

Veritas Classical Schools
Science Assignment Sheet
Week 10

Mrs. Julie O'Bryant
juliebryant@gmail.com
615-541-9860



Our Planet Earth Assignment Sheet #12
Lessons 27 - 29

Lesson 27 – Geysers

- **Read** pages 107-110 in the textbook.
- **Complete** the notebooking pages for Lesson 27 and add them to your binder.

- **Lesson 28 – Weathering and Erosion**
- **Read** pages 111-112 in the textbook.
- **Complete** the notebooking pages for Lesson 28 and add them to your binder.

- **Lesson 29 – Mass Wasting**
- **Read** pages 113-115 in the textbook.
- **Complete** the notebooking pages for Lesson 29 and add them to your binder.

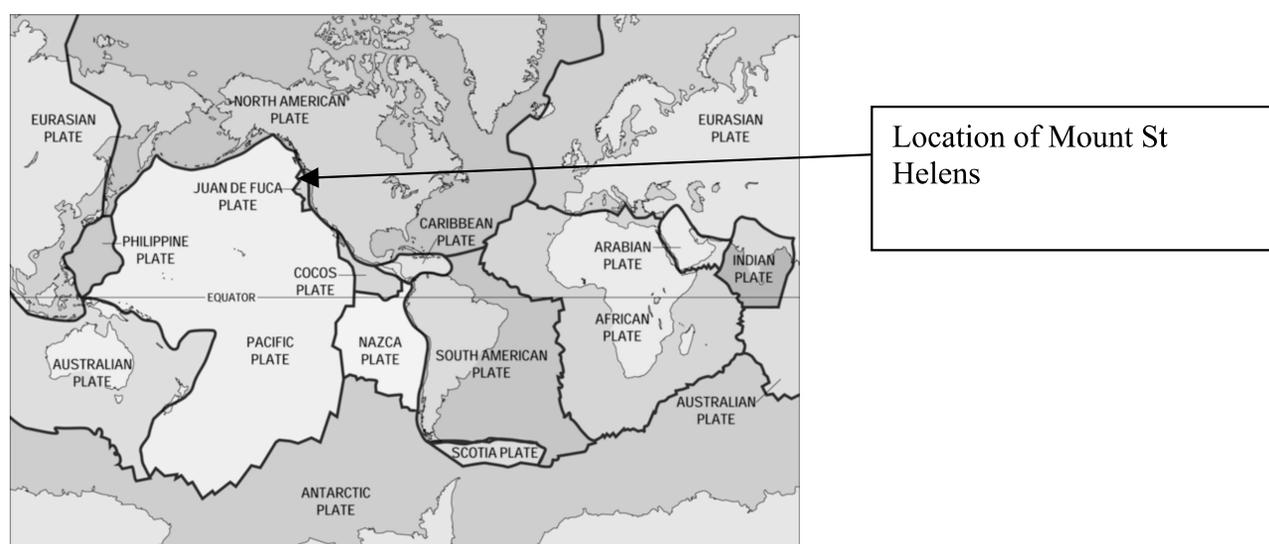
Additional Homework:

Read Mount St. Helen's packet

Mount St Helens – how the eruption of a well-known volcano caused unexpected death and destruction

Introduction

Mount St. Helens, a stratovolcano or *composite* volcano located in Washington State, USA (46.2° latitude north, 122.2° longitude west,) erupted violently on the Sunday morning of May 18th 1980 at precisely 8:32. The Volcanic Explosivity Index (VEI) was recorded to be 5, out of a potential 8, its devastation bringing death to around 57 people directly, along with a plane crash and a traffic accident killing a total of 7 more. The cost of the event itself reached to a height of 1.1 billion dollars.



Causes of the eruption

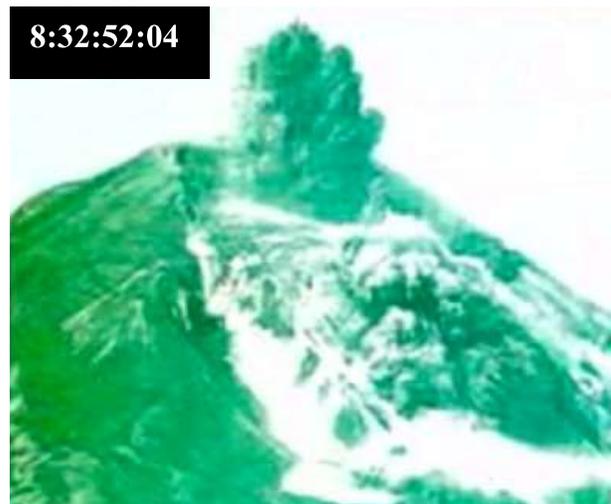
Mount St. Helens sits on the plate boundary between Juan de Fuca and the North American plates (map above). The boundary is part of the so-called 'Ring of Fire' - the string of volcanoes that congregate around the margin of the Pacific Ocean. The plate margin that created Mount St. Helens was *destructive*, with Juan de Fuca plate subducting beneath the North American, producing the line of volcanoes along the Cascade Mountain Range.

