Mount St Helens National Volcanic Monument – Teacher's Corner 2011
Gifford Pinchot National Forest
USDA Forest Service

Mount St. Helens: Blowing, Flowing and Glowing

Outdoor Activity

Time Commitment: 45 minutes to 1 hour
Location: The Eruption Trail on Johnston Ridge

The purpose of this activity is to familiarize students with how topographic features directed or influenced the movement of the May 18, 1980 landslide, lateral blast, and pyroclastic flows. Through small group exploration, students will observe, and identify geological features then develop models about them to determine if topography influenced the eruptive features visible along the Eruption Trail.

Goal: Students will determine how the movement of three May 18, 1980 eruptive events was influenced by the surrounding topography.

Objectives:

1) Students will describe the eruptive characteristics of the May 18, 1980 landslide, lateral blast and pyroclastic flows.
2) Students will identify and describe the characteristics of the landslide, lateral blast and pyroclastic flow deposits.
3) Students will describe how landscape features influenced the movement of the landslide, lateral blast and pyroclastic flows.
4) Students will understand that getting off the trail is prohibited in order to protect fragile plant life, and will abide by the Monument regulations.

Washington Essential Academic Learning Requirements

1.1.2 Motion of Objects
Understand the positions, relative speeds, and changes of speed of objects.

- Describe and measure the position or change in position of one or two objects.

1.1.5 Nature and Properties of Earth Materials
Understand how to classify rocks, soils, air and water into groups based on their chemical and physical properties.

- Describe the properties of minerals and rocks that give evidence as to how they formed.

1.2.1 Structure of Physical Earth/Space and Living Systems
Analyze how the parts of the system interconnect and influence each other

- Explain how the parts of the system interconnect and influence each other
- Describe the interactions and influences between two or more simple systems.

1.3.1 Nature of Force
Understand factors that affect the strength and direction of forces.

- Observe and describe factors that affect the strength of forces.

1.3.4 Processes and Interactions in the Earth's system
Understand the processes that continually change the surface of the Earth.

- Describe how constructive forces change landforms.
- Describe how destructive processes change landforms.

2.1.3 Explaining
Apply understanding of how to construct a scientific explanation using evidence and inferential logic.

- Generate a scientific conclusion including supporting data from an investigation using inferential logic.
- Describe a reason for a given conclusion using evidence from an investigation

2.2.2 Limitations of Science and Technology
Understand that scientific theories explain facts using inferential logic

- Describe how a principle or theory explains a given set of facts.
- Describe how new facts or evidence may result in the modification or rejection of a theory.

2.2.5 Evolution of Scientific Ideas
Understand that increased comprehension of systems leads to new inquiry.

- Describe how scientific inquiry results in new facts, evidence, unexpected findings, ideas and explanations.
- Describe how results of scientific inquiry may change our understanding of the systems of the natural and constructed world.

Vocabulary:

1) **Landslide:** a rapid and unusually sudden sliding or flowage of unsorted masses of rock and other material falling under the force of gravity
2) **Lateral Blast:** a large explosion directed out of the side of a volcano containing a turbulent mixture of hot gas, ash, and rock that flows over the ground at high speeds under the influence of gravity.
3) **Pyroclastic Flow:** the lateral flow of a turbulent mixture of hot gases and unsorted ash, pumice, and volcanic fragments that flow under the influence of gravity. {Pyro (fire) clastic (broken rock)}
4) **Hummock:** large mounds of rock deposited by a landslide.
5) **Pumice:** a light-colored frothy volcanic rock with a high silica content formed by the rapid expansion of gas in erupting lava.
6) **Dacite:** a volcanic rock characteristically light in color, containing 62 to 69% silica. Mount St. Helens erupted dacite lava on May 18, 1980.

Mount St. Helens: Blowing, Flowing and Glowing

Outdoor Activity

Mission: To use the case facts and to make observations in order to determine if topography influenced the movement of eruptive events on May 18, 1980.

Possible Explanations:

1) Topography influenced the movement of the landslide, lateral blast, and pyroclastic flows on May 18, 1980.
2) Topography did not influence the movement of the landslide, lateral blast, and pyroclastic flows on May 18, 1980.

