



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

A Fine Line Between Life & Death **Outdoor Activity**

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

This challenging activity will test your students’ observational skills, and deductive capability. The purpose of this activity is to familiarize students with abiotic (i.e. sunlight, water, wind, degree of slope) and biotic factors that influenced plant and animal survival and colonization on Johnston Ridge. Because students identify and observe geological and biological features along the trail, this is an excellent outdoor activity to conduct on days with poor visibility.

Goal: The student will understand the factors that affect the biologic recovery on Johnston Ridge.

Objectives:

- 1) The student will use the scientific process to deduce a reasonable explanation.
- 2) The student will compare, contrast and sort observations.
- 3) The student will reach a conclusion and be able to support it with evidence in writing.
- 4) Students will abide by all monument regulations while on the trail.

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.

1.2.1 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

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 destructive processes change landforms.

1.3.9 Biologic Evolution

Understand how the theory of biological evolution accounts for species diversity, adaptation, natural selection, extinction, and change in species over time.

- Describe how organisms with certain traits are more likely to survive and have off-spring.

1.3.10 Interdependence of Life

Understand how organisms in ecosystems interact and respond to their environment and other organisms.

- Describe how a population of an organism responds to change in its environment.

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 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.

A Fine Line Between Life & Death

Outdoor Activity

Mission: To evaluate possible factors influencing biologic recovery on Johnston Ridge.

Possible Explanations:

- 1) The physical, non-biologic aspects of an ecosystem (abiotic factors: temperature, moisture, wind, steepness and orientation of slope) greatly influenced plant and animal survival and colonization.
- 2) The physical, non-biologic aspects of an ecosystem did not greatly influence plant and animal survival and colonization.

Case Facts:

- 1) 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 allowed the blast cloud to flow like a fluid east, north and west of the volcano.
- 2) Characteristics of the 1980 blown down forests include: stumps with shredded tops, blown down logs, exposed root systems, pieces of wood in varying sizes.
- 3) Characteristics of areas logged before the 1980 include: stumps with horizontally cut tops, sawed and un-sawed pieces of wood in varying sizes, and the absence of logs.
- 4) Old growth forests consisted of 6 inch” to 4-foot diameter trees, shrubs like salal, huckleberry, and Oregon grape, and a shade-loving herbaceous plant layer.
- 5) Before the eruption sections of Johnston Ridge were part of a tree farm owned by logging companies. Replanted sites consist of 1 to 6 inch diameter conifer trees planted in rows and sun-loving plants like grasses, blackberries and shrubs.

Evaluate the Evidence:

Stop beside a stump or log before the first interpretive sign on the right side of the trail, and answer questions 1a-b.

- 1) Use evidence along the trail and the case facts to determine what kind of ecosystem inhabited this ridge before the 1980 eruption. Circle: Old Growth Forest OR Tree Farm

- a) The lateral blast reached this site 5.5 miles from the volcano in 40 seconds. Use the formulas provided below to determine the speed of the lateral blast in miles/per hour.

$$\text{Speed in miles/second} = \frac{\text{Distance}}{\text{Time}} \quad 60 \text{ seconds} \times \text{_____ miles/second} = \text{_____ miles/minute}$$
$$60 \text{ minutes} \times \text{_____ miles/minute} = \text{_____ miles/hour}$$

$$\text{Speed in miles/second} = \text{_____}$$

- b) Find a stump or log. Their diameter indicates that the trees that stood here were between 150 to 250 feet tall. Describe the lateral blasts impact to the forests that once grew here.

Continue along the eruption trail to the top of the ridge. Stop at the circular plaza on the left side of the trail and use the sundial-like locator map to answer questions 2a-e.

- 2a) Face Mount St. Helens, what direction are you facing? _____

Face Mount St. Helens, what direction does this side of Johnston Ridge face? _____

- b) Turn 180 degrees. What direction are you facing? _____

What direction does the side of Johnston Ridge? _____

If Mount St. Helens suddenly erupted what side of your body would receive the brunt of the lateral blast? (circle: North, South, East or West)

- c) Use the chart below to identify how environmental factors affect each slope differently.

(Use: 'more', 'less', 'about the same')

Environmental Factor	North Facing Slope	South Facing Slope
Sunlight		
Temperature		
Snow/Rain		

- d) What side of the ridge, north or south, appears to have more plant life? _____

- e) Some plants on the ridge side with more vegetation survived the eruption. Of the three factors listed in the chart above, what factor would most likely have enabled plants or animals to survive the lateral blast? _____

Turn left as you leave the circular plaza, and continue on the eruption trail. Observe the types of plants and animals as you walk. Stop at or before the large stone memorial to people who died during the 1980 eruption. Answer questions 3a-c.

