

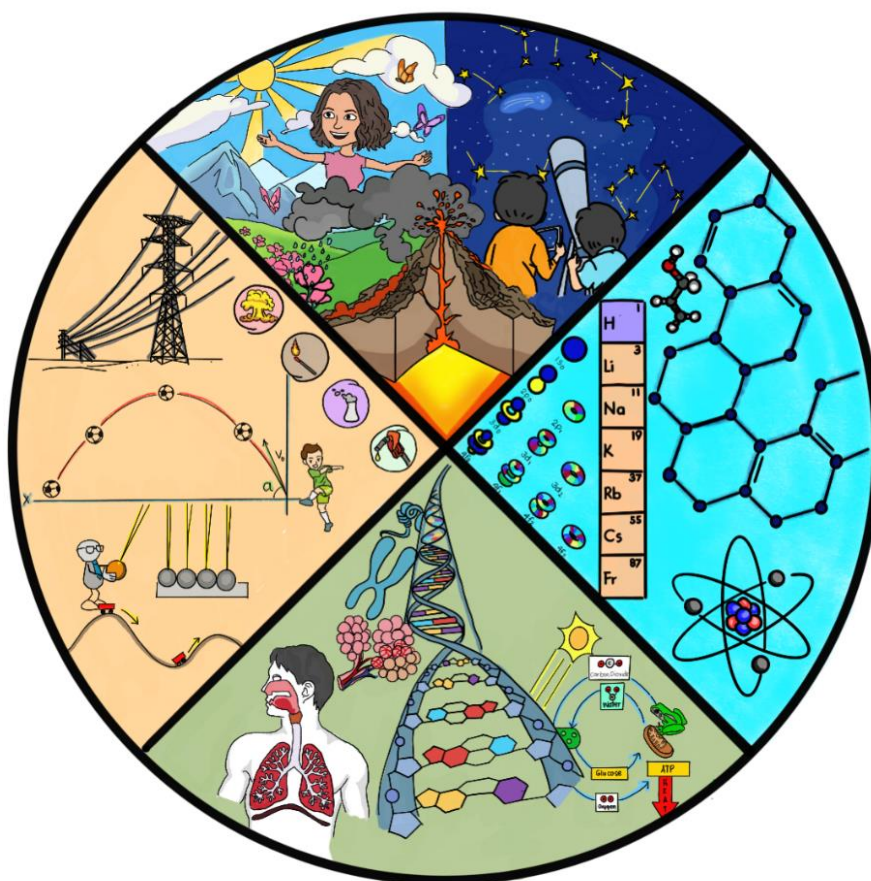
9

Department of Education
National Capital Region
SCHOOLS DIVISION OFFICE
MARIKINA CITY

Science

Quarter 3 - Module 2

Magma and Volcanic Eruption

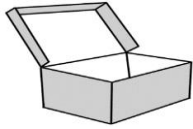


Alma L. Aparece
Catherine C. Balanga



City of Good Character
DISCIPLINE • GOOD TASTE • EXCELLENCE

Government Property
NOT FOR SALE



What I Need to Know

The purpose of this module is to provide a clear concept about volcanic activity. Volcanic eruption is one of the earth's most dramatic and violent agents of change. Understanding how volcanoes erupt can help us anticipate and prepare response plans and expand our knowledge about dangers and risks that it can cause.

This module contains two lessons namely:

- Lesson 1 – Magma: Type and its characteristics
- Lesson 2 – Type of volcanic eruptions

After going through this module, you are expected to **explain what happens when volcanoes erupt. S9ES - III B-27**

Specifically, you should be able to:

- describe how magma is formed by identifying its composition;
- describe the different types of volcanic eruption; and
- enumerate the effects of volcanic eruption on properties, human, and other living things.



What I Know

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

1. When a volcano erupts, the material produced in the air is _____.
A. Ash cloud
B. Magma
C. Fire
D. Lava
2. The most dangerous type of volcanic eruption is _____.
A. Strombolian
B. Vulcanian
C. Plinian
D. Volcano
3. Which statement about magma is correct?
A. Magma forms when rocks melt
B. Temperature of magma exceed 10,000 °C
C. Magma does not contain dissolved gases
D. Magma always comes from the lower mantle



4. The following factors affect the temperature when magma forms **EXCEPT**.
 - A. Pressure
 - B. Water
 - C. Viscosity
 - D. Composition of materials

