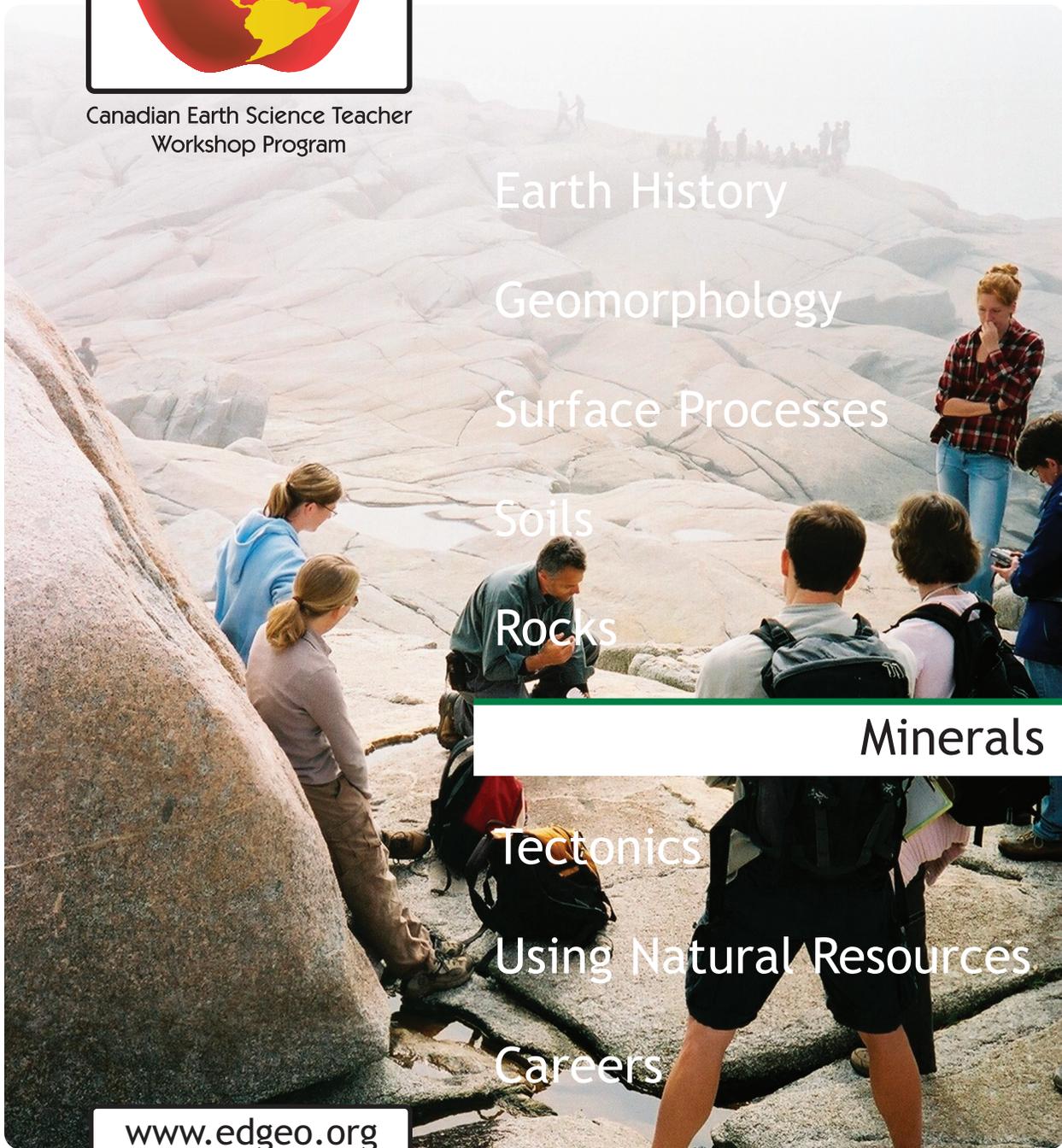




Canadian Earth Science Teacher
Workshop Program

Bringing Earth Science to Life



Earth History

Geomorphology

Surface Processes

Soils

Rocks

Minerals

Tectonics

Using Natural Resources

Careers

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Looking at Minerals

Students observe a variety of minerals then sort them based on their physical properties, using a self-determined classification scheme.

Explanation

Minerals are naturally occurring, non-living substances found in the Earth. There are over 2000 different minerals, but only a few are commonly found in the Earth's crust. Earth scientists use observable physical properties to sort the minerals into groups.

Materials

Variety of minerals, for example: graphite, halite, biotite, muscovite, calcite, galena, fluorite, magnetite, orthoclase, pyrite, quartz, amethyst, hematite, gypsum, talc.
Paper
Marker

Cautions

Use only the senses of touch, smell and sight. Never taste the mineral samples.
Wash hands after handling mineral specimens.

Time

Medium

Grouping

Individual, pairs

Preparation

Collect a variety of mineral specimens, enough for a set of 5 to 10 different minerals for each group. If the students are also to complete the "Testing Minerals" activity, use the same samples that they will be asked in that activity to identify by name.

