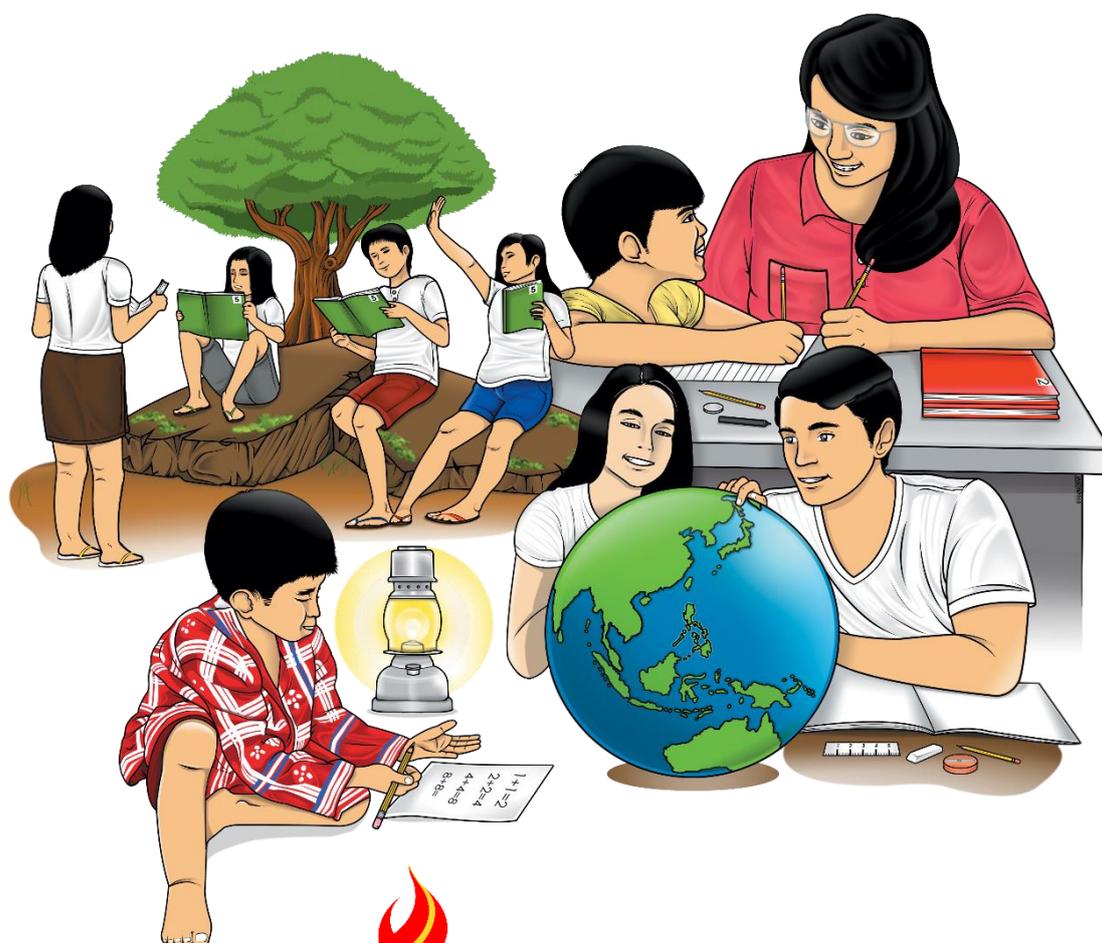


Senior High School

Earth Science for Stem

Quarter 1 – Module 3: Physical and Chemical Properties of Minerals



**Earth Science for STEM
Alternative Delivery Mode
Quarter 1 – Module 3 : Physical and Chemical Properties of Minerals
First Edition, 2021**

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Introductory Message

This Self-Learning Module (SLM) is prepared so that you, our dear learners, can continue your studies and learn while at home. Activities, questions, directions, exercises, and discussions are carefully stated for you to understand each lesson.

Each SLM is composed of different parts. Each part shall guide you step-by-step as you discover and understand the lesson prepared for you.

Pre-tests are provided to measure your prior knowledge on lessons in each SLM. This will tell you if you need to proceed on completing this module or if you need to ask your facilitator or your teacher's assistance for better understanding of the lesson. At the end of each module, you need to answer the post-test to self-check your learning. Answer keys are provided for each activity and test. We trust that you will be honest in using these.