5. Which of the following is **NOT** a sign of volcanic eruption?
 - A. Weather pattern
 - B. Earthquake frequency
 - C. Swelling or changing shape of volcano
 - D. Release of different gases from the volcano

6. The volcanic hazards made up of rocky particles about the size of a grain of sand is called _____.
 - A. Volcanic bombs
 - B. Volcanic cinder
 - C. Pahoehoe
 - D. Volcanic ash

7. What triggers the small earthquakes that occur before a volcanic eruption?
 - A. Pyroclastic flow
 - B. Upward movement of magma
 - C. Plate movements
 - D. Cooling of magma inside the crust

8. What causes magma to erupt towards the earth's surface?
 - A. The silica in the magma
 - B. The density of the magma
 - C. Gravity of the lithosphere
 - D. Dissolved gases trapped in the magma

9. It is a hardened magma that is formed across the rock layers.
 - A. Sill
 - B. Dike
 - C. Batholith
 - D. Volcanic neck

10. What government agency is tasked to monitor earthquakes and volcanoes in our country?
 - A. DOH
 - B. DENR
 - C. PHIVOLCS
 - D. IATF



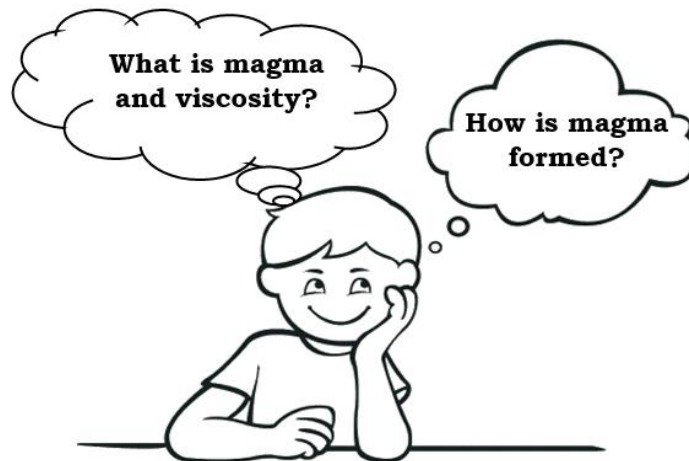
Lesson 1

Magma: Types and Its Characteristics



What's In

Answer the questions that are shown in the speech balloon below. Write your answers on the space provided.



What's New

The rocks below are from different types of magma. Describe each rock according to their texture and color. Write your answers on the space provided.



Basalt

<https://bit.ly/2ZDbbnA>



Andesite

<http://bit.ly/3pJ4c70>



Rhyolite




<http://bit.ly/2ZDTd4w>





What Is It

Magma is a Greek word that means “Thick Ointment”. It is a molten rock that is found beneath the crust and contains different minerals.

Kinds of magma	Rock sample from different magma	Description
Basaltic	 <p>Basalt https://bit.ly/2ZDbbnA</p>	<ul style="list-style-type: none"> rich in iron, magnesium, and calcium but low in potassium and sodium its temperature ranges from 1000° C to 1200° C low viscosity and low gas content formed by dry partial melting
Rhyolitic	 <p>Rhyolite http://bit.ly/2ZDTd4w</p>	<ul style="list-style-type: none"> rich in Potassium and Sodium but low in iron, magnesium, and calcium with temperature of 650 ° C to 800° C high viscosity and gas content formed by wet partial melting of the continental crust
Andesitic	 <p>Andesite http://bit.ly/3pJ4c70</p>	<ul style="list-style-type: none"> moderate amount of present mineral its temperature ranges from 800°C to 1000°C intermediate viscosity formed by wet partial melting of magma under the ocean

Magma is composed of molten rocks, minerals such as iron, calcium, magnesium, silica and different gases such as water vapor, carbon dioxide, hydrogen sulfide, hydrochloric, and sulfuric acid. All types of magma contain silicon dioxide but have different percentages. The magma with high amount of silica has high viscosity.

The composition of magma can be classified according to the composition of igneous rocks.

- a. **Mafic magma** – low in silica, contains magnesium iron and with low viscosity.



- b. Felsic magma** – high in silica, contains minerals such as quartz and feldspar, and with high viscosity.

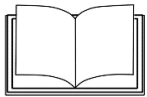
The viscosity (thickness) of the magma affects the shape and steepness of the volcano and can be determined by the eruptive style of a volcano.

Heat is important to form the magma beneath the surface of the earth. It can partially melt rocks in the upper mantle because rocks are made of different minerals having different melting points. The viscosity of magma differs because it is affected by temperature, chemical composition, and number of dissolved gases. Viscosity is the resistance of materials to flow.

