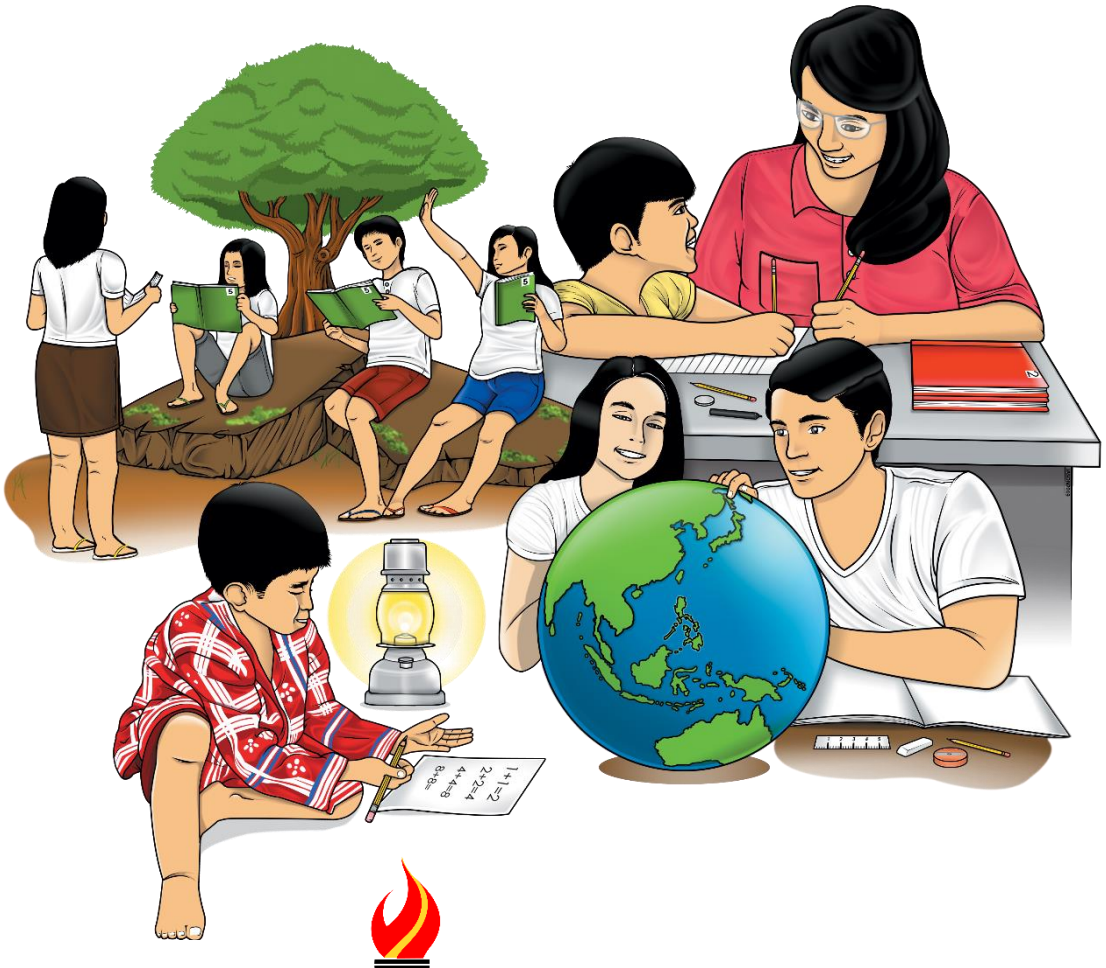
Senior High School

DepED
DEPARTMENT OF EDUCATION

Disaster Readiness and Risk Reduction

Quarter 1 – Module 16: Signs of Impending Volcanic Eruption



ALTERNATIVE DELIVERY MODE
ADM

Disaster Readiness and Risk Reduction
Alternative Delivery Mode
Quarter 1 – Module 16: Signs of Impending Volcanic Eruption
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Disaster Readiness and Risk Reduction

Quarter 1 – Module 16: Signs of Impending Volcanic Eruption

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Introductory Message

For the facilitator:

Welcome to the Grade 11/12 Disaster Readiness and Risk Reduction (DRRR) Alternative Delivery Mode (ADM) Module on Signs of Impending Volcanic Eruption!

This module was collaboratively designed, developed and reviewed by educators both from public and private institutions to assist you, the teacher or facilitator, in helping the learners meet the standards set by the K to 12 Curriculum while overcoming their personal, social, and economic constraints in schooling.

This learning resource hopes to engage the learners into guided and independent learning activities at their own pace and time. Furthermore, this also aims to help learners acquire the needed 21st century skills while taking into consideration their needs and circumstances.

In addition to the material in the main text, you will also see this box in the body of the module:

Notes to the Teacher

This contains helpful tips or strategies that will help you in guiding the learners.

As a facilitator you are expected to orient the learners on how to use this module. You also need to keep track of the learners' progress while allowing them to manage their own learning. Furthermore, you are expected to encourage and assist the learners as they do the tasks included in the module.

For the learner:

Welcome to the Grade 11/12 Disaster Readiness and Risk Reduction (DRRR) Alternative Delivery Mode (ADM) Module on Signs of Impending Volcanic Eruption!

The hand is one of the most symbolized parts of the human body. It is often used to depict skill, action and purpose. Through our hands we may learn, create and accomplish. Hence, the hand in this learning resource signifies that you as a learner is capable and empowered to successfully achieve the relevant competencies and skills at your own pace and time. Your academic success lies in your own hands!

This module was designed to provide you with fun and meaningful opportunities for guided and independent learning at your own pace and time. You will be enabled to process the contents of the learning resource while being an active learner.

This module has the following parts and corresponding icons:

 ***What I Need to Know***	This will give you an idea of the skills or competencies you are expected to learn in the module.
 ***What I Know***	This part includes an activity that aims to check what you already know about the lesson to take. If you get all the answers correct (100%), you may decide to skip this module.
 ***What's In***	This is a brief drill or review to help you link the current lesson with the previous one.
 ***What's New***	In this portion, the new lesson will be introduced to you in various ways such as a story, a song, a poem, a problem opener, an activity or a situation.
 ***What is It***	This section provides a brief discussion of the lesson. This aims to help you discover and understand new concepts and skills.
 ***What's More***	This comprises activities for independent practice to solidify your understanding and skills of the topic. You may check the answers to the exercises using the Answer Key at the end of the module.
 ***What I Have Learned***	This includes questions or blank sentence/paragraph to be filled in to process what you learned from the lesson.
 ***What I Can Do***	This section provides an activity which will help you transfer your new knowledge or skill into real life situations or concerns.
 ***Assessment***	This is a task which aims to evaluate your level of mastery in achieving the learning competency.

