Perilous Beauty Video

Grade Level: 5+

Learner Objectives:

Students will:

- Learn about the types of hazards common to Mount Rainier
- Understand the mechanisms that cause lahars
- Describe how to prepare for lahars from Mount Rainier

Setting: Classroom

Timeframe: 45 minutes (video is 29 minutes)

Materials:

- Video—*Perilous Beauty: The Hidden Dangers of Mount Rainier"*
- VHS video cassette player
- Television monitor
- Copies of *"Perilous Beauty"* student page

USGS science for a changing world

Living with a Volcano in Your Backyard-An Educator's Guide with Emphasis on Mount Rainier

Prepared in collaboration with the National Park Service

U.S. Department of the Interior
U.S. Geological Survey

General Information Product 19

Overview

The ***"Perilous Beauty"*** video introduces students to the volcanic hazards common to Mount Rainier, specifically mudflows (also known as lahars), and the types of mechanisms that produce them.

Vocabulary: Debris flow, Electron Mudflow, hazard, hydrothermal alteration, lahar, landslide, lava flows, monitor, mudflow, Osceola Mudflow, pyroclastic flow, risk

Skills: application, interpretation, listening

Benchmarks:

Science:

1 – Understands and uses scientific concepts and principles

1.2 – Recognize the components, structure, and organization of systems and the interconnections within and among them

Systems – describe how the parts of a system interact and influence each other

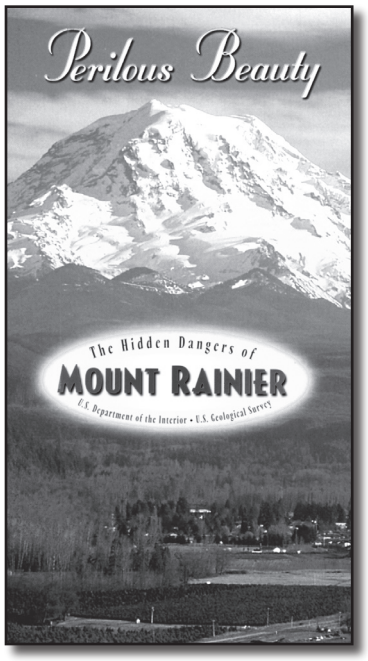
Components and patterns of the earth system –describe the components and relationships of the earth system, including the solid earth (crust, hot convecting mantle and dense metallic core

1.3 – Understand how interactions within and among systems cause changes in matter and energy

Processes and interactions in the earth system –describe the processes of constructive and destructive forces and how they continually change landforms on earth

Activity last modified: Jsnusrty 9, 2008

Teacher Background



The video, ***"Perilous Beauty–The Hidden Dangers of Mount Rainier,"*** describes the types of volcanic activity common to eruptions at Mount Rainier, and places a focus on ***landslides*** and ***mudflows*** (also known as ***lahars***) that have dramatically modified the landscape. Understanding these natural processes is a key step in reducing the ***risk*** from future volcanic activity at Mount Rainier. This video uses computer animation, eruption footage, interviews with scientists, and photography to show how ***lahars*** can affect communities in western Washington. It ends with a recommendation of five actions for citizens to take that reduce volcanic risk in their communities.

Mudflows, as defined in the video, can be triggered by sudden landslides, meltwater produced in eruptions, and the sudden release of glacial water during severe rainfall or intense snow melt. Some of the largest mudflows at Mount Rainier began as landslides of weak, altered rock that, once mobilized, flowed as far as Puget Sound. The most common mudflows at Mount Rainier happen during eruptions and are the result of ***lava flows*** that break apart on steep slopes as avalanches of hot rock and gas called ***pyroclastic flows.*** The pyroclastic flows melt snow and ice, and produce meltwater surges that transform into mudflows as they erode loose rock on the volcano's slopes.

The "Perilous Beauty" video focuses on two large mudflows that buried the terrain where at least 150,000 people live today. The Osceola Mudflow was the largest of the known lahar on Mount Rainier. About 5,600 years ago, magma intruded the volcano and destabilized its eastern flank. This forced a landslide into motion that filled the White River valley with more than 180 meters (600 feet) of mud and rock debris. The landslide became a muddy river of rock, sand, and boulders that swept across the plain at Enumclaw and then settled into the inlets of Puget Sound. The ***Electron Mudflow*** on the volcano's western flank happened approximately 500 years ago. Repeated exposure to hot magma bodies and acidic groundwater (the process is known as ***hydrothermal alteration)*** has weakened much of the rock on the volcano's western slopes.

Scientists and emergency managers use several techniques to ***monitor*** volcanoes for mudflows and inform people of impending danger. The most important way to reduce risk is preparation. You can prepare by determining if you live or work in a hazard zone, finding out what steps local officials have taken to prepare, developing emergency plans for your family and business, and by finding out how ***hazards*** might disrupt your daily routine.