Magma can be formed in different ways:

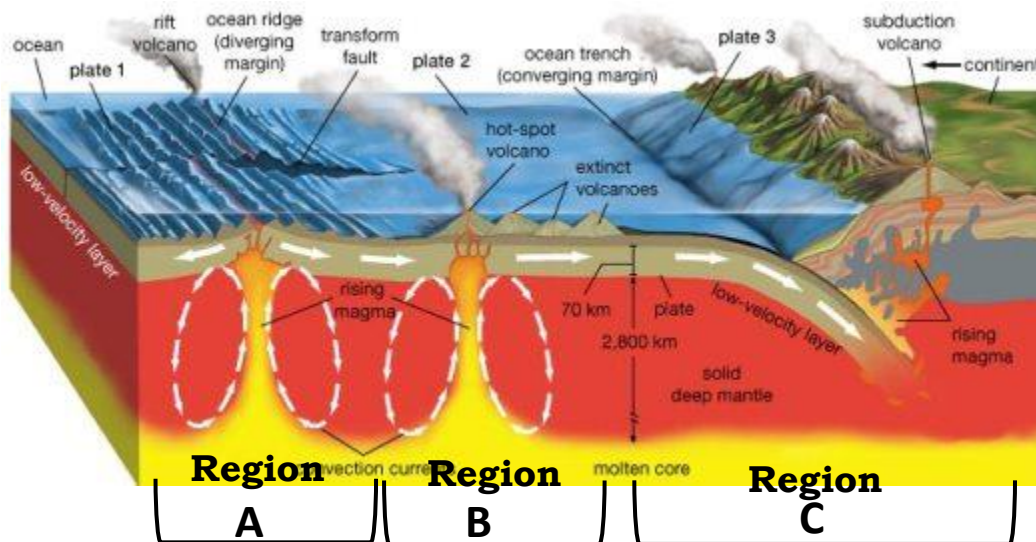
- a. Dry melting** - melting of rocks and minerals without the presence of water and carbon dioxide; involves the specific temperature or specific heat of different minerals.
- b. Wet melting** - melting of rocks and minerals with the presence of water occurring over varied temperature in the subduction zone.

Temperature affects the flow of magma. The magma moves fast at high temperature and has low viscosity. The magma moves slow at low temperature and has high viscosity.



What's More

Activity1: Location Where Dry Melting and Dry Mating Occur



Guide Questions:

1. In what region is magma formed under wet melting? _____
2. In what region is magma formed under dry melting? _____
3. What happen to the materials in the upper mantle during the formation of magma? _____
4. What region has mantle plume? _____
5. Which region produce Basaltic, Rhyolitic, and Andesitic magma? Why?

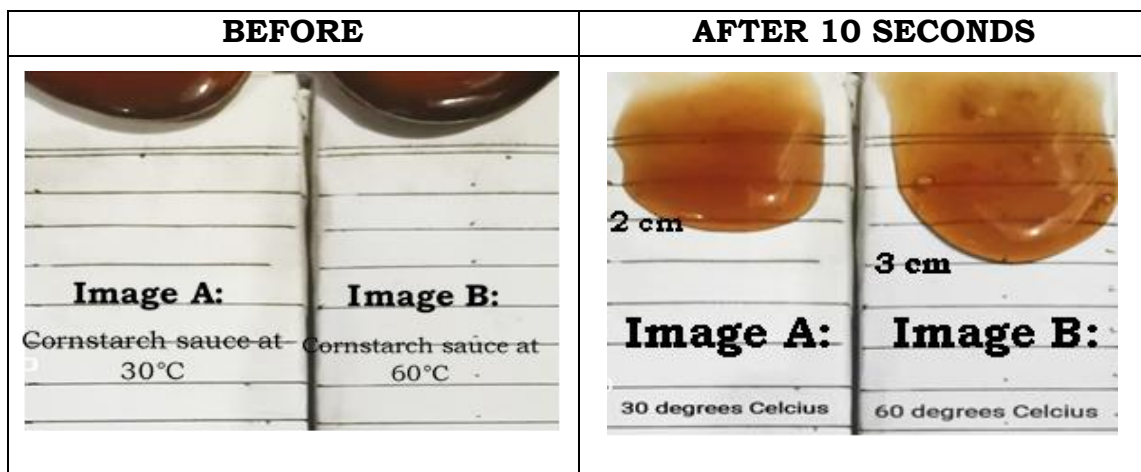
The experiment was done to find out the different factors that affect magma. The materials used are cornstarch sauce, 4 identical glass slides, 4 tablespoons.