The fierce 1980 eruption occurred because of the destructive nature of the margin between the Juan de Fuca oceanic plate and the North American continental plate. Tectonic plates move due to convection currents in the mantle, but movement in a different directions creates different possible margins. With the two plates moving towards each other, the oceanic plate in this case was being subducted beneath the continental because the

oceanic is denser and *heavier*. Rising temperatures, due to the presence of magma and frictional effects, caused the crust to begin to melt, adding to the existing magma. As a result of the melting, bubbles of gasses were produced, forcing the magma to rise closer towards the surface, raising the pressure even further. As well as the Juan de Fuca plate being submerged under North America, seawater was pulled through the subduction zone, coming into contact with the magma and generating a great amount of steam, turning it violently explosive.

The pressure was immense, triggering an earthquake measured 5.1 on the Richter scale below St. Helens. This caused a colossal bulge on the north flank of the volcano, which had developed over many months due to increasing pressure, to collapse instantly, and in turn causing a catastrophic landslide, or *debris avalanche*. This suddenly released the huge pressure and strain on St. Helens, explosively expelling the stored gas and steam causing the famous and violent eruption. Scientists monitoring the explosion expected the eruption to occur through the main vent. On this occasion, because of the huge landslide, the lateral blast shot through the side of the volcano directly after the north flank collapsed, determining the new direction. This lateral blast in turn created the infamous pyroclastic flow as it developed.

Below: two scenes from the eruption, with just 5 seconds difference. These pictures give a vivid picture of the landslide and eruption that followed



8:32:47:02



Photo of St. Helens, taken May 19th 1982, showing the result of the lateral blast. The flank of the volcano has been almost completely removed, showing the power of the lateral eruption

Being a composite volcano, Mount St. Helens is formed from 'denser' lava, called dacite lava. On the day of the eruption of 1980, St. Helens held host to a *Phreatic* eruption and didn't expel a lava flow of any kind,



but it had such an explosive eruption because of its high silica content and high concentration of gas. The reason for the lack of lava is because the explosion broke the dacite magma into pumice and ash particles, which were shot through the main vent, along with volcanic gas and steam, creating a *Plinian* eruption column. During the whole course of the eruption, 24 megatons of thermal energy was released and the vigorous plume of ash reached the midst of Idaho, the next state southeast, by noon. But through

the complete 9 hours of the eruption, it deposited ash in 11 US states. The settled ash managed to reach a maximum of 10 inches thick in areas closer to the eruption.

The height of volcanoes are unclear when looking at a range of sources, but a relatively reliable website claims that before the initial eruption, St. Helen's summit elevation was approximately 9,760 feet (2,975 m) and after, declined to about 8,525 feet (2,600 m).

The photo below shows the nature of this eruption very clearly. Notice the vast plume of ash already being blown eastwards.

The most destructive aspects of the eruption were the enormous landslide (the largest to have ever been recorded), the volcanic bombs and the pyroclastic flow, eventually covering a tremendous 230 square miles. These are all *primary* hazards. The landslide, triggered by the 5.1 magnitude earthquake, crashed down the mountain, growing rapidly in size. It covered 23 square miles, travelling at a speed of 100 – 150mph, easily destroying everything in its path. Whilst the smoke and toxic gasses were released from St. Helens to a height of at least 10 miles high, the pyroclastic flow rushed down the mountain side reaching speeds of 300mph (480kmph) and exceeded temperatures of 350° C (660° F) incinerating anything before it, or engulfing it in dense ash. Volcanic bombs were viciously thrown into the fiery air, up to 8 miles from the eruption, crashing into the ground somewhere already obliterated by the pyroclastic flow, contributing relatively little damage.

The enormous landslide and pyroclastic flow destroyed nearly 250 houses, 185 miles of highway and 15 miles of railway. 4 billion trees were torn down to the ground, enough timber to build around 300,000 two-bedroom homes.

The photos of Spirit Lake before and after the pyroclastic flow (below) illustrate the impact of the eruption on the landscape around St Helens.



