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Science

Quarter 4 – Module 1:
How Rocks Turn into Soil

ALTERNATIVE DELIVERY MODE
ADM

Science– Grade 5
Alternative Delivery Mode
Quarter 4 – Module 1: How Rocks Turn into Soil
First Edition, 2020

Published by the Department of Education
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Undersecretary: Diosdado M. San Antonio

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Printed in the Philippines by _____

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Science

Quarter 4 – Module 1:
How Rocks Turn into Soil

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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 module was designed and written with you in mind. It is here to help you understand how rocks turn into soil. The scope of 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. But the order in which you read them can be changed to correspond with the textbook you are now using.

This module will help you describe how rocks turn into soil.

The module is divided into two lessons, namely:

- **Lesson 1** – Mechanical Weathering
- **Lesson 2** – Chemical Weathering

After going through this module, you are expected to:

1. differentiate mechanical and chemical weathering;
2. appreciate the importance of weathering; and
3. perform how mechanical and chemical weathering occurs.

What I Know

Directions: Read and understand the sentences well. Fill in the blanks with the correct answer. Write your answers in your Science notebook.

weathering	carbonic acid
disintegration	decomposition
chemical weathering	soil
sulfuric acid	water
temperature	nitric acid
mechanical weathering	

1. _____ is the physical wearing away of rocks.
2. _____ involves a change in the composition of rocks that allows them to break down into pieces.
3. _____ is the breaking of rocks into smaller pieces.
4. Chemical weathering is also called _____.
5. The continuous change of _____ causes rocks to break.
6. Physical weathering is also called _____.
7. _____ is a valuable material where most terrestrial plants grow.
8. The common mixture combines with other element compounds in the chemical weathering process is called _____.
9. The _____ is formed by the mixture of carbon dioxide and water.
10. _____ is a strong acid that easily melts rocks and their minerals.

Lesson 1 Mechanical Weathering

The crust of the Earth is a layer that covers the entire surface of the planet and is the top component of the lithosphere. The surface of the earth is always changing. Some changes occur very slow while others take place very rapidly. These changes are brought about by many factors. Some factors are caused by natural forces such as volcanic eruptions and earthquakes, others from human activities, animal actions, or even the growth of plants.

The main cause of soil formation is weathering. Weathering is the wearing away of rocks or the breaking of rocks into fragments. It is an important process that helps shape the surface of the Earth. Weathering occurs when rocks near or on the surface of the Earth are exposed to air, water, and other living things. Rocks break up into smaller pieces and resulted in the formation of soil and different landforms. This is also the reason why we have an amazing rock formation. Weathering can be classified into two general types: mechanical or physical weathering and chemical weathering. In this lesson, we will study the processes of mechanical weathering.

What's In

Directions: Analyze the puzzle below. Find five (5) words related to mechanical weathering inside the box. Write your answers in your Science notebook.

h	e	l	a	r	g	e	t	n	i	s	i	r
y	m	i	p	c	g	o	h	a	y	e	f	o
w	e	a	t	h	e	r	i	n	g	r	h	c
y	x	s	d	e	y	k	r	g	h	o	e	k
l	h	g	o	m	e	s	o	x	d	s	e	s
i	s	e	p	i	a	d	i	t	a	i	z	a
o	d	m	e	c	h	a	n	i	c	a	l	p
s	x	i	b	a	m	i	o	k	a	n	s	z
n	a	g	n	l	r	y	e	a	p	l	g	o
a	b	r	a	s	i	o	n	y	o	n	l	n

What's New

Figure 1: Boulder (Photo Source: Spragg, 2016)

