USGS

VOLCANOES! DEATH AND RECOVERY

LESSON 5

fig. 1

"This is It!"

David A. Johnston, USGS volcanologist, was monitoring Mount St. Helens on a ridge north of the volcano. At 8:30 a.m. on May 18, 1980, he made his last radio transmission: No trace of him or his equipment has ever been found.

The Impact on Plants

The force of the lateral blast from Mount St. Helens' north flank blew down or snapped off trees within a radius of 25 kilometers (15 miles) north of the eruption site. At a distance of 25 kilometers (15 miles) from the blast, the force was no longer powerful enough to mow down trees, but it remained hot enough to kill the trees in its path. Ironically, some of the trees killed were old-growth Douglas firs 200 to 500 years old, which had survived previous eruptions.

Devastation in the wake of the avalanche was equally dramatic, although a few individual plants did survive, sprouting from root fragments that had been swept along on the surface of the debris. Plant survival in the path of the mudflows was likewise sparse. In addition, ashfall, which blanketed the forest to the northeast, smothered small plants and retarded the growth of larger ones.

The Impact on Animals

In the area affected by the blast, almost all wildlife vanished. Animals living above ground in the blast zone had no protection. Birds were particularly hard hit. Even those birds that survived the initial blast and avalanche died because the insects and plants they ate had perished. Insects were heavily affected, particularly by volcanic ash: the insects suffocated because ash clogged their body pores, or they dehydrated because glass-like ash abraded the cuticle that helps them retain moisture. Fewer than one-half of the small mammals species thought to have been living near Mount St. Helens were known to have survived. The death toll was nearly 7,000 large game animals, including deer, elk, and bear. The eruption severely damaged 26 lakes, killing an estimated 11million fish, as well as incalculable numbers of fresh-water invertebrates. The loss of human lives was 57.

Some Organisms Survived

The most surprising discovery following the eruption, however, was that many organisms survived in what appeared to be a lifeless gray landscape. In particular, plants sprouted in areas that had been protected under a snow cover and along stream banks and hillsides where erosion thinned ash deposits. Within a month, fireweed appeared from roots that had survived even though the tops of the plants were sheared off. Animals such as gophers and ants survived in their subterranean homes, while lake-dwelling frogs and salamanders escaped the blast under a protective cover of late winter ice.

The Recovery

Three years after the eruption, biologists had identified the recovery of more than 90 percent of the preeruption species of plants. Many plants owed their lives to gophers. These burrowing animals acted like garden tillers, by bringing the existing soil to the surface and mixing it with nutrient-rich volcanic ash deposited by the May 18, 1980, eruption. As the gophers dug, they also brought seeds, bulbs, and root fragments up to the surface where they could begin to grow. The "tilled" soil was also far more likely to trap seeds blowing across its surface.

In the forests, ash initially retarded the

Rich Volcanic Soils

Active volcanoes are also responsible for some of the world's most fertile soils. Tephra commonly contains potassium and phosphorus, two nutrients essential to plant growth. As tephra weathers, these nutrients are released into the soil, acting as a time-released fertilizer. The benefits of volcanic soils often lure people to risk living in the shadow of active volcanoes.

growth of surviving trees, but as rains washed the ash off leaves and needles, growth recovered. The layers of ash that remained on the ground enhanced growth for several years. The ash had a mulching effect, keeping in check understory plants that normally compete with trees for water and nutrients. Because of its light, reflective color, a coating of ash can help soil retain moisture as well.

Although few large mammals survived in the blast zone, fresh deer tracks were seen within 10 days. Black-tailed and Roosevelt elk were among the game species that moved in from adjacent areas and took advantage of the surviving plants that were beginning to recover. Spirit Lake was black and putrid, but it was not dead—only different. Its waters had been taken over by opportunistic bacteria, feasting on tons of organic matter that had avalanched into the lake. Ten years after the eruption, half a million tree trunks still drifted across the lake's surface; but the recovery had been remarkable. Lake life had almost returned to normal.

Volcanic eruptions are a fact of life for forests at Mount St. Helens. Like wildfires, they are among various natural disturbances that continuously alter the growth of a forest and foster diversity. Without periodic clearing by natural causes, forests could not renew themselves.