July 6 1979



October 4 1980

A *secondary* hazard of the Mt. St. Helens eruption was the lahar (mudflow). Hot rock and gas quickly melted some of the snow and ice, creating flows of water mixing with loose rock debris to form lahars, flowing at a range of velocities due to different gradients of slopes and surfaces, but between 10 and 60mph. The lahars of St. Helens flowed into the Toutle and Cowlitz rivers, travelling many miles down the two, extensively damaging around 35 bridges in the process. 3 million m³ of material was transported 17 miles (27 km) into the Columbia River by these mudflows. These impacts occurred very quickly and went beyond the range predicted by scientists studying the volcano.

The photos below illustrate the power of the lahars and floods created by the eruption of Mount St Helens.



Impacts of the eruption

Luckily, Mount St. Helens isn't situated near a particularly built up area, so the damage she caused wasn't cataclysmic. Inevitably, unemployment in the area of St. Helens immediately followed the eruption, but was back to nearly normal once the timber salvaging and ash clean up operations were underway. Only an incredibly small percentage of residents left the region because of lost jobs due to the event.

Transport was also an issue. As a result of so many roads, bridges and railways being closed or destroyed, road workers were put hard to work creating a huge number of diversions. Several airports had to be shut

down also, and over 1,000 flights were canceled because of ash accumulation and poor visibility, causing unsettlement for staff and people awaiting flights. Fine ash caused short circuiting in electrical generators too, and in turn causing power blackouts and loss of phone communications.

The economy was affected in different respects as well. The total cost of the damage, mentioned before, was more than 1.1 billion US dollars. A few people reported suffering and emotional problems, so some counties in the region requested funding for health programs to assist such people. Tourism decreased also, considered important in Washington, although eventually this was proved only temporary. Perhaps due to its reawakening, St. Helens has regained its attraction to tourists.

How people responded

An immediate response to the eruption was evacuation. Other residents, who were more on the outer section of the blast zone, were evacuated on several premises such as hotels, campsites and research stations. One man, an 84 year old innkeeper by the name of Harry Truman, became 'famous' after solidly refusing to leave. Part of the evacuation team and local authorities were desperately trying to persuade him, but he simply decided not to, claiming that he had lived there since he was 30 years of age.

Locals witnessing the event called emergency services. The Federal Emergency Management Agency arrived not too long after, once permission had been granted owing to the vast situation. They brought with them helicopters, but unfortunately found them less helpful than they thought they would be. Nevertheless, the emergency services reduced the amount of casualties and with the help of aid agencies, set up temporary rescue centers for those left homeless.

Volcanic investigators and geologists also fled towards the scene, in order to proceed in as much research as possible. And because of the great amount of settling ash, street plows were called out and whilst on patrol, were advising people to stay indoors.

Following the 1980 eruption a *longterm* response took place; the area was left to gradually return to its original state. And in 1982, President Ronald Reagan established the Mount St. Helens National Volcanic Monument, with a 100,000 acre area around the mountain.

Preventing impacts – the future

One way to prevent a repeat of such damage and distress, that the national government *has* undertaken, is prediction, the monitoring of the volcano. Since the eruption, the monitoring of St. Helens has had a significant increase, in order to issue warnings far earlier, hoping to give people sufficient time to seek safety.

Ways that they *could* prevent a repeat of any damage and distress, as well as prediction include; protection, education and resettlement. In the example of the Merapi volcano, dams have been built down each valley to hold back Lahars. And in the case of education, each person should simply be educated in evacuation procedures and precautions. And lastly, again using the example of the Merapi volcano, settlement is prohibited in areas close to Merapi, although farming *is* allowed there. But safer concrete houses have been built elsewhere, but with no land of which to farm.

In the case of earthquakes, people might continue living in an earthquake-prone area for a number of reasons. The authorities have usually done quite a lot of ‘earthquake proofing’ after previous strikes, such as reconstructing collapsed buildings into earthquake-proof structures. If so, then they might also have issued an earthquake emergency pack for each home. With just these two precautions alone, this environment has become a reasonably safer place to live already, and people can quite happily live their lives with a clear consciousness, no matter how good or bad their lives may be. Also, instruments such as the seismometers, constantly monitoring earth tremors will hopefully provide them with early warnings of any seismic activity. However, even if this theoretical area does not consist of these measures, there might yet be other reasons for people wanting to keep living here. Such as their whole family living there and maybe always has, having a good enough job that earns a lot of money, or just feeling emotionally attached for whatever reasons.

