Minerals and Their Properties

Teacher's Guide
High/Middle School

Editors:
Brian A. Jerome, Ph.D.
Stephanie Zak Jerome

Assistant Editors:
Heidi Berry
Sara Herberger
Anneliese Brown

Visual Learning Company
Brandon, Vermont
1-800-453-8481
www.visuallearningco.com

Reviewers:

Ray Coish, Ph.D.
Geology Department
Middlebury College
Middlebury, Vermont

Sara Herberger
Geology Consultant
Cleveland, Ohio

Gerald VanOrden
Earth Science Teacher
Dewitt Middle School
Ithaca, New York

Use and Copyright:

71201a

Table of Contents

Viewing Clearances

The video and accompanying teacher's guide are for instructional use only. In showing these programs, no admission charges are to be incurred. The programs are to be utilized in face-to-face classroom instructional settings, library settings, or similar instructional settings.

Duplication rights are available, but must be negotiated with the *Visual Learning Company.*

Television, cable or satellite rights are also available, but must be negotiated with the *Visual Learning Company.*

Closed circuit rights are available, and are defined as the use of the program beyond a single classroom but within a single campus. Institutions wishing to utilize the program in multiple campuses must purchase the multiple campus version of the program, available at a slightly higher fee.

Discounts may be granted to institutions interested in purchasing programs in large quantities. These discounts may be negotiated with the *Visual Learning Company.*

A Message from our Company ...

Dear Educator:

Thank you for your interest in the educational videos produced by the *Visual Learning Company.* We are a Vermont-based, family owned and operated business specializing in the production of quality educational science videos and materials.

We have a long family tradition of education. Our grandmothers graduated from normal school in the 1920's to become teachers. Brian's mother was an elementary teacher and guidance counselor, and his father was a high school teacher and superintendent. This family tradition inspired Brian to become a science teacher, and to earn a Ph.D. in education, and lead Stephanie to work on science educational programs at NASA.

In developing this video, accompanying teacher's guide, and student activities, our goal is to provide educators with the highest quality materials, thus enabling students to be successful. In this era of more demanding standards and assessment requirements, supplementary materials need to be curricular and standards based - this is what we do!

Our videos and accompanying materials focus on the key concepts and vocabulary required by national and state standards and goals. It is our mission to help students meet these goals and standards, while experiencing the joy and thrill of science.

Sincerely,

Brian and Stephanie Jerome

Standards Correlations

National Science Education Standards

(Content Standards: 5-8, National Academy of Sciences, c. 1996)

Earth and Space - Content Standard D:

As a result of their activities in grades 5-8, all students should understand that:

- Some changes in the solid earth can be described as the "rock cycle." Old rocks at the earth's surface weather, forming sediments that are buried, then compacted, heated and often recrystallized into new rock. Eventually, those new rocks may be brought to the surface by the forces that drive plate motions, and the rock cycle continues.
- Fossils provide important evidence of how life and environmental conditions have changed.

Benchmarks for Science Literacy

(Project 2061 - AAAS, c. 1993)

The Physical Setting - Processes that Shape the Earth

By the end of the 8th grade, students should know that:

- The interior of the earth is hot. Heat flow and movement of material within the earth cause earthquakes and volcanic eruptions and create mountains and ocean basins.
- Sediments of sand and smaller particles are gradually buried and are cemented together by dissolved minerals to form solid rock again.
- Sedimentary rock buried deep enough may be reformed by pressure and heat, perhaps melting and recrystallizing into different kinds of rock.

Student Learning Objectives

Upon viewing the video and completing the enclosed student activities, students should be able to do the following:

- Define the terms *minerals* and *rocks* and understand the differences between them;
- Recognize the importance of crystal structures in defining the characteristics of minerals;
- Provide examples of different crystal shapes;
- Describe some of the different ways crystals form;
- Understand that minerals are made up of elements. List the most common elements by weight in the earth's crust;
- Identify and describe the various properties of minerals including color, luster, cleavage, fracture, density, and hardness; and
- Provide examples of some of the many uses of minerals.

Assessment

Preliminary Test:

The Preliminary Test, provided in the Student Masters section, is an assessment tool designed to gain an understanding of student preexisting knowledge. It can also be used as a benchmark upon which to assess student progress based on the objectives stated on the previous pages.