In addition to the material in the main text, Notes to the Teacher are also provided to our facilitators and parents for strategies and reminders on how they can best help you on your home-based learning.

Please use this module with care. Do not put unnecessary marks on any part of this SLM. Use a separate sheet of paper in answering the exercises and tests. And read the instructions carefully before performing each task.

If you have any questions in using this SLM or any difficulty in answering the tasks in this module, do not hesitate to consult your teacher or facilitator.

Thank you.



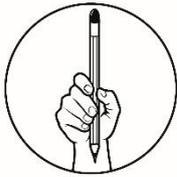
What I Need to Know

This Lesson pertains to the learning competency that would engage the students to explain that the Earth consists of four subsystems, across whose boundaries matter and energy flow. The activities would enable the students to determine the four subsystems of the Earth and help them differentiate the subsystems based on their characteristics. Also, the activities would enable the students to explain how matter and energy flow in the subsystems. They would also be able to trace the flow of matter and energy across the subsystems. This would also help them to internalize the role of humans in the unstoppable flow of matter and energy in the subsystems. This would also help the students intensify their roles as stewards of each subsystem.

This module contains significant activities in which you will be able to identify the different common rock-forming minerals using their physical and chemical properties.

After accomplishing this module, you are expected to:

1. identify the characteristics of minerals;
2. explain the different physical properties of minerals;
3. characterize the different chemical properties of minerals;
4. discuss the Dana Classification System of minerals; and
5. give examples of the different minerals.



What I Know

Choose the letter of the best answer. Write the chosen letter on a separate sheet of paper.

1. Which of the following mineral characteristics refers to the tendency to break along very smooth surfaces?
 - a. Cleavage
 - b. Color
 - c. Hardness
 - d. Luster

2. Silicates are one of the most abundant minerals on Earth. Which of the following example is a silicate?
 - a. Amber
 - b. Apatite
 - c. Feldspar
 - d. Magnetite

3. Quartz are composed of silicon and oxygen. Which common group of minerals do quartz belong?
 - a. Oxide
 - b. Silicate
 - c. Sulfate
 - d. Sulfide

4. Gypsum, also known as desert rose, has a chemical name of Calcium sulfate dehydrate. To which group of rock-forming mineral does it belong?
 - a. Oxides
 - b. Silicates
 - c. Sulfates
 - d. Sulfides

5. Which group of minerals do common table salts belong?
 - a. Carbonates
 - b. Fluorites
 - c. Halides
 - d. Sulfide

6. Which of the following is **NOT** a physical property of minerals?
- Habit
 - Luster
 - Oxidizing potential
 - Streak
7. Which of the following is the most abundant element found in rocks?
- Carbon
 - Hydrogen
 - Oxygen
 - Silicon
8. Which of the following is the correct pairing?
- Gypsum: Sulfate
 - Feldspar: Oxide
 - Magnetite: Silicate
 - Pyrite: Sulfide
9. Which is the hardest mineral?
- Calcite
 - Diamond
 - Quartz
 - Talc
10. What physical property of minerals is considered the least reliable in identifying minerals?
- Color
 - Hardness
 - Specific gravity
 - Streak
11. What property of minerals determines its TRUE color?
- Color
 - Hardness
 - Specific gravity
 - Streak
12. Anton hammers a piece of unidentified mineral. The mineral breaks into two parts with uneven surfaces. What property of mineral does it show?
- Hardness
 - Specific Gravity
 - Streak
 - Fracture

13. Which statement is incorrect about minerals?
- It is organic.
 - It has a crystal lattice.
 - It is naturally occurring.
 - It has a definite composition
14. What class of mineral is considered as the largest and most abundant group?
- Oxide class
 - Silicate class
 - Sulphate class
 - Sulfide class
15. Dan scratched a piece of unknown mineral in a glass plate. He observed that it produced a powdery substance. What property of mineral did he test?
- Color
 - Hardness
 - Specific gravity
 - Streak

Lesson

3

Physical and Chemical Properties of Mineral

Minerals are important component of the Earth's lithosphere. They are naturally occurring materials that play a significant role in human civilization. This module will give you clear understanding of the physical and chemical properties of minerals.



