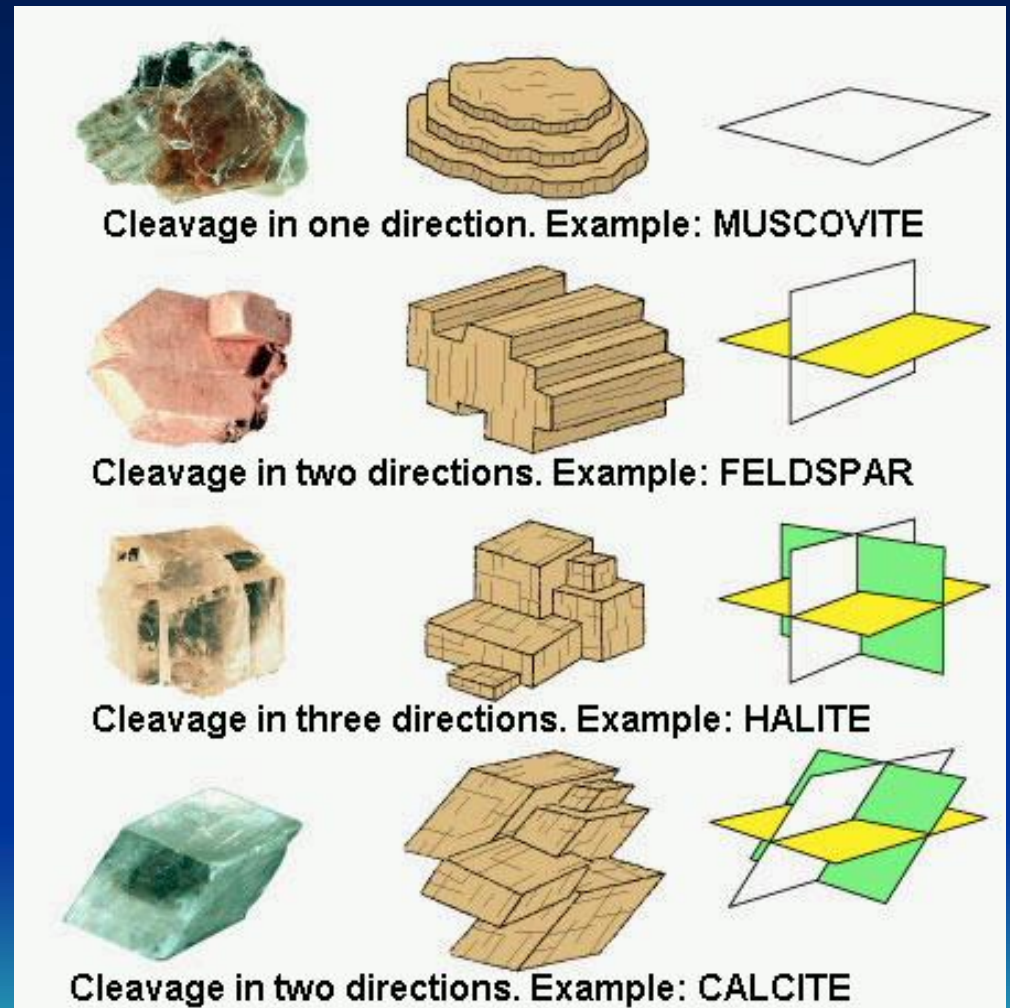
- ✓ Mohs Hardness Scale
- ✓ Identify Mineral by Testing for Hardness
- ✓ Doing the Scratch Test
- ✓ Other Testing Objects



Mineral Cleavage

Defined: Geometric planes of inherent weakness through a mineral crystal

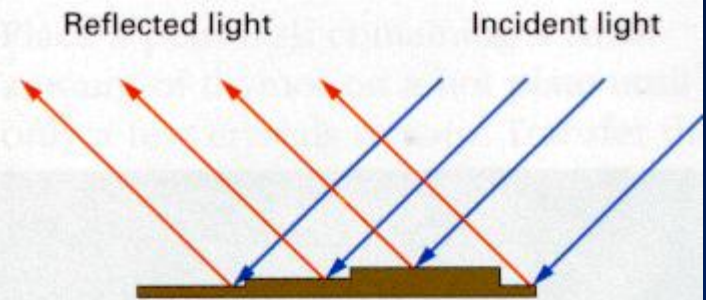
- ✓ Each mineral has a unique identifying cleavage property
- ✓ A mineral has either none, one, two, four, or six sets of cleavage
- ✓ Cleavage is observed as shiny parallel planes on the surfaces of a mineral crystal