Case Facts:

- A massive landslide fell from Mount St. Helens on May 18, 1980.
- The landslide traveled 5-miles north and 13.5 west of the volcano.
- Characteristics of areas impacted by the landslide include: large mounds of rock called hummocks, the absence of logs and exposure of bedrock due to scouring or burial.

- A lateral blast burst out the north side of the volcano. It was composed of hot gasses, ash, and rock.
- Rock made the blast cloud heavy, which held it close to the ground. Gasses made the blast cloud to flow like a fluid east, north and west of the volcano.
- Characteristics of blown down forests include: stumps with shredded tops, blown down logs with exposed root systems, pieces of wood in varying sizes, and igneous rocks and ash that were blasted out of the volcano.

- Four hours after the eruption began super-heated avalanches of gas, ash and pumice, called pyroclastic flows, tumbled down slope from the crater into the valley below it.
- Characteristics of pyroclastic flows include sloping plains of ash and light-weight pumice rocks restricted to the valley bottom. The 30 to 130 foot deep deposit contained loose pieces of 1000-degree lava rock and pumice too heavy to rise into the atmosphere.

Evaluate the Evidence:

1) As you walk the Eruption Trail to its highest point, look at the shattered stumps and blown down trees along the trail. The diameter of the stumps and logs indicates the trees that stood here were 150 to 250 feet tall. Describe the lateral blasts impacts to the forests.

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a) Why do you think the lateral blast able to kill trees on both sides of the ridges?

_____

_____

2) Stop at the circular plaza on the top of the hill and find the sundial-like locator map. Slowly turn one full revolution and look for blown down trees on the nearby ridges as you turn. Use the locator map to identify the direction the blown down trees lay. _____

_____

a) Use the locator map and find east. Look east down the length of Johnston Ridge and find the mounds on the top of the ridge. What are the mounds and how did they get there?

_____

_____

_____

b) Look east at the mounds on again and find the small valley on the left side of Johnston Ridge. The ground in the lower half of the valley has a different color and texture than the ground on the upper half of the valley. What could account for the differences in color?

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_____

c) Look east at the mounds again and note the barren rock on the right side of Johnston Ridge (side facing the volcano). The landslide fell from the north side of the volcano, but traveled farther west than north. Why do you think this happened? Explain your answer.

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d) Use the locator map and find south. The eruption began with a landslide that filled the valley below to a depth of over 200 feet. Why are there so few hummocks between Johnston Ridge and volcano?

_____

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Conclusions:

a) Circle the explanation you think is best or explain how you reached a different conclusion.

1) Topography influenced the movement of the landslide, lateral blast, and pyroclastic flows on May 18, 1980.
2) Topography did not influence the movement of the landslide, lateral blast, and pyroclastic flows on May 18, 1980.

In complete sentences, explain the evidence you used to support your conclusion.

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Teacher's Answer Sheet
Mount St. Helens: Blowing, Flowing and Glowing
Outdoor Activity

Mission: To use the case facts and to make observations in order to determine if topography influenced the movement of eruptive events on May 18, 1980.

Possible Explanations:

1) Topography influenced the movement of the landslide, lateral blast, and pyroclastic flows on May 18, 1980.
2) Topography did not influence the movement of the landslide, lateral blast, and pyroclastic flows on May 18, 1980.

Case Facts:

3) A massive landslide fell from Mount St. Helens on May 18, 1980.
4) The landslide traveled 5-miles north and 13.5 west of the volcano.
5) Characteristics of areas impacted by the landslide include: large mounds of rock called hummocks, the absence of logs and exposure of bedrock due to scouring or burial.

- A lateral blast burst out the north side of the volcano. It was composed of hot gasses, ash, and rock.
- Rock made the blast cloud heavy, which held it close to the ground. Gasses made the blast cloud to flow like a fluid up and over ridges—east, north and west of the volcano.
- Characteristics of blown down forests include: stumps with shredded tops, blown down logs with exposed root systems, pieces of wood in varying sizes, and igneous rocks and ash that were blasted out of the volcano.

