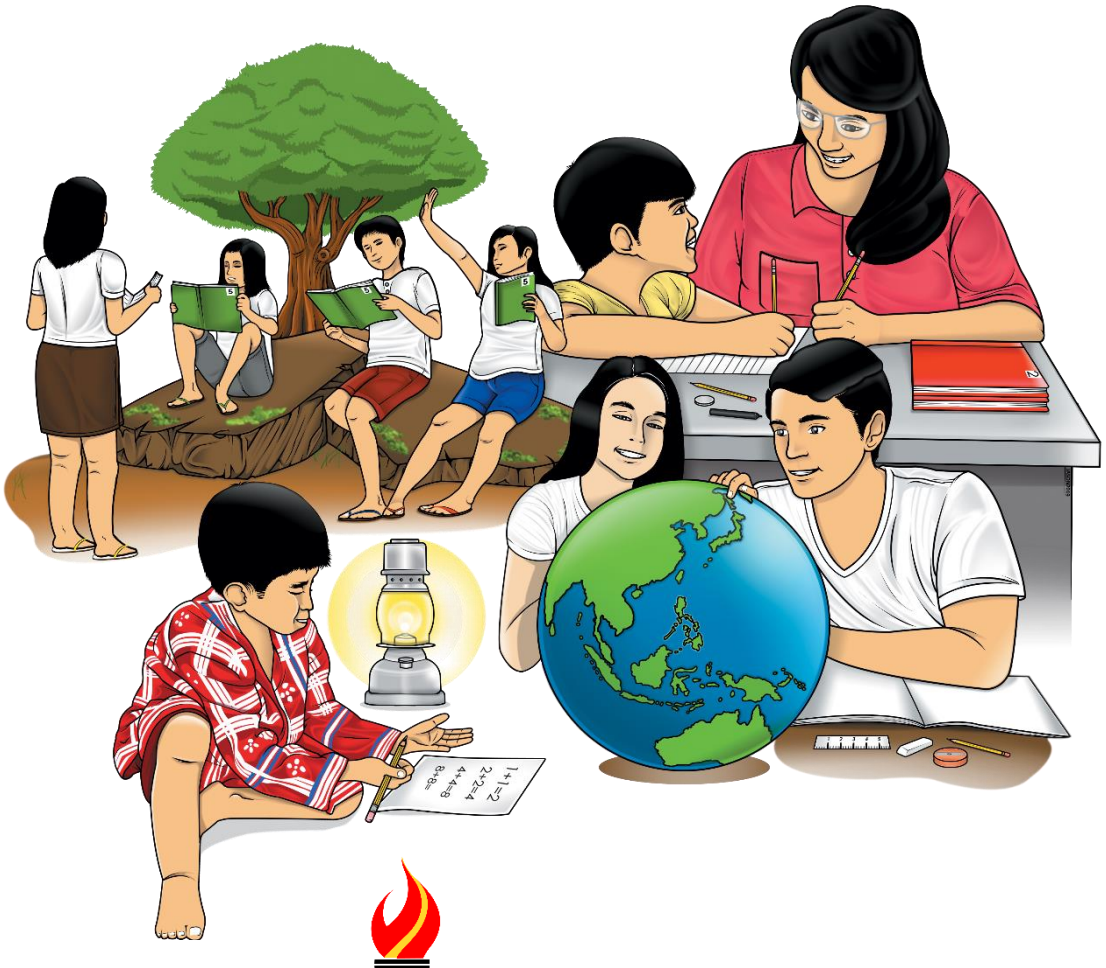
Senior High School

DepED
DEPARTMENT OF EDUCATION

Earth and Life Science

Quarter 1 – Module 7:
Magmatism



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Secretary: Leonor Magtolis Briones
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Development Team of the Module

Writers: Jessa M. Ariola

Editors: Melanie I. Samudio, Jocelyn M. Manset

Reviewers: Jason Ricaforte, Angelica Beriña, Princess Paolah L. De Guzman, Marissa C. Betchaida, Louie L. Alvarez, Gregorio M. De Chavez, Jr., Jocelyn M. Manset, Mario B. Maramot, Elaine T. Balaogan, Job S. Zape Jr., Crisjee B. Silvestre, Colita I. Patricio, Jhimson V. Cabral

