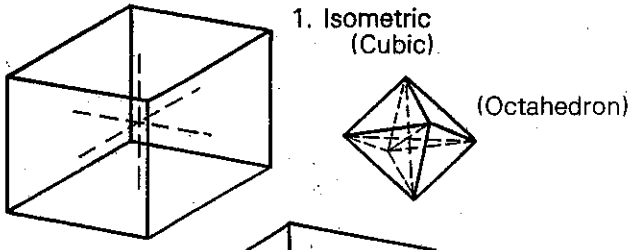
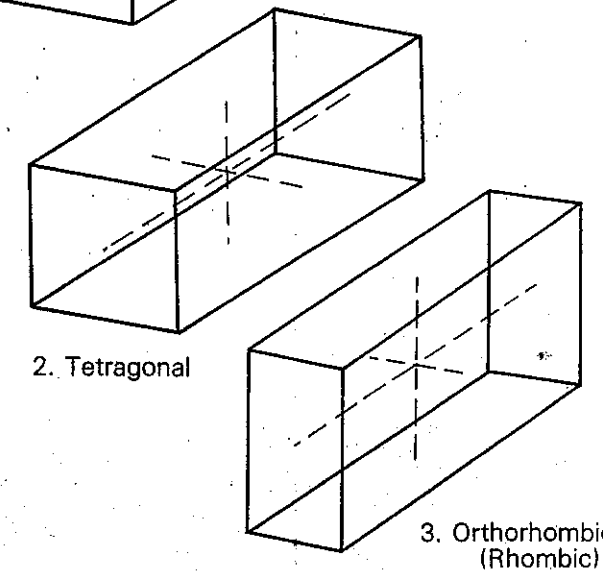


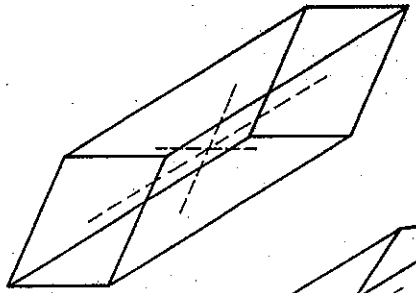
1. Isometric (Cubic)

(Octahedron)

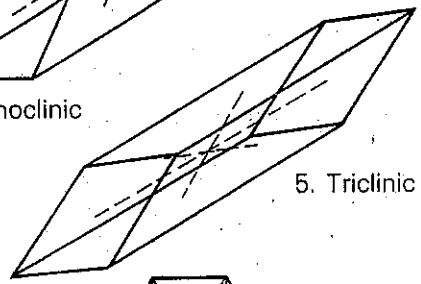


2. Tetragonal

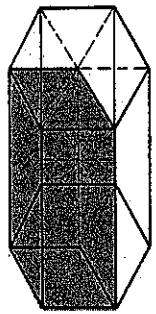
3. Orthorhombic (Rhombic)



4. Monoclinic



5. Triclinic



6. Hexagonal (Shaded area is a Rhombohedron)

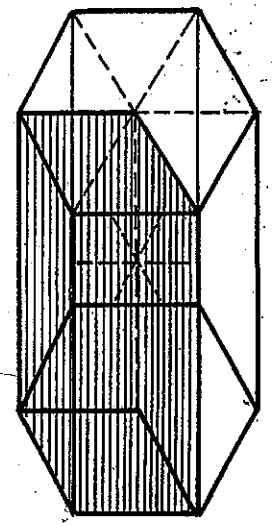
Six Basic Crystal Systems

Crystal System	Description	Examples
1. Isometric (Cubic) Includes octahedrons and dodecahedrons	Has 3 axes of equal length intersecting at right angles.	Gold, alkali halides, & many alums.
2. Tetragonal	Has 3 axes: 2 are of equal length, horizontal and perpendicular to each other with the third axis perpendicular to that plane & of a different length.	Urea, potassium phosphate monobasic, & tin (IV) oxide.
3. Orthorhombic (Rhombic)	Has 3 axes of unequal length intersecting at right angles.	Iodine, sulfur, topaz, potassium sodium tartrate, potassium chromate.
4. Monoclinic	Has 3 axes of unequal length, 2 of which are oblique with the third perpendicular to those.	Tartaric acid, many sugars, azurite, ferrous sulfate, & borax.
5. Triclinic	Has 3 axes of unequal length all having oblique intersections.	Boric acid, cupric sulfate, & potassium dichromate.
6. Hexagonal	Has 4 axes: 3 of equal length lying in same plane & intersecting at 60° with the fourth axis perpendicular to that plane & of a different length.	Calcite, beryl, graphite, sodium nitrate, & aluminum ammonium sulfate.

Bipyramids and various pinacoids are common to these systems.

Micro-crystal Study Kit

64540



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Contents

Item	Quantity	Description
1	1 bottle	Potassium chromate K_2CrO_4 solution
2	1 bottle	Sodium [illegible]
3	1 bottle	Cupric sulfate pentahydrate $CuSO_4 \cdot 5H_2O$ solution
4	1 bottle	Sodium [illegible]
5	1 bottle	Sodium acetate trihydrate CH_3COONa solution
6	1 bottle	Aluminum [illegible] $AlNH_4(SO_4)_2$ solution
7	1 bottle	Potassium phosphate monobasic KH_2PO_4 solution
8	144	Microscope [illegible]
9	100	Slide labels
10	30	Student [illegible]
11	1	Teacher's guide

Additional Materials Needed:

Stereo Microscope
Paper towels

Important Notice

Before beginning this [illegible] read [illegible] Material Safety Data Sheets and the safety information on the label of each of the chemicals. Follow the safety precautions noted.