45-minute work session

Students learn how to "read" tree rings to determine the date of a volcanic eruption and the effects an eruption has on plant growth.

Key teaching points

1. If you look at the top of a tree stump, you will see a series of concentric rings in the cross section of its trunk. Because a single ***tree ring*** is usually formed each year, tree rings can be used to date the tree.

2. Tree ring boundaries are distinguished by a change in appearance between the small thick-walled cells produced at the end of a growth season and the large thin-walled cells produced at the beginning of the next growth season. The wood between these boundaries is formed during one growth season and constitutes one growth ring. (*fig. 2)*. Once the ring has formed, it remains unchanged during the life of the tree.

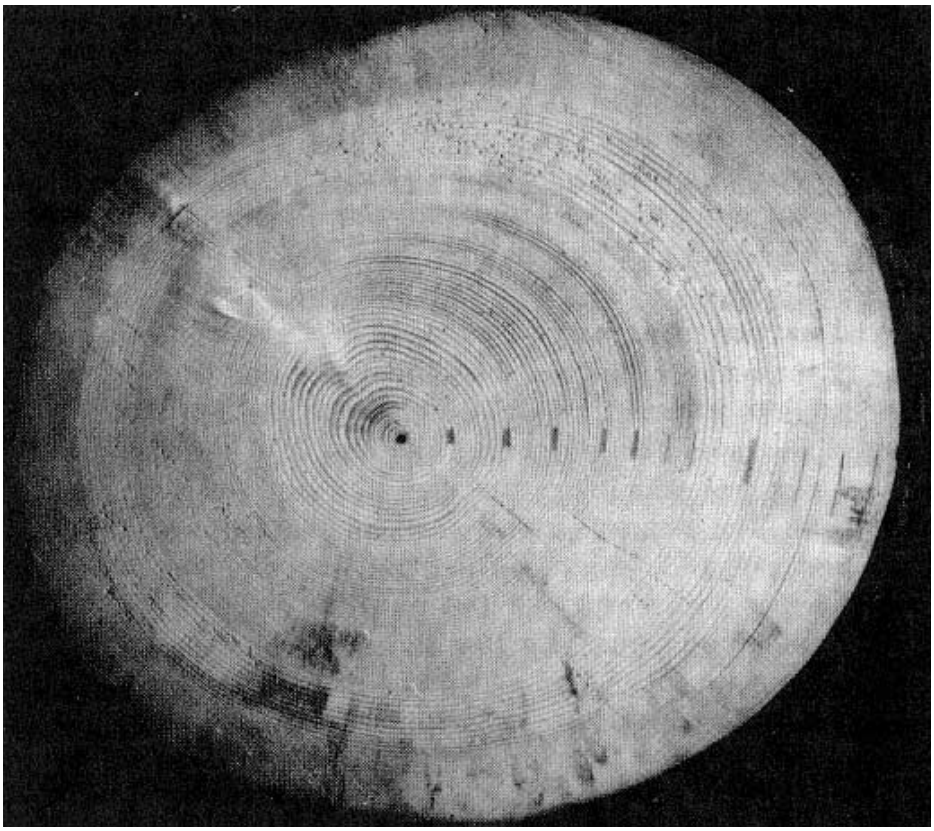
3. Scientists use tree ring data to help them establish the date of volcanic eruptions: the width of each year's growth records evidence of natural events, such as floods, drought, fires, and volcanic eruptions, that increased or decreased the width of that year's ring growth (*fig. 2)*.

4. Tree rings record both the negative and positive effects of volcanic eruptions. After the 1980 eruption of Mount St. Helens, ash that blanketed forests to the northeast of the eruption retarded growth for about 2 years. As rain washed away the ash, the rate of tree growth recovered and actually increased. The effect of the ash was equivalent to putting mulch on garden plants —the mulch reduced competition for water and nutrients by plants in the understory (in a garden mulch helps retain moisture and keep weeds from competing with other plants.)

Materials

1. Activity Sheets 5.1a–b
2. Log with visible tree rings

fig. 2



This 120-year old tree records the 1912 eruption of Mount Katmai, Alaska.

Procedures

1. Using either a piece of cut log or a diagram drawn on the chalkboard of a cross section of a tree, explain what tree rings are and what evidence they record about natural events that occurred during a tree's life.