Illustrator: Ednelinda Robles, Lovely Joy La Rosa, Charles Erick A. Jusay, Sandro Carlo B. Tablizo

Layout Artist: Elizalde L. Piol, Anselma M. Ebero, Jocelyn M. Manset

Management Team: Francis Cesar B. Bringas
Job S. Zape, Jr.
Ramonito Elumbaring
Reicon C. Condes
Elaine T. Balaogan
Fe M. Ong-ongowan
Merthel M. Evardome
Nadine C. Celindro
Nicolas M. Burgos
Mario B. Maramot
Fe M. Ong-ongowan
Rosalinda A. Mendoza

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Department of Education – Region 4A CALABARZON

Office Address: Gate 2 Karangalan Village, Brgy. San Isidro, Cainta, Rizal
Telefax: 02-8682-5773/8684-4914/8647-7487
E-mail Address: lrmd.calabarzon@deped.gov.ph

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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

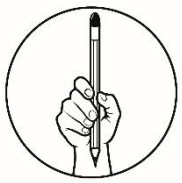
This module was designed and written with you in mind. It is here to help you master the nature of Earth and Life Science. The scope of this module permits it to be used in many different learning situations. The language used recognizes the diverse vocabulary level of students. The lessons are arranged 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.

The module covers:

- Lesson 1 – Magmatism

After going through this module, you are expected to:

1. describe the characteristics of magma;
2. identify the substances/elements present in magma; and
3. explain the processes involved in the formation of magma.



What I Know

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

1. What term should be used to describe a semi-liquid hot molten rock located beneath the Earth?
    A. lava
    B. magma
    C. rocks
    D. sand

2. What do you call the semi-liquid hot molten rocks found on the surface of earth once the volcano erupts?
    A. lava
    B. magma
    C. rocks
    D. sand

3. What process occurs if there are formation and movement of magma under the earth's crust?
    A. decompression melting
    B. flux melting
    C. heat transfer
    D. partial melting

4. In what part of the earth does magmatism happen?
    A. Asthenosphere
    B. Earth's core
    C. Earth's crust
    D. Lithosphere

5. What are the two most abundant elements in magma?
    A. oxygen and iron
    B. oxygen and magnesium
    C. silicon and aluminum
    D. silicon and oxygen

6. What will happen to the temperature of rocks during partial melting?
    A. decreases
    B. increases
    C. remains the same
    D. all of the above

7. Which of the following is NOT a factor of partial melting?
    A. addition of volatiles
    B. an increase in pressure
    C. an increase in temperature
    D. decrease in pressure

8. During partial melting, which of the following minerals melt last?
    A. biotite
    B. feldspar
    C. quartz
    D. none of the above

9. During partial melting, which of the following minerals melt first?
    A. biotite
    B. feldspar
    C. quartz
    D. both b and c

10. Conduction in mantle happens when heat is transferred from hotter molten rocks to the Earth's cold crust. What process is being described?
    A. decompression melting
    B. flux melting
    C. heat transfer
    D. partial melting

11. Mantle rocks remain solid when exposed to high pressure. However, during convection, these rocks tend to go upward (shallower level) and the pressure is reduced. What process is being described?
    A. decompression melting
    B. flux melting
    C. heat transfer
    D. partial melting

12. When water or carbon dioxide is added to hot rocks, the melting points of minerals within the rocks decrease. What process is being described?
    A. decompression melting
    B. flux melting
    C. heat transfer
    D. partial melting

13. During partial melting of magma, where does heat transfer take place?
    A. convergent boundary
    B. mid-ocean ridge
    C. subduction zone
    D. all of the above

14. During partial melting of magma, where does decompression melting take place?
    A. convergent boundary
    B. mid-ocean ridge
    C. subduction zone
    D. all of the above

15. During partial melting of magma, where does flux melting take place?
    A. convergent boundary
    B. mid-ocean ridge
    C. subduction zone
    D. all of the above

Lesson 1 Magmatism

Do you still remember what happened to Taal Volcano last January 12, 2020? Yes, you are right. This volcano, which is located at the province of Batangas, spewed ash plumes up to nine miles (14 kilometers) into the air due to a "steam-driven" or phreatic eruption. According to the Philippine Institute of Volcanology and Seismology (PHIVOLCS), for the past two days, over 600 volcanic tremors have been recorded which was an indication of continuous movement of magma or molten rocks beneath the volcano. You might be wondering how magma got inside the volcano.