Two tablespoons of cornstarch sauce, each at different temperatures were simultaneously poured into two inclined glasses. After 10 seconds, the observations are as follows:

A: Temperature Vs. Viscosity

Image A and B show the condition of cornstarch sauce before and it was heated in different temperatures.

Note: Cornstarch represents as Silica and the cornstarch sauce as Magma and contain the same amount of cornstarch.



Guide Questions:

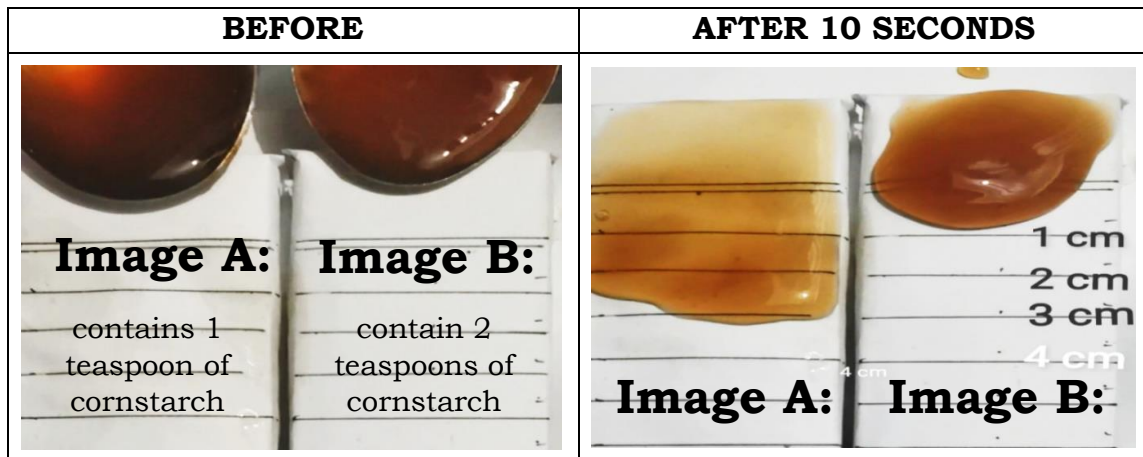
1. Which image has high temperature? low temperature?
2. Which image has high viscosity? Low viscosity?
3. How does temperature affect the viscosity of magma?



B: Composition Vs. Viscosity

Cornstarch sauce with different viscosity. Pour 1 teaspoon of cornstarch sauce in glass A and 2 teaspoons of cornstarch sauce in glass B simultaneously. Record your observations.

(Note: cornstarch represents as Silica and Image B is thicker than Image A)



Guide Questions:

1. Which image has high viscosity? Why?
2. Which image has low viscosity? Why?
3. Does the component of the sauce (magma) affect the viscosity? Why?



What I Have Learned

Fill in the blanks: Choose the words inside the box to complete the sentences below.

andesitic	basaltic	Calcium	dry-melting	fast
high	Iron	low	Magnesium	Molten
Potassium	rhyolitic	silica	wet-melting	
viscosity				

1. Magma is made up of _____ rocks that are found beneath the surface of the Earth.
2. The three types of magma are _____, _____, and _____.
3. The molten rocks are composed of different metals like Sodium, _____, _____, _____ and _____.
4. The percentage of silica can change the _____ of the magma.
5. Mafic magma contains iron and magnesium with _____ silica while



- Felsic magma minerals contain _____ silica.
6. Mafic magma moves _____ than Felsic magma.
 7. Magma can be formed in different ways such as _____ which is with the presence of water and _____ which is without the presence of water.
 8. The higher the temperature of magma, the lower the _____ and more gases are produced.



What I Can Do

Read and analyze each question. Write your answer on the space provided.

1. Why is magma important to the Earth's surface?

2. Why do you need to know the kind of magma emitted by the volcanoes in the Philippines? _____



Assessment

Read the following questions carefully encircle the letter of the correct answer.