Number the mineral specimens for easy reference by painting on each a spot of gesso (acrylic canvas preparer, available from craft stores), white acrylic paint, or correction fluid. When thoroughly dry, write the identifying number for the mineral on the spot using a fine-tip permanent marker.



Looking at Minerals

Prompt

Ask students what classification is? How are things in their lives classified? Examples might be the classes in their school, sports teams or types of vehicles.

Delivery

1. Distribute one set of minerals, paper and marker to each team of students.
2. Have students carefully examine the minerals and decide how to sort them into groups using physical characteristics that they observe. They must be able to explain their reasoning. Tell them that the groups of minerals do not have to be the same numbers of specimens.
3. Ask students to place the minerals into groups on their sheet of paper and label each group title, e.g. shiny, large, or small, etc.
4. Have 2 or 3 groups of students share their classification methods. Look for simple (e.g. colour) and innovative approaches, as well as any common approaches that the students have come up with.
5. Challenge the students to sort their specimens in different ways, and to record each new classification scheme on their paper.
6. Make a class list of the different physical properties used for classification.

Question for Discussion

Why is classification important?

Extension

Introduce the physical properties used by Earth scientists to classify minerals: lustre, streak, hardness and crystal shape. Challenge students to use these properties to sort their samples. The “Testing Minerals” activity has reference cards for lustre, hardness and crystal shape.



The Button Game

Students create a classification key to sort a selection of similar objects.

Explanation

Scientists use **classification keys** to identify unknown specimens based on observations of known examples. This method is applied in Earth science to fossils, rocks and minerals.

Materials

5 to 10 similar objects, e.g. buttons, coins, pens, candies
Paper
Markers

Cautions

None

Time

Short

Grouping

Individual, pairs

Preparation

Collect sets of objects for the students to classify using observable physical characteristics. For best results, the objects should be similar, with none of them identical, e.g. button characteristics may be large, small, metallic, plastic, round, square, smooth or rough.

Delivery

1. Give each team of students one set of objects, paper and markers.
2. Have them put the title of their type of object at the top of the paper, e.g. "buttons"
3. Divide the objects into two groups based on the characteristics, e.g. metal, plastic. The characteristic groups do not have to include the same number of objects. Under the title, record the names of the two groups.
4. Choose one of the two groups, and divide it into two new groups, again based on the characteristics, e.g. round,



The Button Game

square. Under the group name, record the names of the two new groups.

5. Continue dividing each group into two new ones, recording the names, until there is only one object in each group.

Questions for Discussion

Were there any objects that you could not identify?

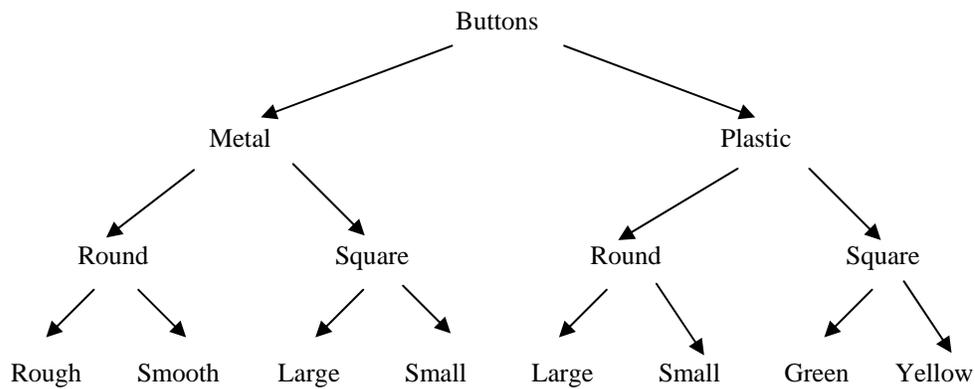
If we added other objects, how would you have to change the chart?

Extension

Have students make up classification keys for countries, cartoon characters, food groups, animals, etc.

Resources

Sample Classification Key for Buttons



Testing Minerals

Students make observations of the physical properties of selected minerals and use a classification key to identify each mineral.

Explanation

Minerals are naturally occurring, non-living substances found in the Earth. There are over 2000 different minerals but only a few are commonly found in the Earth's crust. Each mineral has a unique chemical composition that determines its overall appearance. Earth scientists use a number of physical characteristic properties (e.g. lustre, hardness, crystal shape) to identify minerals.

Materials

Variety of minerals, for example: graphite, halite, biotite, muscovite, calcite, galena, fluorite, magnetite, orthoclase, pyrite, quartz, amethyst, hematite, gypsum, talc
Lustre samples: costume jewellery gem and pearl, candle, clay shard, soap, coin
Hardness testing kit: penny, iron nail, glass marble, steel file
Streak plates
Magnet
Hardness Chart*
Hardness Test*
Lustre Chart*
Mineral Observation Worksheet*
Mineral Characteristics page*
* see Resources

Cautions

Use only the senses of touch, smell, and sight. Never taste the samples.

Wash hands after handling mineral specimens.

Time

Long

Grouping

Individual, pairs



Testing Minerals

Preparation

Number the mineral specimens for easy reference by painting on each a spot of gesso (acrylic canvas preparer, available from craft stores), white acrylic paint, or correction fluid. When thoroughly dry, write the identifying number for the mineral on the spot using a fine-tip permanent marker.