 ***Additional Activities***	In this portion, another activity will be given to you to enrich your knowledge or skill of the lesson learned. This also tends retention of learned concepts.
 ***Answer Key***	This contains answers to all activities in the module.

At the end of this module you will also find:

References	This is a list of all sources used in developing this module.

The following are some reminders in using this module:

1. Use the module with care. Do not put unnecessary mark/s on any part of the module. Use a separate sheet of paper in answering the exercises.
2. Don't forget to answer *What I Know* before moving on to the other activities included in the module.
3. Read the instruction carefully before doing each task.
4. Observe honesty and integrity in doing the tasks and in checking your answers.
5. Finish the task at hand before proceeding to the next.
6. Return this module to your teacher/facilitator once you are through with it.

If you encounter any difficulty in answering the tasks in this module, do not hesitate to consult your teacher or facilitator. Always bear in mind that you are not alone.

We hope that through this material, you will experience meaningful learning and gain deep understanding of the relevant competencies. You can do it!

What I Need to Know

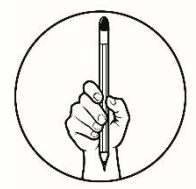
This module was designed and written with you in mind. It is here to help you master the Signs of Impending Volcanic Eruption. The scope of this module permits it to be used in many different learning situations. The language used recognizes the diverse vocabulary level of students. The lessons are arranged 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 is intended to equip you with knowledge or skill in:

- Recognizing the signs of an impending volcanic eruption (DRR11/12 Ih-I-24)

After going through this module, you are expected to:

1. recognize the signs of impending volcanic eruptions;
2. identify the different parameters used to monitor volcanoes;
3. create a family emergency preparedness plan against a volcanic eruption; and
4. appreciate the importance of being prepared especially during the occurrence of disaster.



What I Know

Pre-test
Direction: Read each item comprehensively and write the letter of the correct answer on extra sheet of paper.

1. Which of the following statements is true?
   I. People shall not be alarmed if a small change in tiltmeters is observed.
   II. Increasing sustained number of quakes indicates the volcano is about to erupt.
   III. Increasing number of thermal vents shall be monitored continuously.

   A. I only
   B. I and II only
   C. II and III only
   D. I, II, and III

2. Which of the signs of an impending volcanic eruption refers to the swelling of volcano that signals the accumulation of magma near its surface?
   A. gas emission
   B. harmonic tremors
   C. increase in number of earthquake
   D. bulges in the mountain or inflammation

3. Which of the following instruments is not used in monitoring a volcano?
   A. tiltmeter
   B. seismogram
   C. seismometer
   D. satellite imaging

4. Which toxic gas is released naturally by volcanic activity?
   A. carbon dioxide
   B. carbon monoxide
   C. hydrochloric acid
   D. sulfur dioxide

5. Which of the following is a parameter used to monitor volcanoes by observing the surface of the volcano for any changes?
   A. gases
   B. ground deformation
   C. seismic activity
   D. sensory observations

6. Which of the following characteristics of magma mainly affects the explosiveness of a volcanic eruption?
    A. amount
    B. color
    C. silica content
    D. temperature

7. Which of the following should be continuously monitored to in a lake or hot spring around a volcano?
    A. chemical content
    B. temperature
    C. turbidity
    D. all of the above

8. All of the following events indicate an impending eruption except:
    A. a measurable bulge or swelling of the volcano
    B. occurrence of short earthquakes in the region
    C. discovery of new hot springs around the volcano
    D. increased temperature of hot springs around the volcano

9. What is the property of substances to resist flow?
    A. buoyancy
    B. density
    C. pressure
    D. viscosity

10. What do you call the molten rocks found beneath the Earth?
    A. elements
    B. lava
    C. magma
    D. minerals

11. People residing near volcanoes may detect premonitory events before a volcanic eruption. Which of the following senses is not used?
    A. auditory
    B. gustatory
    C. tactile
    D. visual

12. Which of the following events does not indicate an impending eruption?
    A. drying up of hot springs around the volcano
    B. eroded area of the volcano after a heavy rain
    B. drying up of the vegetation around the volcano
    C. variation in the chemical content of the lakes and springs around the volcano

13. Which of the following statements is true?

I. One warning sign observed is enough to predict an eruption.
II. One warning sign observed is not enough to predict an eruption.
III. Small changes recorded from an instrument is enough to predict an eruption.
IV. Small changes recorded from an instrument is not enough to predict an eruption.

A. I and III
B. I and IV
C. II and III
D. II and IV

14. Which of the following substances is responsible for a rotten egg smell?
A. helium
B. magnesium
C. silica
D. sulfur

15. Which of the following statements is correct?
I. Presence of crater glow indicates that explosive eruption will occur.
II. Bulging of the ground indicates that the volcano is going to erupt within a week.
III. Observed rock falls and landslides indicates an impending volcanic eruption.
IV. Long-lasting rhythmic quakes is a sign of an impending volcanic eruption.
A. I, III, IV
B. II, III, IV
C. III only
D. IV only

Lesson 1 Signs of Impending Volcanic Eruption

Volcanic eruption is one of the most dangerous natural events because of the different hazards that it may bring as discussed previously. While volcanoes may give off several warning signs they are about to blow, some are taken more seriously by volcanologists who alert and advise government officials regarding when evacuations need to take place. These early warning signs make it easier for people to prepare and prevent damages to properties and loss of lives.

What's In

Different volcanic hazards may inflict devastating effects to people, physical structures and even to the environment.

Activity 1 "Volcano-related hazards"

Direction: Recall the different volcano-related hazards and answer the questions below.

What are the different related hazards brought by a volcanic eruption? What are their effects? Differentiate each and one of them.

What's New

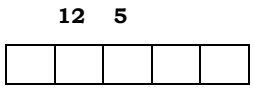
Activity 2 "Decode the Code"

Direction: Rearrange the scrambled words by placing the correct letters in the box. Use the numbered boxes to decode the final word at the bottom.