2. Discuss the impact of the May 18, 1980, eruption of Mount St. Helens on the animal and plant life in the area around the volcano. Use *poster figure 19* to point out that a massive number of trees were killed during the eruption by the lateral blast, by forest fires started by lightning, and by avalanches and mudflows. Trees that survived, however, were charred or had their growth affected by the ash that covered the ground.

3. Distribute Activity Sheets 5.1a–b. Explain to students that they will use tree ring data to determine the date of an eruption of Mount Katmai in Alaska and the effect that the eruption had on the growth of a tree. (The tree's growth decreased for 3 years following the eruption but then increased for 12 years.) As a library assignment, they will make a time line and record on it important events that occurred during the life span of the Mount Katmai tree.

Extension

Have students draw tree ring patterns of their own and trade with other students to interpret.

Activity Sheet 1 Answers

1. 120 years
2. 1842
3. 1912
4. 3
5. 12
6. The ash helped to fertilize the soil

Activity 2 Eyewitness Accounts

45- to 60-minute work session

In a **role-playing exercise**, students use eyewitness accounts to gather and evaluate information about the events of the May 18, 1980, eruption of Mount St. Helens.

Key teaching points

1. Many people who were in the vicinity of Mount St. Helens during the eruption were interviewed to gain information about the nature and sequence of events of the eruption.

2. Although somewhat subjective, these observations were an important component of the scientific investigation of the eruption.

Materials

1. Overhead projector
2. Transparency of Master Sheet 5.2a
3. Master Sheets 5.2a–d
4. Activity Sheets 5.2a–b (photocopy)

Procedures

1. Tell students that on May 18, 1980, people at many locations in the vicinity of Mount St. Helens witnessed the eruption of the volcano. They observed a wide variety of phenomena associated with the eruption, including an earthquake, a massive avalanche, the lateral blast, mudflows, and the fall of airborne materials (tephra, including fine-grained ash). As a review of previous lessons, ask students to name the phenomena they think the eyewitnesses would have seen, heard, or felt.

2. On an overhead projector, show a transparency of Master Sheet 5.2a that shows where the eyewitnesses were located when the eruption occured.

3. Students play the following roles: **reporter(s), eyewitnesses, and scientists** who are serving on a committee investigating the eruption.