Prompt

Optional: Have students carry out the “Button Game” activity to devise a diagnostic classification key before working with minerals.

Delivery

1. Distribute a set of minerals to each group.
2. Provide sequenced instruction in the correct method of applying the diagnostic tests as follows. Have the students practise these tests and share their observations while you monitor their methods.
 - a. **Hardness:** Use your fingernail to scratch a mineral. Press firmly and try to make a 5 mm scratch. If no scratch is made, try with a copper penny. Refer to the Hardness Chart and Hardness Test pages for the sequence of objects to use. Always start with the softest (your fingernail).
 - b. **Streak:** Press the mineral against the streak plate. Applying firm pressure use the mineral to draw a line across the plate. The colour of the powder on the plate is the mineral’s **streak**.
 - c. **Lustre:** Use the Lustre Chart for the terms and sample materials of how a mineral’s appearance is described.
 - d. **Crystal shape:** Describe the geometric shape of visible crystals. Minerals with no visible crystal shapes are described as **massive**.
3. When the students are confident in applying the tests, direct them to investigate all of their specimens, recording the specimen number and properties on their Mineral Identification Worksheet.
4. Distribute the Mineral Characteristics reference page and challenge students to name their specimens based on their observations. Emphasize that this method of diagnostic testing is how Earth scientists identify minerals.

Note: Certain minerals, most notably calcite, will react chemically with an acid. This reaction is called **effervescence** and is characterized by the creation of bubbles or fizzing. An



Testing Minerals

“acid test” is carried out with dilute muriatic acid or strong vinegar. In elementary classes the teacher should demonstrate this test because of the safety hazards of handling acids. Wash the specimens with water after applying the acid. Most minerals can be identified without an acid test.

Question for Discussion

Which properties are more useful for identification?

Extensions

Provide posters and reference materials illustrating the wide range of minerals, their physical properties and appearance.

Have the students research the many different forms of quartz, all of which share the same chemistry and diagnostic properties, but can vary widely in colour.

