Discovering Minerals

Through a series of hands-on activities, students will learn the characteristics of minerals and how crystals form.

Grade Level : 4th

Phenomena:
Observing minerals allows us to understand more about the makeup of rocks.

Objectives:
- Students will state that rocks are made up of minerals.
- Students will examine the four defining properties of minerals through hands-on exploration.
- Students will grow their own crystals.

Materials:
- Plastic container with flat bottom
- A sponge
- 3 tablespoons ammonia
- 1-2 cups water
- 3-4 tablespoons salt
- 2 tbs. Mrs. Stewart's Bluing
- Food coloring
- Pictures of various crystals and salt flats
- Mineral samples
- Enough black paper for each student or group of students
- Salt
- Hand lenses
- Enough cotton swabs for each student or group of students (12 each)

Time Considerations
- Preparations: 10 minutes
- Activity 1: 10-15 minutes
- Activity 2: 10-15 minutes
- Activity 3: 10 minutes
- Activity 4: 10 minutes
- Activity 5: 15 minutes

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Next Generation Science Standards

4-ESS1-1.
Identify evidence from patterns in rock formations and fossils in rock layers to support an explanation for changes in a landscape over time

Science and Engineering Practices (SEP):
Planning and Carrying out Investigations

Disciplinary Core Ideas:
The History of Planet Earth

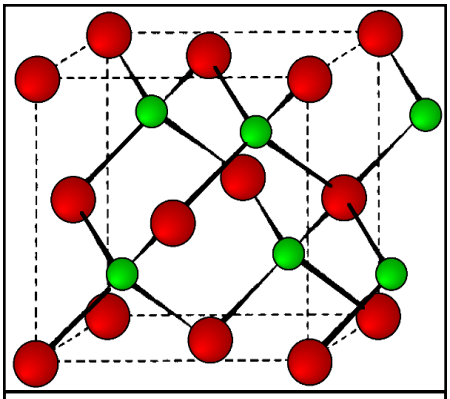
Crosscutting Concepts:
Patterns

Excellence in Environmental Education Guidelines

- **Strand 1– Questioning, Analysis, and Interpretation Skills** *C) Collecting information*– Learners are able to locate and collect information about the environment and environmental topics.

Background

The Earth is composed of rocks. Rocks are aggregates of minerals and minerals are composed of atoms. Minerals have four defining characteristics: they are inorganic (meaning they are not and never were living), they are naturally occurring, they have a specific and constant chemical composition, and they have a specific crystalline structure.



Crystal Structure
http://cnx.org/content/m16927/latest/graphics17.png

Minerals are composed of atoms. Atoms make up the chemical elements. Each chemical element has nearly identical atoms. Atoms are composed of three different particles. These particles are protons, electrons, and neutrons.

A crystal structure requires an orderly and repeated atomic arrangement. Such an arrangement needs to fill space efficiently and keep the charge balanced. Since the size of atoms depends, for the most part, on the number of electrons, atoms of different elements have different sizes. In a crystal, atoms or molecules join together in a pattern that repeats itself over and over to create a certain

shape. A crystal grows by adding atoms or molecules to all its sides in the exact same pattern as the atoms and molecules that were added before.

Minerals are formed in nature by a variety of processes. Among these processes are: crystallization from melt (igneous rocks), precipitation from water (chemical sedimentary rocks, hydrothermal ore deposits), biological activity (biochemical sedimentary rocks), change to a more stable state (the process of weathering, metamorphism, and diagensis), and precipitation from vapor (not common, but sometimes does occur around volcanic vents).
Read and research background information to make sure you are familiar with minerals and how crystals form.

Preparations

Gather all materials for each of the activity: mineral samples, black paper, salt, cotton swabs, plastic container with flat bottom, a sponge, 3 tablespoons ammonia, 1-2 cups water, 3-4 tablespoons salt, 2 tablespoons Mrs. Stewart's Bluing, food coloring.

Doing the Activity

Activity 1:
Rock vs. Mineral

Introduce yourself and your expectations for the lesson.

Hold up a rock and a mineral. Ask the class if these two objects are the same? Allow students to share their thoughts, then identify one is a mineral and the other a rock.

Explain minerals are the building blocks of rocks. Tell the students to think of minerals as letters and rocks as the words they create. Show students a sample of granite and explain that minerals make up this rock. Quartz, feldspar, and mica are the three minerals that compose granite.