For this module, we will be discussing all about magma, its formation and composition.

What's In

Activity 1. Decoding Time

In the previous lesson, you have learned that Earth's interior is the site of great amount of heat. Let us review first about this before proceeding to the next topic.

Your task is to reveal the magic words by decoding the given numbers to their corresponding letters of the alphabet. Then, complete the statement below using those words.

5	1	18	20	8
E	A	R	T	H
Example: Word: EARTH				

18	1	4	9	1	10	9	15	14
1. Word: _____								

18	1	4	9	15	7	5	14	9	3		8	5	1	20
2. Word: _____														

3	15	14	4	21	3	20	9	15	14
3. Word: _____									

16	18	9	13	15	18	4	9	1	12		8	5	1	20
4. Word: _____														

3	15	14	22	5	3	20	9	15	14
5. Word: _____									

9	14	20	5	18	14	1	12		8	5	1	20
6. Word: _____												

The Earth's internal heat comes from two main sources: the radiogenic heat produced by the radioactive decay of isotopes in the mantle and crust, and the (7) _____ left over from the formation of the Earth. The heat can be transferred by three processes, namely, (8) _____, (9) _____, and (10) _____.

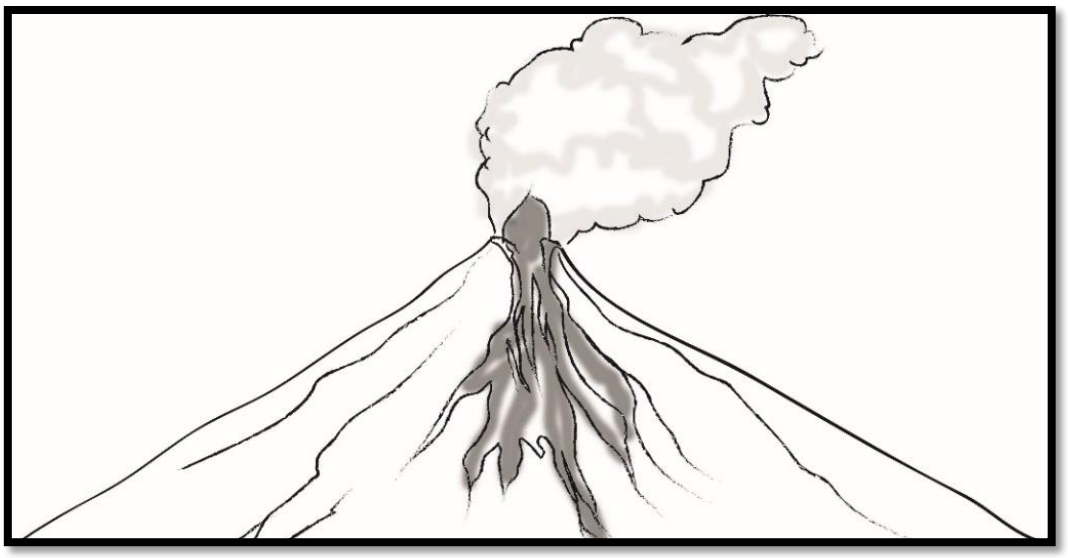
Notes to the Teacher

This module will help you understand the concepts of magmatism. All parts are comprised of various activities. Be guided with the instructions on how you will answer each. Expectedly, you will meet the target at the end of the module.

What's New

Activity 2. Picture Analysis

Observe the picture of Mount Mayon and answer the following.



Mount Mayon is one of the most active volcanoes in the Philippines. It erupted for eight minutes last January 23, 2018, spewing a 3-mile-tall column of debris and volcanic gas. It exploded at least five more times for two days.