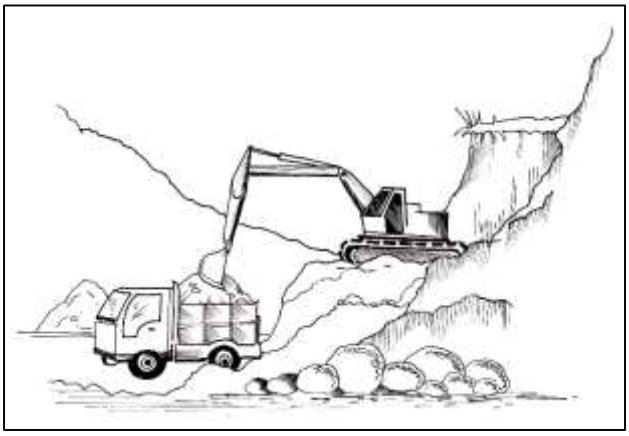
Figure 1 shows a boulder that was separated from a larger mass of rock and has been exposed to the heat of the sun during the day and has been cooled off at night time. Because of the temperature changes the boulder eventually cracked and broke up further into smaller pieces and particles.

What causes the boulder to crack? What will happen if the boulder is constantly subjected to temperature changes?

What is It

Mechanical weathering refers to the process by which rocks disintegrate into small particles due to change in temperature, human activities, and the actions of plants, animals, and frost. In this process, the physical characteristics of rocks are changed but their chemical composition remains the same. It occurs when water enters cracks and crevices of rocks and exerts more pressure, causing the rocks to break.

Rocks are made up of different types of minerals that expand and contract at various rates when exposed to temperature changes. When rocks are heated during the day, they expand. At night time, the temperature drops and cools off, causing rocks to release heat and contract. This continuous expansion and contraction of rocks affect their mineral composition that causes some rocks to crumble and fall apart. This type of mechanical weathering is called thermal expansion.



Illustrated by Ryan A. Machate

Figure 2. A mining site showing mechanical weathering caused by human activity

Many of the changes that humans have made to the environment, involves the breakdown of rocks, either directly or indirectly. When people build homes, schools, roads, bridges, and other infrastructures for any construction purposes, they usually make use of rocks for durability. Other activities like quarrying, making tunnels, landscaping, and mining as shown in Figure 2, also break rocks into pieces. This type of mechanical weathering made by humans transforms rocks into different sizes and shapes to suit their needs.

Illustrated by Reyson Joe G. Cañedp

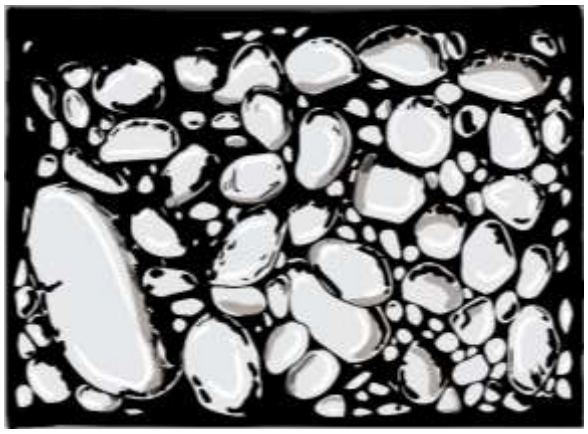
Figure 3: An example of a plant's contribution to mechanical weathering

Plants grow in different places. Some may even grow on rocky areas or rock surfaces. To get water, their roots are forced to make their way into the cracks of rocks (Figure 3). As they grow, their need for water and mineral increased. Their strong roots then, pushed their way deeper into the rocks, causing them to fall apart.

Illustrated by Reyson Joe G. Cañedo

Figure 4. Pigs use their snouts to loosen the soil

Activities of some animals may also expose rocks on the surface of the soil. Pigs loosen the soil with their snouts as shown in Figure 4. Earthworms, frogs, and termites burrow and live underground. When rocks are exposed to the different elements in the environment such as heat, cold, or water, they break into smaller pieces faster.



Illustrated by Kristina C. Aguirre

Figure 5. *Fragments abrade the bedrock or the solid rock layer beneath the stream or river*

Aside from human activities, plants, and animals, other factors that contribute to mechanical weathering include abrasion, exfoliation, temperature changes, and rain. Abrasion is a major mechanical physical weathering process. This means that rocks can break up by abrasion or by rubbing against each other. It occurs when rock fragments are being carried along by agents of erosion, such as water in streams or rivers (Figure 5).