Image 1

Activity 2:
Dissolved Salt Set Up

Explain to class that today they will be investigating minerals. But first, each person will set up a mineral experiment at their desk. One mineral that we see and use everyday around the world, is salt! Salt will be the focus of this experiment and will be examined later in the lesson.

Prior to passing out the listed materials, explain the procedure to students.

Materials:

- 1 cotton swab/student
- 1 piece of black paper/student
- 1 small cup **per 2 students**

Procedure:

Begin by using warm water, to dissolve table salt into a large cup (this may be made before entering the classroom). Pour a small amount of salt water into the small cups shared by students in the class. Students are to use the cotton swab and salt water to write their name or create a design on the black paper.

When finished, students should clean up the experiment by dumping the water and stacking their cups both at the sink, throwing away their cotton swab, and pushing their paper to the top of their desk to dry.

Activity 3:
Mineral Properties Investigation

Share with the class that today we will investigate the properties of minerals. Just like rocks, scientists look for certain characteristics in minerals to identify them.

To better acquaint the class with minerals, in groups of three or four, students will study a mineral in an effort to find three characteristics. Distribute a different mineral to each group and allow five minutes for groups to study and discuss their mineral, When time is finished, have groups share their findings with their classmates.

As groups present, list the characteristics they found on the board. *Time permitting:* group the listed characteristics into the six typical characteristics usually used to identify minerals: color, weight, hardness, cleavage, luster , and transparency. Other characteristics can include smell, texture, etc.
From the list you can begin to describe to the students what a mineral is. Explain to students, the list of characteristics created on the board is how scientists work to identify minerals.

Activity 4:
Four Defining Properties

Image 2: Plagioclase is a common mineral in many volcanic rocks.

Explain to students that regardless of how different all their minerals are, they all have the same four defining properties. Students will work in groups to determine these properties of minerals. Each group will receive four clue cards. Using the clues, students first come up with a word/statement/sentence that may describe each property and record it on paper.

Allow groups to work for five minutes, then list the four properties on the board. Students will then use their thoughts along with the clues, to match each clue cards to the actual properties listed.
The four defining properties of minerals are listed below:

1. **Minerals are Inorganic:** they are not living and never were living) Example question: Are these minerals alive? Were they ever?

2. **Minerals are naturally occurring.** Example question: where these minerals made by man?

3. **Minerals have a definite chemical composition:** (minerals will have the same components no matter where they are found on earth)

4. **Minerals have a crystalline structure:** (minerals grow in a certain way)

Activity 5:
Crystalline Structure
Summarize the last activity by emphasizing minerals have these four properties regardless of where they are found in the world. In the next activity, students will focus on the crystalline structure of a common mineral used everyday: salt.

Students will examine the black paper handed out in the first experiment to examine whether the structure of salt changes if it is dissolved in water. Therefore Hand out black paper and pour salt crystals onto the piece of paper. Have students study the structure of the salt crystals with hand lenses.

Examine the shape of the crystals. Do all of the salt crystals have the same general shape?

The halite (or salt crystal) has a very regular shape, it is cubic.

Explain to the students that crystal shape is entirely dependent on the structures of the original elements or compounds that the crystal is formed by. But, how exactly do they form? .

Activity 6:
How Crystals Grow
There are a variety of ways minerals can form. Have students brainstorm how minerals form, or in other words, where minerals come from (ex. underground, in water, caves, heat, pressure, etc..).

Image 3: Halite

Salt crystals form a lot of the time by evaporation. When water, that is diluted with salt evaporates, it leaves the salt behind and the salt organizes itself into its crystal structure.

Other crystals grow in water that has high levels of dissolved compounds. For example, gypsum crystals

Activity 7:
Making Crystals (Extension)
Tell the students that now they are going to grow some crystals in a tub; the students will have to observe the growth over the next few days.

Have the students help with adding ingredients.

Materials:
Plastic container with flat bottom
A sponge
3 tbs. ammonia
2 tbs. water
2 tbs salt
2 tbs. Mrs. Stewart's Bluing
Food coloring

Have one student wet the sponge and put it in the plastic container. Have another student put food coloring on the sponge in a few

places (it's interesting to leave one uncolored and compare the results).

In a container, pour 1-2 cups of heated water. Have different students help pour in the salt, ammonia, and Bluing. Then have another student help stir the mixture and pour it over the sponge. This recipe may also be cut in half for smaller containers.

