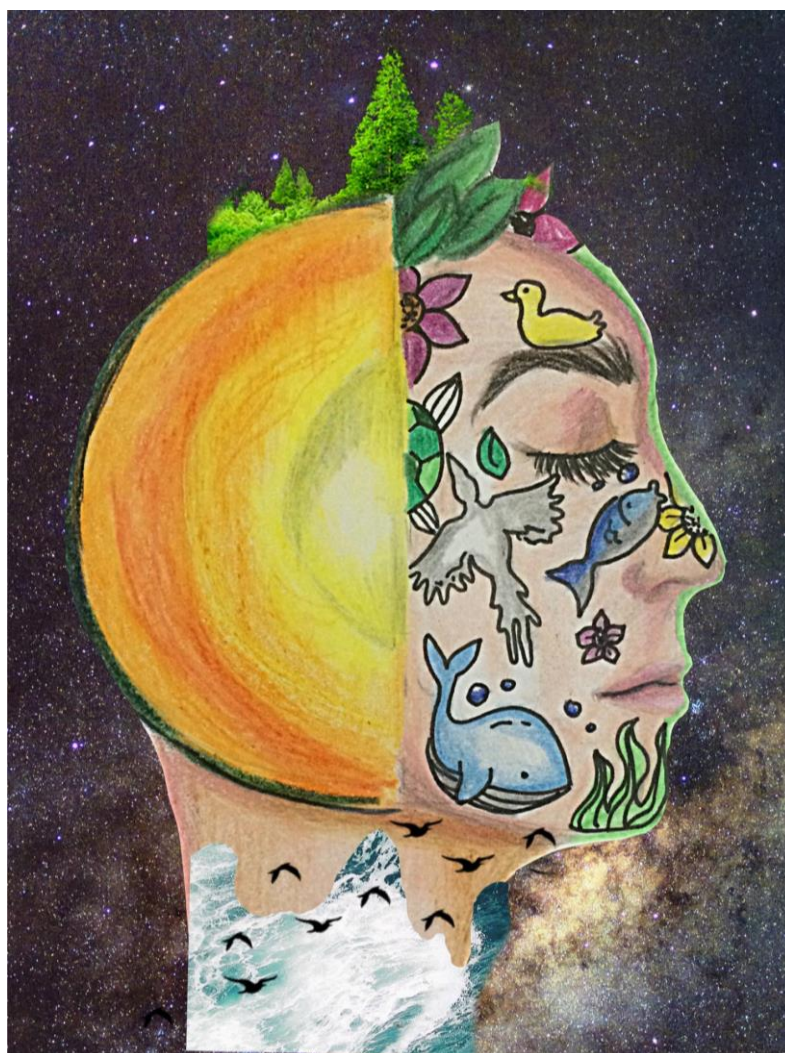


Senior High School

**SCHOOLS DIVISION OFFICE
MARIKINA CITY**

First Quarter-Module 3

Minerals and Rocks

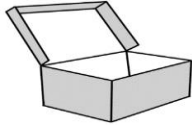


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What I Need to Know

This module was designed and written with you in mind. It is here to help you understand mineral and rocks. This module permits it to be used in many different learning situations. The language used recognizes the diverse vocabulary level of students. The lessons are arranged to follow the standard sequence of the course.

The module has two lessons, namely:

- Lesson 1 – Minerals
- Lesson 2 – Rocks

Learning Competencies:

- Identify common rock-forming minerals using their physical and chemical properties (S11/12ES-Ia-9)
- Classify rocks into igneous, sedimentary, and metamorphic (S11/12ES-Ib-10)

After going through this module, you are expected to

1. define rocks and minerals;
2. identify some common rock-forming minerals using their chemical and physical properties; and
3. classify and describe the three-basic type of rocks.



What I Know

Read each question carefully and encircle the letter of the correct answer.

1. The following are characteristics of minerals **EXCEPT** one. Which one is it?
 - A. They are solid.
 - B. They are both natural and manmade.
 - C. They have definite chemical composition.
 - D. They are never part of a living thing.
2. Quartz is a mineral. Which of the following property is present in a quartz?
 - A. It can be found in liquid state.
 - B. It is once part of a plant.
 - C. It can only be found existing in nature.
 - D. It is made by elements in different proportions.