Illustrated by Reyson Joe G. Cañedo

Figure 6. When the surface of rocks becomes wet, moisture penetrates pores, and crevices between mineral grains and reacts with the feldspar

Exfoliation is another significant process of mechanical weathering. This refers to the scaling off or peeling off successive shells from the surface of rocks. It occurs in coarse-grained rocks that contain the mineral feldspar (Figure 6). A chemical change will occur. Note that exfoliation is a physical process caused by a chemical change.

Illustrated by Reyson Joe G. Canedo

Figure 7. An example of parched soil which is the effect of bushfires

Rocks are subject to constant temperature change as the weather changes. This means that as the temperature rises during the day, rocks expand, and as the temperature falls at night, they contract. Only extreme temperature changes, such as those resulting from forest and bushfires as shown in Figure 7, caused rocks to crack or flake off at the surface.

What's More

Directions: Perform the activities by following each step carefully. Observe it properly and write your answers for the guide questions in your Science notebook.

Activity 1: Mechanical Weathering: Pounding

Things you need:

- 1piece of chalk
- hammer
- A piece of cloth

Reminder:

- *Do not play with the hammer and chalk*

What to Do:

1. Wear goggles.
2. Get a piece of chalk and enclose it with a piece of fabric.
3. Pound it using a hammer. (Be extra cautious in using it.)
4. Observe what happens to the piece of chalk.

Guide Questions

1. What happened to the piece of chalk when beaten with a hammer?
2. What sort of progress did the piece of chalk go through? Why?

Activity 2. Independent Practice

Things you need:

- Clean can (large size)
- A glass of water
- 6 pcs of soft rocks/stones
- A piece of cloth
- A Rubberband

What to do:

1. Put some delicate/soft stones in a clean can loaded up with water and cover it firmly.
2. Shake the can vigorously for about thirty (30) seconds.
3. Drain the water, at that point, put the substance in a compartment with a piece of fabric.
4. Remove the stones and analyze what is left.

Guide Questions

1. Where did the small grains of rocks/stones come from?
2. What might have caused it? Why?

Lesson 2 Chemical Weathering

Rocks are made up of mineral crystals, other solid masses found naturally, and even in fossils. These mineral crystals in rocks have definite chemical compositions that react readily when exposed to air and water. Chemical weathering occurs when the chemical composition of rocks changes. The minerals that make up the rock may undergo chemical changes, which may result in the weakening and breaking down of rocks.

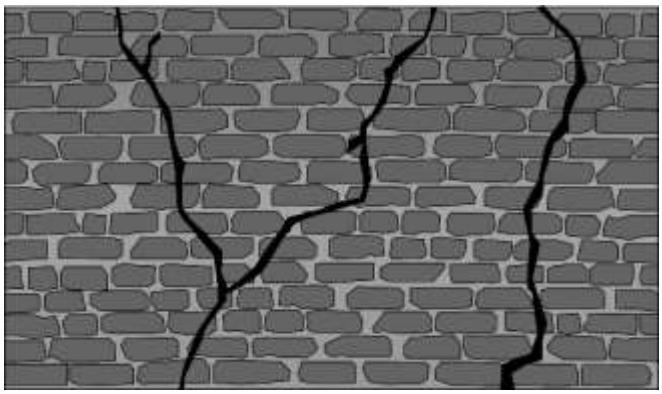
What's In

Directions: Below are jumbled letters. Arrange them accordingly to form a word related to weathering. Write your answers in your Science notebook.

1. UQARYNGRI
2. BOURWRING
3. TPASNL
4. SMILANA
5. AHUMN
6. ERATMERPUE

What's New

What do you see in Figure 8? What has caused the wall to crack? How did the wall crumble and breaks?