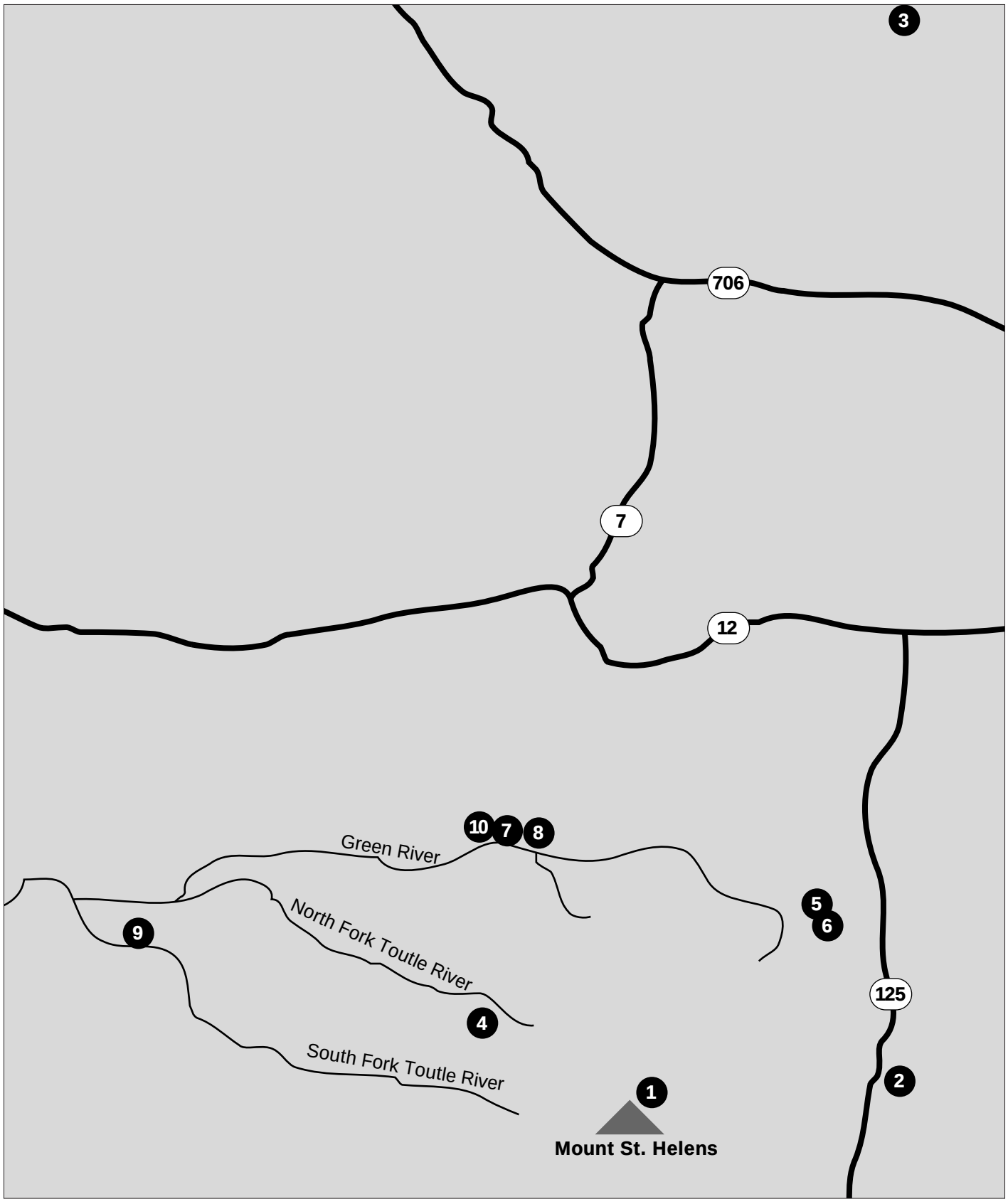
4. Distribute one account to each of the eyewitnesses (see Master Sheets 5.2b–d). Ask eyewitnesses to read the accounts in preparation for being interviewed by a reporter. Encourage students to use props to help them relay their accounts. When they are interviewed, the students should answer questions in their own words.

5. Distribute Activity Sheets 5.2a–b to the scientists. Tell the scientists to take notes while listening to the interviews. After hearing all the interviews, they should list the similarities and differences among the accounts on their Activity Sheet.

6. Divide the scientists into groups of four to six students and ask each group to discuss their recollections of the eyewitness accounts. Eyewitnesses should circulate among the groups of scientists to answer questions. Each group of scientists should prepare a written summary that attempts to reconcile the eyewitness accounts.

This teaching packet was originally published and printed in 1997. The online edition contains full text from the original publication. Some images have been modified or added to improve the scientific visualization of informaiton. This document has undergone official review and approval for publications established by the National Mapping Division, U.S. Geological Survey.

Master Sheet 5.2a



Master Sheet 5.2b

These 10 accounts are listed in approximate chronological order corresponding to the sequence of the eruptive events. The number following the site location corresponds to the numbers on the map (Master Sheet 5.2a) showing the location of eyewitnesses.

Photocopy both sides. Cut up like note cards.

Eyewitness Account #1:
Name: K. and D. Stoffel (geologists)
Event witnessed: avalanche and beginning of the eruption
Site location: in a small aircraft directly over Mount St. Helens

"As we approached the summit, flying at an altitude of about 11,000 feet, everything was calm...Just as we passed above the western side of the summit crater, we noticed landsliding of rock and ice debris... Within a matter of seconds—perhaps 15— the whole north side of the summit crater began to move instantaneously...The entire mass began to ripple and churn up...then the entire north side of the summit began sliding north...We took photographs of this slide sequence occurring, but before we could snap off more than a few pictures, a huge explosion blasted out of the avalanche-detachment... We never felt nor heard a thing...From our viewpoint, the initial cloud appeared to mushroom laterally [sideways] to the north and plunge down. Within seconds, the cloud had mushroomed enough to obscure our view."