3. Which of the following minerals belongs to the most abundant group of rock-forming minerals?
- A. Calcite
B. Dolomite
C. Feldspar
D. Magnetite
4. Calcite and quartz are minerals that look alike. They appear often colorless and look glassy. Which two properties of minerals **CANNOT** be used to identify them?
- A. Color and streak
B. Hardness and streak
C. Color and luster
D. Streak and luster
5. Of all properties of minerals, which is the **LEAST** reliable in identifying a mineral?
- A. Cleavage
B. Color
C. Luster
D. Hardness
6. Minerals have uses. Which is used as a writing material?
- A. Diamond
B. Graphite
C. Halite
D. Talc
7. Which of the following is **NOT TRUE** about rock-forming minerals?
- A. Rock-forming minerals are one of the most abundant minerals found on Earth's crust.
B. Rock-forming minerals are one of the least abundant minerals found on Earth's crust.
C. Rock-forming minerals are the one of the first minerals present at the time of a crustal rock's formation.
D. Rock-forming minerals are very important minerals in deciding the classification of rocks.
8. What is the type of rock that forms through the cooling of magma or lava?
- A. Igneous
B. Metamorphic
C. Sedimentary
D. Unconformity
9. Which of the following **DOES NOT** belong to the group?
- A. Andesite
B. Basalt
C. Diorite
D. Gabbro



10. Which of the following rocks **DOES NOT** belong to the same group as the other three?
- A. Gneiss
 - B. Marble
 - C. Shale
 - D. Slate
11. Which of the following igneous rocks is made of fine crystals?
- A. Andesite
 - B. Basalt
 - C. Granite
 - D. Rhyolite
12. A rock is seen with plant imprints. What type of rock is it?
- A. Igneous
 - B. Metamorphic
 - C. Sedimentary
 - D. Cannot be identified
13. Which of the following pairs contains one igneous and one sedimentary rock?
- A. Schist and marble
 - B. Sandstone and obsidian
 - C. Granite and limestone
 - D. Granite and gneiss
14. Which igneous rock is formed from magma?
- A. Extrusive
 - B. Gneiss
 - C. Granite
 - D. Intrusive
15. Rocks can form from dead plants and animals. What kind of rocks formed from dead plants that lived millions of years ago?
- A. Coal
 - B. Limestone
 - C. Marble
 - D. Shale



Lesson 1

Minerals



What's In

In this lesson, you will learn about what a mineral is and its physical and chemical properties. You will also learn about the most common rock-forming minerals based on their properties. This lesson will also help you understand that rocks are classified into igneous, sedimentary, and metamorphic.

Rocks are formed from minerals. How? Before you can understand how minerals form into rocks, you must understand how minerals form. For this, you must recall how elements, compounds, and mixtures differ from each other. There are also some elements and their symbols that you need to remember.

Try to recall which of the following – element, mixture, or compound – is being described:

1. This can be separated into simpler substances by chemical methods.
2. It is made of two or more substances that retain their identities when combined.
3. It is the simplest substance that cannot be broken into any other substance by chemical methods.

Now, try to recall the symbol of the following elements in the box:

- | | |
|-------------|--------------|
| 1. Oxygen | 5. Sodium |
| 2. Silicon | 6. Potassium |
| 3. Aluminum | 7. Iron |
| 4. Calcium | 8. Magnesium |

? What's New

Activity 1.1. What is in a Birthstone?

The word search puzzle contains what are known as birthstones. Find these birthstones in the puzzle and write them on a separate sheet of paper.



Birthstones are gemstones that represent the month of a person's birth. For example, if a person is born in September, what is the person's birthstone? A birthstone is technically or exactly a mineral. So, what is a mineral?



What Is It

Properties of a Mineral

To understand what a mineral is, you must know that all minerals have five defining characteristics or properties. These properties are:

1. *Solid* – (Minerals are neither liquid nor gas.)
2. *Inorganic* – (Minerals have never been alive.)
3. *Naturally occurring* – (Minerals are found in nature.)
4. *Crystalline structure* – (The atoms of a mineral are arranged in an exact pattern unique to that mineral.)
5. *Definite chemical composition* – (A mineral is made of exact chemicals unique to that mineral.)

Therefore, a mineral is an element or a chemical compound that is solid, inorganic, naturally occurring, has crystalline structure, and has definite chemical composition.

What are minerals made of? Most minerals are made of elements that combined chemically, making them compounds. However, there are minerals that are made only of one element. For example, diamond and graphite are minerals that are made only of the element carbon. Minerals are the building blocks of rocks. This means that rocks are made of a mixture of minerals.

