

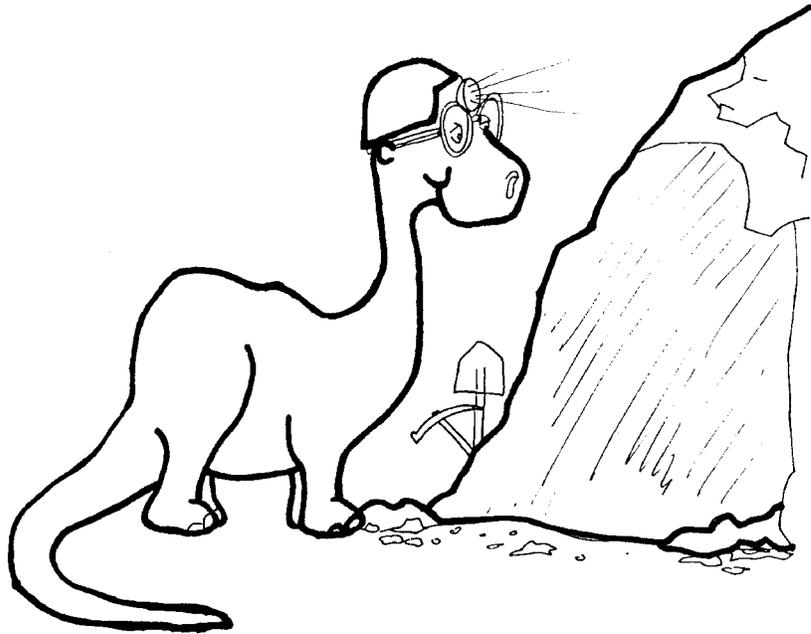


# Rock Cycle

Understanding the Earth's Crust



## THIRD GRADE MINERALS



2 WEEKS  
LESSON PLANS AND  
ACTIVITIES

## ROCK CYCLE OVERVIEW OF THIRD GRADE

### CHEMISTRY

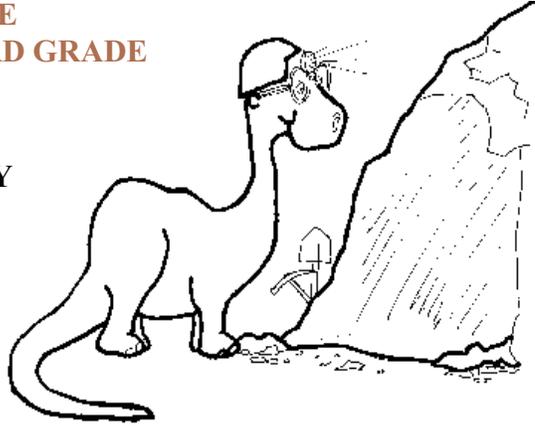
#### WEEK 1.

PRE: *Comparing elements of the periodic table.*

LAB: *Discovering properties of compounds.*

POST: *Exploring why elements combine.*

### MINERALS



#### WEEK 2.

PRE: *Exploring the shapes of gems.*

LAB: *Comparing mineral shapes.*

POST: *Distinguishing the geometric shapes of minerals.*

#### WEEK 3.

PRE: *Distinguishing between crystalline and amorphous substances.*

LAB: *Discovering that all minerals are not crystalline.*

POST: *Exploring crystals.*

### ROCKS

#### WEEK 4.

PRE: *Exploring the etymology of sedimentary, igneous, and metamorphic rocks.*

LAB: *Contrasting different types of rocks.*

POST: *Writing a creative essay on rocks.*

#### WEEK 5.

PRE: *Exploring agents of erosion.*

LAB: *Analyzing different types of sands.*

POST: *Comparing sand formed by wind and water.*

### PAST LIFE

#### WEEK 6.

PRE: *Comparing different modes of fossilization.*

LAB: *Discovering information derived from organisms.*

POST: *Observing fossil and living organisms.*

## ROCK CYCLE - MINERALS (3A)

### PRE LAB

Students compare elements with compounds.