1. Which type of magma has high content of Iron, Magnesium, and Calcium but low in Potassium and Sodium?
A. Magmatic B. Rhyolitic C. Andesitic D. Basaltic
2. Which statements describe magma?
I. The higher the temperature the higher the viscosity.
II. The lower the silica the higher the viscosity.
III. The Basaltic magma has a high temperature and low viscosity.
IV. The Rhyolitic magma has a low temperature and high gas period.
A. I and II B. II and III C. II and IV D. III AND IV
3. The type of magma that has low gas content.
A. Rhyolitic B. Basaltic C. Igneous D. Andesitic
4. Which of these can affect the viscosity of magma?
I. Silica content III. Gas content
II. Temperature IV. Nickel content
A. I only B. I AND II C. I AND IV D. I, II, III, IV
5. Which of these have high viscosity?
A. Felsic B. Mafic C. Basaltic D. Andesitic





Additional Activities

Unlock the words described in the following statements and encircle them in the puzzle box.

T	E	M	P	E	R	A	T	L	M	Y
A	I	R	O	N	O	L	F	T	T	Y
N	F	G	E	C	X	P	A	I	B	J
D	M	A	F	I	C	M	S	Q	A	V
E	S	C	R	O	G	O	T	Y	S	S
S	E	V	F	A	C	A	L	M	A	T
E	P	T	M	S	T	I	M	E	L	L
T	W	E	I	A	L	M	A	C	T	E
I	T	V	M	O	L	T	E	N	I	F
C	R	H	Y	O	L	I	T	I	C	G
T	E	M	P	E	R	A	T	U	R	E

1. A type of magma that is rich in potassium.
2. Magma which has the highest viscosity and low temperature.
3. Resistance to flow of magma.
4. An igneous rock that contains less silica.
5. It has moderate amount of iron and silica.
6. The higher the _____, the lesser the viscosity.
7. Magma is made of _____ rocks.
8. The reason why basalt has dark color.
9. The igneous rock that contains high amount of silica.



Lesson 2

Types of Volcanic Eruptions



What's In

Write the characteristics of the type of magma in the table and answer the guide questions that follow.

	BASALTIC	RHYOLITIC	ANDESITIC
Minerals			
Viscosity			
Temperature			

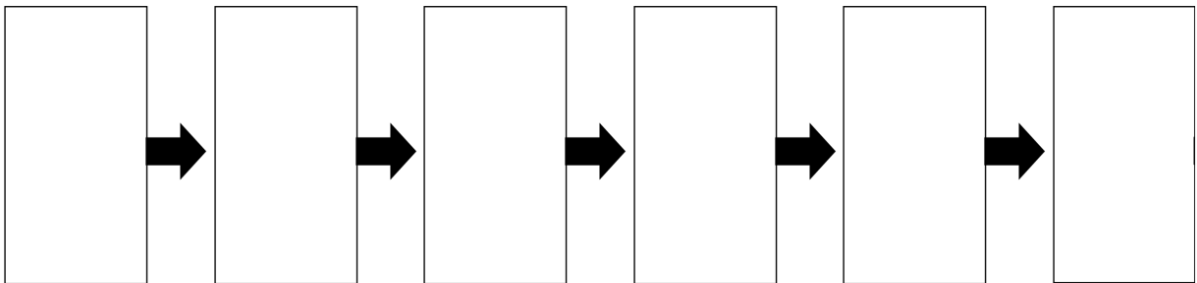
Guide Questions:

1. What materials does a volcano release before and during the eruption?
2. Does magma have anything to do with volcanic eruptions?
3. Why does a volcano erupt?



What's New

Arrange the following volcanic processes listed below according to the correct sequence of occurrence. Write the letter of the process inside the box.



Process of volcanic eruption.

- A. When magma rises or interacts with water, gases are formed.
- B. The temperature and pressure increase inside the volcano.
- C. The rocks near the mantle melts when magma is produced.
- D. Volcanic earthquakes are frequent and intensified, and more gases are emitted.
- E. The magma flows on the fissure of the Earth's surface and crater.
- F. The magma becomes lighter and rises to the vent.





What Is It

Magma is involved in volcanic eruption, but its characteristics depend on viscosity, percentage of silica, mineral content, gas produce, and temperature. The characteristics of magma can be determined by the type of volcanic eruption.