Resources

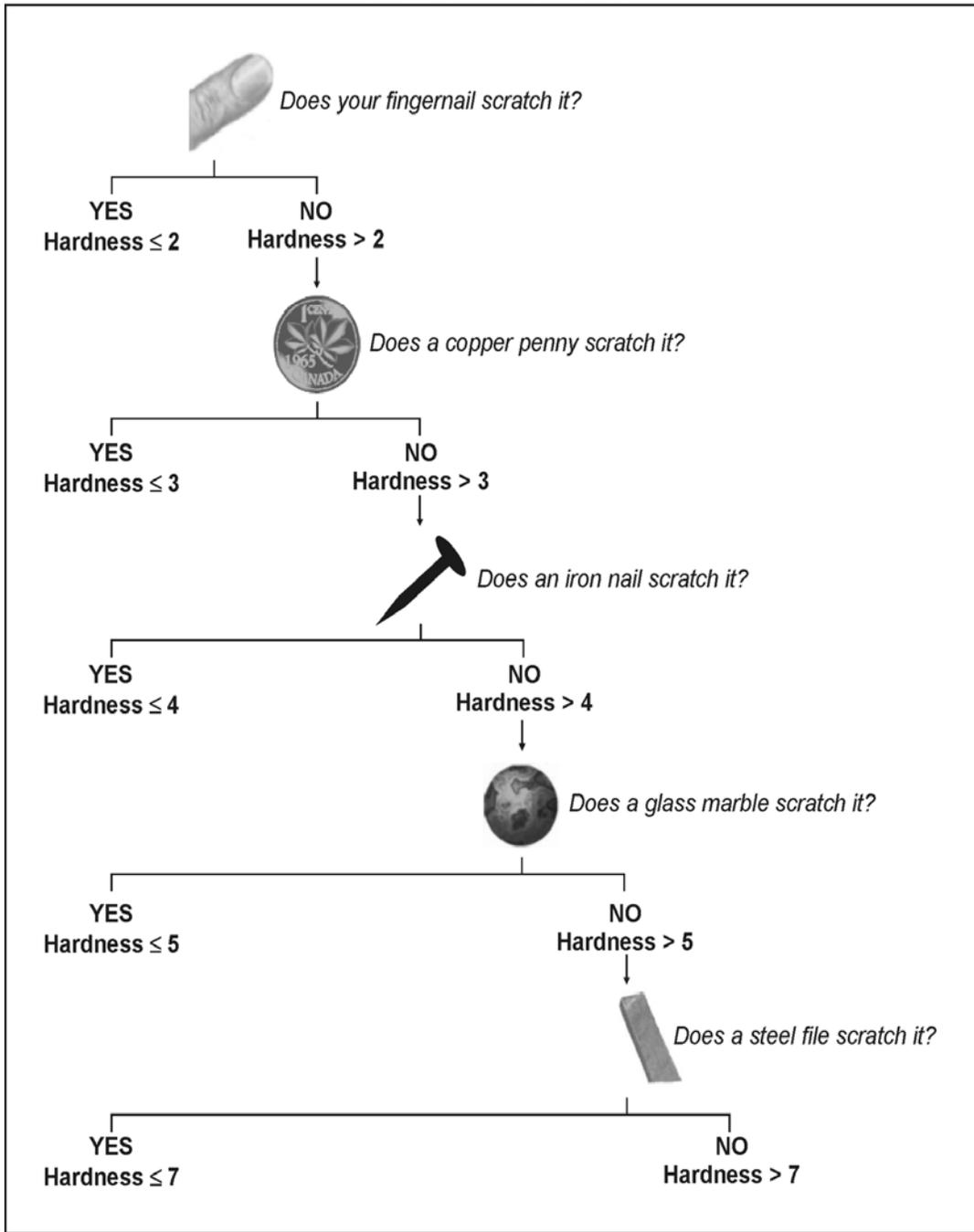
HARDNESS CHART

HARDNESS	MINERAL	TEST MATERIAL
1	Talc	Soft pencil lead
2	Gypsum	Fingernail (2.5)
3	Calcite	Penny (3.5)
4	Fluorite	Iron nail (4.5)
5	Apatite	Glass (5.5)
6	Feldspar	Steel nail
7	Quartz	Steel file
8	Topaz	Sandpaper
9	Corundum	no common equivalent
10	Diamond	no common equivalent



Testing Minerals

HARDNESS TEST

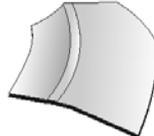


\leq means less than or equal to
 $>$ means greater than



Testing Minerals

LUSTRE CHART

METALLIC LUSTRE			
			
NON-METALLIC LUSTRE			
	Gem, costume jewellery	Glassy	
	Soap	Greasy	
	Pearl, costume jewellery	Pearly	
	Candle	Waxy	
	Clay pot piece	Earthy	

IDENTIFYING MINERALS



Testing Minerals

Mineral Characteristics

Mineral	Lustre	Hardness	Crystal Shape	Streak	Colour	Other characteristics
Graphite	Metallic greasy	1.5	Massive	Black/grey	Black/silver	Very lightweight, marks paper
Halite	Glassy	2	Cubes	White	Colourless	Very lightweight, salty
Biotite	Glassy, pearly	2.5	Sheets	White	Black/brown	Flexible cleavage planes
Muscovite	Glassy, pearly	2.5	Sheets	White	White/yellow/gold	Flexible cleavage planes
Calcite	Glassy to dull	3	Rhombohedra	White	Colourless to dark grey	Reacts with acid, may be iridescent
Galena	Metallic	3	Cubes	Grey	Grey, bluish tint	Very heavy
Fluorite	Glassy	4	Cubes, octahedrons	White	Purple, blue, yellow	May be iridescent or fluorescent
Magnetite	Dull metallic	5.5	Massive	Black	Black	Magnetic
Orthoclase (feldspar)	Glassy, dull	6	Blocky, nearly square	White	Orange to white	
Pyrite	Metallic	6.5	Cubes	Green-black	Brassy yellow	Striations are common
Quartz	Glassy	7	Hexagonal prisms	White	Very variable: white, pink, purple, black	
Hematite	Metallic, dull	6 - 6.5	Rhombohedra	Reddish brown	Grey, black, brown	
Gypsum	Glassy, pearly	2	Long, blocky	White	Colourless, white, grey	Can show good cleavage, may look powdery
Talc	Pearly, greasy	1	Sheets	White	White to green	Very soft



Building Crystals

Students assemble three-dimensional card models of crystal forms from geometric nets.

Explanation

Many minerals have distinctive and beautiful crystal forms. These are visible as flat, clean surfaces on a mineral specimen. The shapes are related to how the atoms arrange themselves inside the crystals. The crystals can be described by their geometric appearance, e.g. cubes, pyramids, hexagonal prisms, etc.

At a more advanced level, crystals are identified according to their internal symmetry. There are seven systems for crystal symmetry but only four are commonly found. These are: cubic (–e.g. galena, pyrite), hexagonal (–e.g. quartz), tetragonal (–e.g. zircon), and rhombic (–e.g. calcite).

Materials

Geometric nets for each crystal shape (see Resources)
Scissors
Glue
Card

Cautions

Normal classroom procedures for using scissors and glue

Time

Long

Grouping

Individual, pairs

Preparation

Collect paper, scissors and glue, and reproduce crystal nets. The nets can be enlarged for easier construction.

Prompt

Show specimens or photos of complex crystal structures, and observe the range of shapes.

Delivery

Direct students to:



Building Crystals

1. Glue the crystal net onto card.
2. Cut out along the solid lines.
3. Score and crease along the dotted lines.
4. Fold in and glue the tabs to produce three-dimensional crystal models.

Question for Discussion

Are all the crystals in one mineral the same? Why might they appear to be different shapes?

Extensions

Have students match their models to mineral specimens.

Integrate discussion of crystal geometric forms, symmetry and properties into mathematics.