### OBJECTIVES:

1. Comparing two and three dimensional shapes
2. Exploring the shapes of gems.

### VOCABULARY:

cube  
parallelogram  
prism  
rhombohedron  
square  
triangle



cut amethyst



citrine



diamond

### MATERIALS:

paper  
pencil  
Gem Display Kit  
Gemstone placemats  
Swift GH microscopes (optional)

### BACKGROUND:

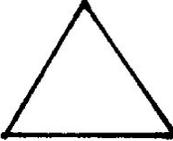
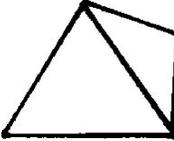
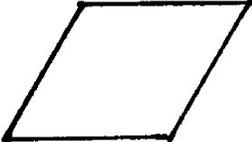
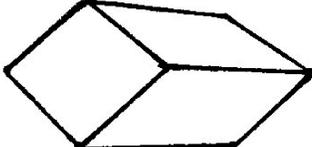
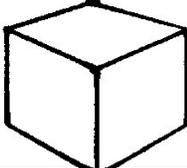
Gems are attractive substances that people find valuable. Many minerals are gems, such as diamonds, but not all gems are minerals; amber is an example. Gems are “cut” into many different geometric shapes. In this exercise, students will begin to look at geometric shapes, and will also learn the differences between a gem and a mineral.

The world is three dimensional, but children usually draw only in two dimensions. In this exercise students also will learn the fundamentals of drawing basic three-dimensional shapes.

### PROCEDURE:

1. Students must know the key components of mineral shapes to be able to distinguish and draw them. The chart below shows three basic geometric shapes that are common in minerals. Draw and label each two dimensional shape on the board, along with its three-dimensional equivalent. Demonstrate how to draw each object one at a time. Allow the students to draw along with you. Drawing intermediate forms will help you

instruct the students on how to draw the shapes. Shading also helps students see the shapes as three-dimensional.

2 dimensional	3 dimensional
TRIANGLE 	PRISM 
PARALLELOGRAM 	RHOMBOHEDRON 
SQUARE 	CUBE 

2. After the students have practiced making the three-dimensional shapes, hand out the gemstone placemats. The section "TYPES OF GEM CUTS" shows side-view pictures of the gems that are illustrated on the placemats. This may be difficult for third graders to visualize. The gem kit contains several examples of these gems; let the students handle the gems; this will help them make the connection. Impress on them that the shapes are cut and faceted by skilled craftsmen.

3. If you have a Swift GH microscope you may want to show the gems under higher magnification to the students.

4. Remember that not all gems are minerals. The lower right hand corner on the Gem Placemat shows "ORGANIC GEMS," that are not minerals. The remaining gems on the placemat are minerals or mineraloids (opal). Students love to look and touch the gems. Be sure to remind the students to look for the shapes that they drew during the lab.

# ROCK CYCLE - MINERALS (3A) PRE LAB

Write the name of the shape and draw it.

**2-dimensional**

**3-dimensional**

Name _____	Name _____
Name _____	Name _____
Name _____	Name _____

## ROCK CYCLE - MINERALS (3A)

### LAB

Students determine shapes of minerals.

### OBJECTIVES:

1. Analyzing characteristic shapes of minerals.
2. Comparing mineral shapes.

### VOCABULARY:

cubic  
dipyramid  
prism  
rhombohedron  
tabular



amethyst

### MATERIALS:

workbook  
ROCK CYCLE - MINERALS (3A)

### BACKGROUND:

Minerals are pure substances composed of one or more elements. Internally, a mineral has a repeating atomic structure or crystalline pattern. This structure is similar to the mathematical term "tessellation" which refers to polygons that repeat themselves in a pattern. The visible crystal shape of a mineral is due to this repeating atomic pattern. If space is available, a mineral will grow in its characteristic crystalline shape. If a growing crystal is constrained, it will take on the shape of the space.

Some minerals break in a characteristic pattern, called "cleavage," which is also caused by alignments in the mineral's atomic structure. Gemologists sometimes use cleavage patterns to cut gems into faceted shapes.