Conclusion

To keep it growing: Add more MSB, salt and water from time to time. It will "bloom" indefinitely into beautiful rosebuds, coral and crystal.

Ask the students what the 4 characteristics of minerals are. They should be able to come up with all 4 without much prompting. The students should also know what each of the characteristics mean..

Ask the students how mineral crystals form. They should be able to tell you that they start out from an element or compound, which is the basis for the crystals' structure.

Assessment

Assess the students on how well they are able to answer your questions in the conclusion. Assess the students on their observations on their salt water drawings.

Assess the students on how well they understand what should happen to the crystals as they grow.

Extension

Growing Crystals

This activity will help students understand the formation and complexity of crystals, as well as the characteristic of uniformity all crystals share.

Explain to the students that the shape of crystals varies and that many are six sided or hexagonal in shape, but other patterns exist.

In this activity, the students will be growing crystals from a solution of sugar and water. The sugar is the catalyst that begins the crystal formation.

CAUTION: Because boiling water is used in this activity, adult supervision is absolutely necessary.

In this activity, students will "grow" crystals and they will observe the way the crystals "grow".

For this activity you will need a glass thermal-treated measuring cup, 10 inch string, a spoon, a pencil, sugar, and boiling water.

First pour boiled water into a glass measuring cup.

Add 1/2 cup of sugar and stir till the sugar has dissolved.

Now tie the string to the pencil and put it in the cup so that it dangles in the sugar water.

Leave this set up undisturbed for four days

Have the students observe what is happening to the strong and describe what they saw. Let them come up with their own explanations as to what is happening.

Have the students tell what happened to the water.

After the students have had a chance to observe what has happened to this experiment, ask them to read about what happens inside clouds when crystals form.

They should find that all crystals have a definite pattern or symmetry. The ions or atoms are arranged in a specific pattern and this is a characteristic of all crystals.

Vocabulary

Crystal: A single, continuous piece of a mineral bounded by flat surfaces that formed naturally as the mineral grew.

Crystal Habit: the general shape of a crystal or cluster of crystals that grew unimpeded

Mineral: A mineral is a chemical element or compound found the earth.
1.It occurs naturally.
2.It is inorganic (not made from living things, never alive, not animal nor plant).
3.It is made of a definite substance
4.It has a crystalline structure (atoms are arranged in a repeating pattern.)

Rock: A coherent, naturally occurring solid, consisting of an aggregate of minerals or a mass of glass

Luster: the way a mineral surface scatters light

Hardness: how hard a mineral is, measured on Moh's Scale

Sources

- Crystal models: http://geologyonline.museum.state.il.us/tools/lessons/1.1/lesson.html
- Pre-lesson exploration questions: http://www.stanford.edu/group/cpima/education/xtals_lesson.pdf
- http://www.teachervision.fen.com/childrens-science-activities/lesson-plan/3859.html

Images:

- Image 1 -http://www.google.com/imgres?num=10&hl=en&tbo=d&authuser=0&biw=1054&bih=599&tbm=isch&tbnid=3h5EwDeBKCKEfM:&imgrefurl=http://geology.com/rocks/igneous-rocks.shtml&docid=wqhdgCuFRsbzaM&imgurl=http://geology.com/rocks/pictures/granite-coarse-grained.jpg&w=560&h=420&ei=S5-aUP-ThFseuiQLatIGQBw&zoom=1&iact=hc&vpx=593&vpy=182&dur=1727&hovh=194&hovw=259&tx=140&ty=116&sig=117584914112995619509&page=1&tbnh=134&tbnw=190&start=0&ndsp=16&ved=1t:429,r:3,s:0,i:149
- Image 2: http://volcano.oregonstate.edu/vwdocs/vwlessons/rocks_pics/plagioclase.jpg
- Image 3: http://hyperphysics.phy-astr.gsu.edu/hbase/geophys/halite.html#c1

Salt Crystals Recipe:

- Place damp sponge pieces in the shallow plastic bowl
- Over sponge, pour **2 tablespoons** each of:
    - ◊ Mrs. Stewarts Bluing
    - ◊ Salt
    - ◊ Water
    - ◊ Ammonia

Clue Card #1

- This is **not** alive in nature
- It cannot be grown
- Examples of this are rocks, soil, and minerals