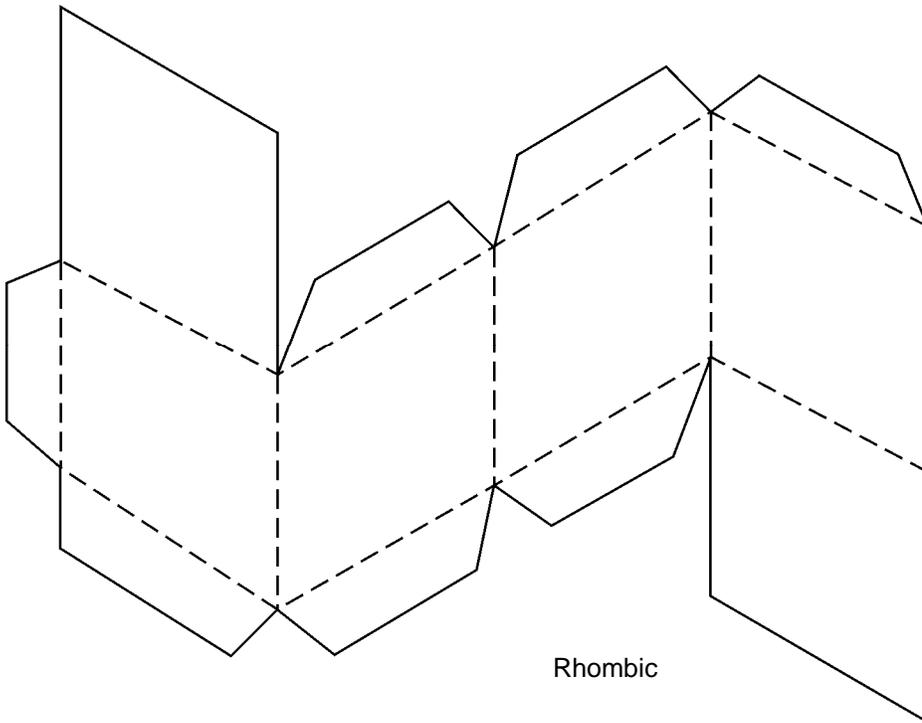
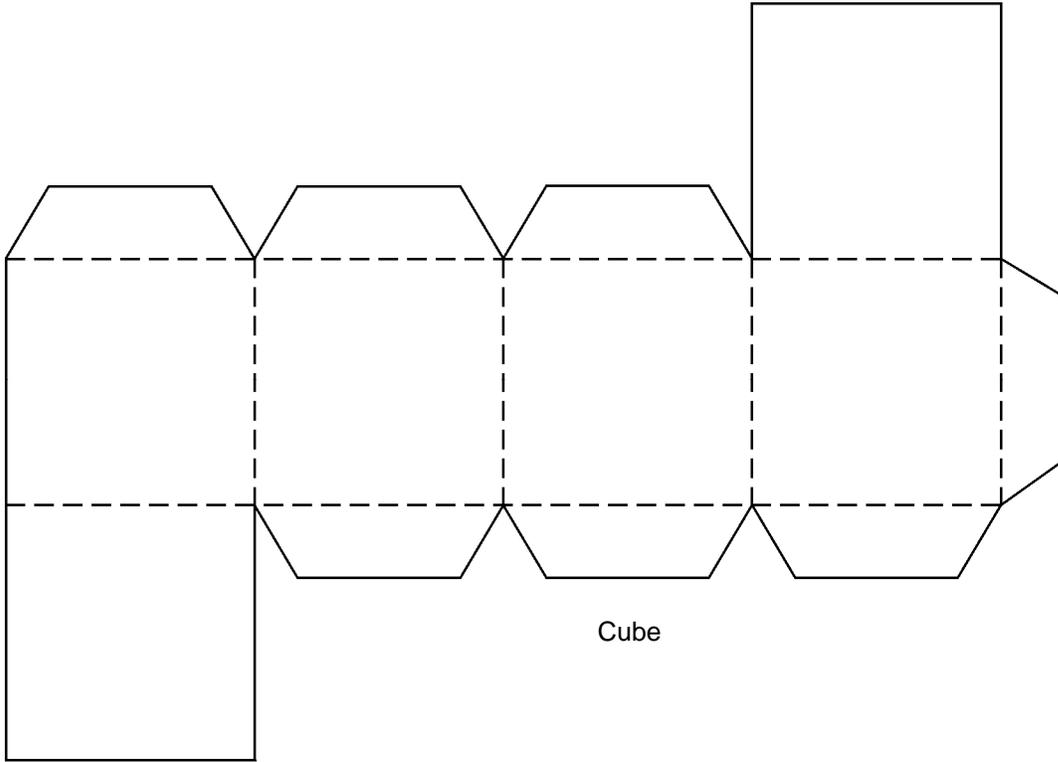
Use coloured paper, multiple crystals and other craft materials to have students create dramatic mobiles, crystal clusters or geodes that integrate into creative visual arts.