It is sometimes difficult to tell whether a specimen is a crystal or a broken mineral. This lab will allow students to touch and see different mineral shapes, and to determine if they are complete crystals or broken pieces.

### PROCEDURE:

1. Make ten stations, one for each mineral. If you have your own specimens, feel free to create additional stations.
2. Review the shapes of a cube, dipyramid, tabular, rhombohedron, and six sided

prism. Print the name of the 3 dimensional shape next to the drawing. Have the students draw the shapes on their worksheets. Explain that some of the specimens are complete crystals, which may match the shapes they have drawn, while others may only show fragments of the shapes.

3. Have the students rotate to the different stations to complete the assignment. When they are done, discuss the characteristics of the each of the specimens, as listed below. Be sure to go over the shapes.

**QUARTZ** - found in quartz watches, one of the most common minerals, crystals form 6 sided prisms

**FLUORITE** - a source of fluorine, dipyramid (octahedron) or cubic (depending on specimen) crystal shape

**PYRITE** - often called fools' gold, used to make sulfuric acid, cubic crystal shape

**HALITE** - common table salt, cubic crystal shape

**AMETHYST** - purple-colored quartz, prismatic crystal shape

**CALCITE** - commonly called iceland spar, can see double image, rhombohedral crystal shape

**FELDSPAR** - used in making some ceramics, rhombohedral crystal shape

**GALENA** - ore of lead, cubic crystal shape

**GYPSUM** - rosette or tabular crystal shapes

**CITRINE** - yellow- to brown-colored quartz, prismatic crystal shape

## ROCK CYCLE - MINERALS (3A) LAB

**PROBLEM:** How many shapes can minerals take?

**PREDICTION:** \_\_\_\_\_

**MATERIALS:** specimens of quartz, amethyst, pyrite, calcite, halite, fluorite, feldspar, galena, gypsum, and citrine

**PROCEDURE:** At each station, match the labeled minerals with the shapes below. Write the names of the minerals next to the correct shapes.

	SHAPE	NAME OF MINERAL
CUBIC		
DIPYRAMID (OCTAHEDRON)		
TABULAR		
RHOMBOHEDRON		
SIX SIDED PRISM		

**CONCLUSION:** Are the shapes of minerals easy to describe? Explain your answer.

\_\_\_\_\_

## ROCK CYCLE - MINERALS (3A)

### POST LAB

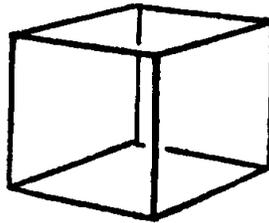
Students compare the shapes of minerals with geometric figures.

### OBJECTIVES:

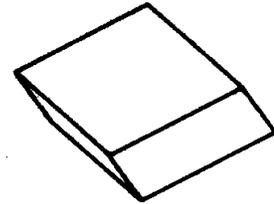
1. Distinguishing the geometric shapes of minerals.
2. Comparing Platonic and Archimedean solids.

### VOCABULARY:

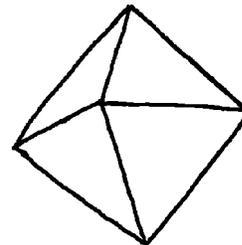
cube  
dipyramid  
dodecahedron  
hextetrahedron  
parallelogram  
prism



cube



rhombohedron



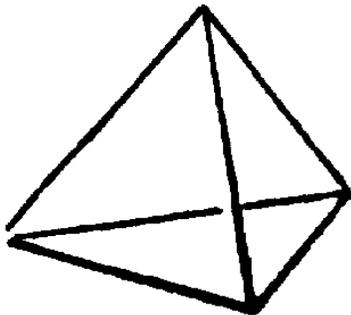
dipyramid

### MATERIALS:

Googolplex

### BACKGROUND:

Geometric shapes help describe minerals. A platonic solid is composed of a single repeated polygon. The five platonic solids are the tetrahedron (4 triangles), cube (6 squares), icosahedron (20 triangles), octahedron (8 triangles) and dodecahedron (12 pentagons). The Archimedean solids are composed of combinations of polygons and named after the Greek philosopher Archimedes.



pyramid

The Greek philosopher Plato, who was born around 430 B.C., wrote about these five solids in a work called *Timaeus*. Historical accounts vary a little, but it is usually agreed that the solids themselves were discovered by the early Pythagoreans, perhaps by 450 B.C.