Authors recommend that teachers preview the recommended videos and determine their appropriateness for the intended grade level. Students gain an understanding of terminology by watching* Understanding Volcanic Hazards *before viewing the video in the* Perilous Beauty *activity. An additional activity,* Reducing Volcanic Risk, *in* Chapter 3 *addresses pro-active community management of volcanic risk.

***A NOTE ON TERMINOLOGY:** The general term "mudflow" used in the video broadly describes both lahars and debris flows. At Mount Rainier, local scientists and public officials have defined the terms more specifically to reduce confusion between major and minor events. They define lahars as the large, far traveling slurries of rock, mud and water caused by landslides or eruptions, which threaten distant communities. They use the term debris flow for small events initiated by excess rain or glacial meltwater, which seldom move beyond park boundaries. Debris flows are common in river valleys at Cascade volcanoes and happen almost annually at Mount Rainier.*

Procedure

Understanding Mount Rainier

1. Explain to students that they will watch a video about some major volcanic events that happen infrequently, but can occur again at Mount Rainier.

2. View the video from beginning to end.

3. Initiate a discussion of the video using the questions that follow. End your discussion with conversation about what risk is faced by students in your school. See **Chapter 3** for information about hazard zones and emergency preparations.

Adaptations

- Provide each student with a copy of the "Perilous Beauty Questions" student page.
- View the video and pause the video after each section on the answer sheet so that students can record their answers
- Following the video, allow students to work in small groups to answer the questions on the student page.

Assessment

Use the video questions to assess students' current knowledge of volcanic processes and hazards at Mount Rainier. You may wish to use the same questions at the end of your study of volcanoes as a post-assessment activity.

Resources

Driedger, C., Scott, K., 2002, Mount Rainier–Learning to live with volcanic risk: U.S. Geological Survey Fact Sheet 034-02, 4p.

Myers, B., Brantley, S., Stauffer, P., and Hendley, J., 1997, What are Volcano Hazards (revised July, 2004): U.S. Geological Survey Fact Sheet 002-97, 2p.

Refer to **Internet Resources Page** for a list of resources available as a supplement to this activity.

Student Page

Name _____

Perilous Beauty Questions

Instructions: *View the video and answer the questions.*

Geologist Rocky Crandell's Surprising Discovery

1. When geologist Rocky Crandell began working around Mount Rainier, the surface of the lowlands near the volcano were thought to have been formed by glacial action. What did he find to show that the old ideas were incorrect?

2. What evidence convinced Crandell that the mudflow (lahar) came from Mount Rainier?

3. Describe the appearance, texture and sound produced by a mudflow (lahar and debris flows.)

4. What is the name of the largest mudflow (lahar) from Mount Rainier?

5. Describe the effects the Osceola Mudflow had on Mount Rainier.

6. Explain what events occurred after this collapse that rebuilt the volcano.

The Electron Mudflow

7. Describe what process formed the Orting plain, and when this event occured.

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Perilous Beauty Questions

Landslides

8. Name two events that can trigger landslides.

9. What does the video suggest is unique about the timing of the Electron Mudflow?

Unstable Rock at Mount Rainier

10. Describe how hydrothermal alteration changes the texture of rock.

11. Explain how hydrothermal alteration makes some slopes of Mount Rainier unstable.

12. What is the most far-reaching eruptive hazard for people in the valleys near Mount Rainier?

Pyroclastic Flows

13. Define pyroclastic flow.

14. Describe where past pyroclastic flow layers exist today at Mount Rainier.

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Perilous Beauty Questions

Pyroclastic Flows continued....

15. Describe how a pyroclastic flow transforms into a mudflow (lahar).

16. What evidence indicates that pyroclastic flows occur frequently during eruptions at Mount Rainier?

Small Mudflows

17. Explain what causes the small mudflows (debris flows) at Mount Rainier.

Comparisons with Nevado del Ruiz

18. Was there historical evidence that mudflows had occurred at Nevado del Ruiz?

19. Explain how the risks of living near Nevado del Ruiz are similar to those of living near Mount Rainier.

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Perilous Beauty Questions

Preparation

20. Describe some of the warning signs of a mudflow (lahar).

21. List five actions that citizens can do to reduce risk.

Teacher Page

Perilous Beauty Questions - Answers

Geologist Rocky Crandell's Surprising Discovery

1. When geologist Rocky Crandell began working around Mount Rainier, the surface of the lowlands near the volcano were thought to have been formed by glacial action. What did he find to show that the old ideas were incorrect?