What's In

In the previous module, you learned that the Earth consists of four subsystems. Specifically, they are the "lithosphere" (land), "hydrosphere" (water), "biosphere" (living things), and "atmosphere" (air). These subsystems interact with each other and work together to influence the climate and Earth's environment that triggers geological processes which affect life on it.

In this lesson, you will learn common rock-forming minerals found in the lithosphere as one of the subsystems of earth as well as their physical and chemical properties.



Notes to the Teacher

This Self-Learning Module encourages learners to answer independently. However, you must orient the learners to answer ALL ACTIVITIES included in this module.



What's New

Minerals are naturally occurring substances that are harnessed and used by humans in everyday life. The poem below will give you an idea on the different characteristics of minerals.

Read the poem silently and underline the characteristics of minerals.

MINERALS

By: Razel M. Ferrer

Most minerals are derived and extracted from nature
They are crystalline solids with definite shape and structure
Minerals are found at home and present everywhere
Like in jewelries, toothpaste, make-up and mirror.

Minerals are made of chemical elements and compounds
Chemical compositions have also been found
They are naturally occurring, this we must understand
Inorganic in nature, let us add!

There are eight classes of minerals Silicates, oxides, sulphides and halides
Sulfates, carbonates, phosphates and mineraloids All minerals on earth fit on these kinds.

Minerals are distinguished through their properties
But geologists prefer their physical form instead
Habit, luster, cleavage, and hardness
Color and streak let's add on these.





What is It

Minerals are present everywhere and some examples can be found at home. Example of these are: Hematite (hinges, handles, make-up color), Chromite (chrome plating, dyes), Copper (electric wiring), Quartz (clocks, mirrors), Gold (jewelries), Feldspar (porcelain, ceramics) and Fluoride (toothpaste). Because of its importance, we need to determine its physical and chemical properties.

This part of the module will give you details on the different physical and chemical properties of minerals.

PHYSICAL AND CHEMICAL PROPERTIES OF MINERALS

Minerals can be distinguished using their physical and chemical properties.

https://www.saddleback.edu/faculty/jrepka/notes/GEomineralLAB_1.pdf

Physical properties include habit, luster, cleavage and fracture, hardness, color, and streak.

1. Crystal Habit – refers to the overall shape or growth pattern of the mineral. It can be described as equant, elongate and platy.

Equant – three dimensions of the mineral have about the same length, like that of a cube or sphere. (ei. garnet)

Elongate – forms prismatic or prism-like crystals that are thicker than the needle as in a pencil. (ei. Indicolite)

Platy – looks like a flattened and thin crystal (like plate). (ei. Wulfenite)

2. Luster - describes the appearance of a mineral when light is reflected from its surface. It can be described as opaque, transparent, dull, or shiny.

Metallic luster is opaque and very reflective like gold and silver.

Nonmetallic luster is dull, silky, greasy, and pearly like silicates.

3. Cleavage and Fracture – Cleavage refers to the tendency of minerals to break along very smooth, flat and shiny surfaces. It can be described as one, two, three, four or all direction. A mineral fracture may break along random, irregular surfaces. It can be classified as conchoidal, uneven, hackly, splintery, and earthy. Some minerals break only by fracturing, while others both cleave and fracture.

Biotite and mica have one direction, orthoclase has two directions, galena has three directions and fluorite has four directions.

Quartz has a *conchoidal fracture* while asbestos has a *splintery fracture*.

4. Hardness – is a measure of the mineral’s resistance to scratching. Harder minerals will scratch softer minerals. Friedrich Mohs in 1812 ranked minerals according to hardness as shown in Table 1. He selected ten minerals of distinctly different hardness that ranged from a very soft mineral (talc) to a very hard mineral (diamond).

Table 1

Moh’s Scale of Hardness

Scale	Mineral
1	Talc
2	Gypsum
2.5	Fingernail
3	Calcite
3.5	Copper penny
4	Fluorite
5	Apatite
5.5	Steel knife blade/glass plate
6	Orthoclase feldspar
7	Quartz
8	Topaz
9	Corundum (ruby)
10	Diamond

5. **Color** - is one of the most obvious properties of a mineral but not reliable alone. Some minerals come in just one color, while others come in many colors and varieties. Quartz varies widely in color, due to minor (parts per billion) impurities and even defects in its crystalline structure.