There is evidence that the Egyptians knew about at least three of the solids; their work influenced the Pythagoreans. In any case, Plato mentioned these solids in his writings. He identified them with the elements then commonly believed to make up all matter in the universe; fire, air, water, earth, and the cosmos (the universe itself). Plato identified fire atoms with the tetrahedron, earth atoms with the cube, air atoms with the octahedron, water atoms with the icosahedron, and the cosmos atoms with the dodecahedron.

## **PROCEDURE:**

1. Have the students make their own geometric forms using Geogolplex. Use the workbooks to direct their work. You may wish to have the students work in groups.

2. You may want the students to determine the geometries of the mineral specimens that they used in the lab. The following key lists the geometric shapes of the lab specimens, along those of some other common minerals .

**QUARTZ, AMETHYST, CITRINE** (prism with six sides)

**CALCITE, FELDSPAR, GYPSUM** (3d parallelogram or rhombohedron)

**HALITE, PYRITE, GALENA**, (cube)

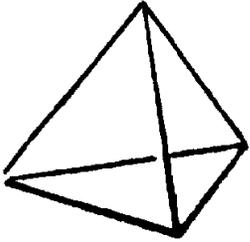
**GARNET** (dodecahedron (12 sides))

**DIAMOND** (hexatetrahedron or dipyramid (8 sides))

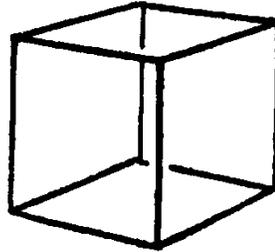
**FLUORITE** (isohedron)