ANSWER: ***Rocky Crandell found a flat plain of Mount Rainier rocks on the valley floor that were moved there by a volcanic mudflow from Mount Rainier.***

2. What evidence convinced Crandell that the mudflow (lahar) came from Mount Rainier?

ANSWER: ***Rocky Crandell realized that rocks in mudflow deposits found in the lowlands are the same composition as rocks found on Steamboat Prow, halfway to the summit of Mount Rainier.***

3. Describe the appearance, texture and sound produced by a mudflow (lahars and debris flows.)

ANSWER: ***A mudflow is a slurry of muddy churning debris, that resembles a fast-flowing river of wet concrete. It is accompanied by intense roaring and shaking.***

4. What is the name of the largest mudflow (lahar) from Mount Rainier?

ANSWER: ***Osceola Mudflow***

5. Describe the effects the Osceola Mudflow had on Mount Rainier.

ANSWER: ***Summit rocks collapsed as a landslide and traveled from the mountain to the lowlands as a mudflow. The mudflow was more than 180 meters (600 feet) deep as it swept through the White River on the mountain's east side.***

6. Explain what events occurred after this collapse that rebuilt the volcano.

ANSWER: ***Lava erupted from the summit and rebuilt the summit cone.***

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Perilous Beauty Questions - Answers

The Electron Mudflow

7. Describe what process formed the Orting plain, and when this event occured.

ANSWER: ***The Electron Mudflow (lahar) formed the Orting plain. The mudflow occurred about 500 years ago.***

Landslides

8. Name two events that can trigger landslides.

ANSWER: ***The video suggests earthquakes and rising magma. Additionally, slopes might fail for other reasons, including water saturation, loss of buttressing by glacier ice, and gradual weakening.***

9. What does the video suggest is unique about the timing of the Electron Mudflow?

ANSWER: ***Scientists have not found conclusive evidence of an eruption coincident with the Electron Mudflow. They are forced to conclude that the Electron Mudflow could have occurred during a period of volcanic quiescence, unheralded by volcanic activity. The video implies that future events could happen during periods of quiescence with little or no advance warning.***

Unstable Rock at Mount Rainier

10. Describe how hydrothermal alteration changes the texture of rock.

ANSWER: ***Hydrothermal alteration is a change in the mineralogy that results from the interaction of the rock with hot acidic water fluids. The minerals are no longer solid, but are turned to clay.***

11. Explain how hydrothermal alteration makes some slopes of Mount Rainier unstable.

ANSWER: ***Hydrothermal alteration chemically changes lava layers from solid rock to a weak, loose, clay-bearing material that is susceptible to collapse. Currently the upper west flank contains the majority of such altered rock.***

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Perilous Beauty Questions - Answers

12. What is the most far-reaching eruptive hazard for people in the valleys near Mount Rainier?

ANSWER: Mudflows (lahars).

Pyroclastic Flows

13. Define pyroclastic flow.

ANSWER: A flow of hot ash and gas.

14. Describe where pyroclastic flow layers exist today at Mount Rainier.

ANSWER: Layers of loose rock from pyroclastic flows are now sandwiched between some layers of lava flows.

15. Describe how a pyroclastic flow transforms into a mudflow (lahar).

ANSWER: These dense flows of hot rock and gases erode and melt ice and snow and mix with meltwater to form mudflows (lahars).

16. What evidence indicates that pyroclastic flows occur frequently during eruptions at Mount Rainier?

ANSWER: Pyroclastic flows left behind many layers of loose rock rubble.

Small Mudflows

17. Explain what causes the small mudflows (debris flows) at Mount Rainier.

ANSWER: Intense rain and rapid melting of snow and ice can overload hidden channels within the glacier and cause sudden expulsions of water that can mix with loose rock to make debris flows.

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Perilous Beauty Questions - Answers

Comparisons with Nevado del Ruiz

18. Was there historical evidence that mudflows had occurred at Nevado del Ruiz?

ANSWER: Yes, historical records in Armero show that mudflows (lahars) covered the town site on several occasions before 1985.

19. Explain how the risks of living near Nevado del Ruiz are similar to those of living near Mount Rainier.

ANSWER: People have constructed communities on top of very young lahar deposits and now those communities are vulnerable to future lahars.

Preparation

20. Describe some of the warning signs of a mudflow (lahar).

ANSWER: Scientists watch for evidence of magma moving to shallow levels in the volcano, such as increases in earthquakes, changes in volcanic gases and changes in shape of the volcano's slopes.

21. List five actions that citizens can do to reduce risk.

ANSWER: Determine if you live or work in a hazard zone.

- *Find out what steps local officials have taken to prepare.*
- *Develop emergency plans for family and business.*
- *If you do not live in a hazard zone, find out how hazards might disrupt your daily routine.*
- *Contact your local Emergency Management agency or the U.S. Geological Survey for more information.*