Video Review:

The Video Review, provided in the Student Masters section, can be used as an assessment tool or as a student activity. There are two main parts. The first part contains questions titled "You Decide" that can be answered during the video. The second series of ten questions consists of a video quiz to be answered at the conclusion of the video.

Post-Test:

The Post-Test, provided in the Student Masters section, can be utilized as an assessment tool following student completion of the video and student activities. The results of the Post-Test can be compared against the results of the Preliminary Test to assess student progress.

Introducing the Video

Before viewing the video, provide the students with a collection of rocks and minerals. Explain to students that there is a difference between rock and minerals and, through discussion, have the class decide what that difference is. Once a general consensus has been reached, ask the class to separate the minerals from the rocks. Next, discuss the different properties of the minerals, such as density and streak. Allow the students to observe the minerals to discover their properties. Finally, tell the students to pay close attention to the video to learn more about minerals and their properties.

Video Viewing Suggestions

The Student Master "Video Review" is provided for distribution to students. You may choose to have your students complete this Master while viewing the program or to do so upon its conclusion.

The program is approximately 20-minutes in length and includes a ten-question video quiz. Answers are not provided to the Video Quiz on the video, but are included in this teacher's guide. You may choose to grade student quizzes as an assessment tool or to review the answers in class.

The video is content-rich with numerous vocabulary words. For this reason you may want to periodically stop the video to review and discuss new terminology and concepts.

Student Assessments And Activities

Assessment Masters:

- Preliminary Test
- Video Review
- Post-Test

Student Activity Masters:

- Gold Rush
- Rock Candy
- Mineral Identification
- Making Mono Lake Water
- Vocabulary of *Minerals and Their Properties*

Video Script: *Minerals and Their Properties*

1. What makes this bicycle frame so light, enabling this cyclist to cover great distances?
2. What gives the metal on this motorcycle its shiny luster?
3. And what enables the computer chips in this computer to process information so quickly?
4. The answer lies in substances called minerals.
5. We use minerals everyday.
6. When you write using a pencil, you are using a mineral called graphite.
7. When you put coins in a soda machine, you are using minerals.
8. When you eat food, you are eating minerals!
9. And when you take vitamins, you are providing your body with minerals needed…
10. …to carry out everyday activities
11. During the next few minutes, we are going to take a look at some of the properties of minerals,…
12. ...and see how minerals affect our lives.
13. **Graphic Transition – What is a Mineral?**
14. During the 1840s and 1850s, thousands of people came to this area from all parts of the globe,...
15. …in search of a precious mineral.
16. **You Decide!** What was that mineral?
17. Gold! In fact, there was such a craze of people and activity that they called it the Gold Rush.
18. Many people did strike it rich searching for this mineral – but most did not.
19. But in the process, towns were built, and the West became populated.
20. What is it that makes gold...
21. …and other substances, minerals?
22. A mineral is a natural, inorganic substance.
23. In other words, minerals are formed in nature…
24. …and they are inorganic, which means they are not made from living things.
25. A rock is a material from the earth that is made of one or more minerals.
26. Minerals are solids, with some like corundum being quite hard.
27. Minerals also have a definite chemical composition or makeup.
28. Quartz, for example, is made up of silicon and oxygen. We'll take a look at the chemical composition of minerals later.
29. Minerals also have definite crystal structures, which we'll also take a look at in a moment.
30. **Graphic Transition – Mineral Structure**
31. Believe it or not, every time you sprinkle salt on your food,...
32. ...you are eating miniature cubes
33. Salt, as seen under the microscope, is made of small crystals in the shape of square cubes.
34. A crystal is a solid in which the atoms are arranged in a pattern that repeats itself.
35. This diagram of salt shows how the atoms arrange themselves in a cube.

Script (cont.)

