

ACTIVITY 2: CRYSTAL FORM AND HABIT: MEASURING CRYSTAL FACES

OBJECTIVE: To verify the relationship between interfacial angles and crystal form.

BACKGROUND INFORMATION: The repeated patterns of the atomic structure for any mineral are reflected by the consistency of certain features readily observed for that mineral. This similarity is exemplified by the constant angular relationship between similar sets of crystal faces on different specimens of any one mineral.

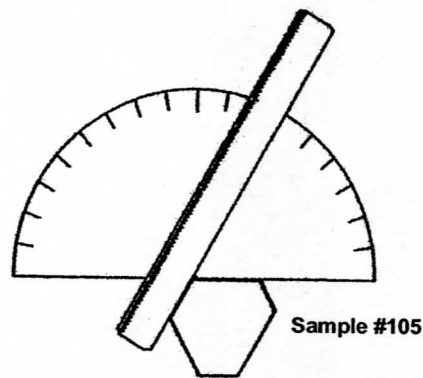
Sample #105 is a representative of the hexagonal crystal system and thus exhibits a six-faced prismatic form. Although the faces on the crystal are of different sizes and shapes, the angles between them are always exactly 120° . If you measure carefully, your readings should be accurate within ± 1 degree.

MATERIALS:

- 6" ruler & protractor
- Sample #105
- Sample #109

PROCEDURE:

1. Make a simple **goniometer**, the instrument used to measure the angle between crystal faces, by placing the ruler as shown over the protractor.
2. Place the crystal of Sample #105 as shown.
3. Read the angle on the protractor that corresponds to the angle between crystal faces.
4. Measure each angle consecutively, holding the crystal against the protractor as shown, and record these angles below (you should have six readings).



Angle #1 _____	Angle #3 _____	Angle #5 _____
Angle #2 _____	Angle #4 _____	Angle #6 _____

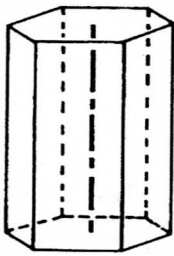
5. Compare and discuss your results with your classmates, and answer the **Assessment** questions that follow.

ACTIVITY 3: IDENTIFYING CRYSTAL SYSTEMS AND THEIR SYMMETRY

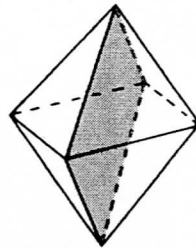
OBJECTIVE: To recognize symmetry in crystals and to identify crystals according to their crystal systems.

BACKGROUND INFORMATION: **Crystal symmetry** is the repetition of the arrangement of the faces on a crystal. The repetition may be relative to:

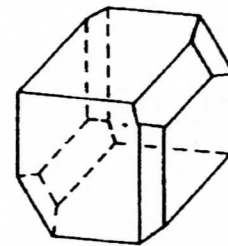
1. An imaginary line through the crystal, known as an **axis of symmetry**, so that as the crystal is rotated 360° around this axis, crystal faces are repeated one or more times.
2. An imaginary plane dividing the crystal into halves, known as a **plane of symmetry**, so that the two halves are mirror images of each other.
3. A symmetry that repeats faces on opposite sides of the crystal, at equal distances diagonally through the center, known as a **center of symmetry**.



Axis of Symmetry

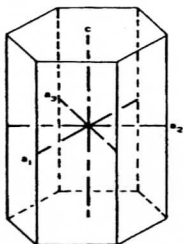
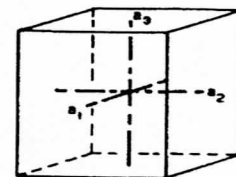


Plane of Symmetry



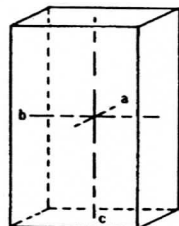
All minerals are classified in one of six **crystal systems** according to the relative lengths and orientations of their **crystallographic axes**. These axes are imaginary straight lines that pass through the center of the crystal and serve as a reference for describing crystal structure and symmetry. The six crystal systems and the nature of their crystallographic axes are as follows:

Isometric System (sometimes called the cubic system) – Three axes of equal length that intersect at right angles, commonly forming shapes such as a cube (6 faces), octahedron (8 faces), or dodecahedron (12 faces).