According to Philippine Institute of Volcanology and Seismology (PHIVOLCS), two "explosion-type earthquakes" had occurred, as well as 18 tremor events — some of which sent forth fountains of lava. One of the lava flows advanced nearly 2 miles from the summit's crater.

The amount of knowledge gained in biology is so large that it has many branches. The following table lists some of the major ones.

A. Give three (3) important details of Mount Mayon eruption.
   1. _____
   2. _____
   3. _____

B. What is the material being extruded by Mount Mayon? Where do you think did this material come from?

   _____

   _____

What is It

What is Magma?

Magma is composed of semi-liquid hot molten rocks located beneath the Earth, specifically in the melted mantle rock and oceanic plate. This molten state, when solidified, creates **igneous rocks** found on the surface of the Earth.

Do you know the difference between magma and lava? **Magma** and lava are both molten rocks. However, they differ in location. Magma is found in the magma chamber of the volcano while **lava** is found on the surface of earth once the volcano erupts.

Magmatism is a process under the earth's crust where formation and movement of magma occur. So where does these formation and movement take place? These happen in the lower part of the Earth's crust and in the upper portion of the mantle, known as **asthenosphere.**

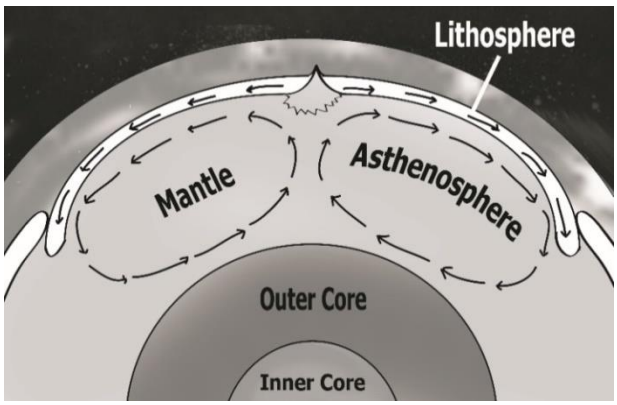


Figure 1. Convection Process in Asthenosphere

On the given figure, identify the substances/elements present in magma.

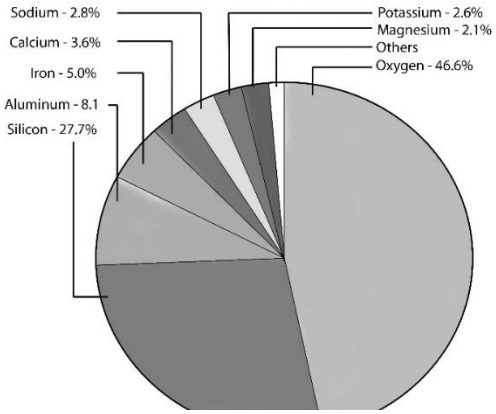


Figure 2. Composition of Magma

Guide Questions:

1. Which of the following elements has the highest amount in the magma?

_____

2. Which of the following elements has the lowest amount in the magma?

_____

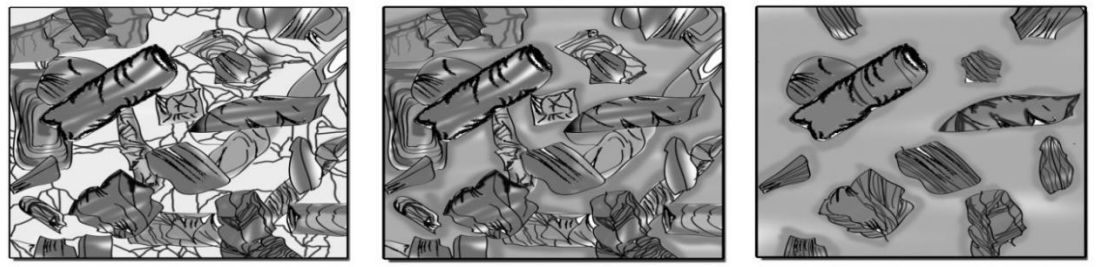
3. What are the top two compositions of magma?

_____

How is magma formed?