36. Most minerals, such as this sulfur, have a definite crystal structure or pattern in which the atoms are arranged.
37. The crystalline structure tends to give the minerals their shape, as well as many of their properties.
38. Let's now take a look at some of the different shapes of crystals.
39. Graphic Transition – Crystal Shapes
40. While there are thousands of different kinds of minerals, most fall into a few different crystal shapes.
41. Each group of crystal shapes is referred to as a crystal system.
42. We already took a look at how salt, or halite, has a cubic crystal system.
43. Pyrite, or "fool's gold," also has a cubic crystal shape.
44. The beautiful crystals seen here are quartz crystals.
45. Quartz crystals have a hexagonal shape.
46. Other crystal shapes include orthorhombic…
47. ...and monoclinic.
48. Each crystal system is defined by an arrangement of three or four lines, called axes.
49. Graphic Transition – Crystal Formation
50. You Decide!
51. What is the name of this place? Here's a hint – it is the hottest, driest, and lowest place in North America.
52. This is Death Valley, California, 282 feet, or 85 meters, below sea level at its lowest point.
53. Daily high temperatures commonly exceed 130 degrees Fahrenheit or 54 degrees Celsius.
54. On a good hot day, it is possible to fry an egg on the hood of a car.
55. Animals, such as this road runner and this coyote, must be able to survive in a place where food and water are scarce.
56. But on occasion it does rain, and water accumulates on the long, flat valley floor.
57. The mineral-laden water quickly evaporates under the hot sun, leaving behind these white crystals containing salt, gypsum, and calcium carbonate.
58. The method by which these crystals form is called evaporation.
59. When the water evaporates, the minerals stay behind in the form of crystals.
60. If you were to leave a container of salty water on the shelf…
61. ...until all the water evaporates,…
62. ...eventually you would find small crystals left behind.
63. Another method by which minerals form is from solutions which are saturated with dissolved minerals.
64. These large structures were formed under water in this lake when the lake was much higher.
65. The lake water is saturated with dissolved substances that include calcium and carbonate seeping from underwater springs.
66. These substances form calcium carbonate, a whitish limestone deposit that forms these large towering structures.

Script (cont.)

67. Similarly, rock candy forms in solutions saturated with sugar. Over time, sugar crystals formed on this thin stick in the solution.
68. Minerals formed in solutions are commonly found in the oceans...
69. ...and in other bodies of water, such as hot springs and geysers.
70. Another way crystals form is from hot, molten rock.
71. You Decide!
72. What is the name for hot, molten rock?
73. If you said magma, or lava, you're right!
74. As magma cools, atoms rearrange themselves and "lock" into place, forming crystals.
75. The kinds of chemicals in molten rock determine the type of crystals that form.
76. The rate at which molten rock cools determines the size of the crystals.
77. When molten rock cools slowly, larger crystals form, as is the case with granite seen here.
78. But when molten rock cools quickly, smaller crystals develop, as in basalt seen here.
79. Let's now take a look at the chemicals that make up minerals and some of the different mineral groups.
80. Graphic Transition – Elements and Rocks
81. Have you ever picked up a stone and skipped it across a pond?
82. Chances are that stone contained silicon and oxygen, the most abundant elements in the Earth's crust.
83. An element is a chemically pure substance made of just one kind of atom.
84. Some minerals, such as sulfur seen here, are made of just one kind of element.
85. But most minerals, such as azurite, are made of two or more elements.
86. While there are 90 elements that naturally occur in the Earth's crust, about 90 percent of the weight of the crust is made up of only 8 elements.
87. This chart illustrates the distribution of some of the major elements found in the Earth's crust.
88. The two most abundant elements are oxygen and silicon, which make up nearly 3/4 of the Earth's crust.
89. Other elements, such as aluminum, iron, calcium and sodium make up a much smaller percentage of the crust.
90. Minerals tend to be grouped based on the elements they contain.
91. Silicates, for example, are minerals that contain silicon and oxygen, as well as one or more other elements.
92. Quartz is a silicate. Quartz is often used in watches.
93. Mica, another silicate, is often used in wallpaper to give it a shiny luster
94. And feldspar, often used in the manufacture of porcelain, is another example of a silicate.
95. Some minerals, such as this calcite, contain carbon and oxygen, and form carbonate, or CO_3.
96. Minerals, such as those found in these stalactites, are referred to as carbonate minerals,...
97. ...as are those found in this limestone which contains these fossils, seen here.
98. Graphic Transition – Properties of Minerals
99. Prospecting for gold is not an easy task.

Script (cont.)