**ROCK CYCLE - MINERALS (3A) POST LAB**

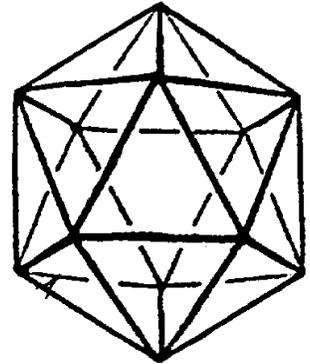
**PLATONIC SOLIDS**



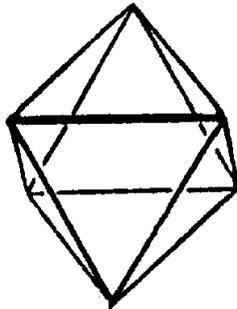
**TETRAHEDRON  
4 TRIANGLES**



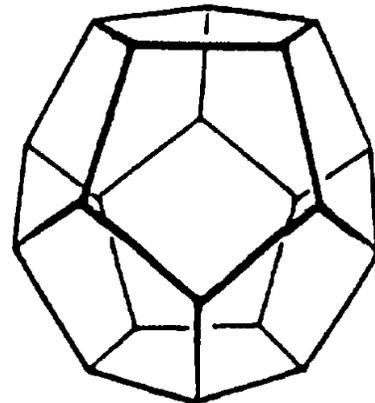
**CUBE  
6 SQUARE**



**ICOSAHEDRON  
20 TRIANGLES**

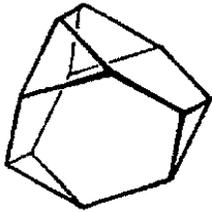


**OCTAHEDRON  
8 TRIANGLES**



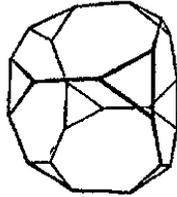
**DODECAHEDRON  
12 PENTAGONS**

## ARCHIMEDEAN SOLIDS



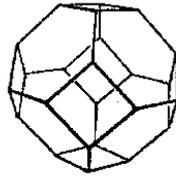
4 HEXAGONS  
4 TRIANGLES

**TRUNCATED  
TETRAHEDRON**



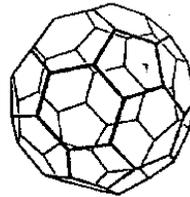
6 OCTAGONS  
8 TRIANGLES

**TRUNCATED  
CUBE**



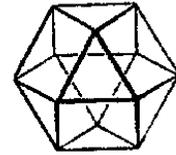
8 HEXAGONS  
6 SQUARES

**TRUNCATED  
OCTAHEDRON**



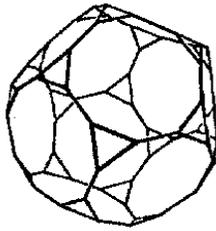
20 HEXAGONS  
12 PENTAGONS

**TRUNCATED  
ICOSAHEDRON**



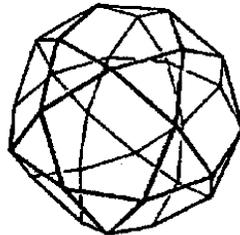
6 SQUARES  
8 TRIANGLES

**CUBOCTAHEDRON**



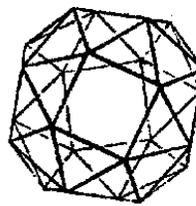
12 DECAGONS  
20 TRIANGLES

**TRUNCATED  
DODECAHEDRON**



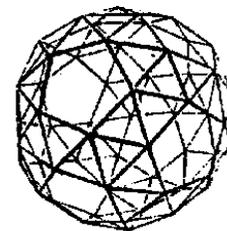
20 TRIANGLES  
12 PENTAGONS

**ICOSIDODECAHEDRON**



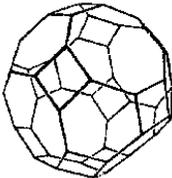
6 SQUARES  
32 TRIANGLES

**SNUB  
CUBOCTAHEDRON**



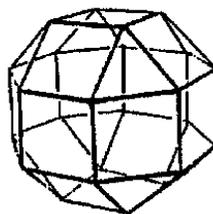
80 TRIANGLES  
12 PENTAGONS

**SNUB  
ICOSIDODECAHEDRON**



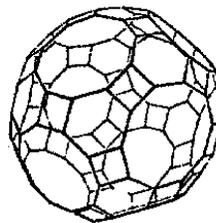
6 OCTAGONS  
8 HEXAGONS  
12 SQUARES

**TRUNCATED  
CUBOCTAHEDRON**



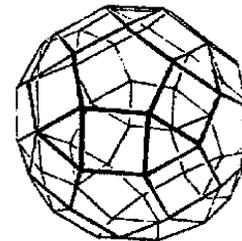
18 SQUARES  
8 TRIANGLES

**RHOMBICUBOCTAHEDRON**



12 DECAGONS  
20 HEXAGONS  
30 SQUARES

**TRUNCATED  
RHOMBICOSIDODECAHEDRON**



20 TRIANGLES  
12 PENTAGONS  
30 SQUARES

**ICOSIDODECAHEDRON**

## ROCK CYCLE - MINERALS (3B)

### PRE LAB

Students create patterns using Altair designs.