3) Turn slowly one full revolution and look for blown down trees on the nearby ridges. Why was the lateral blast able to kill trees on both sides of the ridges, and so far from the volcano?

a) Use evidence along the trail and the case facts to determine what kind of ecosystem inhabited this part of the ridge before the 1980 eruption. Circle: Old Growth Forest OR Tree Farm

b) The plants and animals listed in the table lived on this ridge before the eruption. List the species that you think survived the eruption and describe how they survived, and list the species you think died and colonized the ridge after the eruption.

Plant or Animal	Traits	Survivor or Colonizer?	If it survived, how did it survive? i.e. behind stumps
North American Elk	Moves to higher elevations in the spring and lower elevations in the winter.		
Oval-leaved Huckleberry	A shrub with blue-berry-like berries. It grows in shady forests or in open areas.		
Red-tailed Hawk	A bird that soars in the air when hunting for small mammals. Nests and perches in standing dead trees.		
Northern Pocket Gopher	Lives in underground tunnels, where it feeds on the roots and bulbs of plants		
Oregon Grape	An evergreen shrub with shiny, spine-tipped leaves. It grows in shady forests or in open areas.		
Wolf Spider	It scavenges for wind blown insects and can travel great distances by hang gliding on a long web in the wind.		

c) Some plants and animals did survive the eruption on Johnston Ridge, but most returned to re-colonize the area after the eruption. Complete the chart below by noting the method of travel colonizing style, and where the plant or animal likely came from?

Plant or Animal	Travel Method(s)? swim, walk, fly, hitch hike or drift	Where did they come from? Inside the blast zone, Outside the blast zone, or Both
Huckleberry		
Grasses		
Golden-mantled Ground Squirrel		
Western Toad		
Raven		
Cardwells Penstemon (a low-growing, purple flowered plant)		

Conclusions:

Circle the best explanation.

- 1). The physical, non-biologic aspects of an ecosystem (abiotic factors: temperature, moisture, wind, steepness and orientation of slope) greatly influenced plant and animal survival and colonization.
- 2) The physical, non-biologic aspects of an ecosystem did not greatly influence plant and animal survival and colonization.

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

Answer Sheet to A Fine Line Between Life & Death

Outdoor Activity

Mission: To evaluate possible factors influencing biologic recovery on Johnston Ridge.

Possible Explanations:

- 1) The physical, non-biologic aspects of an ecosystem (abiotic factors: temperature, moisture, wind, steepness and orientation of slope) greatly influenced plant and animal survival and colonization.
- 2) The physical, non-biologic aspects of an ecosystem did not greatly influence plant and animal survival and colonization.

Case Facts:

- 1) The lateral blast that burst out the north side of the volcano 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 east, north and west of the volcano.
- 2) Characteristics of the 1980 blown down forests include: stumps with shredded tops, blown down logs with exposed root systems, pieces of wood in varying sizes.
- 3) Characteristics of clear-cut areas include: stumps with horizontally cut tops, sawed and un-sawed pieces of wood in varying sizes, and the absence of logs.
- 4) Old growth forests consist of medium and large diameter trees, shrubs like salal, huckleberry, and Oregon grape, and an herbaceous plant layer that includes ferns.
- 3) Before the eruption sections of Johnston Ridge were owned logging companies. Replanted sites consist of small diameter conifer trees planted in rows and numerous weeds such as grasses, blackberries and ferns that colonized the sites.

Evaluate the Evidence:

Stop beside a stump or log before the first interpretive sign on the right side of the trail, and answer questions 1a-b.

1) Use evidence along the trail and the case facts to determine what kind of ecosystem inhabited this ridge before the 1980 eruption. Circle: Old Growth Forest OR Tree Farm

a) The lateral blast reached this site 5.5 miles from the volcano in 40 seconds. Use the formulas provided below to determine the lateral blasts speed in miles/per hour.

$$\text{Speed in miles/second} = \frac{5.5 \text{ miles}}{40 \text{ seconds}}$$

$$60 \text{ seconds} \times .1375 \text{ miles/second} = 8.25 \text{ miles/minute}$$

$$60 \text{ minutes} \times 8.25 \text{ miles/minute} = 495 \text{ miles/hour}$$

$$\text{Speed in miles/second} = .1375$$

- b) Find a stump or log. Their diameter indicates that the trees that stood here were between 150 to 250 feet tall. Describe the lateral blasts impact to the forests that once grew here.

The lateral blast shattered and splintered the forest that stood here. The upper parts of the trees (leaves, branches, trunks, and bark) were swept away by the blast leaving behind splintered wood and shattered stumps. The aboveground portions of plants on the forest floor were scoured away by the blast, and the remaining roots were buried under fragmented rock.