Illustrated by Jose Marie E. Baculi

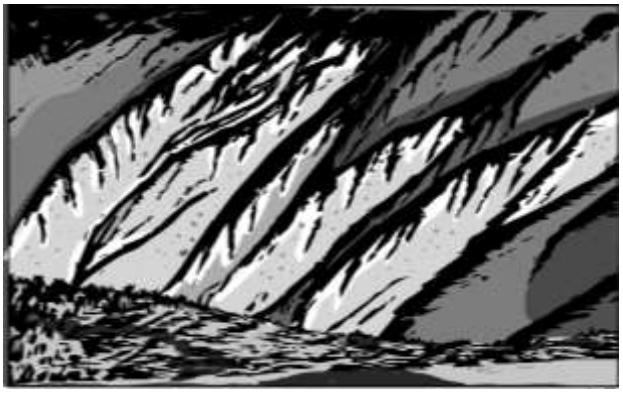
Figure 8: Cracks developed in a brick wall

What is It

Weathering is an important process that helps shape the surface of the Earth. Weathering is the breaking up of rocks into smaller pieces or particles. Weathering may break a large, solid mass of rocks into loose fragments. It includes two processes, disintegration and decomposition. The disintegration of rocks is a physical process of breaking down rocks into fragments, while the decomposition of rocks is the chemical reaction of the minerals present in rocks when exposed to air and water. In this lesson, we will study the chemical process of weathering.

Chemical weathering happens when mineral crystals in rocks react with water and air. It is the process by which new substances are formed from minerals found in rocks. This causes decomposition or changes in the chemical make-up of rocks causing them to crumble. Water is used in the process to interact with minerals found in many rocks. One type of mineral transforms into another.

Chemical weathering refers to the breaking down of rocks into smaller pieces due to the action of some elements and compounds in the environment like oxygen, carbon dioxide, and water. The chemical composition of the rocks is changed during this process, which causes minerals to decompose and even dissolve. Water, oxygen, carbon dioxide, and acids are the most common causes of chemical weathering.



Illustrated by Kristina C. Aguirre and Reyson Joe G. Canedo

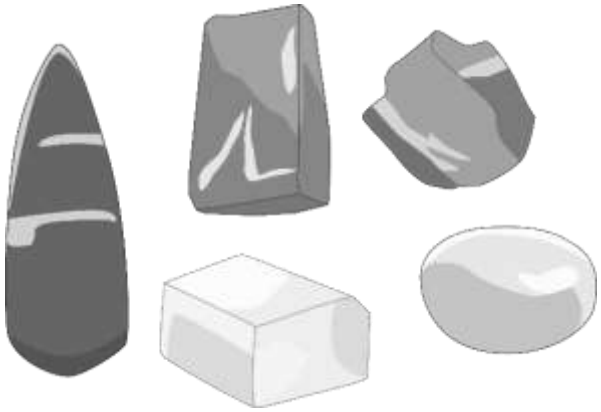
Figure 9: An example of chemical weathering. Feldspar has changed chemically forming clays which are easily eroded

Water can dissolve many minerals. Rocks may either change in composition or fall apart. For instance, when the mineral feldspar combines with water, it changes to a clay material called kaolinite as shown in Figure 9. Water may also combine with some gases in the air to form an acid which can change the composition of the rocks with which it comes into contact.

Illustrated by Jose Marie E. Baculi

Figure 10. An example of a rusty rock on its surface

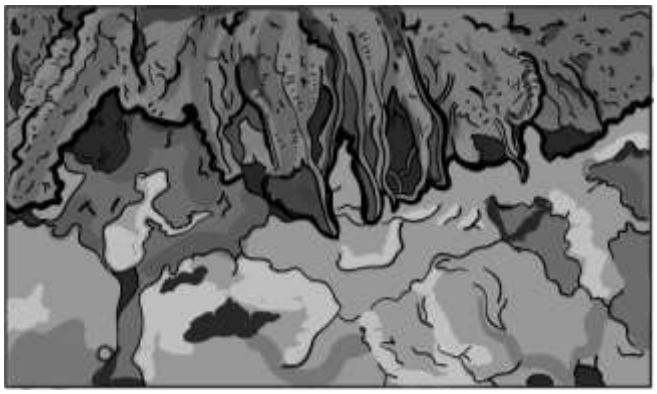
Some minerals found in rocks, especially iron compounds, readily combine with the oxygen in the air. When these rocks are exposed to air, the iron combines with oxygen. The reaction of oxygen and iron form iron oxide or rust as shown in Figure 10. This process is called oxidation. Rocks containing rust particles easily crumble into pieces.