6. **Streak** - refers to the color of the mineral in its powdered form, which may or may not be the same color as the mineral. According to Bayo-ang (2016) streak is obtained by scratching the mineral on an unpolished piece of white porcelain called a streak plate. When the excess powder is blown away, what remains is the color of the streak. Streak is a more reliable property than color as streak shows the true color of minerals. It does not vary even if color does.

Additional Properties

There are other properties of minerals.

(https://fac.ksu.edu.sa/sites/default/files/geo_221-unit-2_0.pdf)

Magnetism - Some minerals are attracted to a hand magnet. To test a mineral for magnetism, just put the magnet and mineral together and see if they are attracted. Magnetite is the only common mineral that is always strongly magnetic.

Striations -presence of very thin, parallel grooves. The grooves are present in only one of the two sets of cleavages and are best seen with a hand lens. They may not be visible on all parts of a cleavage surface. Before you decide if there are no striations, look at all parts of all visible cleavage surfaces, moving the sample around as you look wherein light is reflected from these surfaces at different angles.

Specific Gravity - is the weight of that mineral divided by the weight of an equal volume of water. The specific gravity of water equals 1.0. Most silicate, or rock-forming, minerals have specific gravities of 2.6 to 3.4; the ore minerals are usually heavier, with specific gravities of 5 to 8. For most minerals, specific gravity is not a particularly noteworthy feature, but for some, high specific gravity is distinctive (examples are barite and galena).

Taste, Odor, Feel – Some minerals have distinctive taste (halite is salt, and tastes like it). Some give off a distinctive odor (the powder of some sulfide minerals, such as sphalerite, a zinc sulfide, smells like rotten eggs), and some have a distinctive feel (talc feels slippery).

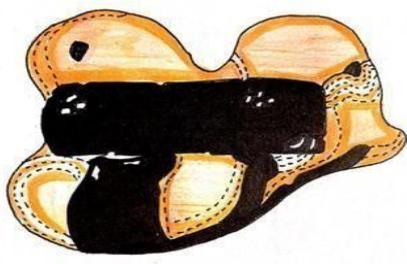
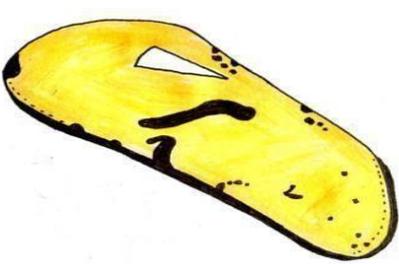
A. Chemical Properties

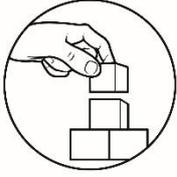
Chemical properties of minerals show the presence and arrangement of atoms in minerals. Using their chemical properties, minerals are identified by how they react to certain substances. Some minerals, especially carbonate minerals, react visibly with acid. (Usually, a dilute hydrochloric acid [HCl] is used.) When a drop of dilute hydrochloric acid is placed on calcite, it readily bubbles or effervesces, releasing carbon dioxide. Some are toxic like cinnabar and soluble in water like halite.

Metallic sulfide minerals form into sulfuric acid when exposed to air and water. Uranium and thorium containing minerals like Autunite (hydrated calcium uranium phosphate) and Thorianite (thorium dioxide) are radioactive. Metals like magnesium are flammable.

Furthermore, Cuarto (2016) classified minerals according to their chemical composition using Dana System which divides minerals into eight basic classes. The classes are native elements, silicates, oxides, sulfides, sulfates, halides, carbonates, phosphates, and mineraloids. This classification shows the chemical composition of minerals.

CLASSIFICATION OF MINERALS	EXAMPLE	DESCRIPTION
Native Elements	 <p>(Silver)</p>	<p>These minerals are naturally occurring in nature in an uncombined form with a distinct mineral structure. It can be classified as metal, semimetals and non-metals.</p>
Silicates	 <p>(feldspar)</p>	<p>This is the largest group of minerals. It contains silicon and oxygen, with some aluminum, magnesium, iron and calcium.</p>
Oxides	 <p>(magnetite)</p>	<p>It is formed from the combination of a metal with oxygen. This group ranges from dull ores like bauxite to gems like rubies and sapphires.</p>
Sulfides	 <p>(pyrite)</p>	<p>These are made of compounds of sulfur usually with a metal. They tend to be heavy and brittle.</p>