100. As water comes into the pan, the prospector is looking for certain properties or characteristics.
101. All minerals have properties that can be identified. Most mineral properties you can identify on your own with no special equipment.
102. Back to our prospector, one property he is looking for is color.
103. Gold is a gold/yellow color. But so is another mineral called pyrite, a mineral not as valuable as gold, therefore often called fool's gold.
104. Sometimes when minerals are rubbed against something, they leave a mark or streak.
105. The color of the powder left on a streak plate is called the streak.
106. Sometimes a mineral's streak is different than the color of the mineral.
107. For example, gold has a gold streak….
108. ...but pyrite has a black streak.
109. Luster is another property used to identify minerals. Luster is the way a mineral reflects light.
110. Some minerals, such as galena, have a shiny, metallic luster.
111. While others, such as talc, have a duller, non-metallic luster.
112. The way a mineral breaks can also tell us a lot.
113. There are two main terms that describe how minerals break.
114. Cleavage occurs when minerals split along flat surfaces.
115. This muscovite cleaves along smooth, flat surfaces...
116. ...and this halite breaks into flat cubes.
117. Most minerals, such as quartz, do not break along smooth, flat surfaces. Instead they break along jagged surfaces. This is called fracture.
118. You Decide!
119. Which rock do you think will float?
120. As you can see the rock that was on the left, called pumice, floats.
121. This is because it is less dense than the piece of copper.
122. Density is the amount of matter in a space. The density of minerals is often measured using specific gravity.
123. Specific gravity is the ratio of a mineral's density to the density of water.
124. For example, galena is a relatively dense material with a specific gravity of 7.5, meaning that it is 7.5 times denser than water.
125. But quartz only has a specific gravity of 2.65, a little more than 2 1/2 times the weight of water.
126. The last property of minerals we will discuss is hardness. Each mineral has a specific hardness.
127. For example, talcum powder is made from a very soft mineral called talc.
128. This saw blade contains diamonds, which are so hard they are able to slice through rock.
129. To compare the hardness of minerals, a scientist by the name of Friedrich Mohs developed Mohs' scale of hardness, seen here.
130. The scale contains 10 minerals of different hardness. Talc is the softest, symbolized by 1, and diamond, symbolized by the number 10, is the hardest.

Script (cont.)

131. Graphic Transition- Some Uses of Minerals
132. These colorful minerals are considered gems.
133. A gem is a highly prized mineral. Gems tend to be brighter and more colorful than some samples of the same minerals.
134. For example, this purple amethyst is considered a gem even though it is made of the same general mineral as quartz.
135. Different kinds of gems include diamonds and garnets, seen here.
136. You Decide !
137. What is the main mineral found in the Golden Gate Bridge? It's Iron!
138. Iron used to make steel is a very important mineral.
139. Iron is most often used as ore. An ore is a mineral or rock that has usable amounts of metal.
140. Copper, another very important mineral used on roofs,...
141. …and in wiring,...
142. …also comes from an ore mineral.
143. Graphic Transition – Summing up
144. During the past few minutes we have looked at some of the different characteristics of minerals and their uses.
145. We took a look at the structure of minerals by looking at their crystal shapes,...
146. ...and how crystals are formed through evaporation or the cooling of hot, molten rock.
147. We also looked at some of the elements which make up rocks and minerals.
148. We explored how you can identify different minerals by looking at their properties, including color, luster, breakage, density and hardness.
149. Finally we took a look at some of the uses of minerals.
150. So the next time you look at a mineral,...
151. …put salt on your food,...
152. …look at your watch to check the time,
153. … or drive over a bridge, think about all the different characteristics of minerals and the way they affect our lives. You might just look at your world a little differently.

Fill in the correct word when you hear this tone ____. Good luck and let's begin.
1. A _____ is an inorganic substance.
2. Salt consists of crystals shaped like _____.
3. Each group of crystal shapes is called a _____ _____.
4. The crystalline structure tends to give minerals their _____.
5. An _____is a chemically pure substance made of one kind of atom.
6. Lava or magma is derived from _____ rock.
7. _____ are minerals that contain silicon and oxygen.
8. The way a mineral reflects light is called _____.
9. _____ occurs when minerals split along flat surfaces.
10. When rocks break along jagged surfaces it is called _____.