Illustrated by Jose Marie E. Baculi

Figure 11. An example of calcite stones

Acids may be formed when water combines with different substances in the environment. When water combines with carbon dioxide, carbonic acid is formed. Carbonic acid is a weak acid from rainwater and carbon dioxide. This acid, as it drains on the ground, dissolves some minerals present in the rocks. This acidic water is more effective than pure water in dissolving some minerals present in rocks. This acid attacks and dissolves a mineral called calcite, which, just like iron, cements rock fragments together. Rocks made up of calcite, such as limestone, sandstone, and marble can be broken down this way. Consequently, the rocks crumble into smaller fragments or fine particles known as soil.



Illustrated by Reyson Joe G. Canedo

Figure 12: An example of a carbonic acid rock

Chemical wastes such as nitrogen oxide and sulfur oxide from burning fuels or volcanic eruptions, mix with water vapor in the air. The mixture of nitrogen oxide and water produces nitric acid while the mixture of sulfur dioxide and water produces sulfuric acid. Sulfuric acid is a strong acid that easily dissolves rocks and their minerals. Acid rain occurs when these acids fall to the ground as rain. On the other hand, carbonic acid is a weak acid that can dissolve some mineral content in rocks. The removal of these minerals may weaken the rock structures, causing rocks to break into smaller pieces.

What's More

Directions: Perform the activities by following each step carefully. Observe it properly and write your answer for the guide questions in your Science notebook.

Activity 1. Chemical Weathering

You will need:

- A piece of chalk
- 1 tablespoon of vinegar
- 1 container
- 1 Goggle

What to do:

1. Get a piece of chalk.
2. Place it in a container and pour the vinegar on it.
3. Observe what happens to the piece of chalk.

Guide Questions

a. What happened to the piece of chalk when you poured the vinegar on it?
b. How did the vinegar respond to the chalk?
c. What sort of progress did the piece of chalk go through?

Activity 2: Independent Practice

Things you need:

- 15 pieces of rocks
- A paper and pen
- 3 large plastic jars or containers with covers
- Water
- Masking tape
- Vinegar

What to do:

1. Label each container with the corresponding numbers (1, 2, and 3). Put five bits of rocks in each marked container.
2. Jars 1 and 3 will be loaded up with water, while Jar 2 will be half loaded up with vinegar.
3. Shake the Jars 1 and 2 vigorously for five (5) minutes, at that point put in a safe spot or rest for five (5) minutes also.
4. For Jar 3, let the water stand for ten (10) minutes, without shaking it.
5. Observe what happened to the stones in the three containers/jars.
6. Remove the stones from the containers after 10 minutes.
7. Examine the measure of rock particles from the stones.

Guide Questions

a. How do the piles of rocks in containers 1, 2, and 3 contrast?
b. What causes the changes in the stone?

What I Have Learned

Directions: Read and understand the paragraph. Supply the missing words by filling in the blanks. Choose the correct answer from the terms given inside the box. Write your answers in your Science notebook.

mechanical weathering	chemical weathering
temperature	rocks
disintegrate	decompose

1._____ are composed of various minerals that expand and contract in response to 2._____changes. When heated during the day, rocks expand, and when the temperature drops at night, they contract. The mineral composition of rocks is affected by their continuous expansion and contraction. 3._____is the process by which rocks crumble and fall apart.