Continue along the eruption trail to the top of the ridge. Stop at the circular plaza on the left side of the trail and use the sundial-like locator map to answer questions 2a-e.

- 2a) Face Mount St. Helens, what direction are you facing? South

Face Mount St. Helens, what direction does this side of Johnston Ridge face? South

- b) Turn 180 degrees. What direction are you facing? North

What direction does the side of Johnston Ridge? North

If Mount St. Helens suddenly erupted what side of your body would receive the brunt of the lateral blast? (Circle: North, South, East or West)

- c) Use the chart below to identify how environmental factors affect each slope differently.
(Use: 'more', 'less', 'about the same')

Environmental Factor	North Facing Slope	South Facing Slope
Sunlight	<i>Faces away from sun so it is cooler and there is less direct sunlight</i>	<i>Hotter and more direct sunlight</i>
Temperature	<i>Cooler, so less evaporation, which means there is more moisture</i>	<i>Hotter so there is more evaporation, which means there is less moisture. Drier conditions</i>
Snow/Rain	<i>Snow pack lasts longer and is thicker. More moisture from melting snow.</i>	<i>Less snow pack accumulates and snow melts off earlier, so there was less snow to protect plants from the blast.</i>

- d) What side of the ridge, north or south, appears to have more plant life? North

- e) Some plants on the ridge side with more vegetation survived the eruption. Of the three factors listed in the chart above, what factor would most likely have enabled plants or animals to survive the lateral blast? Deep snow packs that had accumulated on the north-

facing slopes protected some small plants and animals from the scouring and intense heat of the blast.

Turn left as you leave the circular plaza, and continue on the eruption trail. Observe the types of plants and animals as you walk. Stop at or before the stone memorial to the people who died during the eruption. Answer questions 3a-c.

3) Turn slowly one full revolution and look for blown down trees on the nearby ridges. Why was the lateral blast able to kill trees on both sides of the ridges, and so far from the volcano? The case facts reveal that the lateral blast was composed of hot gasses, fragmented rock and ash. Rock made the blast cloud heavy, which held it close to the ground. Hot gasses allowed the blast cloud to have buoyancy and to flow like a fluid up and over ridges. tops.

a) Use evidence along the trail and the case facts to determine what kind of ecosystem inhabited this part of the ridge before the 1980 eruption. Circle: Old Growth Forest OR **Tree Farm**
The presences of horizontally cut tree stumps are evidence that old growth trees were clearcut here prior to the eruption. The presence of medium diameter logs and stumps with jagged tops are evidence that full-sized trees were broken into pieces and swept away. There was most likely a young forest stand on Johnston Ridge immediately before the 1980 eruption.

b) The plants and animals listed in the table lived on this ridge before the eruption. List the species that you think survived the eruption and describe how they survived, and list the species you think died and colonized the ridge after the eruption.

Plant or Animal	Traits	Survivor or Colonizer?	If it survived, how did it survive? i.e. behind stumps
North American Elk	Moves to higher elevations in the spring and lower elevations in the winter.	Colonizer	Large animals died. There was nowhere to hide and nothing thing to protect them from intense heat and flying debris.
Oval-leaved Huckleberry	A shrub with blue-berry-like berries. It can grow in the shade of forests or in open areas.	Survivor	Under snow on north-facing slopes or behind stumps. It may have re-sprouted from roots that survived the eruption

Red-tailed Hawk	A bird that soars in the air when hunting for small mammals. This hawk often nests and perches in standing dead trees.	<i>Colonizer</i>	<i>Birds died. There was nothing to protect them from flying debris and hot gasses.</i>
Northern Pocket Gopher	Lives its entire life underground. Feeds on the roots and bulbs of plants	<i>Survivor</i>	<i>Survived in underground tunnels</i>
Wolf Spider	It scavenges for wind blown insects and can travel great distances by trailing a long web and letting it catch the wind.	<i>Survivor</i>	<i>Some survived under snow and logs.</i>

c) Some plants and animals did survive the eruption on Johnston Ridge, but most returned to re-colonize the area after the eruption. Complete the chart below by noting the method of travel colonizing style, and where the plant or animal likely came from?