Types of volcanic eruption	Description	Example
Hydrothermal or Phreatic	<ul style="list-style-type: none"> • steam-driven as hot rock come in contact with water • produces ash without ejection of magma • carbon dioxide or hydrogen sulfide • can bring magma fragment and crystals • no new magma erupted 	<ul style="list-style-type: none"> • Taal Volcano
Phreatomagmatic	<ul style="list-style-type: none"> • violent eruption (magma contacts with ground water) • gas is compress within the magma • large column of very fine ash and with ejection magma • high speed and sideways emission of pyroclastic 	<ul style="list-style-type: none"> • Ukinrek Maar in Alaska
Strombolian	<ul style="list-style-type: none"> • least violent explosive • fountain lava about 1km and lava bomb 	<ul style="list-style-type: none"> • Irazu Volcano in Costa Rica
Vulcanian	<ul style="list-style-type: none"> • moderate explosion of gas • tall eruption columns up to 20 km high • pyroclastic flow • ashfall tephra • dense cloud of ash • viscous magma 	<ul style="list-style-type: none"> • Paricutin Volcano in Mexico (1947)
Pelean	<ul style="list-style-type: none"> • large quantity of gas dust and ash • pyroclastic flow, and dense lava rolls down the volcano at high speed 	<ul style="list-style-type: none"> • Mayon Volcano in 1968



Plinian	<ul style="list-style-type: none"> •excessively explosive gas and pyroclastic fragments •clouds can rise up the stratosphere (20-35km tall) •lightning strikes •high magma discharge •very viscous magma 	<ul style="list-style-type: none"> • Mount Pinatubo in 1991
---------	---	--

The process of volcanic eruption:

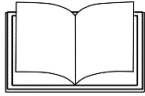
1. The rocks near the mantle melt and become molten rocks called magma.
2. The magma becomes lighter than solid rock, then the magma rises and is collected in the magma chamber.
3. The magma pushes upward to the main vent.
4. As magma rises, gas bubbles are formed, and some magma interacts with water and produces steam and builds pressure inside it.
5. When there is too much pressure, the volcano produces intensified and frequent earthquakes, temperature increases, and gas emission of carbon dioxide and sulfur dioxide increases.
6. The magma flows on the fissure of the earth's surface and it is called lava.

Philippine Institute of Volcanology and Seismology (PHILVOLCS) monitored the different volcanoes in the Philippines. The trained staff and resident volcanologist used three-dimensional seismometers to measure the motions of the ground, including the seismic waves generated by volcanic earthquakes, volcanic eruptions, and other seismic sources. They observe the changes (inflammation) on the ground of the volcano using a tiltmeter that indicates deformation and Global Positioning Satellite (GPS). The emission of gases (carbon dioxide and sulfur dioxide) quantity is measured by a spectrometer to show changes in the deepest part of the volcano. They also use thermal camera to give information when there are changes in temperature.

Volcanic eruption is one of the most hazardous natural disasters on Earth. Pyroclastic explosion, hot ash, and lava flow during a volcanic eruption can damage houses, infrastructures, livelihood, and life of living organism. Human can suffer from psychological effects like anxiety and trauma. Landslides, floods, mudslides, and climate change are the secondary effects of the volcanic eruption.

Volcanic eruption has positive effects such as the soil becomes fertile, precious metals like gold, silver, and diamonds may be found near volcanoes, source of livelihood and income and provides geothermal energy.

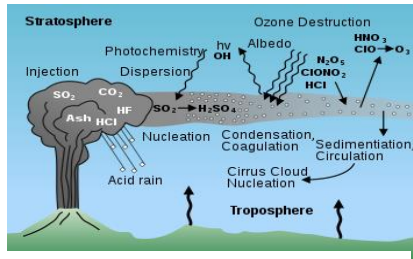




What's More

Describe the impacts of volcanic eruption on properties, human, and other living things.

1.



<http://bit.ly/3pQLI4T>

2.



<http://bit.ly/3aU8jJD>

3.



<http://bit.ly/3aU8jJD>

4.





<http://bit.ly/3aU8jJD>





What I Have Learned

Based on the picture below, write the type of volcanic eruption and materials emitted in the table.

	Types of volcanic eruption	Materials emitted
 http://bit.ly/37HmfEy		
 http://bit.ly/2Z0ORHA		

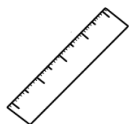


What I Can Do

Write appropriate actions in different alert levels listed below.

Alert Level 1	Alert Level 2	Alert Level 3	Alert Level 4	Alert Level 5
Low level unrest No eruption imminent Activity may be hydrothermal	Moderate unrest Can eventually lead to eruption	Relatively high unrest Eruption is possible within weeks	Intense unrest Hazardous eruption is possible within days	Hazardous eruption ongoing





Assessment

Read the questions carefully and encircle the letter of the correct answer.