Rock-forming Minerals

There are about 4000 minerals that are known, but only a few of these minerals make up most of the rocks on Earth's crust. These minerals are known as **rock-forming minerals**. The criteria to be considered whether a mineral is rock forming or not are as follows: 1) one of the most abundant minerals on Earth's crust; 2) one of the first minerals present at the time of a crustal rock's formation; and 3) be a very important mineral in deciding a rock's classification. The most rock-forming minerals are made by the elements, oxygen, silicon, aluminum, calcium, sodium, potassium, iron, and magnesium.

The table below shows the most common rock-forming minerals, their properties, and examples.

Table 1.1. Most common rock-forming minerals

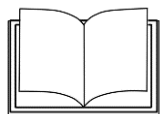
Mineral	Characteristic	Example
Silicates	<ul style="list-style-type: none"> - Most common group of minerals - Made mostly of a few of the elements Na, K, Al, Ca, Mg, Fe, Li, Si, and O 	Feldspar, quartz
Oxides	Made mostly of oxygen and a metal	Hematite, magnetite
Carbonates	Composed of carbonate (CO ₃) compounds	Calcite, dolomite

Properties of minerals

Minerals have properties that are used in identifying them.

1. *Color* – It is the most easily observed property in minerals. But is the least used in identifying minerals. Minerals may have the same color. For example, fluorite and amethyst are both purple in color. Some minerals have different colors. For example, quartz can be colorless, pink, rose, or purple.
2. *Luster* – It refers to the way a mineral shine in reflected light. The three major types of luster are metallic, glassy (vitreous), and dull.
3. *Streak* – The streak of a mineral is the color of the powder that is left when rubbed against an unglazed or rough surface.
4. *Cleavage* – The cleavage of a mineral is its tendency to split easily or to separate along flat surfaces
5. *Fracture* – Minerals that don't break along cleavage surfaces are said to have fracture.
6. *Hardness* – The hardness of a mineral is its resistance to being scratched. It follows the Mohs Scale of Hardness where talc has 1 (softest) in the hardness scale, while diamond has the hardness of 10 (hardest).
7. *Specific gravity* - The specific gravity of a mineral describes the density of the mineral
8. *Crystal shape* - Minerals have specific crystals if they have time to form crystals. They can be a very useful property in identifying minerals.
9. Some other properties used to identify minerals are *fluorescence*, *taste*, *smell*, and *radioactivity*.





What's More

Activity 1.2. Identifying Some of the Properties of Table Salt (Halite)

Use table salt or halite to demonstrate the different properties of minerals. Copy the table on a separate sheet of paper. Then, write the description fitting the property of table salt. Some of the answers are already given.

Property of table salt (halite)	Specific description of the property
Color	
Streak	
Luster	
Taste	
Hardness	2- 2.5
Crystal form	Cubic
Chemical composition (formula)	
Specific gravity	Light (2.2)

Activity 1.3. Mineral or Not?

A. Identify whether the given is a mineral or not. Put a check (/) mark on the numbers you identify as minerals. Write your answers on a separate sheet of paper.

- | | |
|--------------------------|--------------------------------------|
| 1. Water | 6. Sugar |
| 2. Diamond | 7. <i>Tawas</i> (gypsum) |
| 3. Dried leaf | 8. Granite |
| 4. Carbon dioxide | 9. Fossilized bone |
| 5. Potassium-rich banana | 10. Synthetic element like Americium |

B. For the identified minerals on part A, describe the properties (physical or chemical) of each mineral.



What I Have Learned

Activity 1.4. Lesson Summary

Answer briefly what is asked about minerals. Write your answers on a separate sheet of paper.

1. Which group of rock-forming minerals are the most abundant? Give at least two examples.
2. What properties or characteristics define a mineral?
3. How does streak differ from color? Why is streak more reliable for rock identification?
4. When is a mineral considered a rock-forming mineral?
5. What are your personal take-aways about minerals? How will these learnings help you in your everyday life?



What I Can Do

Minerals have several uses in our daily lives. Examples are halite (salt) for cooking, graphite (pencil) for writing, and diamond and gold as jewelry.

Activity 1.5. Daily Applications of Minerals

Cite five (5) examples of minerals and write their uses in your daily living. Write your answers on a separate sheet of paper.



Assessment

Read each question carefully and encircle the letter of the correct answer.