With a volcano there are other things to take into account. Although people know that living near a certain ‘active’ volcano might be dangerous, the risk is often worth taking particularly if you live in a Less Economically Developed Country, growing your own food. This is so because volcanic material makes a fertile soil. This soil is rich in minerals and is prosperous in yielding a very good crop. If this theoretical place is more economically developed, then reasons for staying might be similar to the ones about the earthquake, your whole family being there, having a well paid job, feeling emotionally attached or just taking a calculated risk that the volcano will never erupt in their lifetime.

Tectonic plate map (public domain)

http://commons.wikimedia.org/wiki/File:World_tectonic_plate_map_large.png

Lateral blast (public domain)

http://commons.wikimedia.org/wiki/File:MSH82_st_helens_plume_from_harrys_ridge_05-19-82.jpg

Mudline destruction (public domain)

http://commons.wikimedia.org/wiki/File:Mudline_from_1980_St_Helens_lahars_next_to_Muddy_River.jpg

Eruption plume (public domain)

http://commons.wikimedia.org/wiki/File:Mudline_from_1980_St_Helens_lahars_next_to_Muddy_River.jpg

After image (public domain)

http://commons.wikimedia.org/wiki/File:MSH80_blast_area_spirit_lake_with_rainier_10-04-80_med.jpg

Before image (public domain)

http://vulcan.wr.usgs.gov/Imgs/Jpg/MSH/Images/MSH80_aerial_spirit_lake_from_south_04-10-80_med.jpg

House destruction (public domain)

http://vulcan.wr.usgs.gov/Volcanoes/MSH/Publications/MSHPPF/MSH_past_present_future.html



Name _____ Date: _____

Our Planet Earth Test 3 Lessons 19-26

Please note that for this test taken on 11/5/2020, it is open book.

1. Fill in the Blank

- The currently accepted theory that the earth's crust is actually several large pieces floating on the mantle is called _____ . (2 words).
- The slow movement of several large plates floating on liquid magma is called _____ . (2 words)
- The two names for the original single large landmass are _____ and _____ .

Following Questions 5-8 were modeled in the graham cracker/frosting

- _____ is when two plates move away from each other.
- _____ occurs when one of the plates is pushed down below the other plate. It occurs most frequently when an oceanic plate is pushed below a continental plate.
- _____ (3 words) is the horizontal movement of two tectonic plates against each other. The plates can get stuck against each other and pressure builds up. When it is high enough the plates lurch in opposite directions and an earthquake occurs.

8. 10. The area where two plates collide and one slides under the other is called a _____ (2 words).

9. The area around the _____ (2 words) is often called the "Ring of Fire". It is called that because there is so much _____ activity there.

10. The largest mountain range in the Eastern United States is the
a. _____ Mountains.

11. The longest/most extensive mountain range in the world is the
a. _____. It is located under the _____ (2 words).

12. A group of mountain ranges is called a _____ (2 words).

13. A series of mountains in a given area is called a _____ (2 words).

14. The four categories of mountains are:

- a. 1. _____ 2. _____
b. 3. _____ 4. _____

15. An _____ is the rapid movement of the earth's crust.

16. _____ are smaller quakes that follow a severe earthquake.

17. The area on the surface of the earth directly above the area where an

- a. earthquake begins is called the _____.

18. The center of activity for an earthquake is the _____. It is located
19. deep underground.
20. On December 26, 2004 an undersea earthquake in the _____
21. _____ (2 words) generated a wave that killed more than 283,000 people.
22. The huge waves that can be generated by ocean based earthquakes are called _____.
23. In 2010 a massive earthquake on the island country of _____ occurred. Between 230,000 and 316,000 people died as a result of that earthquake.
24. The fault that runs from San Francisco down the California coast to Mexico is called the _____ Fault.
25. The two plates that meet at this fault are the _____ Plate and the _____ Plate.
26. Name 3 of the 5 items that spew out during a volcanic eruption.
1. _____ 2. _____ 3. _____
- _____
27. The piece of equipment that is used to detect and measure the magnitude of earthquakes is a _____.
28. The _____ Scale measures the magnitude (strength) of an earthquake.
29. A _____ is a bowl-shaped depression at the mouth of a volcano.

30. _____ volcanoes emit mostly ash.
31. _____ volcanoes emit mostly lava.
32. _____ volcanoes alternate between emitting large amounts of ash and large amounts of lava. .
33. Over our study of earthquakes and volcanoes, we learned that scientists are able to _____ them, but currently, are **unable to** _____ them.