- Which type of volcanic eruption reaches 35 km high in ash clouds?
A. Plinian B. Strombolian C. Vulcanian D. Phreatic
- Taal volcano erupted last January 12, 2020. What type of volcanic eruption was observed?
A. Vulcanian B. Strombolian C. Phreatic D. Plinian
- Which is **NOT** a sign of volcanic eruption?
A. Inflation of the ground near the volcano
B. Increase in temperature
C. Increased amount of gas emission
D. Depletion of the volcano's height
- The solid rock fragments ejected during a volcanic eruption are called _____.
A. Pyroclastic materials C. Magma
B. Silica D. Lahar
- What substance that interacts with magma can cause Phreatomagmatic eruption?
A. Ash B. Air C. Soil D. Water



Additional Activities

Make a picture collage showing the effects of volcanic eruption on properties, human and other living things.

CATEGORY	4	3	2	1
Presentation	The pictures clearly communicate the main idea and strongly promotes awareness.	The pictures communicate some of important ideas and slightly promotes awareness.	The pictures indirectly communicate the idea and hardly promotes awareness.	The pictures do not sufficiently communicate any idea that can promote awareness.
Creativity and Originality	All the pictures used on the poster collage reflect an exceptional degree of student ingenuity in their creation.	Most of the pictures used on the collage reflect student ingenuity in their creation.	The pictures were made by the student but were copied from the designs or ideas of others.	The pictures were not made by the student.
Accuracy and Relevance of the content	All pictures in the collage are accurate and related to the topic.	Most pictures in the collage are accurate and related to the topic.	Some pictures in the collage are accurate and related to the topic.	The pictures in the collage are neither nor related to the topic.
Required Elements	The collage includes all required elements as well as additional information.	All required elements are included.	Few required elements are included.	Required elements are missing.





Posttest

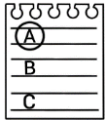
Read and understand each question and encircle the letter of the correct answer.

1. The following are components of magma **EXCEPT**
A. silica
B. carbon
C. iron
D. different gases
2. It affects the shape and steepness of the volcano and determines the eruptive style of a volcano.
A. Amount of magma
B. Content of magma
C. Temperature of magma
D. Viscosity of magma
3. What causes magma to erupt towards the earth's surface?
A. The silica in the magma
B. The density of the magma
C. Gravity of the lithosphere
D. Dissolved gases trapped in the magma
4. This happens when temperature of lava increases.
A. It begins to harden
B. Its viscosity decreases
C. Its viscosity increases
D. It can flow on short distance
5. Explosive volcanoes tend to have _____.
A. Low viscosity magma
B. Gentle, sloping sides
C. High viscosity magma
D. Gases rich in sulfur dioxide
6. Which arrangement of magma types illustrates a decreasing order of viscosity?
A. Basaltic, andesitic, rhyolitic
B. Rhyolitic, andesitic, basaltic
C. Andesitic, basaltic, rhyolitic
D. Basaltic, rhyolitic, andesitic
7. What is the relationship between silica and the viscosity of the magma?
A. The magma that is poor in Silica the higher the viscosity.
B. The magma rich in silica the higher the viscosity.
C. The magma that is poor in silica the lesser the viscosity.
D. The magma that is rich in silica the lesser the viscosity.



8. Which is true about the relationship between temperature and viscosity?
- A. The higher the temperature the higher the viscosity.
 - B. The higher the temperature the lesser the viscosity.
 - C. The lower the temperature the higher the viscosity.
 - D. The lower the temperature the lesser the viscosity.
9. Which of these can affect the viscosity of magma?
- I. Silica content
 - II. Temperature
 - III. Gas content
 - IV. Nickel content
- A. I only B. I AND II C. I AND IV D. I, II, III, IV
10. Which does not affect the viscosity of the magma?
- A. Potassium B. Iron C. Calcium D. Gold





Answer Key

Module 2

Lesson 1

What I Know

1. A 6. A 11. A

2. A 7. C 12. A

3. D 8. C 13. A

4. D 9. 14. B

5. A 10. D 15. B

What's In

The answers may vary

What's New

The answers may vary

What Is It

Guide Questions

1. Region C and A

2. Region B

3. It melts because of heat

from upper mantle

(asthenosphere)

4. Region B

What's More

A. Temperature Vs. Gas produced

1. A

2. A, because of high

Temperature

3. Temperature is directly proportional to gas

produced

B. Temperature Vs. Viscosity

1. The image b has high

temperature.

The image A has low

temperature.

2. Image A has high viscosity.

Image B has low viscosity.

3. The temperature can affect the viscosity of

magma.