The magma present in the lower crust and upper mantle of the Earth is formed or generated through the process of **partial melting**. In this process, different minerals in rock melt at different temperature and pressure. Another factor being considered in this process is the addition of volatile materials such as water and carbon dioxide.

This is a diagram showing how minerals in rocks undergo partial melting.



This solid rock contains the minerals quartz, feldspar, biotite, and hornblende.	The first minerals that melt are quartz and some types of feldspar. The background represents magma.	Minerals such as biotite and hornblende generally melt last, which changes the composition of magma.

Figure 3. The Process of Partial Melting

Melting in the mantle requires one of three possible events to occur:

1. **An increase in temperature:** Conduction in mantle happens when heat is transferred from hotter molten rocks to the Earth's cold crust. This process is known as **heat transfer**. As magma rises, it is often hot enough to melt the rock it touches. It happens at **convergent boundaries**, where tectonic plates are crashing together.

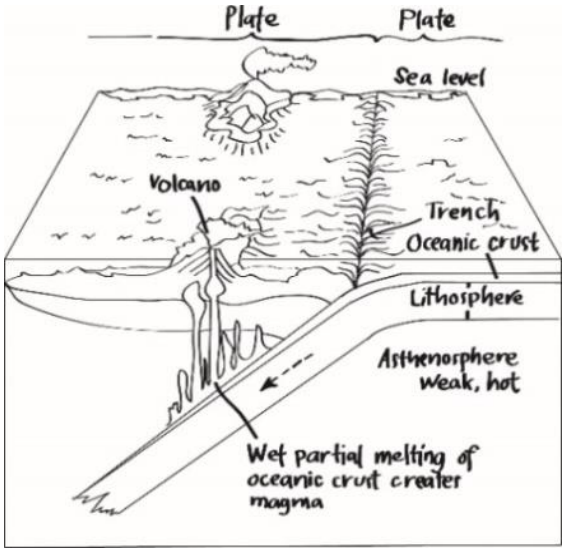


Figure 4. Heat Transfer in Convergent Boundary

Rocks are composed of minerals. These rocks start to melt once the temperature in the lower crust and upper mantle increases or exceeds the melting point of minerals. The temperature of mantle is around 1200 degrees Celsius. Rock minerals such as quartz and feldspar begin to partially melt at around 650-850 degrees Celsius.

2. A decrease of pressure: Mantle rocks remain solid when exposed to high pressure. However, during convection, these rocks tend to go upward (shallower level) and the pressure is reduced. This triggers the melting of magma. This is known as **decompression melting**. This process occurs at the **Mid-Ocean Ridge**, an underwater mountain system.

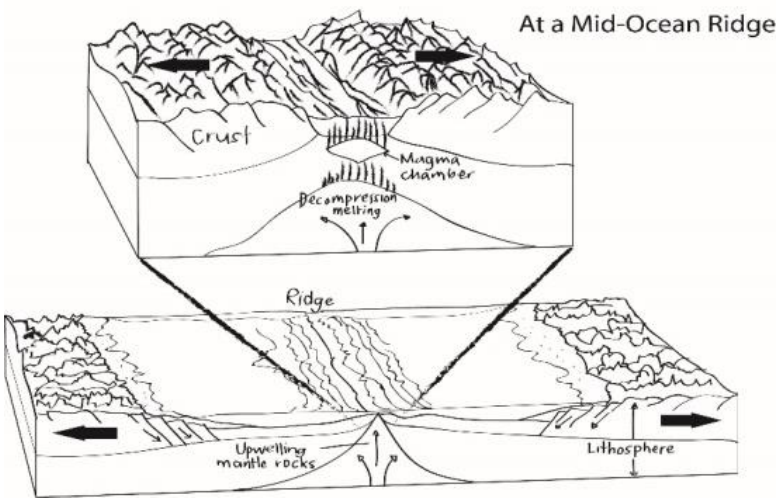


Figure 5. Depression Melting in Mid-Ocean Ridge

3. Addition of volatiles: When water or carbon dioxide is added to hot rocks, **flux melting** occurs. The melting points of minerals within the rocks decrease. If a rock is already close to its melting point, the effect of adding these volatiles can be enough to trigger partial melting. It occurs around **subduction zones**.