Clue Card #2

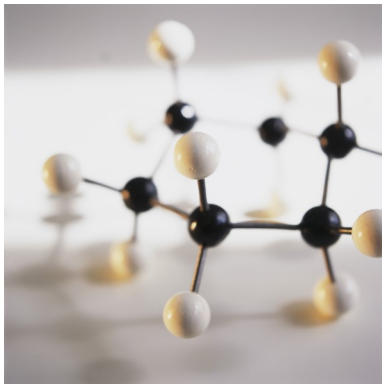
- Can be found in nature
- Is found all over the world, in all different places
- Many processes in nature allows minerals to form

Clue Card #3

- Regardless of where a mineral is found, it is **always** made of the same stuff
- Specific recipe
- Exact sequence of molecules

Clue Card #4

- Minerals are always shaped or form a certain way.
- The shape of diamond will always form to look like diamonds, and not any other shape.
- A crystal's shape is unique to the type of mineral that is forming.

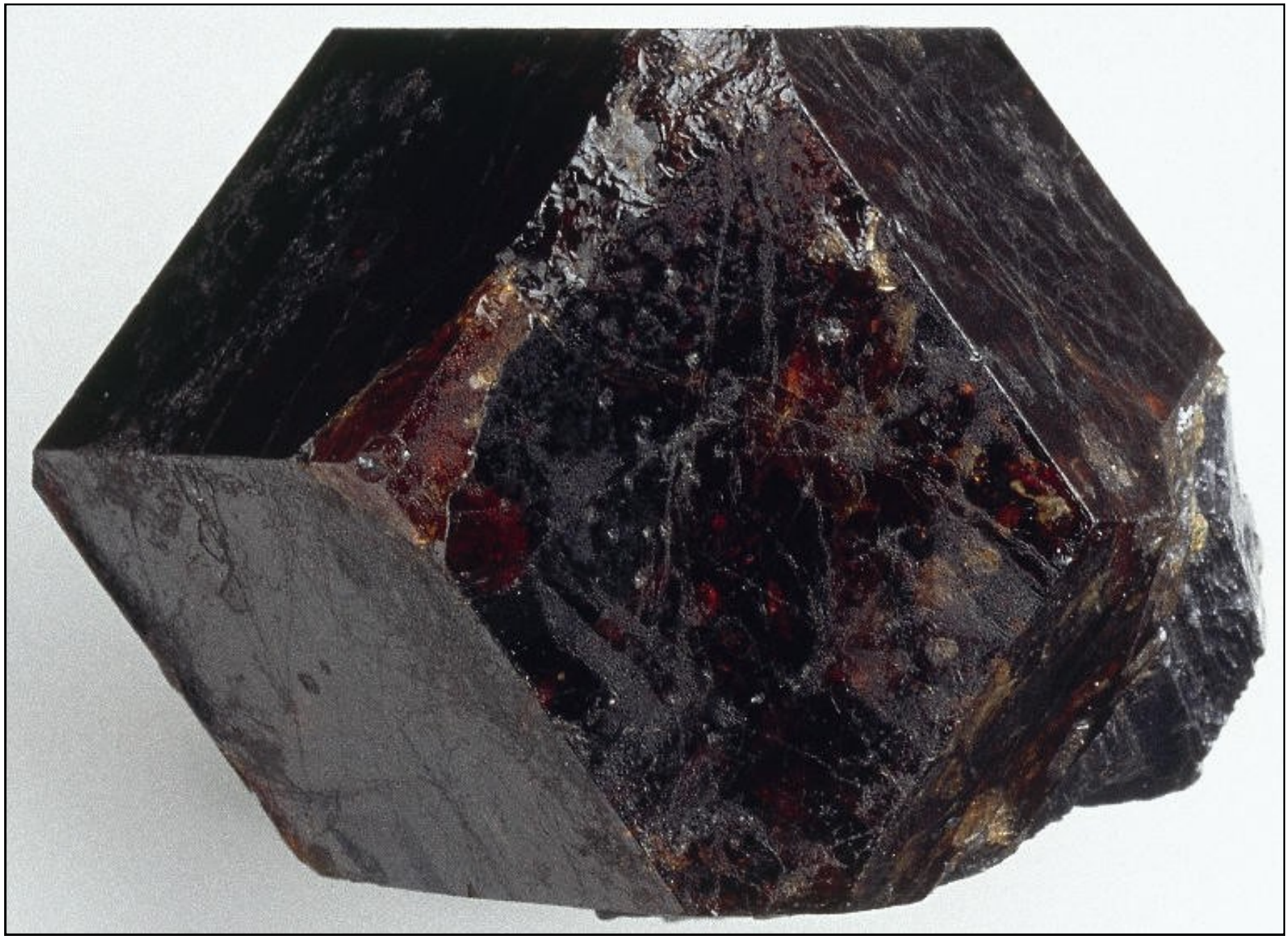


Properties of Minerals **Name:**_____

#1 Inorganic	**#2 Naturally Occurring**
#3 Specific Chemical Composition	**#4 Crystalline Structure**