1. The following are characteristics of minerals **EXCEPT** one. Which one is it?
 - A. They are solid.
 - B. They are both natural and manmade.
 - C. They have definite chemical composition.
 - D. They are never part of a living thing.

2. Quartz is a mineral. Which of the following property is present in a quartz?
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 - A. Calcite
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 - C. Feldspar
 - D. Magnetite
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 - C. Color and luster
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 - B. Rock-forming minerals are one of the least abundant minerals found on Earth's crust.
 - C. Rock-forming minerals are the one of the first minerals present at the time of a crustal rock's formation.
 - D. Rock-forming minerals are very important minerals in deciding the classification of rocks.





Additional Activities

Use the chart below to identify minerals in the food that you eat. These minerals are usually listed in the nutritional fact section of the food label. The first one is done for you. Write as many minerals you can find in food. (Note: According to the <https://www.accessdata.fda.gov/>, there are at most 14 minerals that may be listed on the *Nutrition Facts* label).

Table 1.2. Minerals in food and their uses

Mineral	Use
Calcium	For healthy bones and teeth

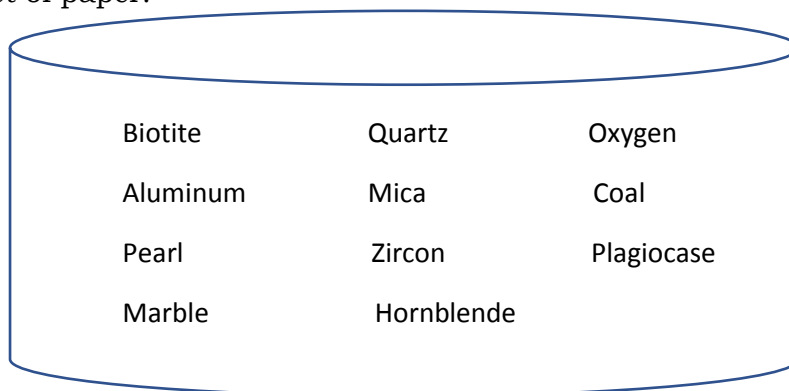
Lesson 2

Rocks



What's In

In Lesson 1, you learned about minerals and their properties and characteristics. Choose from the list in the cylinder those that are minerals. Write them on a separate sheet of paper.



? What's New

The minerals included in the list above make up the rock that is in the picture below. What kind of rock do you think is this?



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Sources (From left to right):

- (1) "Pumice". Opengeology.org. Accessed August 13, 2020. https://opengeology.org/textbook/wp-content/uploads/2016/07/04.9_Pumice_stone-e1495052465796-298x300.jpg
- (2) "Pumice". Highlandsoaps.com. Accessed August 13, 2020. http://www.highlandsoaps.com/media/catalog/product/cache/1/image/900x900/0dc2d03fe217f8c83829496872af24a0/p/u/pumice_foot_file_zoom_7.jpg

The rock on the (left) in the previous page is a pumice. This type of rock is popularly used as *panghilod* (right) among Filipinos. A pumice is a rock made up of the minerals found in the list above (*What's In*).



What Is It

Rocks are a mixture of minerals. They are made of a combination of two or more minerals. Based on their mode of formation, they are classified as igneous, sedimentary, and metamorphic.

Igneous Rocks

- Igneous rocks are rocks formed when magma or lava solidified.
- Igneous rocks are **intrusive** or *plutonic* if they form below the surface of the earth. They have large crystals. Examples of intrusive igneous rocks are granite, diorite, and gabbro.

- Igneous rocks are **extrusive** or *volcanic* if they form on the surface of the earth. These rocks have no or small crystals. Examples of extrusive igneous rocks are rhyolite, andesite, obsidian, and basalt.



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Figure 2.1. Examples of Igneous Rocks.

Source: "Igneous Rocks". [Openpress.usask.ca](https://openpress.usask.ca/physicalgeology/chapter/7-3-classification-of-igneous-rocks-2/). Accessed August 13, 2020.
<https://openpress.usask.ca/physicalgeology/chapter/7-3-classification-of-igneous-rocks-2/>

Sedimentary Rocks

- Sedimentary rocks are rocks that formed through the cementation of sediments: clay, sand, pebbles, gravel, and plants or animal remains. Formation of sedimentary rocks involve processes that include weathering of rocks, transport and deposition of sediments. Last of these sedimentary processes are compaction and cementation.
- Sedimentary rocks are generally classified into two: clastic and non-clastic. **Clastic rocks** are made of grains or fragments of rocks and/or minerals that have been eroded, transported, deposited, and cemented together. Examples of clastic sedimentary rocks are conglomerate, breccia, shale, siltstone, and sandstone. **Non-clastic rocks** are formed from sediments that precipitated from concentrated solutions, like seawater. They are also formed from the accumulation of once living matter like shells and plant parts. Non-clastic rocks are further classified as biological or chemical, based on their chemical composition. Examples of non-clastic rocks are halite, dolomite, gypsum, limestone (chemical), coal, and coquina (biological).