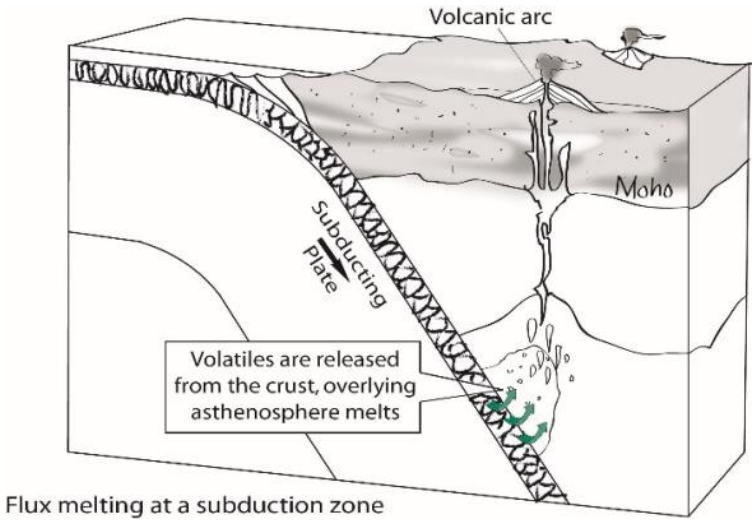


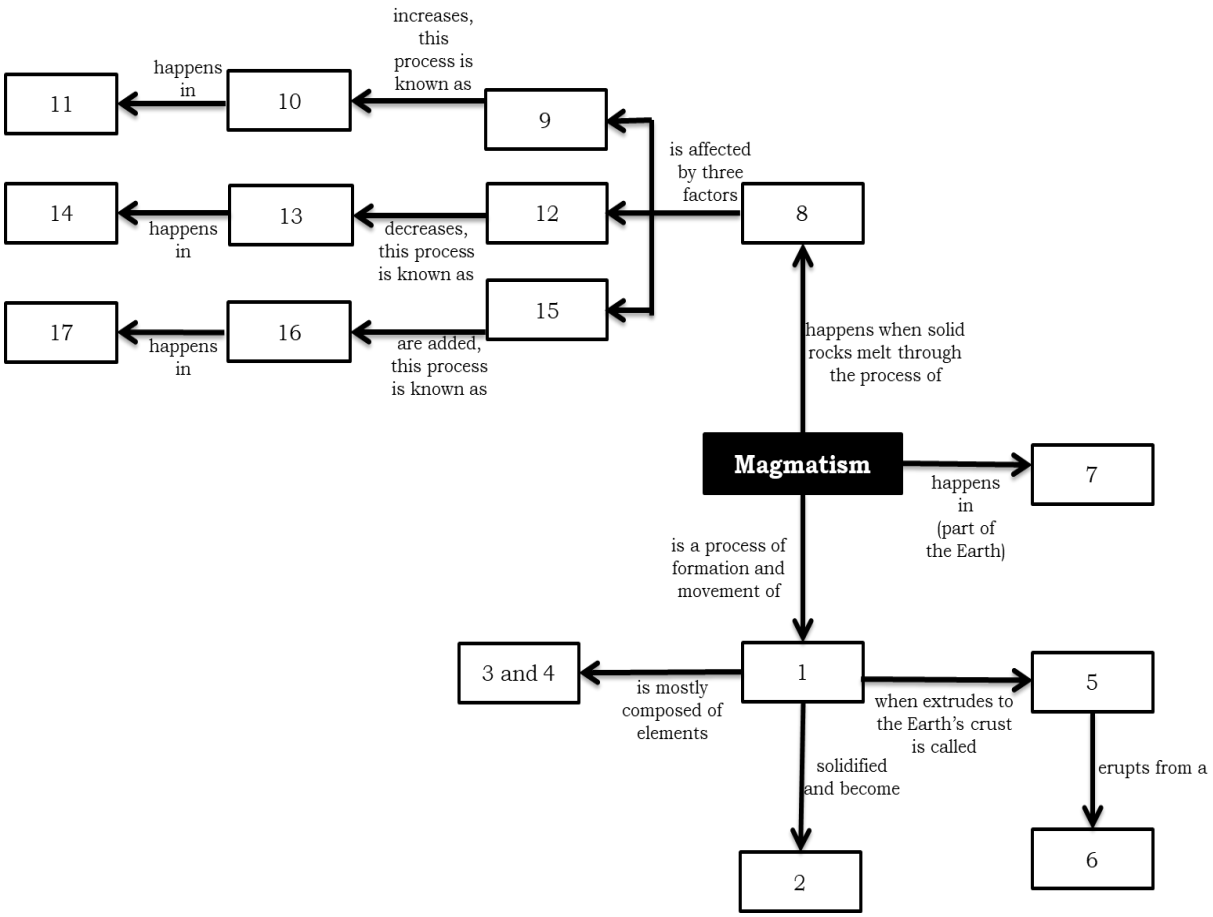
Figure 6. Flux Melting in Subduction Zone