- Four hours after the eruption began super-heated avalanches of gas, ash and pumice, called pyroclastic flows, tumbled down slope from the crater into the valley below it.
- Characteristics of pyroclastic flows include sloping plains of ash and light-weight pumice rocks restricted to the valley bottom. The 30 to 130 foot deep deposit contained loose pieces of 1000-degree lava rock and pumice too heavy to rise into the atmosphere.

Evaluate the Evidence:

1) As you walk the Eruption Trail to its highest point, look at the shattered stumps and blown down trees along the trail. The diameter of the stumps and logs indicates the trees that stood here were 150 to 250 feet tall. Describe the lateral blasts impacts to the forests.

The lateral blast shattered and splintered the forest that stood here. Tree trunks, branches, and bark were swept away. Scientists believe the blast cloud doubled in volume the first five miles it raveled by shattering the forest in its pathway._ Plant communities beneath the trees were buried under rock and ash.____

a) Why do you think the lateral blast able to kill trees on both sides of the ridges?

The case facts reveal that the lateral blast was composed of hot gasses, ash, and rock. Rock made the blast cloud heavy, which held it close to the ground. Gasses allowed the blast cloud to flow like a fluid up and over ridge tops.

2) Stop at the circular plaza on the top of the hill and find the sundial-like locator map. Slowly turn one full revolution and look for blown down trees on the nearby ridges as you turn. Use the locator map to identify the direction the blown down trees lay. *North- northwest*

a) Use the locator map and find east. Look east down the length of Johnston Ridge and find the mounds on the top of the ridge. What are the mounds and how did they get there?

The mounds on the top of the ridge are hummocks, indicating the landslide spilled over Johnston Ridge then flowed down the South Coldwater Creek drainage. The landslide spilled over in two locations, separated by a small narrow patch of blown down trees.

b) Look east at the mounds on again and find the small valley on the left side of Johnston Ridge. The ground in the lower half of the valley has a different color and texture than the ground on the upper half of the valley. What could account for the differences in color?

When the landslide spilled over Johnston Ridge, it turned and flowed down the South Coldwater Creek. The lighter color in the lower half of the drainage is due to the landslide, which scoured away the soil exposing bedrock. A "trim line" reveals the height of the landslide as it flowed down South Coldwater Creek.

c) Look east at the mounds again and note the barren rock on the right side of Johnston Ridge (side facing the volcano). The landslide fell from the north side of the volcano, but traveled farther west than north. Why do you think this happened? Explain your answer.

The landslide fell from the north face of the volcano, but traveled 13.5 miles to the west because it struck Johnston Ridge. When the landslide hit Johnston Ridge, it was deflected westward. The landslide scraped away the soil, exposing bedrock, as the landslide crashed against the ridge.

d) Use the locator map and find south. The eruption began with a landslide that filled the valley below to a depth of over 200 feet. Why are there so few hummocks between Johnston Ridge and volcano?

There are few hummocks between Johnston Ridge and the volcano, because pyroclastic flows covered most of the landslide deposits within five miles of Mount St. Helens. These super-heated rock avalanches began to spill out of the crater about 4-hours after the eruption began, covering the landslide deposit with up to 130 feet of ash and pumice.

Conclusions:

a) Circle the explanation you think is best or explain how you reached a different conclusion.

(i.) Topography influenced the movement of the landslide, lateral blast, and pyroclastic flows on May 18, 1980.

ii. Topography did not influence the movement of the landslide, lateral blast, and pyroclastic flows on May 18, 1980.

In complete sentences, explain the evidence you used to support your conclusion.

Blown down trees and shattered stumps reveal that topography influenced the direction the blast traveled. Hummocks and scour marks reveal that Johnston Ridge deflected and directed the landslide down the Toutle River valley, and down the South Coldwater Creek drainage. Pyroclastic flows travel as far as slope and gravity allow. The presence of hummocks just down valley from Johnston Ridge indicates that the topography influenced how far the pyroclastic flows were able to move.

Instructional Sequence for Mount St. Helens Blowing Flowing Glowing:

1. Gather students at the outdoor viewing plaza at the Johnston Ridge Observatory. Divide students into groups of five and assign one chaperone to assist each student group. Explain that the students will need a pencil, "Mount St. Helens: Blowing, Flowing, Glowing" worksheet and clipboard or notebook to write on.