### OBJECTIVES:

1. Distinguishing between crystalline and amorphous substances.
2. Recognizing crystalline substances.

### VOCABULARY:

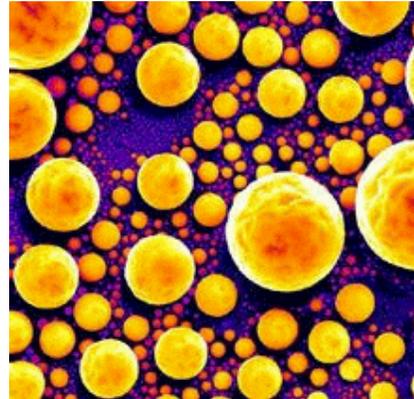
amorphous  
crystalline

### MATERIALS:

worksheet

### BACKGROUND:

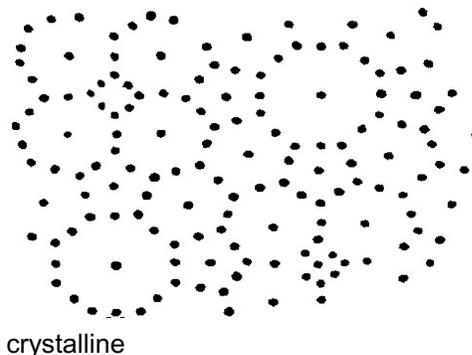
The atoms in crystalline solid matter are arranged in regular, repeating patterns. All other types of solid matter are amorphous or without a regular atomic arrangement. Metals and minerals are crystalline. Glass is amorphous. Depending upon its composition, the crystalline pattern of a mineral may not be visible in a hand sample. In this case minerals are studied using X-ray diffraction, a technique that uses the reflection of X-rays to determine crystal structure and composition.