What's More

Activity 3. Concept Map

Fill-in the boxes from the Magmatism concept map. Choose your answers on the box below.

Example: Item Number 1 is MAGMA



asthenosphere	igneous rocks	pressure
convergent boundary	lava	silicon
decompression	magma	subduction zone
melting	mid-ocean ridge	temperature
flux melting	oxygen	volatiles
heat transfer	partial melting	volcano

Activity 4. What Do You Think?

Based on the discussion, justify your answer to the following questions.

a. Do you think partial melting will occur if the pressure is high in the asthenosphere?

_____
_____
_____

b. Do you think partial melting will occur if there is too much amount of water in the subduction zone?

_____
_____
_____

What I Have Learned

Activity 5. Safety First!

Read the given paragraph and answer the following questions.

Last January 12, 2020, Taal Volcano located in the province of Batangas, started spewing ash and began showing signs of unrest after 43 years of inactivity. Philippine Institute of Volcanology and Seismology (PHIVOLCS) raised its alert status to Level 2 due to a "steam-driven" or phreatic eruption, according to Phivolcs, which happens when water beneath the ground or on the surface gets in contact with hot magma. This disaster had tremendous impacts to Batanguenos and people near Batangas.

1. How would you prepare yourself to survive a volcanic eruption in the place where you live?

_____
_____
_____

2. From that event, what are the values you learned and witnessed?

_____
_____
_____

What I Can Do

Activity 6. Apply It!

Observe the illustrations below and relate these to the lesson.

A. 

What is in the picture?

_____

_____

How will you relate it to magmatism?

_____

_____

B. 

https://www.istockphoto.com/vector/young-woman-sitting-on-overflowed-suitcase-and-trying-to-close-it-preparing-for-gm642734944-116522947

What is in the picture?

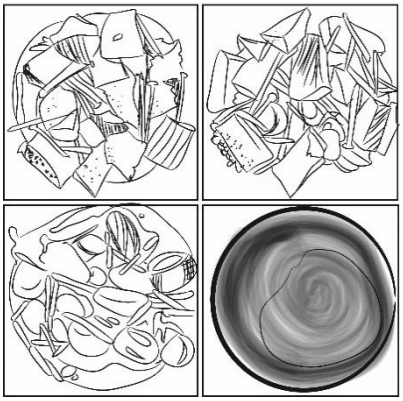
_____

_____

How will you relate it to magmatism?

_____

_____

C. 

What is in the pictures?

_____

_____

How will you relate it to magmatism?

_____

_____

Activity 7. ACRONYM!

Use the word MAGMATISM as an acronym. Use each letter to represent word/s that is related to the lesson.