This Photo by Unknown Author is licensed under CC BY-SA-NC
Source: "Igneous Rocks".

Openpress.usask.ca Accessed August 13, 2020

https://openpre Figure 2.2. Examples of Sedimentary Rocks. lastic_table.png

Metamorphic Rocks

- Metamorphic rocks are formed when high heat and pressure changes the original or parent rock into a completely new rock.
- The parent rock can be either sedimentary or igneous. It can even be another metamorphic rock.
- Metamorphic rocks are **foliated** when their mineral grains flatten and line up in parallel layers. Light and dark bands are observed. Examples of foliated metamorphic rocks are gneiss, slate, and schist. Metamorphic rocks are **non-foliated** if their mineral grains do not form bands. Examples of non-foliated metamorphic are quartzite and marble.



(a) Slate, near to Golden, BC



(b) Phyllite, location unknown



(c) Schist, location unknown



(d) Gneiss from the Victoria area, BC

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Source: "Metamorphic Rocks". Opentextbc.ca. Accessed August 13, 2020.
<https://opentextbc.ca/geology/chapter/7-2-classification-of-metamorphic-rocks/>

The chart below shows the classification of rocks, the grouping for kind of rock, and examples for each group.

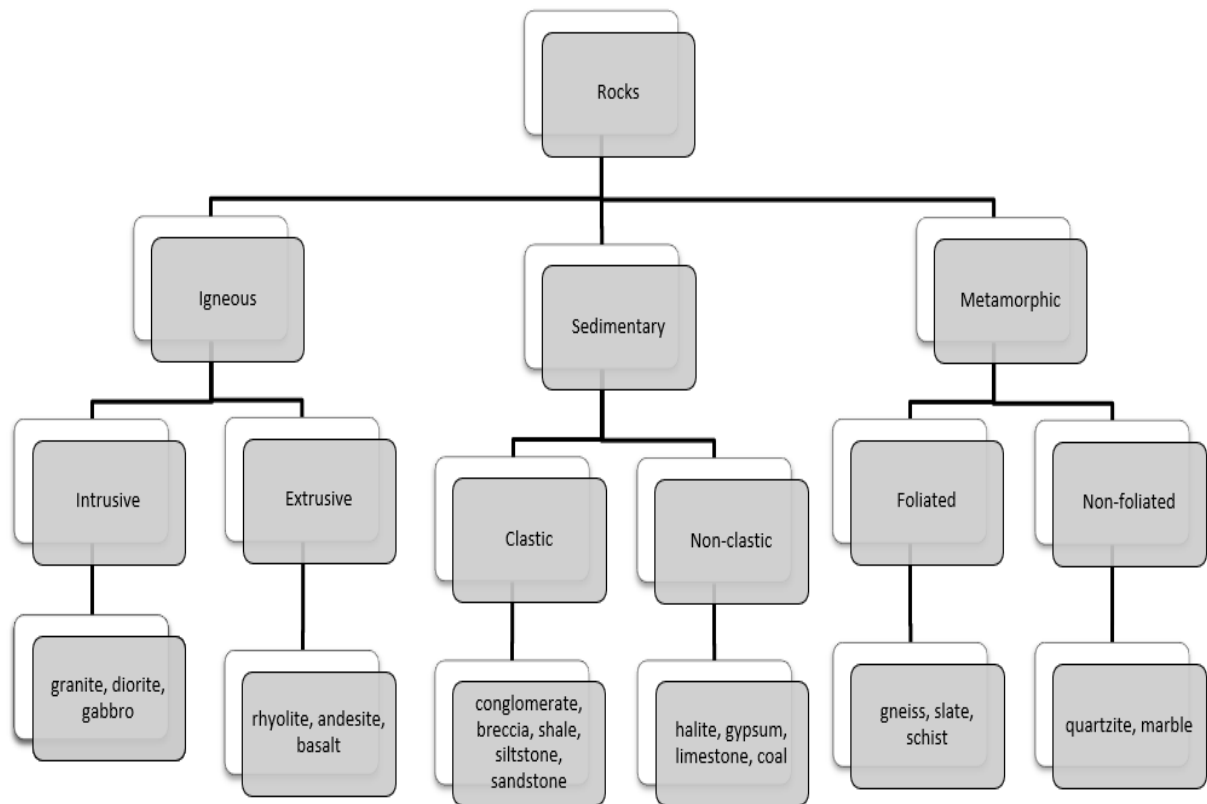
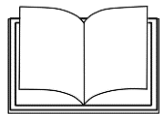