Answers to Student Assessments

Preliminary Test

1. rock
2. crystal
3. cubic
4. silicon
5. pyrite
6. luster
7. silicates
8. ore
9. gems
10. fracture
11. False
12. True
13. True
14. False
15. False
16. True
17. False
18. True
19. False
20. False

Video Review

You Decide:

A. Gold was the precious mineral sought after by thousands of people.
B. Death Valley, California
C. Magma or lava are the terms for hot, molten rock.
D. The pumice on the left will float.
E. Iron is the main mineral used in the Golden Gate Bridge.

Video Quiz:

1. mineral
2. cubes
3. crystal system
4. shape
5. element
6. molten
7. silicates
8. luster
9. cleavage
10. fracture

Post Test

1. False
2. False
3. False
4. False
5. True
6. False
7. True
8. True
9. False
10. True
11. pyrite
12. cubic
13. gems
14. rock
15. ore
16. silicon
17. crystal
18. luster
19 fracture
20. silicates

Answers to Student Activities

Gold Rush

1. Many people left their homes in search of instant riches. Others left in order to embark on a wild and dangerous adventure.
2. Towns developed quickly because of the large influx of people. There were supplies and food to be sold to the migrant miners, which in turn brought money into the small towns.
3. The miners were called "forty niners" because they came in the year 1849.
4. Horrendous, dangerous living and working conditions caused many deaths. Disease and violence also led to the deaths of many miners.
5. Placer deposits are found in stream and river beds while vein deposits are mined underground.

Rock Candy

1. The string or the side of the jar serve as the site of formation.
Crystals first formed on top of the solution. It cooled and evaporated here first.
2. The holes are used to allow steam and moisture to escape.
3. Answers will vary.

Mineral Identification

Answers will vary according to the minerals observed by each student.

Making Mono Lake Water

1. 150-160 miles, or 241-257 kilometers.
2. Lab procedure.
3. The pH level is approximately 10. This indicates that the water is strongly alkaline.
4. A dry, crusty, white residue is left behind once the water evaporates.

Vocabulary

1. e, streak
2. i, gem
3. g, fracture
4. d, solution
5. b, crystal structure
6. a, mineral
7. f, cleavage
8. j, ore
9. h, specific gravity
10. c, evaporation

Assessment and Student Activity Masters

Name_____

Preliminary Test

Directions: Fill in the blank with the correct word. A list of possible answers is provided at the bottom of the page.

1. A _____ is a material from the earth that is made of one or more minerals.
2. The shape of a mineral largely depends on its _____ structure.
3. Salt has a _____ crystal structure.
4. _____ and oxygen are the two most abundant elements in the Earth's crust.
5. The term "fool's gold" refers to the mineral _____.
6. _____ is the way in which a mineral reflects light.
7. _____ are minerals containing silicon and oxygen.
8. A mineral or rock that is capable of producing a usable amount of metal is called _____.
9. _____ are colorful, highly prized minerals.
10. Cleavage and _____ are used to describe the way a mineral breaks.

ore	axes
fracture	silicon
luster	pyrite
gems	rock
cubic	crystal
silicates	gold

Name_____

Preliminary Test

Directions: Decide whether the answer is True (T) or False (F).

11. The mineral used in pencils is called corundum. T F

12. The main chemical composition of the mineral quartz is silicon and oxygen. T F

13. Salt or halite is a mineral. T F

14. Pyrite is commonly mistaken for quartz. T F

15. Cleavage describes the uneven, random way a mineral breaks. T F

16. Gems are colorful minerals considered to be very valuable. T F

17. The Earth's crust is largely made up of silicon and calcite. T F

18. Color, streak, luster, and hardness are properties used to classify minerals. T F

19. Specific gravity is used to describe the color of minerals. T F

20. A mineral is made from an organic substance. T F

Name_____

Video Review

Directions: During the course of the program, answer the "You Decide" questions as they are presented in the video. Answer the Video Quiz questions at the end of the video.