Salt Crystal

Garnet Crystal

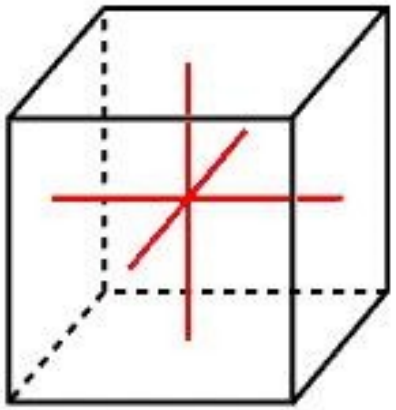


Sugar Crystals

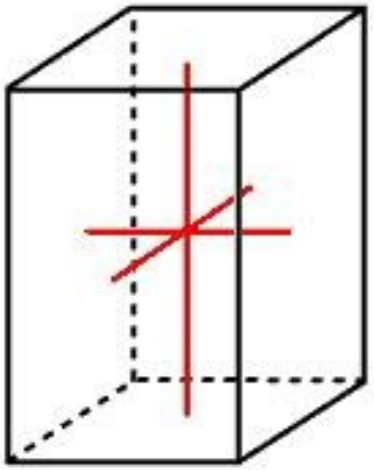
Pyrite Crystals

Quartz Crystal

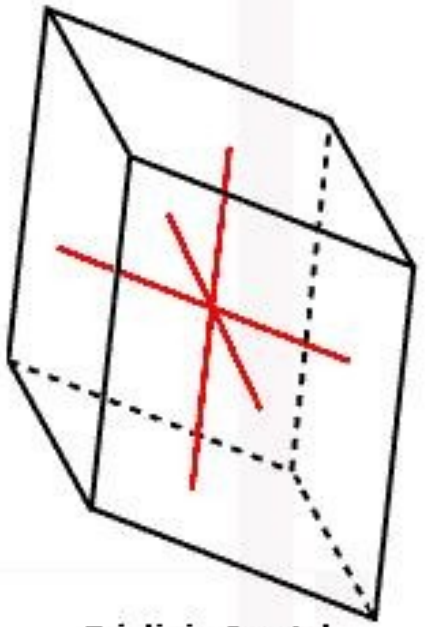