Figure 2.4. Classification of Rocks with their Specific Types and Given Examples.



What's More

Activity 2.1 Classifying Rocks

Classify the following rocks as igneous, sedimentary, or metamorphic. Write **I** for igneous, **S** for sedimentary, and **M** for metamorphic. Write your answers on a separate sheet of paper.

- | | |
|--------------|--------------|
| 1. Marble | 6. Shale |
| 2. Limestone | 7. Granite |
| 3. Coal | 8. Quartzite |
| 4. Basalt | 9. Obsidian |
| 5. Pumice | 10. Dolomite |



What I Have Learned

Activity 2.2 Lesson Summary

Use the 3Ws to help you understand what you learned and their value. Do this activity on a separate sheet of paper.

1. **What?** (Give the three types of rocks and briefly describe each.)
2. **So what?** (What is the importance of knowing the three types of rocks?)
3. **What now?** (How will you apply what you learned in your life? Or, what would you like to learn more about this topic?)



What I Can Do

Activity 2.3 My Rock

Find a rock around your house. Write a story about this rock – what type it is (igneous, sedimentary, or metamorphic), what it could be based on its observable characteristics, what minerals it is made of, where it came from, etc. Include in your story the future of this rock, or where it might end up in. Give your rock a good back story. Then, draw your rock.

Read each question carefully and encircle the letter of the correct answer.





Posttest

1. What type of rock forms through the cooling of magma or lava?
A. Biochemical
B. Igneous
C. Metamorphic
D. Sedimentary
2. Which of the following **DOES NOT** belong to the group?
A. Andesite
B. Basalt
C. Diorite
D. Rhyolite
3. Which of the following rocks **DOES NOT** belong to the same group as the other three?
A. Gneiss
B. Marble
C. Shale
D. Slate
4. Which of the following igneous rocks is made of fine crystals?
A. Andesite
B. Basalt
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5. A rock is seen with plant imprints. What type of rock is it?
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D. Cannot be identified
6. Which of the following pairs contains one igneous and one sedimentary rock?
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C. Granite and limestone
D. Granite and gneiss
7. Which igneous rocks form from magma?
A. Extrusive
B. Gneiss
C. Granite
D. Intrusive
8. Rocks can form from dead plants and animals. What kind of rocks formed from dead plants that lived millions of years ago?
A. Coal
B. Limestone
C. Marble
D. Shale



Additional Activities

Do the crossword puzzle below. Write your answers on a separate sheet of paper.

Across

- 2. form from lava
- 6. sedimentary, cemented sediments
- 7. limestone, coquina, mudstone
- 8. form from magma

Down

- 1. marble schist gneiss
- 3. intrusive or extrusive
- 4. an example of igneous rock
- 5. metamorphic with bands



Posttest

Read each question carefully and encircle the letter of the correct answer.

1. The following are characteristics of minerals **EXCEPT** one. Which one is it?
 - A. They are solid.
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 - B. Hardness and streak
 - C. Color and luster
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 - A. Diamond
 - B. Graphite
 - C. Halite
 - D. Talc

7. Which of the following is **NOT TRUE** about rock-forming minerals?
 - A. Rock-forming minerals are one of the most abundant minerals found on Earth's crust.
 - B. Rock-forming minerals are one of the least abundant minerals found on Earth's crust.
 - C. Rock-forming minerals are the one of the first minerals present at the time of a crustal rock's formation.
 - D. Rock-forming minerals are very important minerals in deciding the classification of rocks.

8. What is the type of rock forms through the cooling of magma or lava?
 - A. Biochemical
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15. Rocks can form from dead plants and animals. What kind of rocks formed from dead plants that lived millions of years ago?
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