You Decide:

A. What was that mineral? Answer _____

B. What is the name of this place? Answer _____

C. What is the name for hot, molten rock? Answer _____

D. Which rock do you think will float? Answer _____

E. What is the main mineral found in the Golden Gate Bridge? Answer _____

Video Quiz:

1. A _____ is an inorganic substance.
2. Salt consists of crystals shaped like _____.
3. Each group of crystal shapes is called a _____.
4. The crystalline structure tends to give minerals their _____.
5. An _____ is a chemically pure substance made of one kind of atom.
6. Lava or magma is derived from _____ rock.
7. _____ are minerals that contain silicon and oxygen.
8. The way a mineral reflects light is called _____.
9. _____ occurs when minerals split along flat surfaces.
10. When rocks break along jagged surfaces it is called _____.

Name_____

Post Test

Directions: Decide whether the answer is True (T) or False (F).

1. The Earth's crust is largely made up of silicon and calcite. T F
2. Pyrite is commonly mistaken for quartz. T F
3. Specific gravity is used to describe the color of minerals. T F
4. The mineral used in pencils is called corundum. T F
5. Salt, or halite, is a mineral. T F
6. A mineral is made from an organic substance. T F
7. The main chemical composition of the mineral quartz is silicon and oxygen. T F
8. Gems are colorful minerals considered to be very valuable. T F
9. Cleavage describes the uneven, random way a mineral breaks. T F
10. Color, streak, luster, and hardness are properties used to classify minerals. T F

Name_____

Post Test

Directions: Fill in the blank with the correct word. Choose from the list of possible answers at the bottom of the page.

11. The term "fool's gold" refers to the mineral _____.

12. Salt has a _____ crystal structure.

13. _____ are colorful, highly prized minerals.

14. A _____ is a material from the earth that is made of one or more minerals.

15. A mineral or rock that is capable of producing a usable amount of metal is called _____.

16. _____ and oxygen are the two most abundant elements in the Earth's crust.

17. The shape of a mineral largely depends on its _____ structure.

18. _____ is the way in which a mineral reflects light.

19. Cleavage and _____ are used to describe the way a mineral breaks.

20. _____ are minerals containing silicon and oxygen.

ore	crystal
fracture	silicon
luster	pyrite
gems	rock
cubic	crystals
silicates	gold

Name_____

Gold Rush

To most people, the words "Gold Rush" bring to mind The California Gold Rush of 1849. This was only one of the so-called gold rushes which took place within our country and throughout the world. However, the California Gold Rush is the event most popularly embedded in American cultural mythology.

A gold rush is the frantic movement of large numbers of people into an area in response to news of the discovery of gold. In the case of the California Gold Rush, word spread after the discovery of gold in 1848 at Sutter's Mill on the American River in the Sierra Mountains near Sacramento. About 100,000 people took part in the California Gold Rush, coming not only from the eastern U.S., but also from all over the world. Men as well as some women left their generally tedious jobs to strike out in search of instant riches. The movement of people, along with equipment and supplies, resulted in instantaneous development of boom towns in the mining areas and also the growth of San Francisco.

The living and working conditions in the settlements were rugged, resulting in high death rates from violent accidents and disease. For most "forty-niners," as the people in search of gold were often called, the quest for fortune was a failure. They found no gold as the streams had been scavenged long before they arrived. The journey to the gold field was also long and dangerous. "Around the horn," or across the Isthmus of Panama, most stampeders were left penniless and saddened by their experience. With few exceptions, money and fortune was made only by those who sold food and supplies to the gold seekers.

The mining of gold occurred in two ways. The first process, called p***lacer deposits***, was the most convenient method because the entire mining process was carried out at gravel deposits of stream and river beds. Gold was found by washing, filtering or panning. Over time, these surface deposits were picked clean and miners were forced to look underground. In ***vein or lode deposits***, gold is embedded in another material, often quartz. The gold ore present in these deposits was removed by drilling and/or blasting.

Questions:

1. For what reasons did so many people leave their homes and travel to California in 1849?
2. The rapid development of small California towns was due largely to what factor?
3. What was the name given to the migrant miners in California? What aspect of the gold rush does this name refer to?
4. Many people died during the California Gold Rush. What caused these untimely deaths?
5. Explain the difference between placer deposits and vein deposits.

Name_____

Rock Candy

Objective: Students will observe crystal growth.