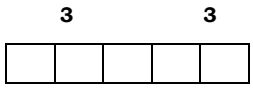
1. UQKAE

			6	5

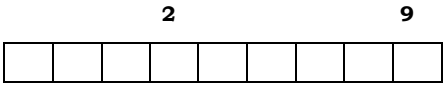
2. EATSM



3. MMAAG



4. IFNALITON



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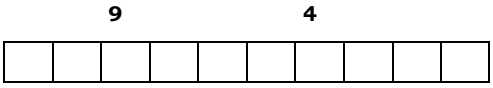
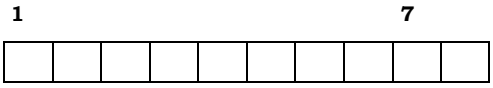
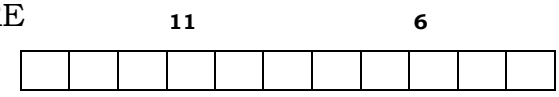


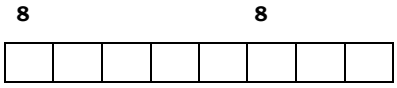
6. VEEGTITOAN



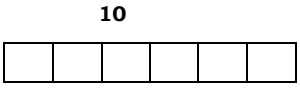
7. TAMPUEERTRE



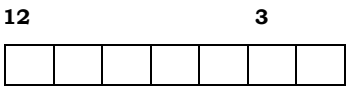
8. CMIECHAL



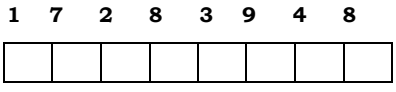
9. SGPINR

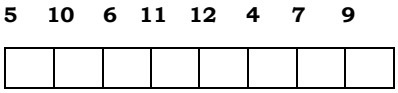


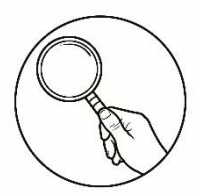
10. TEARHML



** using the numbered boxes*
(hint: numbers 1-10 are natural signs of _____?)



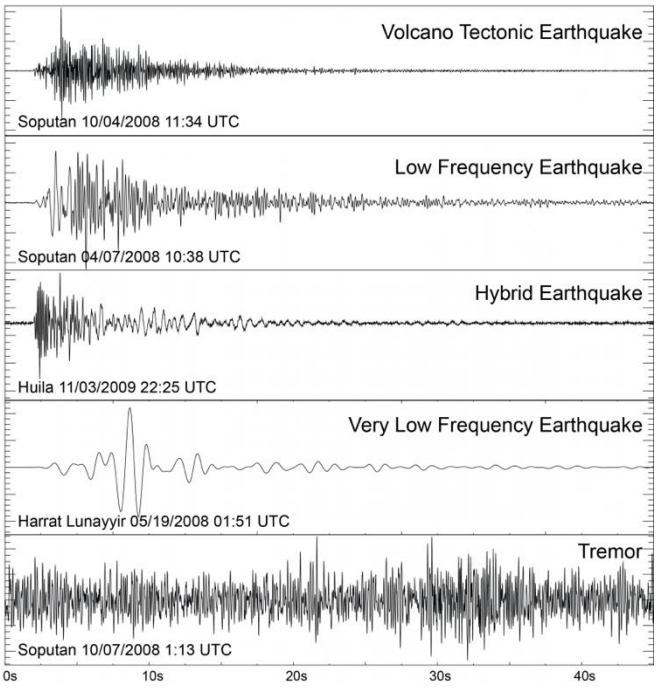




What is It

What are the natural signs of an impending volcanic eruption? The following are commonly observed signs that a volcano is about to erupt. These precursors may vary from volcano to volcano.

1. Increase in the **frequency of volcanic quakes** with rumbling sounds; occurrence of **volcanic tremors**



Source: Zoback, Mary Lou, Eric Geist, John Pallister, David P. Hill, Simon Young, and Wendy McCausland. "Advances in natural hazard science and assessment, 1963–2013." *Geological society of America, special papers* 501 (2013): 81-154.

Volcanic earthquakes serve as an early warning sign for an impending eruption, as well as well as a marker for the location of a moving magma and sudden rise of gases. Earthquakes are caused by the magma breaking through rocks or by moving through rock cracks. On the other hand, volcanic tremor is a long-lasting rhythmic signal associated with magma in motion that can last for minutes or days.

2. **Increased steaming activity**; change in **color of steam from white to gray** due to entrained ash

Source: U.S. Geological Survey (2003), Volcano Hazards Program – Heat/Thermal, July 20, 2020, retrieved from https://volcanoes.usgs.gov/vhp/thermal.html

Steam occurs mostly on active volcanoes. Presence of steam signals that magma is lying relatively close to the surface of the volcano. Steam is produced when groundwater and magma or any ignited fragment of rock interacts. Meanwhile, ash is one of the fragments of magma produced when magma is ejected with great force. Presence of ashes signals that the magma is being ejected violently.

3. **Crater glow** due to presence of magma at or near the crater

Source: U.S. Geological Survey (2013.), Glossary – Lava Lake, July 20, 2020, retrieved from https://volcanoes.usgs.gov/vsc/glossary/lavalake.html

Crater glow can be observed when the magma finally reaches the surface, and thus referred as lava.

4. **Ground swells** (or inflation), ground **tilt** and ground **fissuring** due to magma intrusion

Source: U.S. Geological Survey (2011), Glossary – Fissure, July 20, 2020, retrieved from https://volcanoes.usgs.gov/vsc/glossary/fissure.html

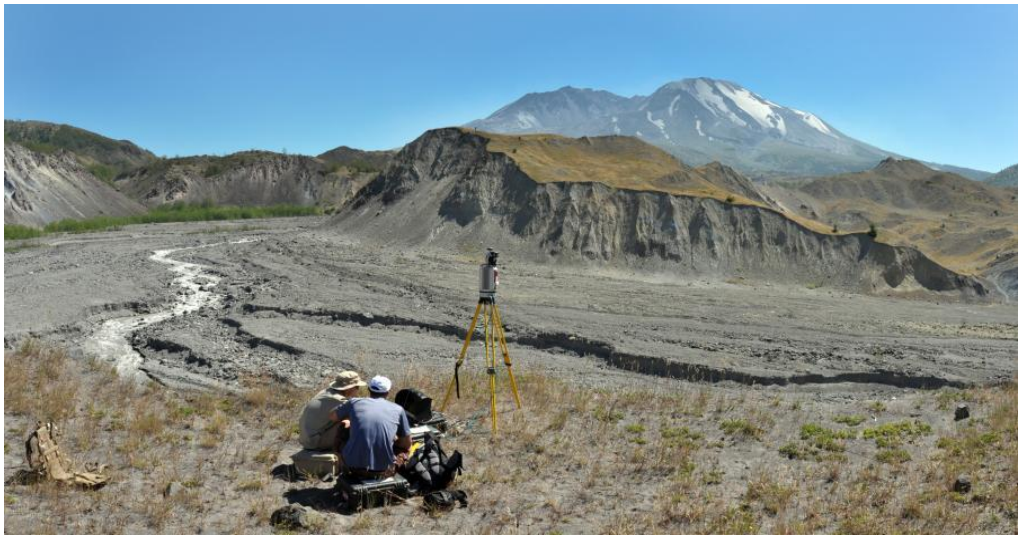
Moving magma, gases, and other volcanic fluids tend to cause the surface of the Earth to bulge upward (inflate) or spread apart which can eventually lead to ground fissuring or cracking.

5. **Localized landslides**, rock falls and landslides from the summit area that are not attributed to heavy rains

Source: U.S. Geological Survey (1980), Volcano Hazards – Volcanic Landslides, July 20, 2020, retrieved from https://volcanoes.usgs.gov/vhp/landslides.html

Landslide is the movement of rocks and soil influenced by the force of gravity, strength of the material, and steepness of a volcano. As magma rises together with volcanic gases, rocks are altered and weakened.