Sulfates	 <p>(gypsum)</p>	<p>These are made of compounds of sulfur combined with metals and oxygen. It is a large group of minerals that tend to be soft, and translucent.</p>
Halides	 <p>(halite/ table salt)</p>	<p>They form from halogen elements like chlorine, bromine, fluorine, and iodine combined with metallic elements. They are very soft and easily dissolved in water.</p>
Carbonates	 <p>(dolomite)</p>	<p>These are group of minerals made of carbon, oxygen, and a metallic element.</p>
Phosphates	 <p>(apatite)</p>	<p>They are often formed when other minerals are broken down by weathering. They are often brightly colored.</p>
Mineraloid	 <p>(amber)</p>	<p>It is the term used for those substances that do not fit neatly into one of the eight classes.</p>



What's More

After reading the details on the different physical and chemical properties of minerals, let's see if you understand it by answering the following activities.

A. Identify the physical properties of minerals given in the statement by arranging the jumbled letters that follow. Write your answer on your answer sheet.

- | | |
|---|------------------------|
| 1. The color of the mineral in its powdered form. | K T R S E A |
| 2. The overall shape or growth pattern of the mineral. | B I H A T |
| 3. One of the most obvious properties of a mineral. | C L O O R |
| 4. The measure of the mineral's resistance to scratching. | S D R H A N E S |
| 5. The tendency of minerals to break along very smooth, flat, and shiny surfaces. | G E C L A V A E |

B. Identify the classification of minerals that corresponds to the description below. Select from the choices inside the box. Write the letter of the correct answer on other sheet of paper.

A. Silicate	C. Halide	E. Mineraloid	G. Oxide
B. Sulfate	D. Carbonate	F. Sulfide	H. Phosphate

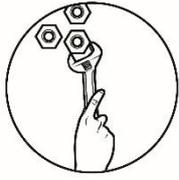
- ___ 1. Formed when other minerals are broken down by weathering
- ___ 2. Contains silicon and oxygen, with some metals
- ___ 3. Combination of sulfur with metals and oxygen
- ___ 4. Substances that do not fit neatly into one of the eight classes
- ___ 5. Combination of halogen elements like chlorine, bromine, fluorine, and iodine with metallic elements
- ___ 6. Combination of a metal with oxygen
- ___ 7. Made of carbon, oxygen, and a metallic element
- ___ 8. Combination of compounds of sulfur with a metal.



What I Have Learned

Complete the following sentences by identifying the physical and chemical properties of minerals.

1. Equant, elongate and platy are descriptions of minerals' _____.
2. The weight of the mineral divided by the weight of an equal volume of water is called _____.
3. The most obvious property of a mineral is _____.
4. Substances that do not fit neatly into one of the eight classes are called _____.
5. The largest group of minerals is _____.
6. The overall shape or growth pattern of the mineral determines its _____.
7. Minerals that are made of carbon, oxygen, and a metallic element are _____.
8. A mineral exhibit _____ if it breaks along random, irregular surfaces.
9. The measure of the mineral's resistance to scratching is called _____.
10. Minerals that are formed when other minerals are broken down by weathering are _____.



What I Can Do

Read the situation and answer the question below.

Situation:

A jeweler offers you an expensive ring with diamonds as a gift for your Mom. You doubt the authenticity of the diamonds. What measures will you take to determine its authenticity if he allows you to test it? Explain your answer. Do this in a separate sheet of paper.

Criteria	5	4	3	2	1
Explanation	All information provided is accurate. The answer demonstrates a deep understanding of the content	The answer is missing 1 detail. All information provided is accurate. The answer demonstrates understanding of the content.	The answer is missing 2 details. Almost all information provided is accurate. The answer demonstrates basic understanding of the content	The answer to the question is lacking any detail. Some information provided is accurate. The answer demonstrates a lack of understanding of the content.	Question is not answered. A small amount to none of the information provided is accurate. The answer demonstrates a lack of understanding of the content.
Textual evidence	At least 2 details from the text were included to support the claim being made. The details included were accurate, clear, and properly supported the claim.	At least 2 details from the text were included to support the claim being made. However, the details included were somewhat unclear and/or included minor errors in fact.	At least 1 detail from the text was included to support the claim being made. However, the detail included was somewhat unclear and/or included minor errors in fact.	At least 1 detail from the text was included to support the claim being made. However, the detail included was very unclear and/or included major errors in the fact.	Paragraph(s) have no textual evidence and/or all textual evidence provided is inaccurate.