Eyewitness Account #2:
Name: P. and C. Hickson (geologists)
Event witnessed: avalanche and beginning of the eruption
Site location: 15 km (9 miles) E/Near road 125, east of Mount St. Helens

"As the avalanche reached the halfway point on the mountain, the summit eruption began with a dense black cloud followed by lighter gray material. A second eruption halfway down the slope occurred moments later." At this time the avalanche appeared to consist of upper and lower parts. The flank eruption was between the two. Seconds later the upper slide overrode the flank eruption and material was hurled far down the slope onto the lower slide. About 45 seconds after the avalanche began, the eruptive centers merged and the rapidly expanding cloud overtook the avalanche.

Eyewitness Account #3:
Name: J. Downing (climber)
Event witnessed: directed blast
Site location: 75 kilometers (47 miles) N/climbing on Mount Rainier at 3,200 meters (1,050 feet)

Climbers on Mount Rainier observed two distinct "flows," which began very shortly after the eruption started. These "flows" were described as clouds 300 to 600 meters (1,000 to 2,000 feet) thick that appeared to hug the ground. The heads of the "flows" disappeared into valleys and reappeared as they "hopped" over ridges. The earlier flow traveled to the west, perhaps down the North Fork Toutle River, and was followed almost immediately by a "flow" that seemed to travel to the east.

Eyewitness Account #4:
Name: C. McNerney
Event witnessed: directed blast
Site location: 13 kilometers (8 miles) NW/driving on south side of North Fork Toutle River

Following the collapse of the north side, a foglike ring (cloud) descended very quickly and expanded out from the mountain. At about 2 minutes after the beginning of the eruption, the witnesses began driving west at about 110-120 kilometers per hour (70-75 miles per hour). At this speed, they did not seem to get any farther away from the cloud. The wind blowing into the car was warm enough to give the impression that the car heater was on. They increased their speed to 135 kilometers per hour (85 miles per hour) and began outdistancing the cloud. About four kilometers (2.5 miles) farther west they stopped and could not see the black cloud. After a short time the cloud reappeared. The base of the black cloud looked "like avalanches of black chalk dust—first one part of the black cloud would shoot out in front, then another, then another, like waves lapping up on a beach." Pulling back onto the highway, they outran the cloud at about 105 kilometers per hour (65 miles per hour).

Master Sheet 5.2c

Eyewitness Account #5:
Name: W. and L. Johnson
Event witnessed: directed blast
Site location: 17 kilometers (10.5 miles) NE/on ridge top with good view of Mount St. Helens

Shortly after the vertical eruption began, a large horizontal blast occurred. Just before the top of the mountain became obscured, the south side of the summit crumbled into the hole formed by the avalanche. As the cloud grew, what appeared to be a shock wave similar to that associated with a nuclear explosion moved ahead of the cloud. About l 1/2 minutes after the start of the avalanche and perhaps 45 seconds after the start of the blast, a noise like a clap of thunder accompanied some sort of pressure change. The initial noise was followed by a continuous rumbling, "like a freight train."

Eyewitness Account #6:
Name: C. Rosenquist (amateur photographer)
Event witnessed: directed blast
Site location: 17 kilometers (10.5 miles) NE/ on ridge top with good view of Mount St. Helens

A rumbling noise began within 7-8 seconds of the start of the avalanche. One member of the group sensed a pressure decrease at about the same time. A "shock wave," which looked like heat waves, formed ahead of the blast cloud.

Eyewitness Account #7:
Name: M. and L. Moore (campers)
Event witnessed: directed blast and ash cloud
Site location: 22 kilometers (14 miles) N/on north side of Green River

A noise similar to, but which "didn't sound quite right" for, a propeller-driven aircraft occurred for 10-20 seconds before a rapid pressure change, which caused ears to pop numerous times over a period of about 10 seconds. One person also felt as if she was being squeezed gently over her entire body. A short time later, an immense ash cloud approached that seemed to consist of a lower vertical wall and upper overhanging part.

Eyewitness Account #8:
Name: B. Nelson (loggers)
Event witnessed: directed blast
Site location: 21 kilometers (13 miles) N/on north bank of the Green River

The witness and two companions were cutting timber with chain saws. Mount St. Helens was hidden by a ridge and the three men neither heard nor felt anything unusual until they were alerted to the eruption by a fourth man. About 10 seconds later, "a horrible crashing, crunching, grinding sound" came through the trees from the east. Suddenly, it became totally dark: " I could see absolutely nothing." It immediately got very hot, and almost impossible to breathe. While the men were gasping for air, the inside of their mouths and their throats were burned. The witness was knocked down, although he does not recall being hit by rocks or other projectiles. He arose with his back to searing, painful heat that lasted about 2 minutes. All trees had been knocked down, and everything was covered with about a foot of drab gray ash. None of the men's clothing had been burned, but their bodies had been burned extensively. Three of the men subsequently died. Heavy ash fall resumed after about 20 minutes.