6. Noticeable increase in **drying up of vegetation** around the volcano's upper slopes



Source: U.S. Geological Survey (2012), Monitoring efforts at Mount St. Helens, July 20, 2020, retrieved from https://volcanoes.usgs.gov/volcanoes/st_helens/st_helens_gallery_31.html

As the magma rises, the temperature of the volcano also increases. The heat brought by the rising magma if high enough, can dry up the vegetation.

7. **Increase in temperature** of hot springs, wells (e.g. Bulusan and Canlaon) and crater lake (e.g. Taal) near the volcano

Source: U.S. Geological Survey (2019), Imperial Geyser looking south, Yellowstone, July 20, 2020, retrieved from https://www.usgs.gov/media/images/imperial-geyser-looking-south-yellowstone

Again, as the magma rises, the temperature of the volcano also increases. The heat brought by the rising magma influences and causes the temperature of the springs, wells, or lake to increase.

8. Noticeable **variation** in the **chemical content** of springs, crater lakes within the vicinity of the volcano

Source: U.S. Geological Survey (2011), Volcano Hazards Program – Gas and Water, July 20, 2020, retrieved from https://volcanoes.usgs.gov/vhp/gas_types.html#:~:text=Water%20chemistry%20changes%20can%20be,from%20a%20deeper%20volcanic%20source.

Groundwater deep within the surface of the volcano interacts with magma, volcanic gases, host rocks, and even with other water coming from springs, lakes, wells. Presence of certain compounds signals the presence of magma such as magmatic carbon dioxide, or high helium isotopes.

9. **Drying up of springs**/wells around the volcano

Source: U.S. Geological Survey (2019), Contrasting photos of Heart Spring from 1988 and 2019 Yellowstone, July 20, 2020, retrieved from https://www.usgs.gov/media/images/contrasting-photos-heart-spring-1988-and-2019-yellowstone

As mentioned, rising magma generates quakes and tremors which may cause ground deformation (cracks or fissures) on the surface. This may cause the water from springs or well to recede and seep through these cracks. Also, as the magma rise, the temperature of the surface of the volcano also increases and if high enough, may cause the drying up of the springs and wells.

10. Development of **new thermal areas** and/or reactivation of old ones; appearance of **solfataras** (craters with sulfur gas)

Source: U.S. Geological Survey (1973), Glossary – Fumarole, July 20, 2020, retrieved from https://volcanoes.usgs.gov/vsc/glossary/fumarole.html

Development of new thermal areas and/or reactivation of old ones signals the active movement of magma within the volcano as it interacts with groundwater or rocks.

Therefore, it is important to be able to observe warning signs of volcanic unrest so that people can evacuate in time, and minimize injuries and casualties. It is therefore important to be able to monitor a volcano's activity, and this is normally done with the aid of different tools or instruments to monitor the different parameters.

The parameters used to monitor volcanoes are:

1. **Ground deformation** – any surface changes on a volcano (subsidence/sinking, tilting, bulging); often use of tiltmeters as well as satellite imaging which results to less exposure on the ground or safer for volcanologists. However, interpretation needs field verification sometimes.

2. **Seismic Activity** – when magma rises up, it breaks rock along the way. Thus, earthquakes are generated. Monitoring of quakes/tremors is done by using a seismometer that determines which patterns of seismic waves precede an eruption.

3. **Gases** – monitor types and rate of emission of different gases; Concentrations of gases are sometimes high enough to create acid rain that kills vegetation around the volcano; collection of samples from vents directly with the use of remote sensing instruments that identify and quantify the present gases

4. **Sensory observations** (by people living near volcano)
   - Visual – intensified presence of steam; drying up of vegetation, wells/spring/lake; crater glow at the mouth of the volcano
   - Auditory – rumbling sounds are heard.
   - Olfactory – observed foul smell (usually rotten egg caused by sulfur) caused by presence of volcanic gases
   - Tactile – ground movement/earthquake is felt

What's More

Activity 3: Look Out For the Warnings!

Direction: Read the following passages carefully. Analyze and determine the recognized sign of an impending volcanic eruption in each case study.

Case Study # 1

For 123 years, Mount St. Helens remained dormant. The large sleeping volcano was a favorite spot for hikers and outdoor enthusiasts. Thousands of people of visited the national park to fish, camp, and play.

On March 16th, 1980, three small earthquakes were measured at the park ranger station. The earthquakes were so small most visitors did not notice them. Each day after that, the number of earthquakes steadily increased. By the week of March 26th, an average of 10 earthquakes was occurring daily.

On March 27th a helicopter tourist company flew a group around the crater of the still dormant volcano. During flight, the group observed a small steam explosion blow a 15 meter hole in the top of the mountain. The group took pictures and passed them to the United States Geological Service when they returned. For the next two weeks, small spots of steam could be seen shooting out of the top of the volcano. By April 22nd, however, all steam activity ceased. Because there were no small steam eruptions, the park rangers believed the volcano was returning to dormancy and did not issue an evacuation.

Geologists, however, started to notice a bulge forming in part of the mountain. Like the mountain was growing fatter, they could see part of it growing in size. By May 17th, the bulge was growing at 2 meters per day. Finally, on May 18th, a final earthquake occurred followed by the immediate eruption of the volcano. The blast from the volcano was so large the ash cloud circled the Earth for 15 days. 57 people died.

(Before eruption, 1980)

(After eruption, 1982)

Source: Discovery Place Education Studio & SK Films (n.d.), *Educator Guide: Volcanoes, The fires of creation*, June 08, 2020, retrieved from https://www.fleetscience.org/sites/default/files/files

Case Study # 2

Mount Pinatubo is found on an island of the Philippines. The island is densely populated with large towns and tourist sites. Mount Pinatubo had not erupted in 500 years. For the past 500 years, small bursts of steam would shoot from a hot spring on the volcano. On July 16th, 1990, a magnitude 7.8 quake shook the volcano. This earthquake was followed by a series of smaller earthquakes and increase in steam activity for one week. After the week, however, the volcano appeared to return to dormancy.

In March and April 1991, earthquakes returned and steam activity increased again. The steam explosions created three craters towards the top of the volcano. For the next three months, steam explosions continued to increase in frequency. On June 7th, the first magma explosion erupted. Though the eruption was weak, geologists decided to evacuate the area. On June 15th, a large explosive eruption demolished the area, resulting in one of the largest volcanic eruptions in history.