Building Crystals

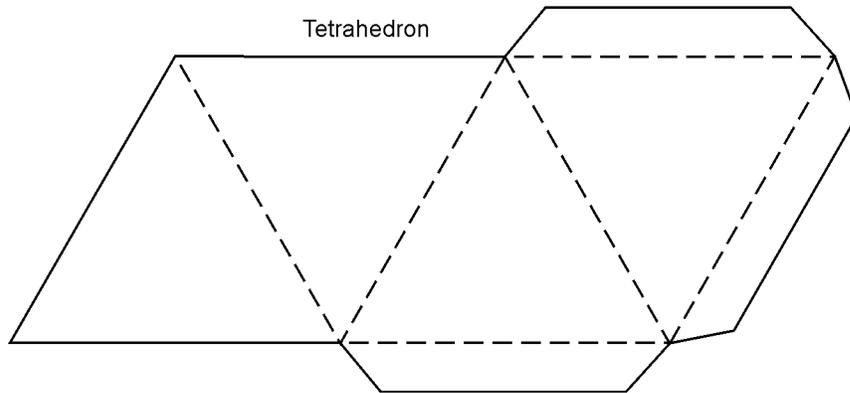
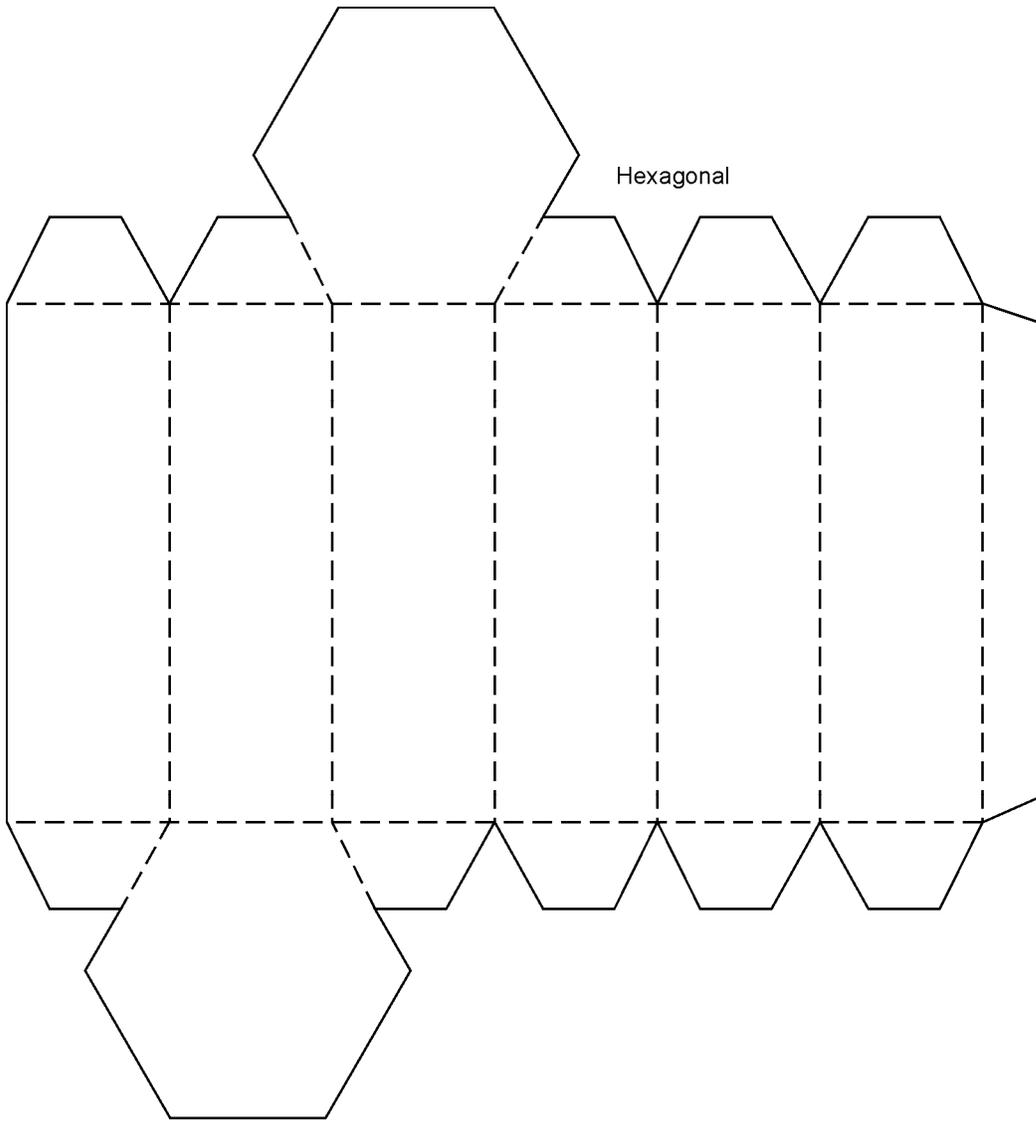
Resources