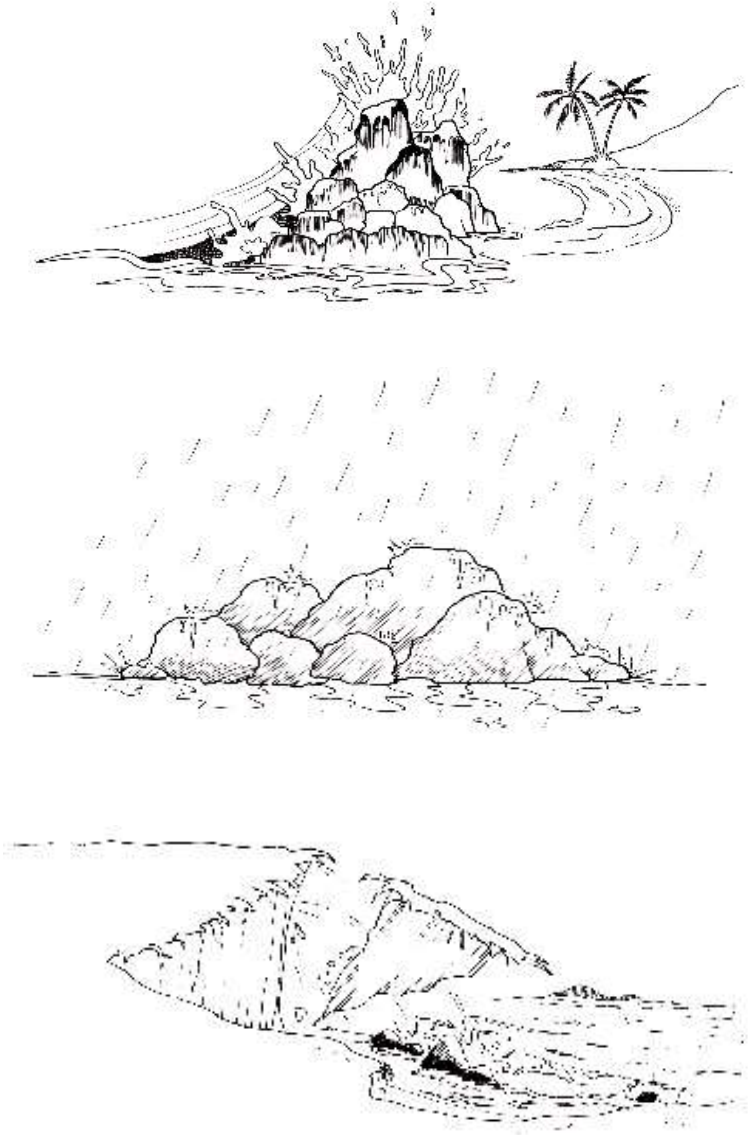
When mineral crystals in rocks react with water and air, 4._____ occurs. It is the process of forming new substances from minerals found in rocks. During this process, the chemical composition of the rocks changes, causing minerals to decompose and even dissolve. Rocks 5._____ as a result of the action of certain elements and compounds in the environment, such as oxygen, carbon dioxide, and water.

What I Can Do

A. Directions: Read and understand the sentences well. Identify the number of the statement in the sequence that describes mechanical weathering. Write your answers in your Science notebook.

1. When rocks are exposed to hot and cold temperature
2. When rocks are exposed to air.
3. Breaking of rocks due to different human activities
4. When quarrying and blasting the rocks
5. When plants grow in rocks

B. Directions: Analyze the pictures below. Then answer the following questions in your science notebook.



Illustrated by Ryan A. Machate

Based on your analysis in the illustrations above, describe how rocks turn into soil.

1. How do rocks break into pieces?
2. How does the chemical weathering process break down rocks into particles?

Assessment

A. Directions: Read and understand the sentences well. Write **True** if the statement is correct and **False** if it is not, then underline the word/phrase that made the statement false. Write your answers in your Science notebook.

1. Weathering is the process of soil formation.
2. Disintegration is also known as chemical weathering.
3. Rocks on the surface of the Earth do not change by weathering.
4. When water freezes, it expands and exerts more pressure on the rocks causing the rocks to break.
5. Disintegration is a mechanical process that breaks rocks into smaller pieces.

B. Directions: Read the statements carefully. Choose the letter of the correct answer. Place your answers in your Science notebook.