(Before eruption, 1991)

(After eruption, 2008)

Source: Discovery Place Education Studio & SK Films (n.d.), *Educator Guide: Volcanoes, The fires of creation*, June 08, 2020, retrieved from https://www.fleetscience.org/sites/default/files/files

Case Study # 3

Nevado Del Ruiz is a volcano located in the Andes Mountains. In November 1985, the volcano began to experience earthquakes. For the next two months, geologists recorded 10 earthquakes per day. Scientists observed small spouts of steam shot from the top of the volcano each day. Scientists feared that a major eruption would come soon. By February 1985, however, the earthquakes and steam ejections stopped. Geologists still feared an eruption, but town politicians refused to evacuate. They believed that the volcano would not erupt because the earthquakes stopped.

The volcano stayed silent for several more months. On October 1985, one year after earthquakes began; a large eruption shook the volcano. The volcano exploded in a major and sudden eruption. The eruption was so strong, people could not evacuate. In the end, 25,000 people had died.

(Before eruption, 1985)

(After eruption, 2007)

Source: Discovery Place Education Studio & SK Films (n.d.), *Educator Guide: Volcanoes, The fires of creation*, June 08, 2020, retrieved from https://www.fleetscience.org/sites/default/files/files

_____

_____

_____

_____

_____

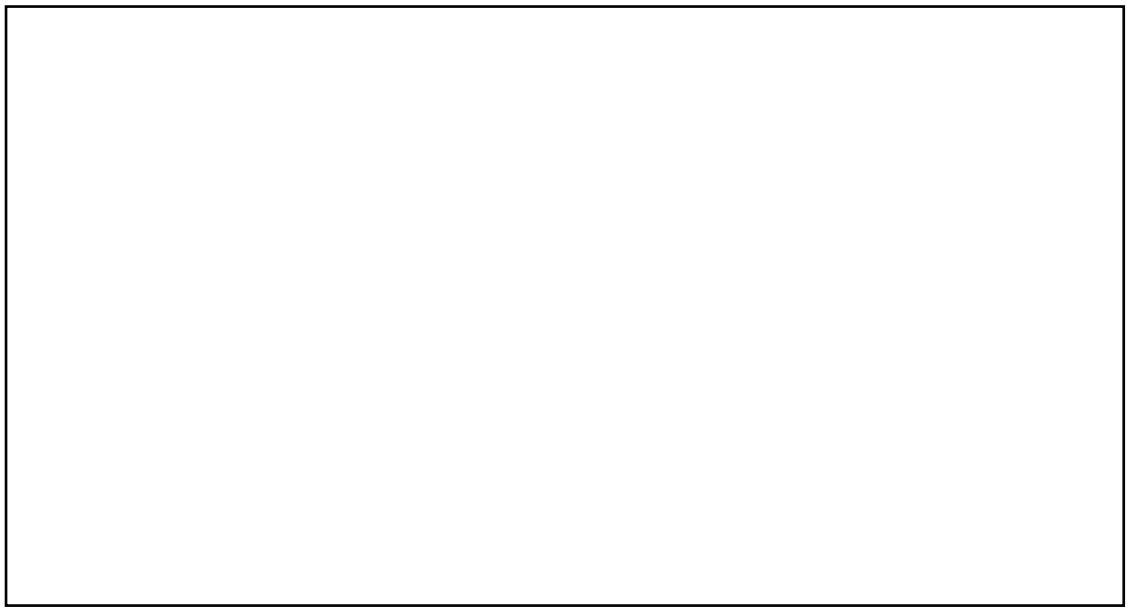
Can you recognize what sign was observed by the main narrator of each story? Were the signs observed by the narrators the same?

Activity 4: Before and After

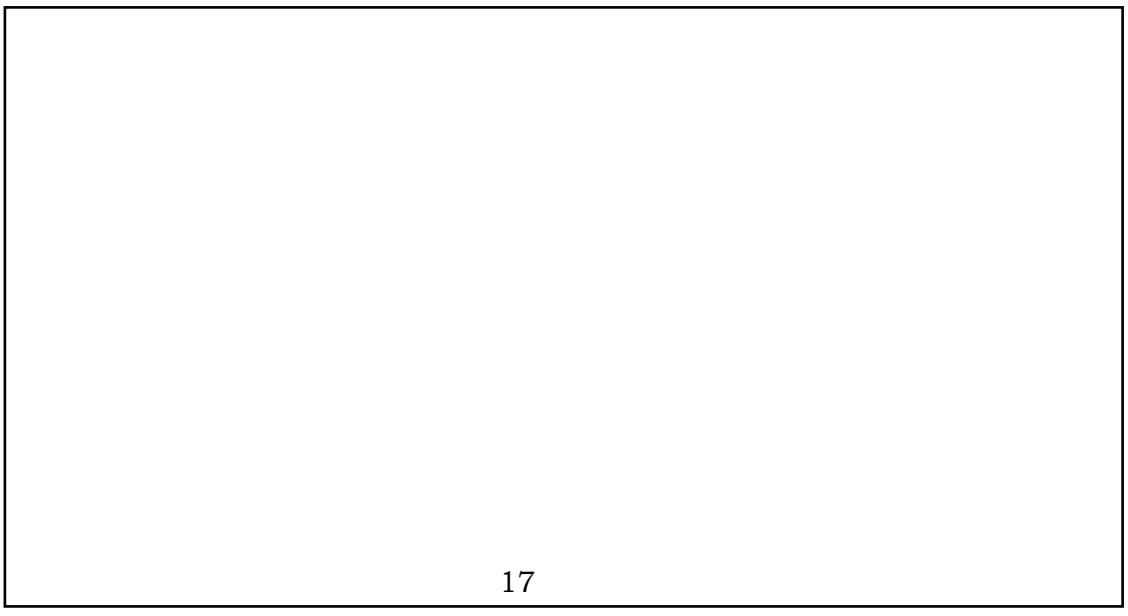
What are the characteristics and conditions of a volcano you must look for to predict an eruption? Are there visible changes after the volcano erupted? Do all of these warning signals appear to work equally well in predicting eruptions.

Direction: Answer the following questions below.

1. Draw a volcano as it looks before erupting (label the signs). Describe the details that you will draw.



2. Draw a volcano as it looks after erupting (label the signs). Describe the details that you will draw.



_____
_____
_____
_____
_____
_____
_____
_____
_____
_____

3. Compare the volcano before and after it erupted. What changes happened? Explain.

_____
_____
_____
_____
_____
_____
_____
_____
_____
_____

Activity 5: Predicting Eruptions

Congratulations! Today is your first day of internship at a volcano observatory. As an intern, you are tasked to help in monitoring and analyzing date of specific volcanoes in the Philippines.

Direction: You will be given a set of data from different volcanoes. Graph the data over time on the graphs below. Answer the following questions using the provided data.