Assessment

Choose the letter of the best answer. Write your answer on a separate sheet of paper.

1. Given the list of minerals below, what is the correct arrangement from hardest to softest according to Moh's Scale?

1. Quartz 2. Calcite 3. Flourite 4. Gypsum

- a. 1, 3, 2, 4 (Quartz, Florite, Calcite, Gypsum)
 - b. 1, 3, 4, 2 (Quartz, Florite , Gypsum, Calcite)
 - c. 4, 2, 3, 1 (Gypsum, Calcite , Florite , Quartz)
 - d. 4, 2, 1, 3 (Gypsum, Calcite, Quartz, Florite)
2. Angela tests a mineral sample by scratching it to white and black porcelain plate to determine its true color. What property of minerals did she test?
- a. Color
 - b. Hardness
 - c. Specific gravity
 - d. Streak
3. James Dana developed a classification scheme for minerals. Which of the following is the basis of his classification?
- a. Color of mineral
 - b. Hardness of the mineral
 - c. Location of mineral occurrence
 - d. Chemical composition of the minerals
4. Which group of minerals is most common in the earth's crust?
- a. Ore minerals
 - b. Oxides
 - c. Silicates
 - d. Sulfates

5. One of the most abundant minerals on Earth quartz. Which physical property of quartz could not be used to verify its authenticity?
- Cleavage
 - Color
 - Habit
 - Hardness
6. Which of the following is not a reliable physical property of minerals?
- Cleavage
 - Color
 - Specific Gravity
 - Hardness
7. Diamonds are used in jewelry because of its ability to reflect light that cause its brilliance or shining effect. What physical property exhibited in the aforementioned statement?
- Cleavage
 - Hardness
 - Luster
 - Streak
8. Which of the following mineral properties relates why talc is used as a component for baby powder?
- Cleavage
 - Fracture
 - Hardness
 - Streak
9. An unknown mineral sample was tested by putting a drop of HCl solution on the surface of the container. After few minutes there was a bubble formed. What chemical property of mineral was tested in the unknown mineral sample?
- Odor
 - Reaction to acid
 - Specific gravity
 - Striations

10. Scientists use a scale of 1-10 to show the hardness of a mineral. What number would be given to the hardest?
- 1
 - 5
 - 6
 - 10
11. Which refers to the color of the mineral in its powdered form, which may or may not be the same color as the mineral?
- Cleavage
 - Color
 - Luster
 - Streak
12. What property of mineral is shown if a rock breaks into an irregular pattern?
- Specific Gravity
 - Fracture
 - Hardness
 - Luster
13. Which of the following statement is TRUE about silicates?
- brightly colored minerals
 - largest group of minerals
 - very soft and easily dissolved in water
 - made of carbon, oxygen, and metallic element
14. Which of the following is not included in the group?
- Copper
 - Gold
 - Gypsum
 - Silver

15. Salt is in cooking to enhance food taste. Which group of minerals does it belong?

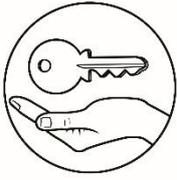
- a. Carbonates
- b. Florites
- c. Halides
- d. Sulfides



Additional Activities

Search at least three (3) other examples of minerals based on Dana Classification System. Present your answer in tabular form.

Classification of Minerals	Examples



Answer Key

What's More

A.

1. STREAK
2. HABIT
3. COLOR
4. HARDNESS
5. CLEAVAGE

B.

1. H
2. A
3. B
4. E
5. C
6. G
7. D
8. F

What's New

Crystalline
Solid
with definite shape and
structure
Made of chemicals elements
and compounds naturally
occurring

What I Know

1. A
2. C
3. B
4. C
5. C
6. C
7. C
8. B
9. B
10. A
11. D
12. D
13. A
14. B
15. B

Assessment

1. A
2. D
3. D
4. C
5. B
6. B
7. C
8. C
9. B
10. D
11. D
12. B
13. B
14. C
15. C

What I have Learned

1. habit
2. specific gravity
3. color
4. mineraloid
5. silicate
6. habit
7. carbonate
8. fracture
9. hardness
10. phosphates

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