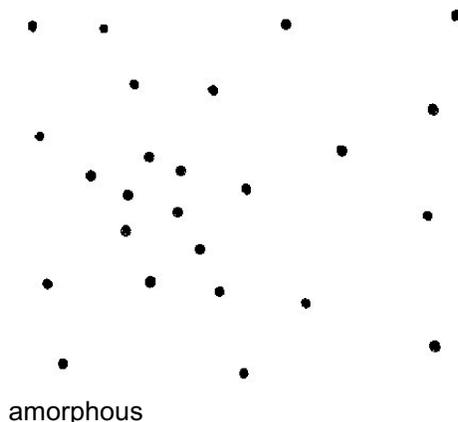


Electron level picture of tin

### PROCEDURE:

1. Draw the following diagram on the board to illustrate crystalline versus a non-crystalline (amorphous) patterns.

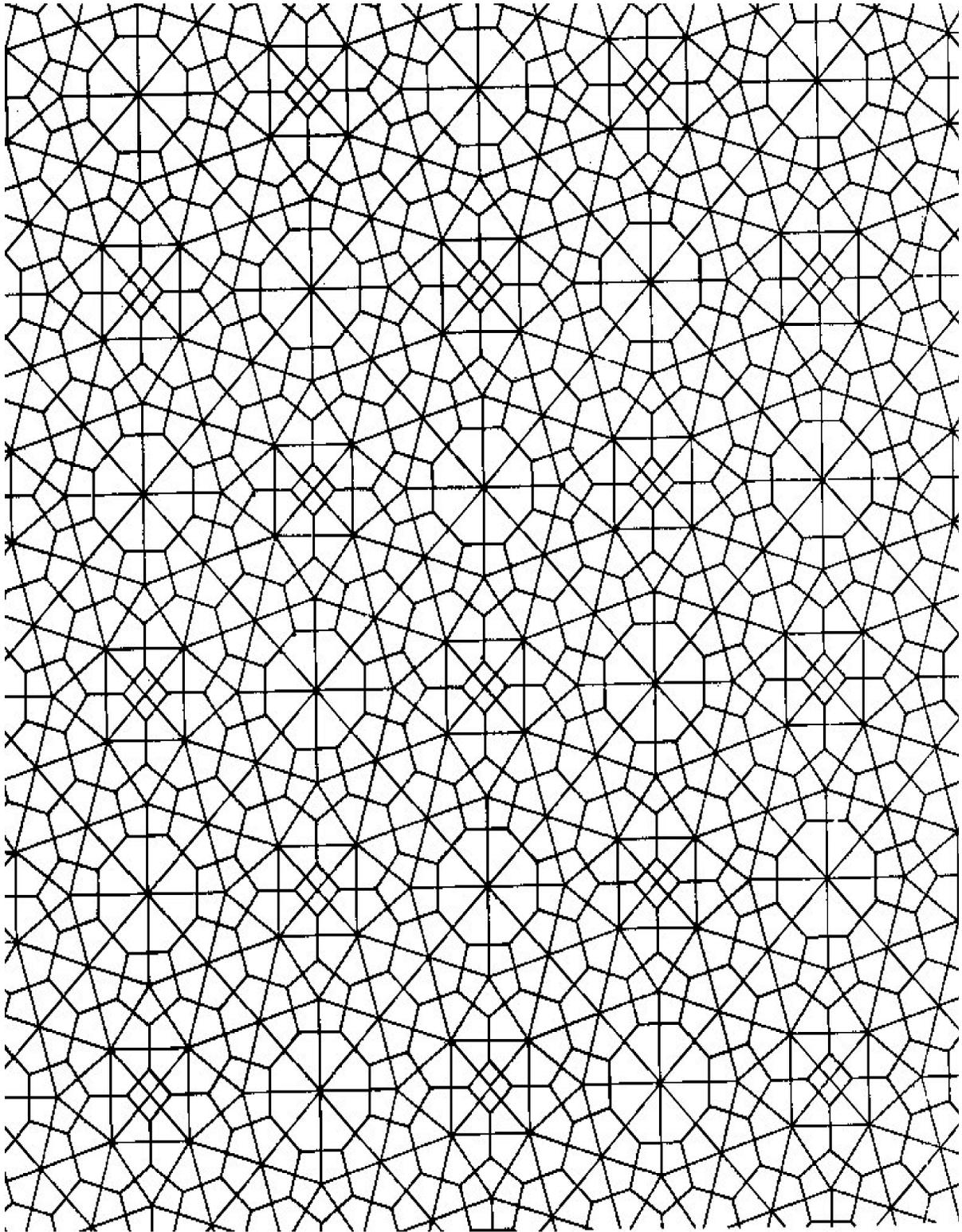




2. On the worksheet, have the students outline or fill in spaces on the Altair designs sheet to create patterns. Their patterns are examples of order within the overall structure of the design. This same type of organization generates crystalline structures in minerals. The Altair designs sheet will naturally guide each student's imagination through the maze of lines. Since no two students are alike, none of them will see the same shapes, forms or patterns hidden in these designs. They may create some very interesting artwork.

3. After the students finish their patterns, see if there are any similar patterns. Use any similarities and differences to reinforce that there are many types of minerals, and hence many different crystal patterns.

**ROCK CYCLE - MINERALS (3B) PRE LAB**



## ROCK CYCLE- MINERALS (3B)

### LAB

Students look at organic and inorganic crystals.

### OBJECTIVES:

1. Discovering that not all crystals are minerals.
2. Comparing organic and inorganic crystals.

### VOCABULARY:

crystal  
inorganic  
organic

### MATERIALS:

Swift-GH microscope  
worksheet

Rock Cycle - Minerals (3B) (geode, epsom salt, table salt, sugar, quartz crystal, massive quartz, gypsum crystal, massive gypsum)



Geode

### BACKGROUND:

Crystals consist of solid matter that has a regular, internal pattern of atoms: a crystalline structure. Individual crystals are bounded by smooth, planar surfaces called faces, that meet at specific angles. For example, in halite crystals, the faces meet at right angles and can be seen by its cubic crystals.

Many times, however, the internal pattern is present but not visible. This may happen if the crystal grows in a confined space, and could not assume its preferred shape. Students usually think that all minerals have nice crystal shapes. This is not true. Only minerals that had "room to grow" will produce nice crystals.

Minerals are the basic building block of rocks. Minerals are inorganic crystals. Crystals can also form from organic compounds. For example, sugar can form crystals, but since sugar is composed of organic material, these crystals are not minerals. Minerals have to be naturally created or else they are classified as man-made substances.