MOUNT PINATUBO			
Day	Earthquake Count	Tiltmeter	Phreatic or Steam ejection
1	1	22	2
2	1	22	2
3	2	22	2
4	1	22	2
5	1	22	2
6	0	22	2
7	1	22	2
8	2	22	2

9	2	22	2
10	2	22	2
11	2	22	4
12	2	23	6
13	2	24	6
14	3	25	4
15	3	26	4
16	4	26	6
17	5	26	5
18	6	26	6
19	7	27	6
20	7	27	6
21	9	27	6
22	8	27	6
23	9	27	10
24	11	27	10
25	10	27	10
26	12	27	11
27	15	27	12
28	16	27	15
29	17	27	15
30	18	27	15

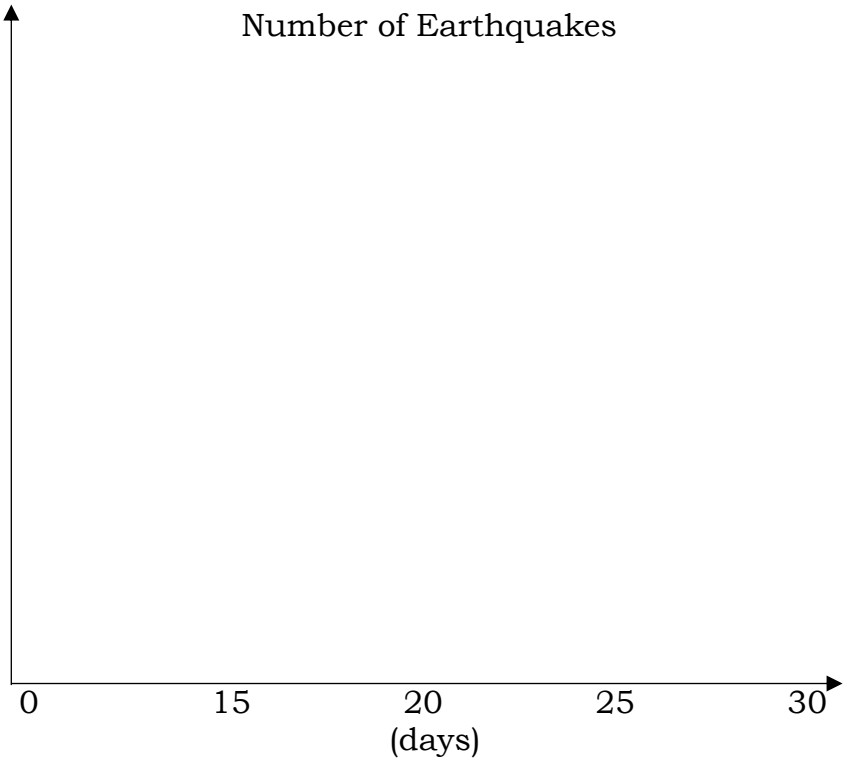
MOUNT MAYON			
Day	Earthquake Count	Tiltmeter	Phreatic or Steam ejection
1	2	15	6
2	1	15	6
3	2	14	6
4	0	15	6
5	0	15	6
6	0	15	6
7	0	15	6
8	1	14	6
9	0	15	6
10	0	15	6
11	2	15	6
12	3	15	6
13	4	14	6
14	5	15	6
15	6	15	6
16	5	15	6
17	4	15	6

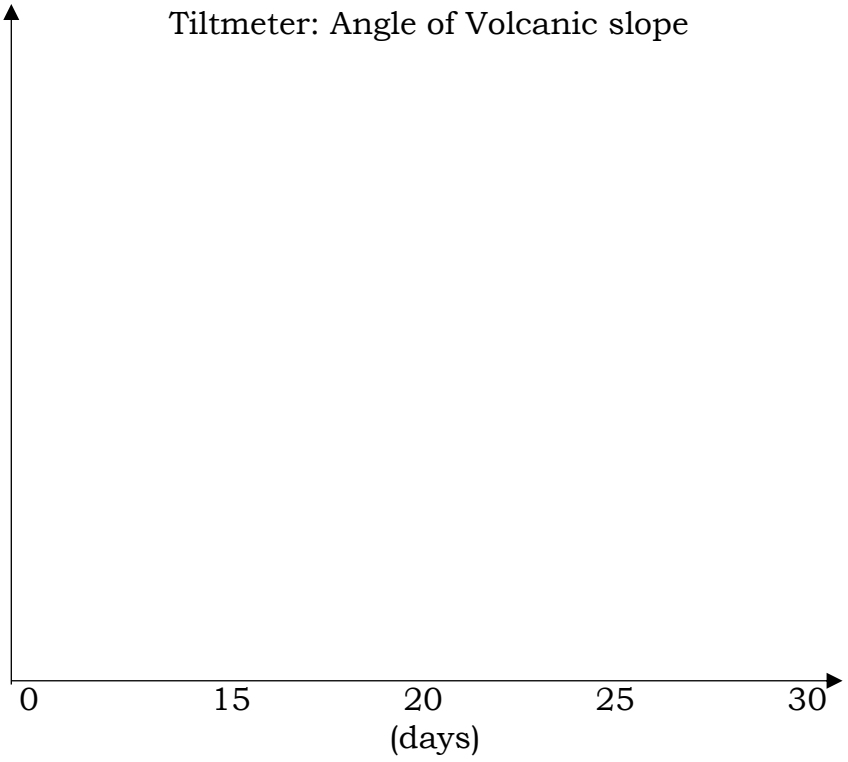
18	3	15	6
19	2	15	6
20	1	15	6
21	2	15	6
22	2	15	6
23	3	15	6
24	4	15	6
25	2	15	6
26	1	15	6
27	2	15	6
28	5	15	6
29	2	15	6
30	1	15	6

