



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

## **Biologic Pathways** **Outdoor Activity**

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

The purpose of this activity is to familiarize students with the characteristics of three of the May 18, 1980 eruptive events, and to explore how these events set unique pathways for biologic succession. Through small group exploration, students will observe, and identify landscape features then develop models about them to determine possible explanations for what is driving the biologic recovery of the areas affected by eruptive events. Because students identify and observe landscape-level features, this activity should be conducted on days with good visibility. Students will be better served if they have prior knowledge of the following vocabulary words:

- 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 flow 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) **Habitat:** the native environment of a plant or animal.
- 6) **Ecosystem:** a community of organisms and their interaction between each other and their environment.
- 7) **Abiotic:** of or related to the non-biological aspects of an ecosystem (i.e. water, rocks, sunlight, degree of slope)

**Goal:** The student will understand the factors that affected the biologic recovery within three disturbance zones.

### **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.

### 1.1.6 Characteristics of Living Matter

Understand how to classify organisms by their external and internal structures

- Describe how organisms can be classified using similarities and differences in physical and functional characteristics.

### 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

### 1.2.4 Components and Patterns of Earth Systems

Understand the components and interconnections of Earth's systems.

- Describe the interactions among the components of the Earth's 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 destructive processes change landforms.

### 1.3.8 Life Processes and the Flow of Matter and Energy

Understand how individual organisms obtain matter and energy for life processes.

- Describe how organisms acquire materials needed for life processes.

### 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 new facts or evidence 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.

# **Biologic Pathways**

## Outdoor Activity

**Mission:** To determine which explanation is responsible for the biologic recovery on areas affected by the May 18, 1980 landslide, lateral blast, and pyroclastic flows.

### **Possible Explanations:**

- 1) Each stage of the eruption changed the landscape in similar ways, thus the biologic recovery in each area is similar.
- 2) Each stage of the eruption changed the landscape in different ways, thus the biologic recovery is different in each area.

### **Case Facts:**

- 1) Characteristics of blown down forests include: stumps with shredded tops, blown down logs with exposed root systems, pieces of wood in varying sizes.
- 2) 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.
- 3) Characteristics of pyroclastic flows include sloping plains of ash and light-weight pumice rocks restricted to the valley bottom. Pyroclastic flows contained loose pieces of 1000-degree lava rock and pumice too heavy to rise into the atmosphere.

### **Evaluate the Evidence:**

**Walk to a point where you can see Mount St. Helens and the parking lot and answer questions 1a-e. Do not walk past the first interpretive sign on the right side of the trail.**

1) Look at the shattered stumps and blown down trees along the trail. The diameter of the stumps and logs indicates that the trees that stood here were between 150 to 250 feet tall. Describe the 300 mph lateral blasts impacts to the forests that once grew here.

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a) Turn slowly a full revolution and look for blown down trees on this ridge and on the nearby ridges. Why was the lateral blast able to kill trees on both sides of the ridges, and so far away?

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b) If Mount St. Helens is due south of this position, which direction are you facing? \_\_\_\_\_

Which direction does this side of Johnston Ridge face? \_\_\_\_\_

Scientists would refer to this side of Johnston Ridge as a \_\_\_\_\_ -facing slope

- c) Turn 180 degrees. Which direction are you facing? \_\_\_\_\_  
 Which direction does this opposite side of Johnston Ridge face? \_\_\_\_\_  
 Scientists would refer to this opposite side of Johnston Ridge as a \_\_\_\_\_-facing slope  
 If Mount St. Helens suddenly erupted which side of your body would receive the brunt of the eruption? Circle the correct answer: North South East 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		
Snow/Rain		
Wind		

- d) Which side of Johnston Ridge appears to have more plant life growing on it? \_\_\_\_\_  
 On which side of Johnston Ridge could plants and animals have survived? Why?  
 \_\_\_\_\_  
 Of the three factors listed in the chart above, which factor could have enabled plants or animals to survive the lateral blast? \_\_\_\_\_

- e) Geologist David Johnston died on this ridge on May 18, 1980. The animals listed in the table lived here before the eruption. Which animals could have survived the eruption at this site, and which colonized it afterward?