### PROCEDURE:

1. Pass around the geode from the module to demonstrate crystal growth. The quartz crystals in the geode are a good example of crystals that grew into an open space. You may wish to describe how the geode formed. As water percolated through a void (a

cavity) in a rock, it precipitated a compound (see the picture above). In the case of a quartz geode, Si (silicon) + O (oxygen) slowly formed quartz around the edge of the void. Little crystals grew and grew, until there was no room. Geodes that completely "fill up" are called thunder eggs.

2. Next, have students examine the samples of epsom salt, table salt (halite), and sugar under the microscope. Instruct them to draw what they see in their workbooks. Point out that halite and epsom salt are minerals, but sugar is not, because it is organic. Make clear, however, that all three specimens are crystalline.

3. Instruct students to look at the crystal specimens of quartz and gypsum and try to determine how they are different. They may distinguish hardness, color, shininess (luster) or other properties. Next have them examine the massive examples of gypsum and quartz. Tell them to try to identify each specimen. Emphasize with the students that although many substances can form crystals they don't always do so, which may make identification more difficult.

## ROCK CYCLE - MINERALS (3B) LAB

**PROBLEM:** Are all crystals minerals?

**PREDICTION:** \_\_\_\_\_

**MATERIALS:** salt, epsom salt, sugar; gypsum and quartz samples, microscope

**PROCEDURE:** Look at the following samples under a microscope.

**EXERCISE I.** Draw what you see

	DRAWING
EPSOM SALT	
TABLE SALT	
SUGAR	

**EXERCISE II.** Draw and describe the two varieties of quartz and gypsum

QUARTZ	MASSIVE QUARTZ
GYPSUM	MASSIVE GYPSUM

**CONCLUSION:** What type of substances can be crystals?

\_\_\_\_\_

## ROCK CYCLE - MINERALS (3B)

### POST LAB

#### OBJECTIVES:

1. Making a crystalline model of salt.
2. Exploring crystals.

#### VOCABULARY:

crystal  
cube  
halite

#### MATERIALS:

worksheet  
*Crystal and Gem* (Eyewitness Book) by R.F. Symes and R. Harding

#### BACKGROUND:

Review the characteristics of halite, especially its salty taste. Children take salt for granted, but yet it is a unique compound that is important to many animals including humans. Salt has been very important for humans. Salt was used to preserve food before the refrigerator was invented. Imagine a world without refrigerators! We need a balance of salt in our blood or we would not be able to live.

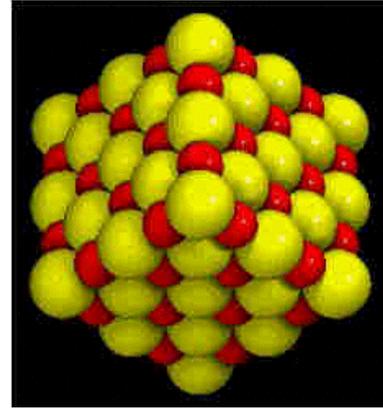


Although sodium and chlorine are very different elements, they combine to form the compound halite (NaCl). Salt crystals grow and break into cubes because the sodium and chlorine atoms are arranged in what is called "cubic packing". A sodium atom is half the size of an atom of chlorine, so chemically they combine perfectly in a cubic pattern, as shown in the diagram above.

#### PROCEDURE:

1. The purpose of this art lesson is to reinforce the concepts presented in the previous labs on crystals. Review that all minerals are crystalline, but only when the minerals have enough room to grow will they exhibit

Students make a cubic model of salt.



model of a salt crystal



visible crystal shapes.

2. The *Crystal and Gem Eyewitness* book will appeal to your students. There are so many stories in the book that we suggest you take one and retell it to the students. Children are sure to tell you about their jewelry at home.

3. In the next part of the exercise, students will make a model of a halite crystal. You may want them to color the crystals different colors. Salt is naturally clear, white, or pink. Salt will take on any natural dye, so it can be any color.

4. Students should color the crystal before they cut it out. After cutting, the students should fold the model along the black lines, using a straight edge. If folded correctly, the crystal will go together easily. Finally, students can glue or tape the tabs in place.

ROCK CYCLE - MINERALS (3B) POST LAB

HALITE CRYSTAL