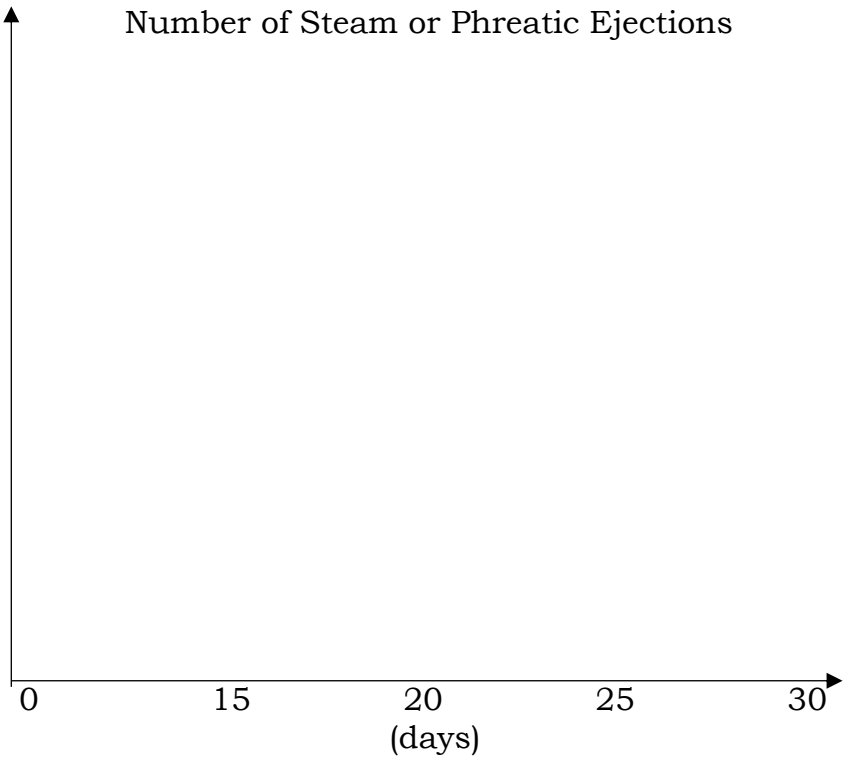
MOUNT TAAL			
Day	Earthquake Count	Tiltmeter	Phreatic or Steam Ejection
1	0	30	2
2	0	30	2
3	0	30	2
4	1	31	2
5	2	31	2
6	2	31	4
7	2	31	2
8	2	31	2
9	2	31	2
10	3	31	2
11	4	32	5
12	6	32	6
13	8	33	0
14	7	33	0
15	10	33	0
16	10	34	0
17	11	34	0
18	12	35	0
19	10	35	0
20	11	36	0
21	ACTIVE		
22	ACTIVE		
23	ACTIVE		
24	ACTIVE		
25	ACTIVE		
26	ACTIVE		

27	ACTIVE
28	ACTIVE
29	ACTIVE
30	ACTIVE

MOUNT HIBOK-HIBOK			
Day	Earthquake Count	Tiltmeter	Phreatic or Steam ejection
1	3	33	3
2	2	33	3
3	3	33	3
4	3	33	3
5	3	33	3
6	3	33	3
7	3	33	3
8	3	33	3
9	3	33	3
10	3	34	4
11	3	33	4
12	4	35	6
13	5	36	6
14	6	38	6
15	8	38	6
16	8	38	6
17	9	38	8
18	8	38	8
19	9	38	8
20	8	38	4
21	9	38	12
22	11	38	10
23	15	38	9
24	16	38	12
25	15	38	10
26	ACTIVE		
27	ACTIVE		
28	ACTIVE		
29	ACTIVE		
30	ACTIVE		


Number of Earthquakes
0
15
20
25
30
(days)


Tiltmeter: Angle of Volcanic slope
0
15
20
25
30
(days)



How many people do you think live near an active volcano? Why it is important to evacuate neighboring towns before the eruption begins? What do you think are the consequences of evacuating a town too early or causing a false alarm?

1. Which of the following volcanoes is about to erupt:

   a. Based from 1st day to 5th day:
      _____
   b. Based from 6th day to 10th day:
      _____
   c. Based from 11th day to 15th day:
      _____
   d. Based from 16th day to 20th day:
      _____
   e. Based from 21st day to 25th day:
      _____
   f. Based from 26th day to 30th day:
      _____

   Explain your answer using the data given and interpreting your graph.

   _____
   _____
   _____
   _____
   _____

_____

2. What action (student recommendation to continue normal activity, prepare to evacuate, or evacuate immediately) shall the geologic station release for the communities near each volcanoes?

   a. Based from 1st day to 5th day:
      _____
   b. Based from 6th day to 10th day:
      _____
   c. Based from 11th day to 15th day:
      _____
   d. Based from 16th day to 20th day:
      _____
   e. Based from 21st day to 25th day:
      _____
   f. Based from 26th day to 30th day:
      _____

   Explain your answer using the data given and interpreting your graph.

_____
_____
_____
_____
_____
_____

What I Have Learned

Activity 6 "Don't leave a blank"

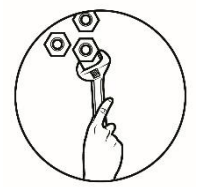
Direction: Fill in the blanks with the correct answer.

Volcanic eruption is one of the dangerous natural events due to different hazards that it may bring such as (1) _____, (2) _____, (3) _____, and a whole lot more. However, unlike earthquake, volcanic eruption is much more predictable and measurable due to its early warning signs.

Some of the early warning signs for an impending volcanic eruption are increased in frequency of (4) _____ with rumbling sounds; change in steam color from (5) _____ to (6) _____; and crater glow

at or near the crater due to presence of (7) _____. Furthermore, noticeable increase in (8) _____ of vegetation, hot springs, wells, lakes near the volcano is observed due to increase in (9) _____.

Volcanologists consider different parameters in monitoring a volcano. (10) _____ focuses on any surface changes on a volcano such as bulging, sinking, or tilting. (11) _____ is often used to lessen the exposure of volcanologists on the ground. Seismic activity is also observed and monitored using a (12) _____ which determines the pattern of seismic waves. People living near volcanoes may also detect premonitory events before a volcanic eruption which make use of senses such as (13) _____, (14) _____, (15) _____, and (16) _____.



What I Can Do

Public awareness and dissemination of information plays a crucial part in ensuring the safety of the community living near a volcano in the event of an eruption. Now that you know the warning signs of an impending volcanic eruption, how can you help in disseminating and raising the awareness of the community?

Activity 7 "Pass the Message"

Direction: Create an infographic on the different warning signs of an impending volcanic eruption.

CATEGORY	5	3	2	1
Graphics - Relevance	All graphics are related to the topic and makes it easier to understand. All borrowed graphics have a source citation.	All graphics are related to the topic and most make it easier to understand. All borrowed graphics have a source citation.	All graphics relate to the topic. Most borrowed graphics have a source citation.	Graphics do not relate to the topic OR several borrowed graphics do not have a source citation.
Graphics - Originality	Several of the graphics used on the poster reflect an exceptional degree of learner creativity in their creation and/or display.	One or two of the graphics used on the poster reflect learner creativity in their creation and/or display.	The graphics are made by the learner, but are based on the designs or ideas of others.	No graphics made by the learner are included.
Required Elements	The poster includes all required elements as well as additional information.	All required elements are included on the poster.	All but one of the required elements is included on the poster.	Several required elements were missing.
Attractiveness	The poster is exceptionally attractive in terms of design, layout, and neatness.	The poster is attractive in terms of design, layout and neatness.	The poster is acceptably attractive though it may be a bit messy.	The poster is distractingly messy or very poorly designed. It is not attractive.
Grammar	There are no grammatical mistakes on the poster.	There is 1 grammatical mistake on the poster.	There are 2 grammatical mistakes on the poster.	There are more than 2 grammatical mistakes on the poster.

Assessment

Post Test

Direction: Read each item comprehensively and write the letter of the correct answer on extra sheet of paper.