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 blueberry-like berries. It can grow in the shade of forests or in open areas.		
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.		
Northern Pocket Gopher	Lives its entire life underground. Feeds on the roots and bulbs of plants		

**Continue on the eruption trail to the top of the hillside. Stop at the circular plaza on the left side of the trail and use the sundial-like orientation dial to answer questions 2a-d.**

2) Use the directional finder and look east down Johnston Ridge. Notice that there are many mounds on Johnston Ridge. What are the mounds and how did they get there?

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a) Locate the highway in the valley on the left side of Johnston Ridge. There are no blown down trees in the lower half of this valley, and the color of the ground is different than the ground on the upper half. What could account for the lack of blown down trees and differences in color?

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b) The creek located in this valley re-formed after the eruption. How has the presence of water in the valley impacted the return of life? Explain your answer.

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c) Look east down the top of Johnston Ridge and note the barren rock on the right side of ridge facing the volcano. Now look west down the Toutle River Valley. If the landslide fell from the north side of the volcano, why did it travel much farther west than north?

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d) Prior to the eruption, 30 lakes and ponds existed within what is now the blast zone. 150 new lakes, ponds, and wetlands formed in the Toutle River Valley as a result of the landslide. Look west and describe how has the presence of water in the valley impacted the return of life?

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**Turn left as you leave the circular plaza, and continue on the eruption trail. Stop at the stone memorial to people who died during the eruption. Answer questions 3a-e.**

3) The eruption began with a landslide that filled the Toutle Valley below to a depth of over 300 feet. Why are there so few hummocks in the valley between Johnston Ridge and volcano?

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a) The deposits that buried the hummocks were 1,350 degrees Fahrenheit. Could any plant or animal survive these temperatures? If so how? \_\_\_\_\_

b) Large flood plains and canyons on the valley floor formed after the eruption. How might these flood plains and canyons affect the return of plant and animal life?

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c) The climate in the valley is harsh. Pumice rocks are filled with tiny holes that cause water to flow through the rock instead of being absorbed. Pumice's light color also reflects sunlight, creating hot surface temperatures. How might these climatic conditions affect colonizing plants?

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d) Which word best describes the amount of plant growth in the valley?

Circle the correct answer: Sparse Moderate Abundant

e) Rank the conditions below in their order of importance in shaping the amount of plant growth in the valley. Rank: eruption temperatures, erosion, climatic conditions

1. \_\_\_\_\_

2. \_\_\_\_\_

3. \_\_\_\_\_

### Conclusions:

Circle the explanation you think is best:

1) Each stage of the eruption changed the landscape in similar ways, thus the biologic recovery in each area is similar.

2) Each stage of the eruption changed the landscape in different ways, thus the biologic recovery is different in each area.

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

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## Answer Sheet to Biologic Pathways

### Outdoor Activity

**Mission:** To determine which explanation is responsible for the biologic recovery on areas affected by the May 18, 1980 landslide, lateral blast, and pyroclastic flows.

### Possible Explanations:

- 1) Each stage of the eruption changed the landscape in similar ways, thus the biologic recovery in each area is similar.
- 2) Each stage of the eruption changed the landscape in different ways, thus the biologic recovery is different in each area.

### Case Facts:

- 1) Characteristics of blown down forests include: stumps with shredded tops, blown down logs with exposed root systems, pieces of wood in varying sizes.
- 2) 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.
- 3) Characteristics of pyroclastic flows include sloping plains of ash and light-weight pumice rocks restricted to the valley bottom. Pyroclastic flows contained loose pieces of 1000-degree lava rock and pumice too heavy to rise into the atmosphere.