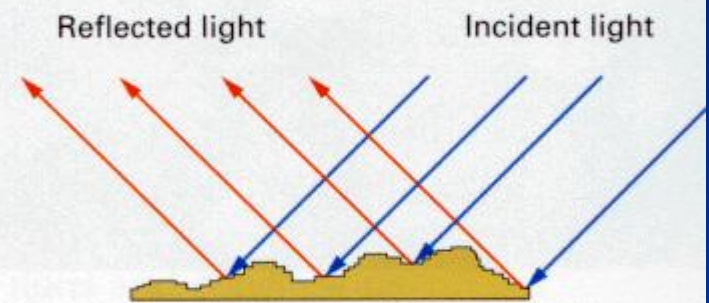
Mineral Cleavage Quality

Cleavage is observed as shiny parallel planes on the surfaces of a mineral crystal

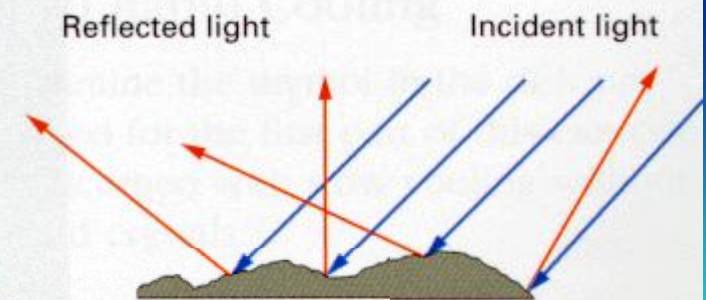
- ✓ **Quality:** Variation in degree of smoothness of cleavage surface.
- ✓ Each mineral has a unique cleavage quality
- ✓ A mineral has either excellent/perfect, good, poor, or none



A. Reflected Light from Smooth Cleavage Surface



B. Reflected Light from Stepped Cleavage Surfaces

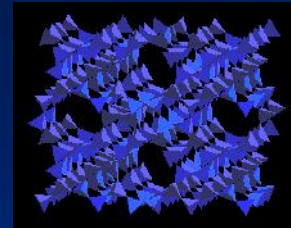
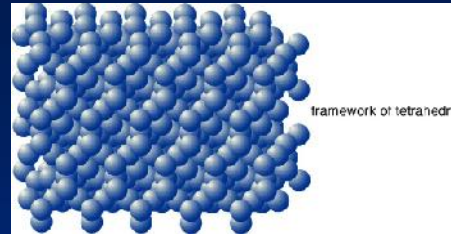


C. Reflected Light from Fracture

Determining Mineral Cleavage

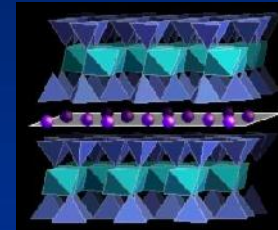
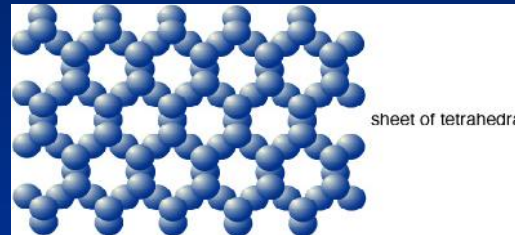
No Cleavage

Example =
Quartz



One Set of Cleavage

Example = Muscovite



Two Sets of Cleavage

✓ 90 degrees

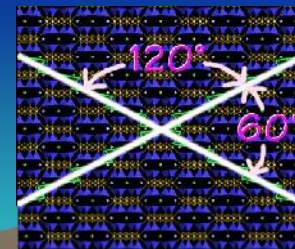
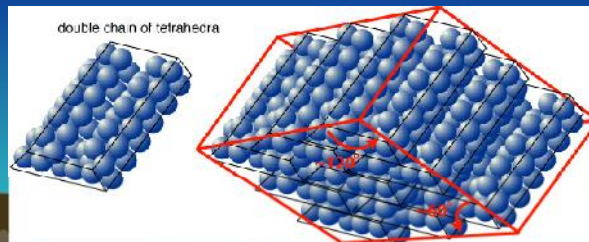
✓ Example = Augite