2. Explain that the area around them was forested prior to the eruption, and that the May 18, 1980 eruptive events changed the landscape or topography around them. The students' mission is to determine if the topography around them influenced the movement of the landslide, lateral blast and pyroclastic flows.

    A. If you selected an itinerary where this activity is done before your students have explored the Johnston Ridge Observatory, complete instructions 3-4.

    B. If you selected an itinerary where your students explored the Johnston Ridge Observatory before conducting this activity, bypass instructional sequence 3-4.

3. Explain that when Mount St. Helens became active in March of 1980 that magma rose up into the volcano and found a weak spot on the north side of the mountain (If the volcano is visible point to the large hole where the north side of the mountain use to be.) The magma or molten rock pushed into the north side of the volcano, causing it to swell sideways at a rate of five feet per day. A large lump, called the "bulge", developed on the north side of the volcano. By May 18th the bulge was 1½-miles long, 1 mile wide and up to 450 feet high.

4. Describe that on the morning of May 18th a 5.1 magnitude earthquake shook the bulge, causing the north face and summit of Mount St. Helens to collapse. The landslide caused the lateral blast—an explosion to burst out the side of the volcano. This lateral blast traveled at an average speed of 300mph. About 10-minutes after the landslide and blast began, a gigantic plume of ash rose skyward. The volcano pumped ash up into the atmosphere for 9-hours, but by noon parts of the ash plume began to collapse. Super-heated avalanches of hot gas, ash and pumice, called pyroclastic flows, spilled out of the crater down into the valley below.

5. Read aloud to your students both possible explanations on the "Mount St. Helens: Blowing, Flowing Glowing" worksheet. Their mission is use the case facts, and evidence along the eruption trail to answer questions on the worksheet. When they have answered the questions, they should be able to determine which explanation is best.

6. Explain that they will walk the Eruption Trail to its highest point, where they will find a circular plaza with sundial-like directional finder in the middle of it. As students walk, have them look for signs indicating a hot, stone filled wind blew through the area. . Explain that the group will meet at the circular plaza on the top of the hill in 10 minutes.

7. Allow students 15 to 20-minutes to make observations and use the directional finder in the circular plaza to answer questions on their worksheet. Allow 5 to 10 minutes for each student group to present their findings to the class. After the groups have presented their findings, review the answers to each question on the worksheet.

8. Explain that answer #1 is correct. Topography did influence the movement of the eruptive events in question.
    a. Blown down trees are like compass needles frozen in time, pointing the direction the blast traveled. The steam powered blast flowed like a fluid, but rock in the cloud made it heavy, holding the blast cloud to the ground. This enabled the blast cloud to flow up a hill, crest the top, then flow down the opposite side of the ridge, because the blast cloud was too dense to rise.

       The blown down trees reveal that the blast followed the topography. If a hillside sloped to the left, the blast cloud followed the pathway of least resistance and flowed to the left. The blast killed trees 15 miles due west, because the cloud was funneled down the Toutle River Valley. Trees were killed only 11 miles due east because the rugged topography slowed the blast cloud.

    B. Hummocks on the top of Johnston Ridge indicate that the landslide spilled over Johnston Ridge then flowed down the South Coldwater Creek drainage. The lighter color in the lower half of the drainage is due to the landslide, which scoured away the soil exposing bedrock. A “trim line” reveals the height of the landslide as it flowed down South Coldwater Creek.

       The landslide fell from the north face of the volcano, but traveled 13.5 miles to the west after it was deflected by Johnston Ridge. The landslide scraped away the soil, exposing bedrock, as the landslide crashed against the ridge.

    C. Pyroclastic flows fell under the force of gravity and traveled up to five miles, due to the slope between the crater floor and Johnston Ridge. These super-heated rock avalanches began to spill out of the crater about 4-hours after the eruption began, covering the landslide deposit with up to 130 feet of pumice, ash and rock. There are few hummocks between Johnston Ridge and volcano, because most were buried under pyroclastic flow deposits.

9. NOTE: If you have selected an itinerary that requires watching the next showing of the theatre presentation “Message from the Mountain”, you may not have time to review the answers to the worksheet. Allow 10-minutes for students to return to the Observatory.