CRYSTALS

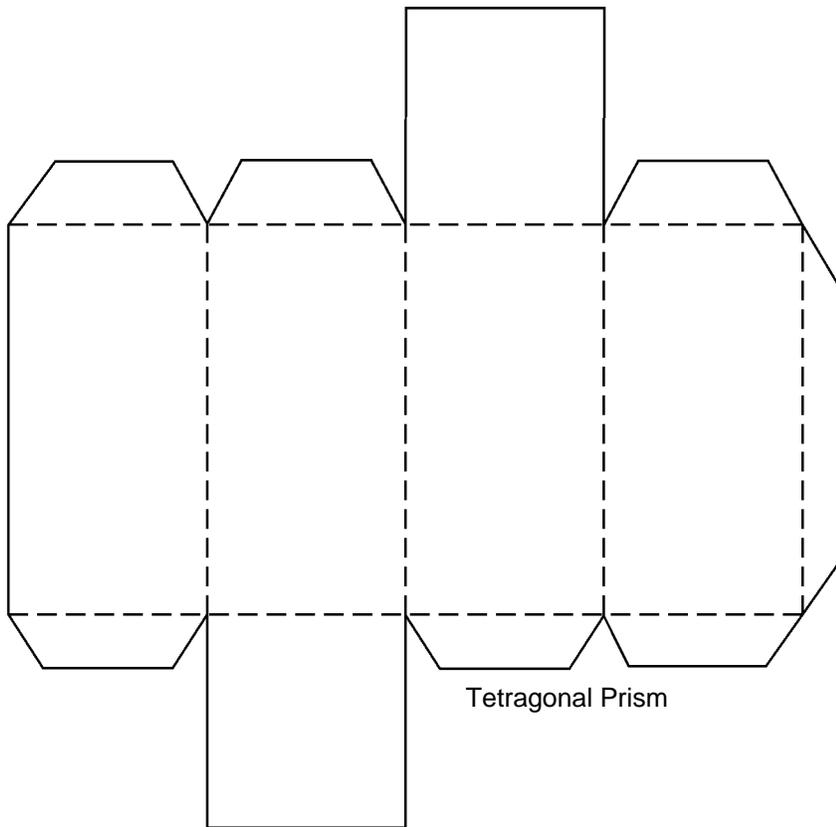
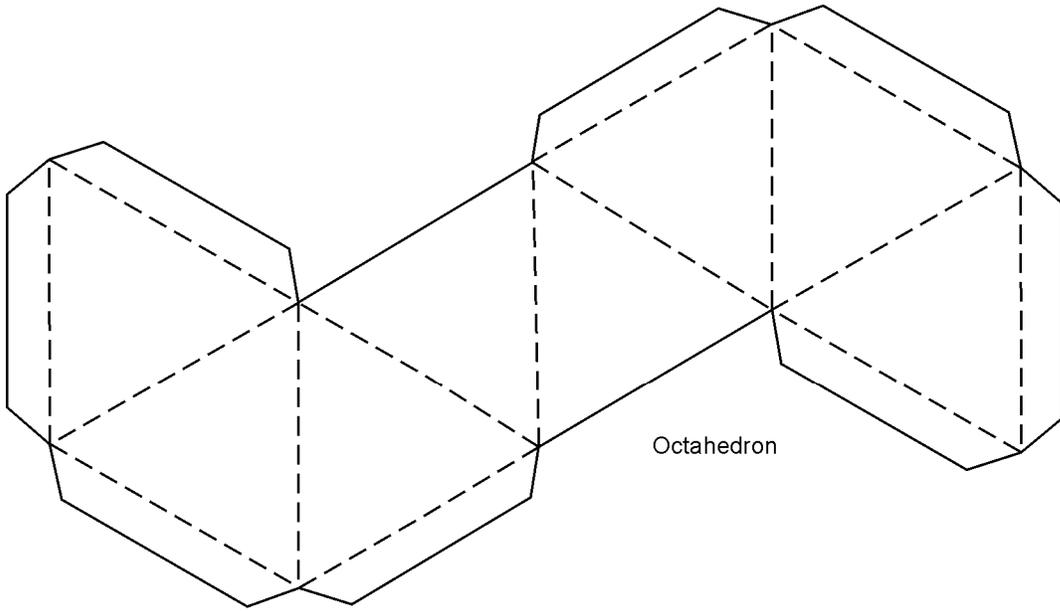


Building Crystals

CRYSTALS



Building Crystals



Growing Crystals

Students create saturated solutions and observe crystal growth.

Explanation

Many minerals have distinctive and beautiful crystal forms. These are visible as flat, clean surfaces on a mineral specimen.

Materials

See individual methods.

Cautions

Chemicals should not be tasted.
Use protective gloves when handling boiling water.
Wash hands after this activity.

Time

Long (multiple days for observations)

Grouping

Individual, pairs

Preparation

A selection of methods is provided for growing crystals. Choose the one most appropriate for your classroom and gather the necessary materials.

Methods 3-5 will result in beautiful crystals, or in the case of the rock candy, a most desirable effect, but they need materials that are more difficult to access materials, involve more complicated procedures, or require more time. Method 6 is an extension that may be applied to any of the other methods and it will produce larger crystals.

Prompt

Show specimens or photos of complex crystal structures. Ask students to describe how they think these crystals were formed.



Growing Crystals

Method 1: Sugar, Alum or Epsom Salts

This is the easiest, quickest and most successful method. The crystals form within a day or two and are large compared to those produced by some other methods, allowing students to easily study and compare them using a hand lens.

Materials:

Kettle for hot water
Disposable plastic saucers
Sugar, alum and/or Epsom salts, about 125 ml
1-litre shatterproof, heat-resistant container, e.g. laboratory beaker
2 spoons (25 ml)
Hand lens

Procedure:

Prepare saucers for students by putting their names on them with permanent marker. Write “alum,” “salt” and/or “Epsom salts” on saucer: if you use all three, students can observe different crystal shapes.