### Evaluate the Evidence:

**Walk to a point where you can see Mount St. Helens and the parking lot and answer questions 1a-e. Do not walk past the first interpretive sign on the right side of the trail.**

1) Look at the shattered stumps and blown down trees along the trail. The diameter of the stumps and logs indicates that the trees that stood here were between 150 to 250 feet tall. Describe the 300 mph lateral blasts impacts to the forests that once grew here.

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

a) Turn slowly a full revolution and look for blown down trees on this ridge and on the nearby ridges. Why was the lateral blast able to kill trees on both sides of the ridges, and so far away?

*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.*



b) If Mount St. Helens is due south of this position, which direction are you facing? South

Which direction are you facing? South

Which direction does this side of Johnston Ridge face? South

Scientists would refer to this side of Johnston Ridge as a South-facing slope

c) Turn 180 degrees. Which direction are you facing? North

Which direction does the opposite side of Johnston Ridge face? North

Scientists would refer to the opposite side of Johnston Ridge as a North-facing slope

If Mount St. Helens suddenly erupted which side of your body would receive the brunt of the eruption? Circle the correct answer: North **South** East West

d) 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>Less sunlight</i>	<i>More sunlight</i>
Snow/Rain	<i>Snow pack lasts longer &amp; thicker. Rain: more moisture &amp; less evaporation</i>	<i>Melts earlier &amp; thinner</i>
Wind	<i>Less evaporation, more moisture</i>	<i>More evaporation, drier</i>

d) Which side of Johnston Ridge appears to have more plant life growing on it? North

On which side of Johnston Ridge could plants and animals have survived? Why?

The north side, because it offered some protection from the direct brunt of the lateral blast.

Of the three factors listed in the chart above, which factor could have enabled plants or animals to survive the lateral blast? Deep snow packs on north facing slopes protected some small plants and animals from the blasts intense heat

e) Geologist David Johnston died on this ridge on May 18, 1980. The animals listed in the table lived here before the eruption. Which animals could have survived the eruption at this site, and which colonized it afterward?

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 nothing 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, behind stumps, or root systems survived underground
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.	Colonizer	Birds died. There was nothing to protect them from flying debris and hot gasses.
Northern Pocket Gopher	Lives its entire life underground. Feeds on the roots and bulbs of plants	Survivor	Underground

**Continue on the eruption trail to the top of the hillside. Stop at the circular plaza on the left side of the trail and use the sundial-like orientation dial to answer questions 2a-d.**

2) Use the directional finder and look east down Johnston Ridge. Notice that there are many mounds on Johnston Ridge. What are the mounds and how did they get there?

The “case facts” indicate that the mounds are hummocks. Hummocks were deposited there when the landslide tumbled over Johnston Ridge. The narrow patch of blown down trees in foreground of the mounds reveal that the landslide spilled over Johnston Ridge in two locations.

a) Locate the highway in the valley on the left side of Johnston Ridge. There are no blown down trees in the lower half of this valley, and the color of the ground is different than the ground on the upper half. What could account for the lack of blown down trees and differences in color?

The “case facts” indicate that the absence of trees and exposed bedrock reveal areas scoured or buried by the landslide. As the landslide crested Johnston Ridge it turned and flowed down the South Coldwater Creek drainage. The scour marks in the valley reveal the height of the landslide as it flowed down the drainage.

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b) The creek located in this valley re-formed after the eruption. How has the presence of water in the valley impacted the return of life? Explain your answer.

Sitka and red alder trees were able to colonize the creeks moist shorelines. These clearly visible alder forests are slowly spreading up the hillsides, accelerating the pace of recovery in the landslide-scoured areas and adjacent blown down forests.

c) Look east down the top of Johnston Ridge and note the barren rock on the right side of ridge facing the volcano. Now look west down the Toutle River Valley. If the landslide fell from the north side of the volcano, why did it travel much farther west than north?