1. What do you call the molten rocks found beneath the Earth?
   A. elements
   B. lava
   C. magma
   D. minerals

2. Which of the signs of an impending volcanic eruption refers to the swelling of volcano that signals the accumulation of magma near its surface?
   A. gas emission
   B. harmonic tremors
   C. increase in number of earthquake
   D. bulges in the mountain or inflammation

3. People residing near volcanoes may detect premonitory events before a volcanic eruption. Which of the following senses is not used?
   A. auditory
   B. gustatory
   C. tactile
   D. visual

4. What is the property of substances to resist flow?
   A. buoyancy
   B. density
   C. pressure
   D. viscosity

5. Which toxic gas is released naturally by volcanic activity?
   A. carbon dioxide
   B. carbon monoxide
   C. hydrochloric acid
   D. sulfur dioxide

6. Which of the following substances is responsible for a rotten egg smell?
   A. helium
   B. magnesium
   C. silica
   D. sulfur

7. Which of the following statements is true?
   I. One warning sign observed is enough to predict an eruption.
   II. One warning sign observed is not enough to predict an eruption.
   III. Small changes recorded from an instrument is enough to predict an eruption.
   IV. Small changes recorded from an instrument is not enough to predict an eruption.

   A. I and III
   B. I and IV
   C. II and III
   D. II and IV

8. Which of the following characteristics of magma mainly affects the explosiveness of a volcanic eruption?
   A. amount
   B. color
   C. silica content
   D. temperature

9. Which of the following statements is true?
   I. People shall not be alarmed if a small change in tiltmeters is observed.
   II. Increasing sustained number of quakes indicates the volcano is about to erupt.
   III. Increasing number of thermal vents shall be monitored continuously.

   A. I only
   B. I and II only
   C. II and III only
   D. I, II, and III

10. Which of the following statements is correct?
    I. Presence of crater glow indicates that explosive eruption will occur.
    II. Bulging of the ground indicates that the volcano is going to erupt within a week.
    III. Observed rock falls and landslides indicates an impending volcanic eruption.
    IV. Long-lasting rhythmic quakes is a sign of an impending volcanic eruption.

    A. I, III, IV
    B. II, III, IV
    C. III only
    D. IV only

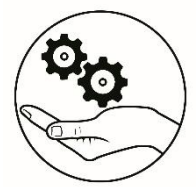
11. All of the following events indicate an impending eruption except:
    A. a measurable bulge or swelling of the volcano
    B. occurrence of short earthquakes in the region
    C. discovery of new hot springs around the volcano
    D. increased temperature of hot springs around the volcano

12. Which of the following is a parameter used to monitor volcanoes by observing the surface of the volcano for any changes?
    A. gases
    B. ground deformation
    C. seismic activity
    D. sensory observations

13. Which of the following should be continuously monitored to in a lake or hot spring around a volcano?
    A. chemical content
    B. temperature
    C. turbidity
    D. all of the above

14. Which of the following instruments is not used in monitoring a volcano?
    A. tiltmeter
    B. seismogram
    C. seismometer
    D. satellite imaging

15. Which of the following events does not indicate an impending eruption?
    A. drying up of hot springs around the volcano
    B. eroded area of the volcano after a heavy rain
    B. drying up of the vegetation around the volcano
    C. variation in the chemical content of the lakes and springs around the volcano



Additional Activities

Enrichment Activity

Make a poster or a slogan that gives warning to people about an approaching volcanic eruption. Put your work on a short bond paper.

5	4	3	2	1
Substantial, specific, illustrative, and creative content demonstrating strong development of ideas	Sufficiently developed content with adequate creativity and explanation of ideas	Limited content with less creativity and inadequate explanation	Minimal content and minimal creativity	Irrelevant content and no creativity

Answer Key

Activity 5

1. a. none, all volcanoes are dormant or inactive
   b. none, all volcanoes are dormant or inactive
   c. none, all volcanoes are dormant or inactive
   d. Mount Taal (increased frequency of earthquakes and tilting of the slope)
   e. Mount Taal and Mount Hibok-hibok (increased steam ejections)
   f. Mount Taal, Mount Hibok-hibok, and Mount Pinatubo (increased frequency of earthquakes and steam ejections)

2. a. All communities near each volcano: student recommendation to continue normal activity.
   b. All communities near each volcano: student recommendation to continue normal activity.
   c. Community near Mount Taal shall prepare to evacuate any time. Other areas are recommended to continue normal activity
   d. Community near Mount Taal shall evacuate. Other areas shall prepare to evacuate any time. (increased frequency of earthquakes, increased tilting of the slope, and decreased steam ejections)
   e. Community near Mount Hibok-hibok shall evacuate. Community near Mount Taal shall remain away from the active volcano. Other areas are recommended to continue normal activity.
   f. Community near Mount Pinatubo shall evacuate. Communities near Mount Taal and Mount Hibok-hibok shall remain away from the active volcanoes.

Activity 6

1-3. Any of the following (in no particular order): Lava flow, ashfall, debris avalanche, landslides, emission of volcanic gases, lahar, and pyroclastic flow
4. earthquakes
5. white
6. gray
7. magma
8. drying up
9. temperature
10. ground deformation
11. satellite imaging
12. seismometer
13-16. In no particular order: Auditory, Visual, Olfactory, and Tactile

Post-Test

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

Pre-Test

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

Activity 1

- Evacuate
- Bring emergency kit or survival kit
- Stay tuned for new and announcements via battery powered radio
- Do not panic
- Follow the advice issued by the officials

Activity 2

1. QUAKE
2. STEAM
3. MAGMA
4. INFLATION
5. LANDSLIDES
6. VEGETATION
7. TEMPERATURE
8. CHEMICAL
9. SPRING
10. THERMAL

FINAL BOX: VOLCANIC ERUPTION

Activity 3

Case Study # 1: increased in frequency of earthquakes, observed steam ejection, bulge formation or tilting of the ground
Case Study # 2: increased steam ejection; increased frequency of earthquakes, magma eruption
Case Study # 3: increased frequency of earthquakes, increased steam explosion or ejections

Activity 4

1.Increase in the frequency of volcanic quakes with rumbling sounds; occurrence of volcanic tremors;
2.Increased steaming activity; change in color of steam from white to gray due to entrained ash;
3.Crater glow due to presence of magma at or near the crater
4.Ground swells (or inflation), ground tilt and ground fissuring due to magma intrusion
5.Localized landslides, rockfalls and landslides from the summit area not attributable to heavy rains
6.Noticeable increase in drying up of vegetation around the volcano's upper slopes
7.Increase in temperature of hot springs, wells (e.g. Bulusan and Canlaon) and crater lake (e.g. Taal) near the volcano
8.Noticeable variation in the chemical content of springs, crater lakes within the vicinity of the volcano
9.Drying up of springs/wells around the volcano
10. Development of new thermal areas and/or reactivation of old ones; appearance of solfataras (craters with sulfur gas)

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