Introduction

Crystals are solids having natural plane surfaces known as crystal faces. The external shape of the crystal depends upon the geometrical internal arrangement of its atoms and molecules. Through regular alignment of its faces, the basic crystal pattern is repeated extensively as it grows. The crystal pattern largely governs the intensive physical properties of the crystalline substance.

Using This Kit

This kit gives students the opportunity to observe the crystals of seven basic salts. Working in up to 15 teams of 2, each team will prepare a set of seven slides. The differences in crystalline geometry will become apparent as students compare the slides containing evaporated drops of each salt solution. Students will observe the crystals under a microscope and sketch their shapes on the student worksheets.

Six basic patterns of internal arrangement are commonly used to classify crystal structure. They are known as crystal systems and are defined in terms of crystal axes.

A chart of the six basic crystal systems is provided on the back of this guide and on the student worksheets for use when observing and comparing the crystals. The chart identifies the crystalline class for each salt and the teacher's guide includes a description and examples of each crystal structure. A Descriptive Chemistry for each of the seven salts in this kit is given below.

Suggested Time Schedule

DAY ONE: 15 minutes of class time.
DAY TWO: Full class period.

Preparation

Step 1. Before class, shake each dropper bottle well to ensure that all the salts are dissolved. The salt solutions must be at room temperature to work properly. Note: If the solutions were shipped during very cold weather, crystals may have formed in the bottom of the dropper bottles. These crystals can be dissolved by holding the bottle under hot running water for a few minutes. Shake the bottle occasionally until all the crystals are dissolved.

Step 2. Review the instructions on the student worksheet and set out the seven salt solutions, slides and labels at convenient work stations.

The student teams will prepare seven slides, each slide containing two samples of each salt solution. **One or two drops** per sample are ideal for viewing purposes.

Step 3. Make provision for students to store their slides in a lab drawer or undisturbed area overnight to complete the evaporation process.

Step 4. During the second lab period, students view the slides under a stereo microscope and sketch the crystal shapes using the chart provided.

Descriptive Chemistry of Salts Used

1. K_2CrO_4 – Potassium Chromate

Bright yellow, orthorhombic crystals; density 2.73 g/cm³; m.p. 968.3°C; solubility 62.9 g/100 ml cold water, 79.2 g/100 ml hot water.

Used in analytical chemistry as a precipitant for lead salts; also, used in a small degree in the production of enamels, finishing leather, and rustproofing metals.

2. $NaNO_3$ – Sodium Nitrate (Chile Saltpeter)

Colorless or white, hexagonal crystals; density 2.26 g/cm³; m.p. 306.8°C; solubility 92.1 g/100 ml cold water, 180 g/100 ml hot water.

Used primarily in the manufacture of nitric acid and some other chemicals; also, used in matches, to improve the burning properties of tobacco, for pickling meats, and as a fertilizer.

3. $CuSO_4 \cdot 5H_2O$ – Cupric Sulfate Pentahydrate (Copper (II) Sulfate Pentahydrate, Blue Vitriol, Chalcanthite)

Deep blue, triclinic crystals; density 2.28 g/cm³; m.p. 110°C (– 4 H_2O); solubility 31.6 g/100 ml cold water, 203.3 g/100 ml hot water.

Has many industrial applications. Used in swimming pools (20-30 ppm) to destroy algae, in agriculture as a herbicide and fungicide, as a mordant in textile dyeing, as a battery electrolyte, as a flotation agent, as an antirust component in radiator and heating systems, in preparing Fehling's and Benedict's testing solutions for sugars, in paint pigment, in reagent toner for photography, and in manufacturing many other copper salts.

4. NaCl – Sodium Chloride (Common Salt, Halite)

Colorless to white, isometric crystals; density 2.17 g/cm³; m.p. 801°C; solubility 35.7 g/100 ml cold water, 39.1 g/100 ml hot water. Found worldwide - obtained from mining and from evaporating sea water.

Commercial salt generally has some calcium and magnesium chlorides which absorb moisture and make it cake. Salt is a necessary nutrient. Solutions of NaCl more nearly resemble the body fluid composition than any other single salt. More than 90% of the cations in extracellular fluid is sodium, and more than 60% of the anions is chloride. A 0.9% solution has about the same osmotic pressure as body fluids and can be safely administered by injection. Thus, isotonic saline can be used to restore body fluids and also serve as a vehicle for administering medicine.

NaCl is used as a source for chlorine and its compounds, as a source for sodium and its compounds, and as a food preservative; also, used in production of soaps and dyes as a salting-out agent, in freezing mixtures, in glazing pottery, in curing hides, and in metallurgy.

5. $CH_3COONa \cdot 3H_2O$ – Sodium Acetate Trihydrate

Colorless, monoclinic crystals or crystalline powder; density 1.45 g/cm³; m.p. 58°C; solubility 76.2 g/100 ml cold water, 138.8 g/100 ml hot water. Effloresces in dry air.

Used in photography, as a buffer reagent in chemistry, as an acidulant in food, and in foot/hand warmers and other such devices.

6. $AlNH_4(SO_4)_2 \cdot 12H_2O$ – Aluminum Ammonium Sulfate (Ammonium Alum, Purified Alum, Alumen)

Colorless, cubic crystals; density 1.65 g/cm³; m.p. 94.5°C; solubility 15 g/100 ml in cold water, 200 g/100 ml in hot water.

Used as a styptic or astringent, in the purification of water, in baking powders, in leather tanning, in the manufacture of glues, and as a mordant in dyeing textiles and other such processes.

7. KH_2PO_4 – Potassium Phosphate Monobasic (Potassium Dihydrogen Phosphate)

Colorless to white, tetragonal crystals; density 2.34 g/cm³; m.p. 252.6°C; solubility 33 g/100 ml cold water, 83.5 g/100 ml hot water.

Used as a buffering agent in pH regulation.