When the landslide hit Johnston Ridge, it scraped away the soil and exposed bedrock on the right side of the ridge facing the volcano. Although the landslide fell from the north side of the volcano, it was deflected westward by Johnston Ridge. As the landslide entered the Toutle River Valley it was funneled down slope and traveled 13.5 miles to the west.

d) Prior to the eruption, 30 lakes and ponds existed within what is now the blast zone. 150 new lakes, ponds, and wetlands formed in the Toutle River Valley as a result of the landslide. Look west describe how has the presence of water in the valley impacted the return of life?

Most of the valley floor appears to be forested. There is far more vegetation growing in the valley than on this ridge. Water enabled trees (alder, willow, and cottonwood) to establish along the moist shorelines of the new ponds and wetlands. After gaining a foothold in these moist sites, the forests have spread across the valley floor and up the surrounding hillsides. This spreading process is clearly accelerating the pace of recovery on the landslide deposit and in the adjacent blown down forest.

**Turn left as you leave the circular plaza, and continue on the eruption trail. Stop at the stone memorial to people who died during the eruption. Answer questions 3a-e.**

3) The eruption began with a landslide that filled the Toutle Valley below to a depth of over 300 feet. Why are there so few hummocks in the valley between Johnston Ridge and volcano?

There are few hummocks between Johnston Ridge and the volcano, because they were covered by pyroclastic flows. These super-heated rock avalanches spilled out of the crater and covered most of the landslide deposit within five miles of the volcano with 130 feet of ash and pumice.

a) The deposits that buried the hummocks were 1,350 degrees Fahrenheit. Could any plant or animal survive these temperatures? If so how? No plants or animals survived

b) Large flood plains and canyons on the valley floor formed after the eruption. How might these flood plains and canyons affect the return of plant and animal life?

Plant seeds do not have time to take root before they are washed away when water levels are high. The absence of root systems allows sediment to continue to be washed away.

c) The climate in the valley is harsh. Pumice rocks are filled with tiny holes that cause water to flow through the rock instead of being absorbed. Pumice's light color also reflects sunlight, creating hot surface temperatures. How might these climatic conditions affect colonizing plants?

The pumice plain is located within a very wet climate, but water is in short supply during the summer when plants need it most. These drought-like conditions and intense heat make it very difficult for plants to colonize this site. Temperature measurements taken on the pumice plain during the month of August were eight degrees Celsius higher than temperatures taken in forests surrounding the blast zone. Plant communities reflect these harsh conditions. Many plants growing on the pumice plain are normally found at high elevation sites. In a sense, the eruption "lowered timberline" at Mount St. Helens by creating a similar environment in the valley.

d) Which word best describes the amount of plant growth in the valley?

(Circle: Sparse, Moderate, Abundant)

e) Rank the conditions below in their order of importance in shaping the amount of plant growth in the valley. Rank: eruption temperatures, erosion, climatic conditions

1. Eruption Temperatures—nothing survived the intense heat
2. Climatic Conditions—harsh environment in the Monument
3. Erosion—parts of the pumice plain are chronically re-disturbed

### Conclusions:

Circle the explanation you think is best:

1) Each stage of the eruption changed the landscape in similar ways, thus the biologic recovery in each area is similar.

2) Each stage of the eruption changed the landscape in different ways, thus the biologic recovery is different in each area.

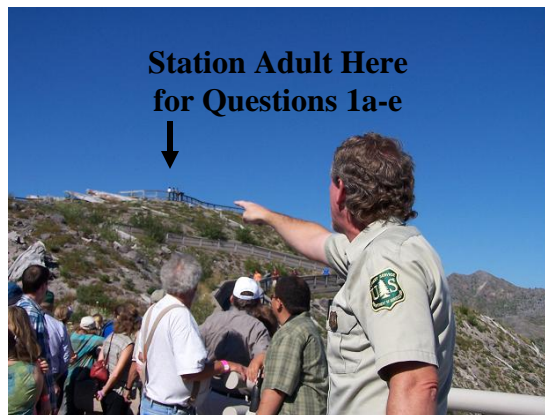
In complete sentences, explain the evidence you used to support your conclusion.