Plant or Animal	Travel Method(s)? swim, walk, fly, hitch hike or drift	Where did they come from? Inside the blast zone, Outside the blast zone, or Both
Huckleberry	<i>Hitchhike</i> <i>(carried and deposited as a seed in birds and mammal excrement)</i>	<i>Both</i>
Grasses	<i>Drift</i> <i>(blown on the wind)</i> <i>Hitchhike</i> <i>(seed carried in the gut of an elk and deposited in excrement)</i>	<i>Outside the blast zone</i>
Golden-mantled Ground Squirrel	<i>Walk</i>	<i>Outside the blast zone</i> <i>(these small mammals did not survive the eruption)</i>
Western Toad	<i>Walk</i>	<i>Inside the blast zone</i> <i>(survived beneath logs, underwater, underground. Toads are capable of disperse great distances)</i>
Raven	<i>Fly</i>	<i>Outside the blast zone</i> <i>(all birds died during the eruption)</i>
Cardwells Penstemon (low-growing, purple flowered plant)	<i>Drift</i>	<i>Inside the blast zone</i> <i>(roots survived and re-sprouted, has gradually spread vegetatively.)</i>

Conclusions:

Circle the best explanation

- 1) The physical, non-biologic aspects of an ecosystem (abiotic factors: temperature, moisture, wind, steepness and orientation of slope) greatly influenced plant and animal survival and colonization.

- 2) The physical, non-biologic aspects of an ecosystem did not greatly influence plant and animal survival and colonization.

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

Abiotic factors were critical to plant and animals survival and colonization. Abiotic factors such as slope affected the amount or presence of snow which was critical to plant and animal survival. The same cooler, moister north-facing slope affects the climate surrounding Johnston Ridge today. The superior growing conditions on this slope play an important role in plant and animal colonization. The south facing slope receives as much precipitation as the north facing slope, but snow pack doesn't last as long, and water evaporates more quickly under the sun's rays and intense winds. These factors produce a drier slope, and there is clearly less vegetation growing on the south facing slope. The wind plays an important role in transporting seeds into the blast zone. Plant survivors, rocks and landscape features act as "nets" that catch windblown seeds. This in turn enables plants to establish and over the long-term as organic compost from vegetation accumulates over many decades, a rich, well-developed forest soil will develop from the 1980 deposits.

Instructional Sequence for “A Fine Line Between Life & Death”

1. Send a chaperone up the eruption trail ahead of the group and have the adult stop at the first interpretive sign on the right side of the trail. Make sure the adult is clearly visible to the students at the trailhead. The adult’s role will be to orient students to a maximum distance to travel before stopping.
2. Gather students at the trailhead, located on 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, “A *Fine Line Between Life & Death*” worksheet and clipboard or notebook to write on.
 - a) Explain that the area around them was forested prior to the May 18, 1980 eruption, and that this ridge was heavily scoured and buried by the lateral blast.
 - b) Ask the students to explain the differences between biotic and abiotic (i.e. sunlight, water, wind, degree of slope). Listen to student definitions and clarify if necessary. Explain that the students’ mission is to determine if the non-biologic aspects of an ecosystem were critical or not critical to plant and animal survival and colonization.
 - c) Explain the importance of staying on trail at all times. It has taken over 28 years for plant life to get a foothold on this ridge. **Hiking in this area is a privilege and that student behavior will determine if future groups will be able to use this site.** Students will observe ash, rocks, stumps, and plants, but are not to walk off the paved trail. **Off trail travel and the collection of rocks, plants, and wood is strictly prohibited (\$100 fine).**
2. Point to the chaperone standing by the interpretive sign. Students are not to proceed beyond the chaperone until you indicate it is time to continue. Explain that groups will need to spread out along this stretch of the trail. They will need to stop near a stump or log in order to answer questions 1a-b. The ‘case facts’ will be critical to answering questions.



- a) While the students are answering these questions send another adult to the top of the hill and have them stop at the intersection to the viewing plaza with sundial-like locator map. Move between groups, and assist where needed. Inform the students to stop at the circular viewing plaza where the adult will be waiting.

3. Allow the students 15 to 20-minutes to make observations and use the sundial-like locator map in the circular plaza to answer questions 2a-c. North-south orientation is critical to this stop and to the biological stories on this ridge—make sure students are oriented.

View south of volcano
from circular plaza



View of vegetation on
south-facing slope



View of vegetation on
north-facing slopes



- a) While the students are answering these questions send another adult to the top of the hill and have them stop 75 to 100 feet before the memorial to the people who died during the May 18, 1980 eruption. Stop where there is abundant plant life.
4. Turn left as they leave the plaza. Walk down hill and stop 75 to 100 feet before the memorial to those who died during the eruption. Student groups will need to spread out along this stretch of the trail and that they should stop where there is a lot of plant life. The ‘case facts’ will be critical to answering questions 3a-c.



- a) Allow the students 15 to 20-minutes to make observations, answer the questions, and to answer the concluding question. Move between groups and assist where needed.
- b) Gather students by the memorial and review answers to the concluding question. Continue on the eruption trail to the parking lot. Use your chaperones to safely direct students across the parking lot to the busses.