M	
A	
G	
M	
A	
T	
I	
S	
M	

Assessment

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

1. What process occurs if there are formation and movement of magma under the earth's crust?
   A. decompression melting
   B. flux melting
   C. heat transfer
   D. partial melting

2. What term should be used to describe a semi-liquid hot molten rock located beneath the Earth?
   A. lava
   B. magma
   C. rocks
   D. sand

3. In what part of the earth does magmatism happen?
   A. Asthenosphere
   B. Earth's crust
   C. Earth's core
   D. Lithosphere

4. What do you call the semi-liquid hot molten rocks found on the surface of earth once the volcano erupts?
   A. lava
   B. magma
   C. sand
   D. rocks

5. During partial melting of magma, where does decompression melting take place?
    A. convergent boundary
    B. mid-ocean ridge
    C. subduction zone
    D. all of the above

6. Which of the following is NOT a factor of partial melting?
    A. addition of volatiles
    B. an increase in pressure
    C. an increase in temperature
    D. decrease in pressure

7. When water or carbon dioxide is added to hot rocks, the melting points of minerals within the rocks decrease. What process is being described?
    1. decompression melting
    2. flux melting
    3. heat transfer
    4. partial melting

8. During partial melting, which of the following minerals melt last?
    A. biotite
    B. feldspar
    C. quartz
    D. none of the above

9. What are the two most abundant elements in magma?
    A. oxygen and iron
    B. oxygen and magnesium
    C. silicon and aluminum
    D. silicon and oxygen

10. What will happen to the temperature of rocks during partial melting?
    A. decreases
    B. increases
    C. remains the same
    D. all of the above

11. During partial melting of magma, where does heat transfer take place?
    A. convergent boundary
    B. mid-ocean ridge
    C. subduction zone
    D. all of the above

12. Mantle rocks remain solid when exposed to high pressure. However, during convection, these rocks tend to go upward (shallower level), and the pressure is reduced. What process is being described?
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    D. partial melting

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    C. quartz
    D. both b and c

14. During partial melting of magma, where does flux melting take place?
    A. convergent boundary
    B. mid-ocean ridge
    C. subduction zone
    D. all of the above

15. Conduction in mantle happens when heat is transferred from hotter molten rocks to the Earth's cold crust. What process is being described?
    A. decompression melting
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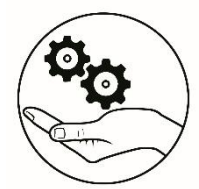
    C. heat transfer
    D. partial melting



Additional Activities

Read the poem below and answer the question that follows.

Magma
by Jemie Ann A. Quiroba
(Mataasnakahoy Senior High School)
HUMSS 12 SY 2019-20

I kept myself
I hid to deep
Burned and pressured
I must go out, must go with the flow
My red tears shouted pain, as it glows
So as I am, later on it would be tough
I freed my burning self and I'll go reach the top

What is the message of the poem?

_____
_____
_____
_____
_____
_____

Answer Key

What I Can Do

Activity 6

A. The ice cream is melting due to sunlight. This is related to heat transfer.

B. Compressing clothes in the luggage. This is related to the decompression melting.

C. Melting of different materials. This is the same as the minerals in the rocks melt to form magma.

Activity 7

Answers may vary.

Assessment

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

What's More

Activity 3

1. magma
2. igneous rocks
3. silicon
4. oxygen
5. lava
6. volcano
7. asthenosphere
8. partial melting
9. temperature
10. heat transfer
11. convergent boundary
12. pressure
13. decompression
14. mid-ocean ridge melting
15. volatiles
16. flux melting
17. subduction zone

Activity 4

A. No. There is NO partial melting because there should be a decrease of pressure in the asthenosphere.

B. No. There is NO partial melting because too much water will decrease the melting of the rocks.

What I Have Learned

Activity 5

Answers may vary

What I Know

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

What's In

Activity 1

1. RADIATION
2. RADIOGENIC HEAT
3. CONDUCTION
4. PRIMORDIAL HEAT
5. CONVECTION
6. INTERNAL HEAT
7. primordial heat
8. conduction
9. convection
10. radiation

What's New

Activity 2

Answers may vary

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For inquiries or feedback, please write or call:

Department of Education - Bureau of Learning Resources (DepEd-BLR)

Ground Floor, Bonifacio Bldg., DepEd Complex
Meralco Avenue, Pasig City, Philippines 1600

Telefax: (632) 8634-1072; 8634-1054; 8631-4985

Email Address: blr.lrqad@deped.gov.ph * blr.lrpd@deped.gov.ph