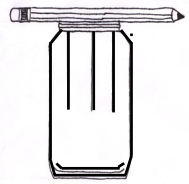
Background: Crystals are formed via chemical reactions. In this recipe for rock candy, several chemical reactions occur, leading to the crystallization of sugar into large "rocks." Although making candy is a simplified version, in many ways it mimics the earth processes that create minerals.

Materials:

pan to heat water and sugar	string	hand lens
1 cup of water	pencil	protective eye glasses
2 cups of sugar	aluminum foil	
clean, dry, glass jar	wooden spoon	

Procedure:

1) Examine the sugar with a hand lens. Sketch your observations in the space below.
2) Set up the glass jar as sketched below. Hang the strings so that they do not touch each other or the bottom of the jar.
3) ***Your teacher will prepare the sugar solution by heating the solution. Be extremely careful when making and pouring this solution.*** Bring the water to a boil. Carefully add sugar and stir constantly until the sugar is completely dissolved and boiling again.
4) Have your teacher remove the pan from heat and allow the solution to cool for 5 minutes.
5) Remove the pencil so that your teacher can carefully pour the solution into the jar. Replace the pencil and strings. When there is no more steam rising from the jar, lightly cover the mouth of the jar with a piece of aluminum foil that you have pierced several times with scissors.
6) Place the jar in a warm, dry, well-ventilated location where it will not be disturbed.
7) Observe the jar every other day for one week. Record your observations in your lab journal.
8) Observe the finished rock candy with a hand lens. Sketch crystals in the space below.



Sugar crystal Rock candy crystals Jar diagram

Analysis: Answer the following questions in your lab journal.
1) Crystals need a site for formation. Which material(s) in our experiment provided this site? Where did the crystals form first? Why?
2) Why did you make holes in the aluminum foil cover?
3) Which chemical process do you think caused the crystals to form?

Name_____

Mineral Identification

Objective: Students will classify common rock-forming minerals by investigating and drawing conclusions based on their physical properties.

Background: Every mineral has a unique set of physical properties that are a result of its atomic arrangement and chemical composition. Because these properties are unique and constant, they can be used to identify unknown minerals. The most obvious feature of a mineral is its color. It is also one of the trickiest. **Color** is often determined by slight chemical variations in the chemical formula of a mineral, therefore it is often not a reliable indicator. **Streak** is the color of the powder that is created by rubbing the mineral on a white porcelain plate. The streak shows less variation than the color of a sample and is therefore a more useful identification property. **Hardness** is determined by a scratch test. Moh's scale of hardness classifies minerals from 1 (soft) to 10 (hard). The **luster** of a mineral is either metallic (having an appearance of metals) or nonmetallic (not having the appearance of metals). Some minerals break along more or less well-defined planes. This is called **cleavage**. Other minerals break into fragments, referred to as **fracture**.

Materials:

5 "unknown" mineral samples
copper penny
glass square
steel file or nail
streak plate
hand lens
Mineral Identification Key

Prelab Exercise:

Use the following table to approximate *Moh's Scale of Hardness*:

If the mineral sample can be scratched by:	Hardness equals:
Fingernail	2.5
Copper penny	3.0
Glass	5.5
Steel file or nail	6.5

Procedure:

Record your observations in the chart on the following page.

1. Observe and record the color of each mineral. Note whether the luster of each mineral is metallic or nonmetallic. If nonmetallic, is it glossy, pearly, greasy, earthy, or dull?
2. Rub each mineral against the streak plate and determine the color of the mineral's streak. Record your observations.
3. Using a fingernail, copper penny, glass square, and a steel file, test each mineral to determine its hardness according to the hardness scale provided above. Arrange the minerals in order of hardness. Record your observations.
4. Determine whether the surface of each mineral displays cleavage or fracture. Record your observations.
5. Use the Mineral Identification Key to help identify your unknown mineral samples.

Name_____

Mineral Identification (cont).