Each stage of the eruption changed the landscape in different ways thus the biologic recovery is different in each area. Plants and animals survived the eruption on north facing slopes within areas impacted by the lateral blast. The legacy of these survivors is clearly visible on the north side of Johnston Ridge. Dense alder forests covered much of the areas impacted by the landslide. The presence of water in the South Coldwater Creek drainage and the creation of new ponds and wetlands in the Toutle River Valley clearly reveal that water is fueling spectacular change. The intensity of the disturbance caused by the pyroclastic flows, lack of survivors, and harsh environment created have caused the pumice plain to recovery at a far slower pace.

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## Instructional Sequence for “Biologic Pathways”

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 standing next to the sign and 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, “*Biologic Pathways*” worksheet and clipboard or notebook to write on.
  - a) Explain that the area around them was forested prior to the May 18, 1980 eruption, Read the mission of the activity out.
  - b) Inform the students that hiking in this area is a privilege and that student behavior will determine if future groups will be able to use this site. Off trail travel and the collection of rocks, plants, and wood is strictly prohibited (\$100 fine).
2. Point to the chaperone standing next to the interpretive sign and explain that the students are not to proceed beyond the chaperone until you indicate it is time to continue. Explain that the student groups will need to spread out between along this stretch of the trail and they will need to be able to see Mount St. Helens and plants growing the opposite side of Johnston Ridge (without getting off trail). Inform the students that the ‘case facts’ will be critical to answering these questions 1a-e.



- a) 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’ need to determine if the non-biologic aspects of an ecosystem were critical or not critical to plant and animal survival and colonization.
- b) 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 orientation dial. Move between groups, and assist where needed. Inform the students to stop at the circular viewing plaza where the adult will be waiting.

View of volcano from first interpretive sign



View of blast impacts & south slope vegetation



View of vegetation on north facing slope

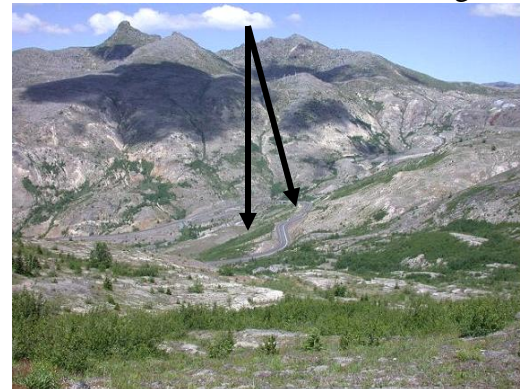


3. Allow the students 15 to 20-minutes to make observations and use the directional finder in the circular plaza to answer questions 2a-c. North-south orientation is critical to this stop and to the biological stories on this ridge—make sure students are oriented.

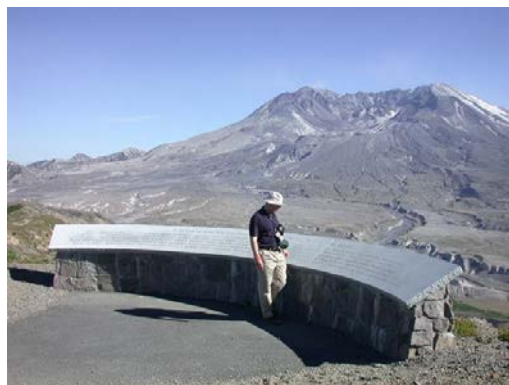
View south of volcano from circular plaza



View of vegetation in the South Coldwater Creek Drainage



- a) While the students are answering these questions send another adult to the top of the hill and have them stop at the memorial to the people who died during the May 18, 1980 eruption.
4. Inform the students to turn left as they leave the plaza and to continue on the eruption trail to a stone memorial to those who died during the eruption. Inform the students that the ‘case facts’ will be critical to answering these questions 3 a-e.



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