6 BASIC CRYSTAL SYSTEMS



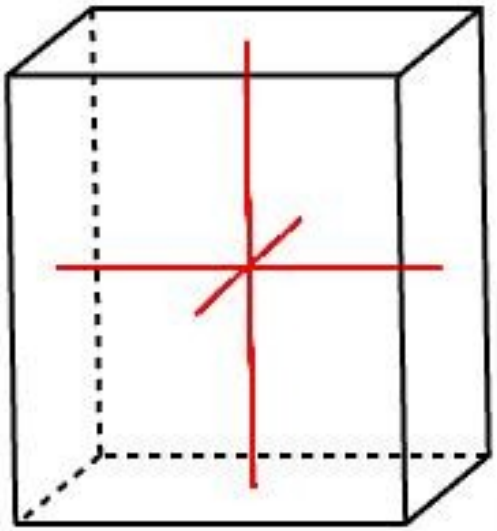
Isometric Crystal



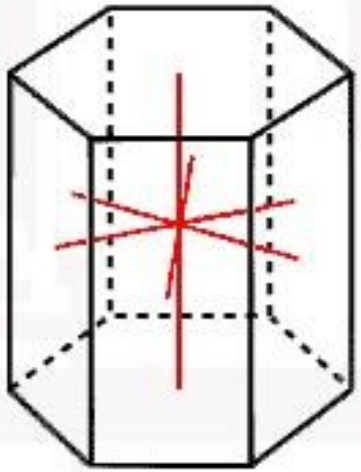
Tetragonal Crystal



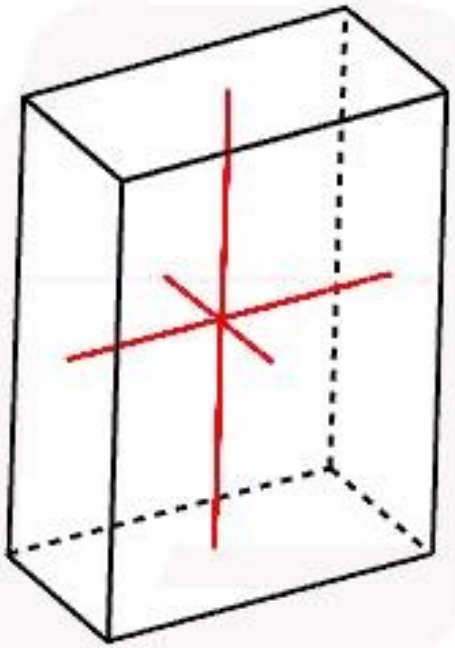