1. Put 500 ml boiling water into the beaker.
2. Add one spoonful of dry material to the water and stir with other spoon until completely dissolved. It is important to keep one spoon dry for measuring out the materials.
3. Continue adding and dissolving one spoonful at a time until you notice that a few, tiny grains remain on the bottom of the beaker that won't dissolve. You have now made a saturated solution.
4. Pour enough of the saturated solution into the bottom of the saucer to cover it to a depth of approximately 3-5 mm. Set aside. If using all three materials, repeat steps for each of the remaining two.
5. Check each day for crystal growth. You will see them change daily. Students can make measurements and record this progress.

Method 2: Crystal Rock Garden

This is similar to the previous method where crystals are grown in saucers. The crystals are the same, but this one allows student to see how crystals grow in nature.

Materials:

For alum garden: 250 ml boiling water to 60 ml alum
For salt garden: 180 ml boiling water to 125 ml salt



Growing Crystals

For Epsom salts: 125 ml water to 250 ml Epsom salts
Kettle for boiling water
2 spoons
2-litre pop bottle, cut off 15 cm up from the bottom
Collection of small rocks that will fit on bottom of pop bottle
Optional: green florist's clay will hold rocks firmly to the bottom of bottle
Optional: Use a geode as a good example from nature of what the students are creating.

Procedure:

1. Prepare rock garden by placing rocks in bottom of cut-off pop bottle.
2. Prepare crystal solution by boiling water, and then add dry material to it. Stir until as much of the powder has dissolved as possible.
3. Pour liquid solution over rocks in pop bottle.
4. Set aside and get ready to make observations. Within a few hours, crystals will start to form. After a few days, there will be a beautiful "garden" to look at. Geodes and many other rock crystals are formed this way when water, saturated with minerals, seeps into spaces in rocks. When the liquid evaporates, the crystals are left behind.

Method 3: Bluing Garden

Materials:

Dry sponge
Aluminum pie plate
Glass measuring cup
Mixing bowl, metal spoon
60 ml table salt, 60 ml water
60 ml laundry bluing (Mrs. Stewart's - available in laundry section)
30 ml household ammonia
Food colouring - the more colours, the better

Procedure:

1. Place sponge in pie plate.
2. Pour salt, water, bluing and ammonia into bowl and stir.
3. Pour over sponge, making sure to include any solid particles.
4. Sprinkle food colour randomly over sponge.
5. Set aside where it will not be disturbed for a few days. Observe crystals with hand lens. These beautifully coloured crystals are very delicate and will disintegrate if touched.



Growing Crystals

Method 4: Charcoal Garden

Materials:

Several pieces of charcoal (briquettes or aquarium filter material)
Aluminum pie plate
Glass measuring cup and spoon
250 ml boiling water, 100 to 200 ml salt
60 ml vinegar
Food colouring - variety of colours

Procedure:

1. Scatter charcoal onto bottom of pie plate.
2. Fill measuring cup with 250 ml boiling water.
3. Stir salt into water until no more dissolves (saturated solution).
4. Add 60 ml vinegar to salt solution.
5. Pour over charcoal. The top of the charcoal should be above the liquid level. Put several drops of food colouring over the charcoal.
6. Place the container where it will not be disturbed for a few weeks. Observe crystals with hand lens. These crystals are very fragile and will break if container is handled roughly.

Method 5: Rock Candy

Materials:

500 ml sugar
250 ml water
Optional: food colouring
Hot plate
Tall narrow jar
String
Paper clip
Pencil

Procedure:

1. Add sugar to water. Optional: Add food colour to produce coloured rock candy.
2. Bring to a boil, stirring constantly until all the sugar has dissolved. Take off the heat immediately.
3. Stir and allow to cool.
4. Pour into tall narrow jar.
5. Tie the paper clip to one end of the string and a pencil to the other end. Place the pencil across the top of the jar, with string and paper clip dangling down into the



Growing Crystals

solution. Do not allow the paper clip to touch the bottom. Within a day, students will observe sugar crystals forming along the string. These will continue to grow for the next week.

Method 6: Using a Seed Crystal

Crystals will grow larger from any solution if a seed crystal is used. For any of the above recipes, use this method:

1. Prepare the saturated solution in a jar, and cover with a cloth to prevent dust from entering.
2. Allow the solution to cool overnight. Crystals should form on the bottom of the jar. Pour the solution from above the crystals into a second jar. Take one of the nicest crystals, tie it to a piece of thread, and suspend it in the solution of the second jar. Allow it to stand as the crystals grow.

For the largest and best formed crystals, use any or all of these suggestions:

- Use filtered or distilled water
- Rotate the seed crystal for even growth
- Superglue the thread to the seed crystal
- Suspend the seed crystal on one side of jar, and on the opposite side place undissolved solute. Gently heat the solute, which creates a plume of supersaturated solution that will condense on the seed.

Question for Discussion

How do these classroom crystals relate to what happens when minerals are formed in nature?