Two Sets of Cleavage

✓ 120 & 60 degrees

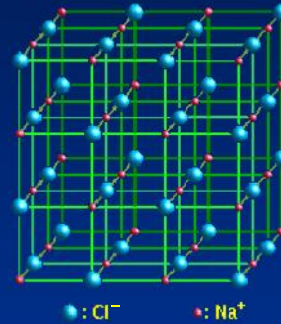
✓ Example =
Hornblende



Determining Mineral Cleavage

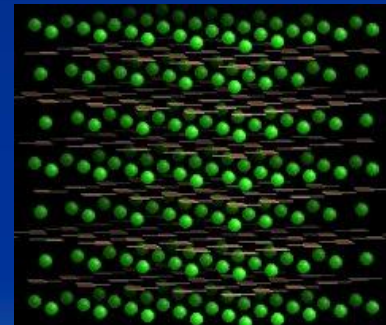
Three Sets of Cleavage

- ✓ 90 degrees
- ✓ Example = Halite



Three Sets of Cleavage

- ✓ 120 & 60 degrees
- ✓ Example = Calcite



Common Rock-Forming Minerals

- 1) Plagioclase
- 2) K-Feldspar
- 3) Quartz
- 4) Muscovite
- 5) Clay
- 6) Calcite
- 7) Gypsum
- 8) Halite
- 9) Biotite
- 10) Hornblende
- 11) Pyroxene
- 12) Olivine
- 13) Tourmaline
- 14) Garnet
- 15) Magnetite
- 16) Hematite



Distinguishing Between K-Feldspar and Plagioclase



Potassium Feldspar

- ✓ Salmon pink to cream colored
- ✓ Wavy “flame-like” streaks



Plagioclase Feldspar

- ✓ Dark grey to off-white colored
- ✓ Sets of thin, straight, groove-like striations on some cleavage faces

Mineral Identification Procedure

Step #1 Mineral Luster? – Metallic or Nonmetallic?

Metallic

Nonmetallic

Step #2 Mineral Hardness?

Step #2 Mineral Color? – Light or Dark

Step #3 Mineral Streak?

Step #3 Mineral Hardness?

Step #4 Other Properties?

Step #4 Mineral Cleavage?

Step #5 Mineral Name?

Step #5 Other Defining Properties?

Step #6 Mineral Name?



Unknown Minerals

- 1) Pyroxene
- 2) K-Feldspar
- 3) Garnet
- 4) Biotite
- 5) Gypsum
- 6) Olivine
- 7) Plagioclase
- 8) Hornblende
- 9) Muscovite
- 10) Magnetite
- 11) Calcite
- 12) Quartz
- 13) Tourmaline
- 14) Halite



Olivine



Ca-Plagioclase Feldspar



Halite



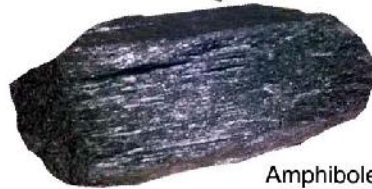
Pyroxene



Na-Plagioclase feldspar



Gypsum



Amphibole



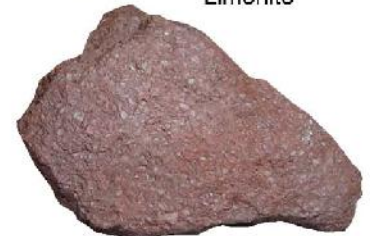
Orthoclase feldspar



Limonite



Biotite



Hematite



Muscovite



Quartz



Calcite

Next Weeks Lab Topic

Igneous Rocks

- Define
- Origin and Importance to Formation of Igneous Rocks
- Classification – Igneous Rock Groups
- Physical Properties
- Identification of Hand Specimens

Pre-lab Exercises

- Read Mineral and Igneous Chapter in Lab Book
- Complete the Pre-lab Worksheet Section

Mineral Web References



[Common Minerals in Igneous Rocks](#)

[Mineral Hardness Testing](#)

[Mineral Identification – Physical Properties](#)

[MINERAL PROPERTIES, USES, & IDENTIFICATION](#)

[Index of minerals in thin-section](#)

[WHAT IS CRYSTAL CLEAVAGE?](#)

[PHYSICAL CHARACTERISTICS OF MINERALS](#)

<http://www.cobweb.net/~bug2/mineral.htm>

http://www.rockhounds.com/rockshop/mineral_id/index.html

<http://www.union.edu/PUBLIC/GEODEPT/COURSES/geo-10/mineral.htm>

<http://academic.brooklyn.cuny.edu/geology/grocha/mineral/mineral.html>

<http://cmssc.minotstateu.edu/Labs/web%20minerals/minerals%20lab.html>