Triclinic Crystal



Orthorhombic Crystal

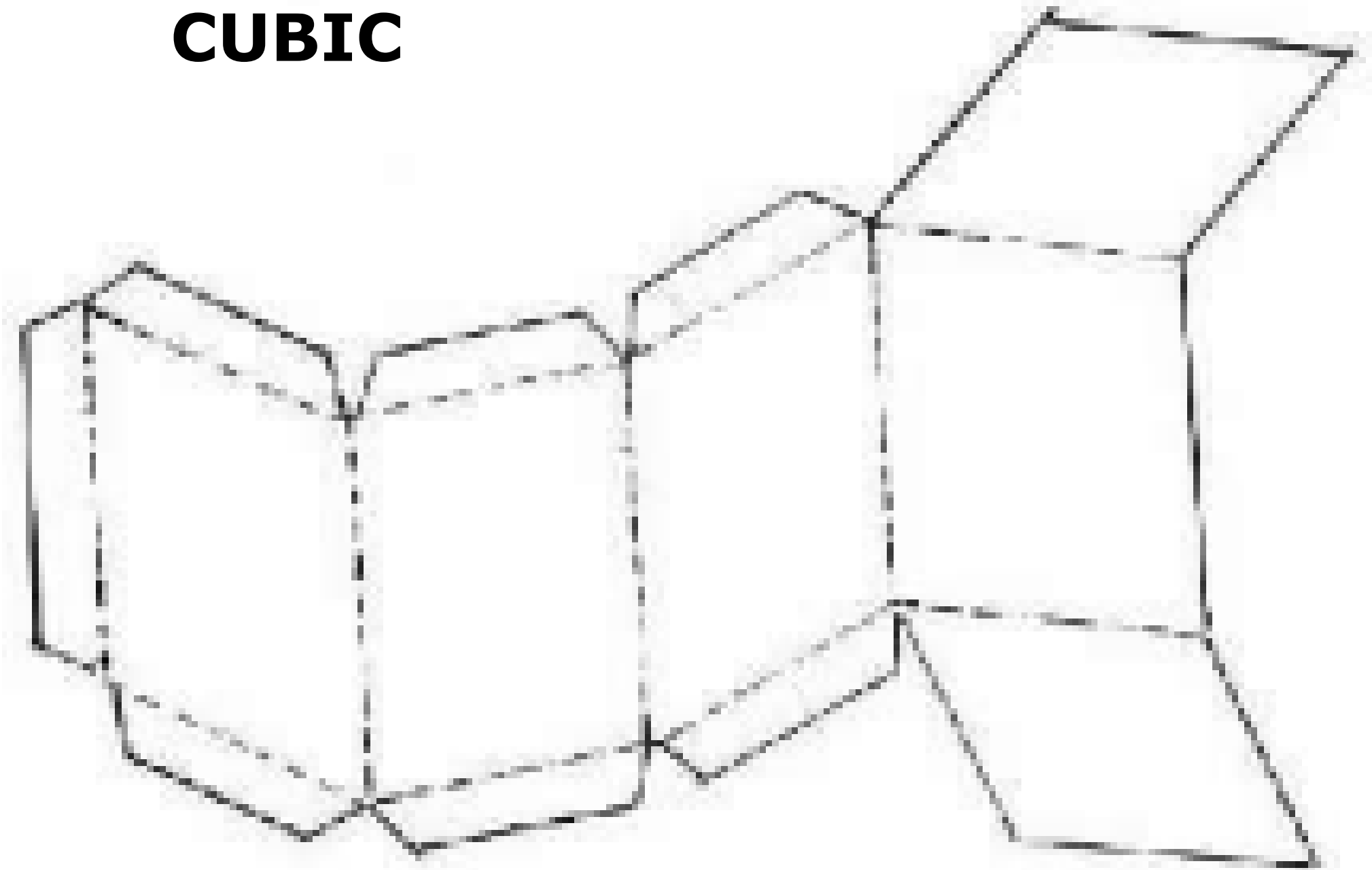


Hexagonal Crystal

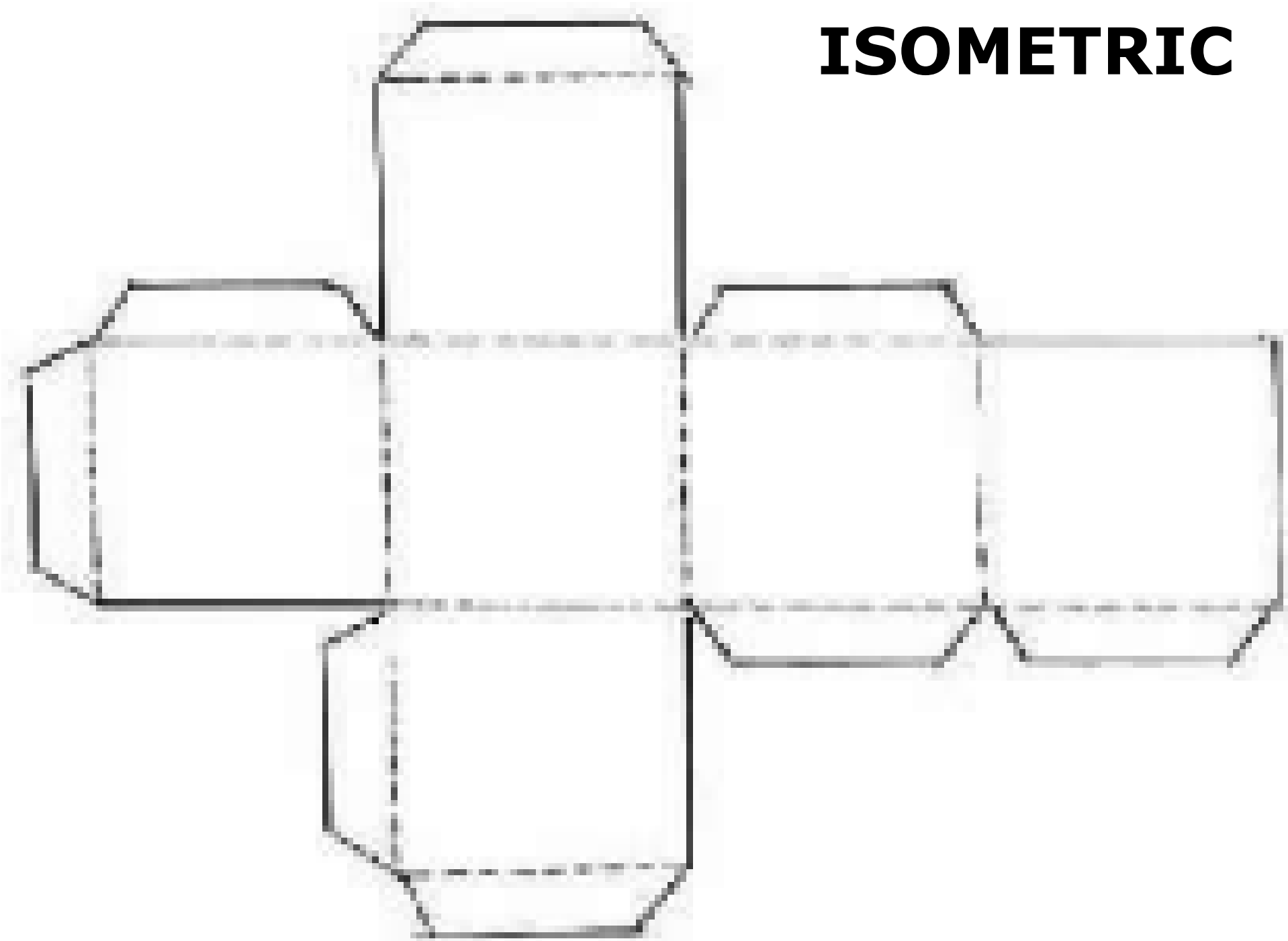


Monoclinic Crystal

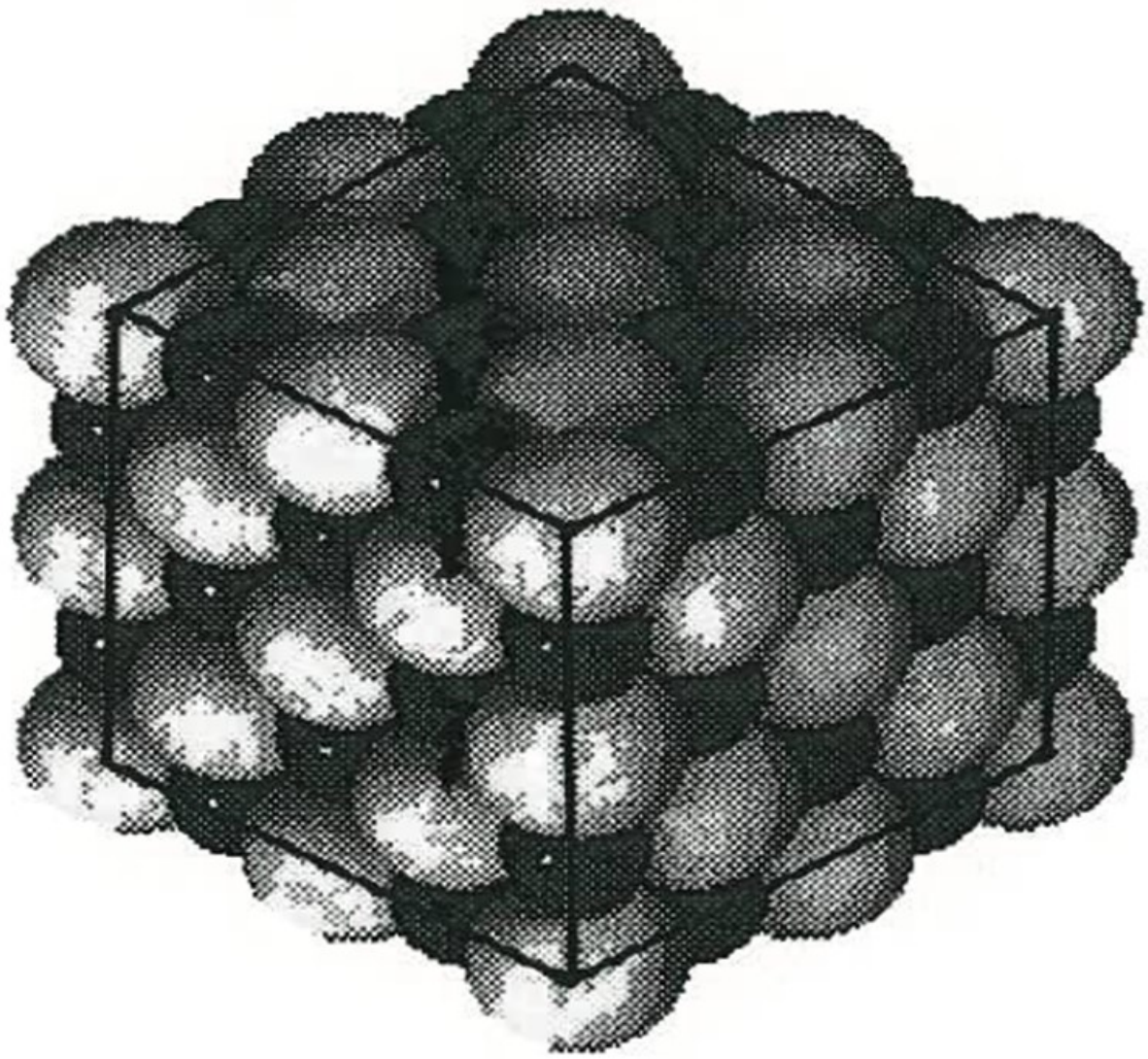
CUBIC



ISOMETRIC



Giant gypsum crystals
found in a cave in Mexico



Crystalline structure of Halite
(salt crystal)

Close up of salt crystal formation

crystal found in a cave in Mexico