The higher the temperature the lower the

viscosity or

the lower the temperature the higher the viscosity.

C. Component of magma Vs. Viscosity

1. Image B has high viscosity because it contains

more cornstarch.

2. Image A has low viscosity because it contains

less cornstarch.

3. Yes, Component of magma can affect the

viscosity of the magma. The higher the silica

content of the magma higher the viscosity of the

magma or the lower the silica content of the

magma the lower the viscosity of the magma.

What I Have Learned

1. molten

2. Basaltic, Rhyolitic, and andesitic

3. Carbon dioxide

Sulfide

Hydrogen sulfide

Hydrochloric

4. viscosity

5. low, high

6. fast

7. wet melting, dry melting

8. viscosity

Assessment

1. D 3. A 5. B

2. B 4. D

Additional Activity

1. Rhyolitic

2. Basaltic

3. Viscosity

4. felsic

5. Andesitic

6. Temperature

7. Molten

8. Manganese

10. Mafic





Lesson 2

What's In

The Answer may vary.

What's New

	BASALTIC	RHYOLITIC	ANDESITIC
MINERALS	Rich in iron, potassium, silica, and sodium, but poor in calcium and iron	Rich in iron, potassium, silica, and sodium, but poor in calcium and iron	moderates in silica, sodium, potassium, iron, calcium and magnesium
VISCOSITY	low	high	intermediate
Temperature	1000° C to 1200° C	650° C to 800° C	800° C to 1000° C

Guide Questions:

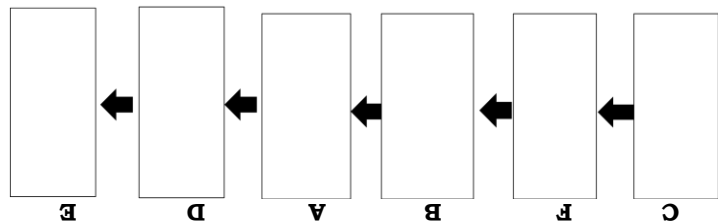
Expected answer

1. Volcanic ashes, gas, and lava

2. yes

3. The magma rose, and temperature increase then, it creates too much pressure.

What's New



WHAT'S MORE

The answers may vary

What I have Learned

The answers may vary

What I can do

The answers may vary

Assessment

1. A 2. C 3. D 4. A 5. D

Additional Activities

The answer may vary.



References

- “Magma”. National Geographic. Accessed November 5, 2020.
<https://www.nationalgeographic.org/encyclopedia/magma>
- “Principal Types Of Volcano”. USGS. Accessed November 5, 2020.
<https://pubs.usgs.gov/gip/volc/types.html>
- “Whats on Earth are the 7different Types of Magma”. NAYTURR.
<https://nayturr.com/types-of-magma/>
- “The Big Question: Why do volcanoes erupt?” bbc. Accessed January 22,2021.
<https://www.bbc.co.uk/newsround/44100737>
- “What Causes a Volcano to Erupt, and How Do Scientists PredictEruptions?”. Scientific American. Accessed December 17, 2020.
<https://www.scientificamerican.com/article/what-causes-a-volcano-to-erupt-and-how-do-scientists-predict-eruptions/>
- “Natural Hazard”. USGS. Accessed December 17, 2020.
https://www.usgs.gov/faqs/how-do-volcanoes-erupt?qt-news_science_products=0#qt-news_science_products



Development Team of the Module

Writers:

Alma L. Aparece
Catherine C. Balanga

Content Editors: Jenalyn M. Salonga
Robert J. Gaviola
Jessica S. Mateo

Language Editor: Garvie L. Medina

Cover Illustrators: Jordan B. Plopino
Arriane Joy F. Isorena

Layout Artists: Keith Angeline N. Alejandro
Jemwel Dela Paz

Management Team:

Sheryll T. Gayola

Assistant Schools Division Superintendent
OIC, Office of the Schools Division Superintendent

Elisa O. Cerveza

Chief, CID
OIC, Office of the Assistant Schools Division Superintendent

Jessica S. Mateo

EPS-Science

Ivy Coney A. Gamatero

EPS – LRMS

For inquiries or feedback, please write or call:

Schools Division Office- Marikina City

Email Address: sdo.marikina@deped.gov.ph

191 Shoe Ave., Sta. Elena, Marikina City, 1800, Philippines

Telefax: (02) 682-2472 / 682-3989



City of Good Character
DISCIPLINE • GOOD TASTE • EXCELLENCE