Sample Number	Color/ Luster	Hardness	Cleavage/ Fracture	Streak	Mineral Name
1					
2					
3					
4					
5					

Name_____

Mineral Identification Key

- Non-Metallic Luster
  - Light color
    - Scratches glass
      - Cleavage
        - Streak= white
          - White or pink; H=6: **Orthoclase**
      - No Cleavage
        - Streak= white
          - Glassy; transparent to opaque;6-sided crystal shape; H=7: **Quartz**
    - Does not scratch glass
      - Cleavage
        - Streak= white
          - Colorless to grey; three cleavage planes; H=2: **Halite**
          - Colorless to tinted; transparent; double image; H=3: **Calcite**
          - White to pink; small pieces; flexible; H=2: **Gypsum**
          - White to green; greasy feel; H=1: **Talc**
  - Dark color
    - Scratches glass
      - Cleavage
        - Streak= green to grey/brown
          - Colorless to light brown; one thin cleavage plane; H=2: **Muscovite**
          - Black; H=5: **Hornblende**
      - No Cleavage
        - Streak= white
          - Tinted red; dull; fracture could be taken for cleavage; H=6.5: **Garnet**
    - Does not scratch glass
      - Cleavage
        - Streak= white to greenish
          - Black to dark brown; one thin cleavage plane; H=2.5: **Biotite**
      - No Cleavage
        - Streak= red
          - Red to black; earthy; dull; H=5: **Hematite**
- Metallic Luster
  - Streak= black to dark green
    - Black; strongly magnetic; H=5.5: **Magnetite**
    - Black; greasy feel; flak;, H=1: **Graphite**
    - Brass, yellow; uneven fracture; cubic crystals; H=6: **Pyrite**
    - Lead grey; very heavy; H=2.5: **Galena**

Name_____

Making Mono Lake Water

Objective: Students will explore the ways in which the water chemistry of Mono Lake leads to the development of tufa rocks.

Background: Mono Lake is a watery oasis in the Great Basin Desert along the California/ Nevada border. It is one of a string of naturally occurring lakes that formed in this region thousands of years ago when the climate was wetter. With the retreat of the glaciers and the onset of a drier, warmer climate, these lakes have shrunk or dried up completely. Mono Lake is one of the largest of these lakes, though it is not as large as the Great Salt Lake found in Utah.

Mountains surround Mono Lake, forming a closed hydrological basin-water flows into the lake, but does not flow out. There is no outlet to the ocean. The only way for water to leave Mono Lake is through evaporation. Four vertical feet of water can evaporate from Mono Lake during the course of a year.

Freshwater streams and underwater springs have brought trace amounts of minerals into Mono Lake over the eons. Streams and springs contain dissolved minerals in amounts so small they are immeasurable. Because Mono Lake has no outlet, these minerals accumulate. The water has become naturally saline, or salty. Mono Lake contains about 78 grams of salt per liter of water (g/L). For comparison, the ocean contains about 31.5 g/L. That is 2-3 times saltier than the ocean! The unique chemical composition of the water has led to the development of large formations of calcium carbonate, referred to as **tufa**. Within Mono's waters are dissolved sodium salts of chlorides, carbonates, and sulfates. The water tastes bitter and feels slippery.

Procedure:

1) Locate Mono Lake on a map. How far is it from Death Valley, one of the hottest and driest parts of the country?

2) Use this "secret recipe" to mimic the water composition of Mono Lake.

Pour 1 quart of fresh water into a bowl.

Add 2 Tablespoons of table salt

4 Tablespoons of Baking Soda

2 teaspoons of Epsom Salt

1 teaspoon of Borax

1 teaspoon of laundry detergent

3) Measure the pH of your "lake." Record it here _____. What does this indicate?

4) Feel the water. Stir it, swoosh it, and let it settle. Remove a small amount of the water and let it evaporate. Describe what you see after all the water has evaporated.

Name_____

Vocabulary of *Minerals and Their Properties*

1. _____ ketsar
2. _____ meg
3. _____ eutcrfar
4. _____ ionlsout
5. _____ ylcsrat usurttrce
6. _____ neiraml
7. _____ evlceaag
8. _____ reo
9. _____ ciipfsec aygitrv
10. _____ prvaaeioont

a. a natural substance, not made from living things

b. pattern in which atoms are arranged

c. the method by which crystals are formed

d. a mixture formed by dissolving a solid in a liquid

e. the mark left by a mineral used to help identify the mineral

f. the breaking a mineral along a flat surface

g. pattern of irregular, random breaking of a mineral

h. the ratio of a mineral's density compared to the density of water

i. a colorful mineral considered to be more valuable than others

j. a mineral or rock that has a usable amount of a metal