1. It is the breaking down of rocks into fragments.
   A. Erosion C. Runoff
   B. Flooding D. Weathering

2. A type of weathering that involves a change in the composition of the rock.
   A. Chemical C. Both chemical and mechanical
   B. Mechanical D. None of these

3. What do you call the process by which humans extract stones from the mountains for construction purposes?
   A. Digging C. Weathering
   B. Flattering D. Quarrying

4. What will happen to a rock when it is exposed to higher temperatures?
   A. Contracts C. Expands
   B. Evaporates D. Sinks

5. Which of the following is NOT a factor that causes chemical weathering?
   A. water C. oxygen
   B. open-field D. carbon dioxide

Additional Activities

Diamond is one of the most expensive stones in the world. It is a kind of gem or gemstone. Gemstones are precious stones that are cut, shaped, and made into jewelry. They are very attractive and most of them are very expensive too. They come in different colors and hardness. Their value depends on their luster and clarity.

Before being used as jewelry, what could be done with this gemstone to make them more beautiful and expensive? Write your answer in your Science notebook.

Answer Key

What I Know

1. mechanical weathering
2. chemical weathering
3. weathering
4. decomposition
5. temperature
6. disintegration
7. soil
8. water
9. carbonic acid
10. sulfuric acid

Lesson 1

What's In

h	e	l	a	r	g	e	t	n	i	s	i	r	
y	m	i	p	c	g	o	h	a	y	e	f	o	
w	e	a	t	h	e	r	i	n	g	r	h	c	
y	x	s	d	e	y	k	r	g	h	o	e	k	
l	h	g	o	m	e	s	o	x	d	s	e	s	
i	s	e	p	i	a	d	i	t	a	i	z	a	
o	d	m	e	c	h	a	n	i	c	a	l	p	
s	x	i	b	a	m	i	o	k	a	n	s	z	
n	a	g	n	l	r	y	e	a	p	l	g	o	
a	b	r	a	s	i	o	n	y	o	n	l	n	

Answers: rocks, weathering, soil, mechanical, abrasion

What's New

The boulder cracked because of weathering process. It is caused by the constant change of temperature or maybe because of some human activities such as quarrying and digging for construction purposes. If this boulder will continue to crack it will turn into pieces which will become soil after sometimes.

What's More

Lesson 1

Activity 1

1. The piece of chalk when pounded broke into tiny pieces/particles.
2. It is a mechanical change that caused to break the chalk into pieces due to the force done by human with the use of a hammer.

Activity 2

1. The small grains of rocks come from the soft rocks which was put in the glass.
2. It was caused by the vigorous shaking of the glass. The continuous pounding or hitting to the can and with other rocks.

What I have learned

Answers:

1. Rocks
2. Temperature
3. mechanical weathering
4. chemical weathering
5. disintegrate

What I can do

A.

Answers:

- 1
- 3
- 4
- 5

Lesson 2

What's In

1. QUARRYING
2. BURROWING
3. PLANTS
4. ANIMALS
5. HUMAN
6. TEMPERATURE

What I Can Do

1. As I do the analysis on the three pictures, the rocks break into pieces through the process of chemical weathering.
2. The pictures shows that the rocks breaks down into smaller one because of the waves, rivers and acid rains. Thi is because of chemical weathering. The chemical composition of the rocks is changed during this process, which causes minerals to decompose and even dissolve.

What's New

1. The wall was so much exposed to air, water and dust. Chemical content in water accelerates the breakdown of the wall and allow air and water to penetrate more deeply and caused the crumble and decay of the wall.

Assessment

1. True
2. False, Disintegration is also known as chemical weathering.
3. False, Rocks in the Earth's surface does not undergo changes by weathering.
4. True
5. True
6. d
7. a
8. d
9. c
10. b

What's More
Activity 1

A. The chalk was broken down to small pieces, or was "melted".

B. The piece of chalk when poured with a vinegar, slowly melted or "peeled".

C. It is a chemical weathering process that caused the chalk to melt. It is because of the acid contain in the vinegar solution.

Activity 2

a. The piles of rocks in Jars 1 and 2 turned into pieces or there were small grains that appeared while jar 3 there was no change.

Additional Activities

Before being used into jewelry, these stones are first cut and polished. Other treatments may also be done to enhance and show the beauty of the gemstones. They could be heated and waxed to make them more beautiful, attractive and expensive.

Activity 2

a. The changes on the rock sample was caused by shaking of the jars.and the presence of vinegar and water which reacted to the stones.

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