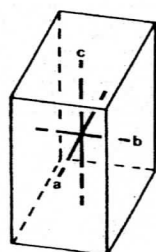
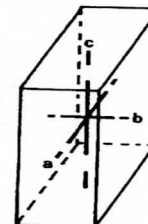
Hexagonal System – The only system with four axes, it has three axes of equal length intersecting at 60° angles. The fourth axis is either shorter or longer than the other three and perpendicular to them. Rhombohedrons and prisms (both with six faces) are typical forms.

Tetragonal System – Three axes that intersect at right angles. Two axes are of equal length and the third is either longer or shorter than the other two. A pattern of four faces and multiples of four are characteristic.



Orthorhombic System – Three axes of unequal length that intersect at right angles. Patterns of 2, 4, and 8 faces are characteristic of this system.

Monoclinic System – All three axes of unequal length. Two axes are perpendicular and the third is inclined to one of these two. Patterns of 2 and 4 faces are characteristic.



Triclinic System – All three axes of unequal length, none of which are mutually perpendicular. Crystals are characterized by shapes in sets of two faces each.

MATERIALS:

Minerals from Topic Set
Mineral Identification Chart from copymaster supplied

PROCEDURE: Carefully examine each of the mineral specimens in your set as follows:

1. Determine if the sample has an axis of symmetry; if it does not, determine whether it has a plane or center of symmetry.
2. Determine the relative lengths and orientations of the crystallographic axes and with this information, identify the crystal system.
3. Using the **Mineral Identification Chart**, identify each specimen by mineral name and complete the columns for **CRYSTAL SYSTEM** and **SAMPLE #**. (Note: Some specimens may be groups of crystals that contain more than one mineral. An example is specimen #104. A magnifier will be helpful in working with small crystals and small crystal faces.)
4. When you have completed the identification process, answer the **Assessment** questions that follow.

MINERAL IDENTIFICATION CHART

MINERAL NAME	CHEMICAL FORMULA	COLOR	STREAK	LUSTER	HARDNESS	SPECIFIC GRAVITY	CLEAVAGE OR FRACTURE	SPECIAL FEATURES	CRYSTAL SYSTEM	SAMPLE #
Amazonite (Microcline)	KAlSi_3O_8	Turquoise Blue	White	Vitreous	6.0-6.5	2.56	1 direction perfect; 1 direction good; uneven fracture	—		
Apophyllite	$\text{KCa}_4(\text{Si}_4\text{O}_{10})_2\text{F}\cdot 8(\text{H}_2\text{O})$	Varied	White	Vitreous, Pearly	4.5-5.0	2.37	1 direction good; 1 direction poor; uneven fracture	—		
Celestite	SrSO_4	Colorless or white	White	Vitreous, Pearly	3.0-3.5	3.98	1 direction perfect; 1 direction good; 1 direction poor	—		
Corundum	Al_2O_3	Varied	White	Vitreous	9	4.0	Basal parting	Hexagonal prisms		
Diopside	$\text{CaMg}(\text{Si}_2\text{O}_6)$	Gray to pale green or white	White	Vitreous to dull	5.5-6.5	3.2-3.4	1 direction	—		
Dolomite	$\text{CaMg}(\text{CO}_3)_2$	Colorless to white or pale pink	White	Vitreous to pearly	3.5-4	2.9-3	3 directions at 75° (rhombic)	Powder effervescent in HCl		
Fluorite	CaF_2	Varied	White	Vitreous	4	3.0-3.2	Uneven fracture	Fluorescent		
Garnet (group)	Variable silicates	Variable, commonly dark	White or pale shade	Vitreous to resinous	7-7.5	3.6-4.3	Uneven fracture;	Commonly in crystals		
Pyrite	FeS_2	Brass yellow	Black	Metallic	6-6.5	5-5.2	Uneven fracture	Cubic crystals; "fool's gold"		
Schorl	$\text{NaFe}^{2+}_3\text{Al}_6(\text{BO}_3)_3\text{Si}_6\text{O}_{18}(\text{OH})_4$	Black	Grayish-white	Vitreous to resinous	7	3.1-3.2	Irregular, sub-conchoidal fracture	—		
Staurolite	$(\text{Fe}^{+2}, \text{Mg}, \text{Zn})_2\text{Al}_9(\text{Si}, \text{Al})_4\text{O}_{22}(\text{OH})_2$	Brown	Gray	Vitreous	7	3.7-3.8	1 direction	Cross or x-shaped twins common		
Topaz	$\text{Al}_2\text{SiO}_4(\text{F}, \text{OH})_2$	Varied	White	Vitreous	8	3.4-3.6	1 direction	Some fluorescence		