Master Sheet 5.2d

Eyewitness Account #9:
Name: V. Dergan and R. Reitman
Event witnessed: mudflow
Site location: 40 kilometers (25 miles) NW/on the South Fork Toutle River

Sometime after 9:00 a.m. Pacific Daylight Time, the South Fork Toutle River began rising and quickly rose about a meter (3 feet). The river was slightly muddy and carried numerous logs. About 2-3 minutes after the first logs moved downstream, a railroad bridge moving at about 40 kilometers per hour (25 miles per hour) appeared. Trees were being snapped off. As the bridge went by, large logs behind it rolled up the bank. The mass of thick mud and logs pushed the witnesses and their car off the bank and into the river. They were swept along for about 5 minutes at about 40 to 50 kilometers per hour (25 to 30 miles per hour) in very thick, warm mud. The witnesses jumped from log to log toward shore where the flow was moving more slowly, and waded through warm mud over 5 meters (1.5 feet) deep. The mud continued to rise slowly for a short time. After perhaps 15-30 minutes the mud and logs stopped moving.

Eyewitness Account #10:
Name: B. Nelson and S. Ruff
Event witnessed: tephra fall
Site location: 21 kilometers (13 miles) N/on north bank of Green River

After the blast and a few minutes of clear sky, hot ash began to fall. Again, it became totally dark. This ash seemed to fall vertically. It was "like someone pouring a bag over your head." The extremely heavy ash fall lasted about 15 minutes. The ash fall was so intense that the witnesses had to use their fingers to dig the ash out of their mouths. They put their shirts over their heads in an effort to keep the ash out of their mouths and noses. After 15-20 minutes "stuff started coming out of the sky." They could hear this material hitting trees. One witness was hit on the head by something large enough to raise a lump. During the heavy ash fall, they became cold, sleepy, and nauseous, but did not suffer from headaches. After an hour and a half visibility began to return.

VOLCANOES!

Activity Sheet 5.1a
Dating A Volcanic Eruption

Have you ever looked at a tree stump and noticed its rings? Count the rings and you will know how old the tree is. Each ring represents 1 year in the life of the tree.

If you look closely at tree rings*, however, you will see that the spaces between rings vary in width. Trees do not grow the same amount each year.*

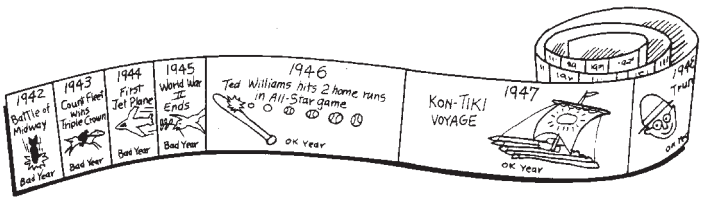
What to do

You can "read" these tree rings and find out what year there was an eruption of Mount Katmai in Alaska.

What you know:

1. This tree was growing 48 kilometers (29 miles) northwest of Katmai Volcano.
2. After the eruption, the forests were blanketed in ash.
3. This tree's growth decreased for some years after the eruption, but then it increased.
4. This tree was cut down in 1962.

Make a time line for the years that this tree was alive. Research and record events that occurred during the tree's life.



What you want to find out:

1. The tree's age:

   _____

   (Count the number of rings from the center of the tree to the bark. Each dark band represents 10 years.)

2. The year the tree started to grow:

   _____

   1962 – _____ = _____

   the year the tree was cut down | *the age of the tree* | *the year the tree started to grow*

3. The year of the eruption:

   _____

   (Count the number of rings from the center to the first thin ring.)

4. The number of years the tree's growth decreased:

   _____

   (Count the number of thin tree rings)

5. The number of years the tree's growth increased:

   _____

   (Count the number of wide rings.)

6. Why do you think the tree's growth increased?

   _____

   _____

   _____

   _____

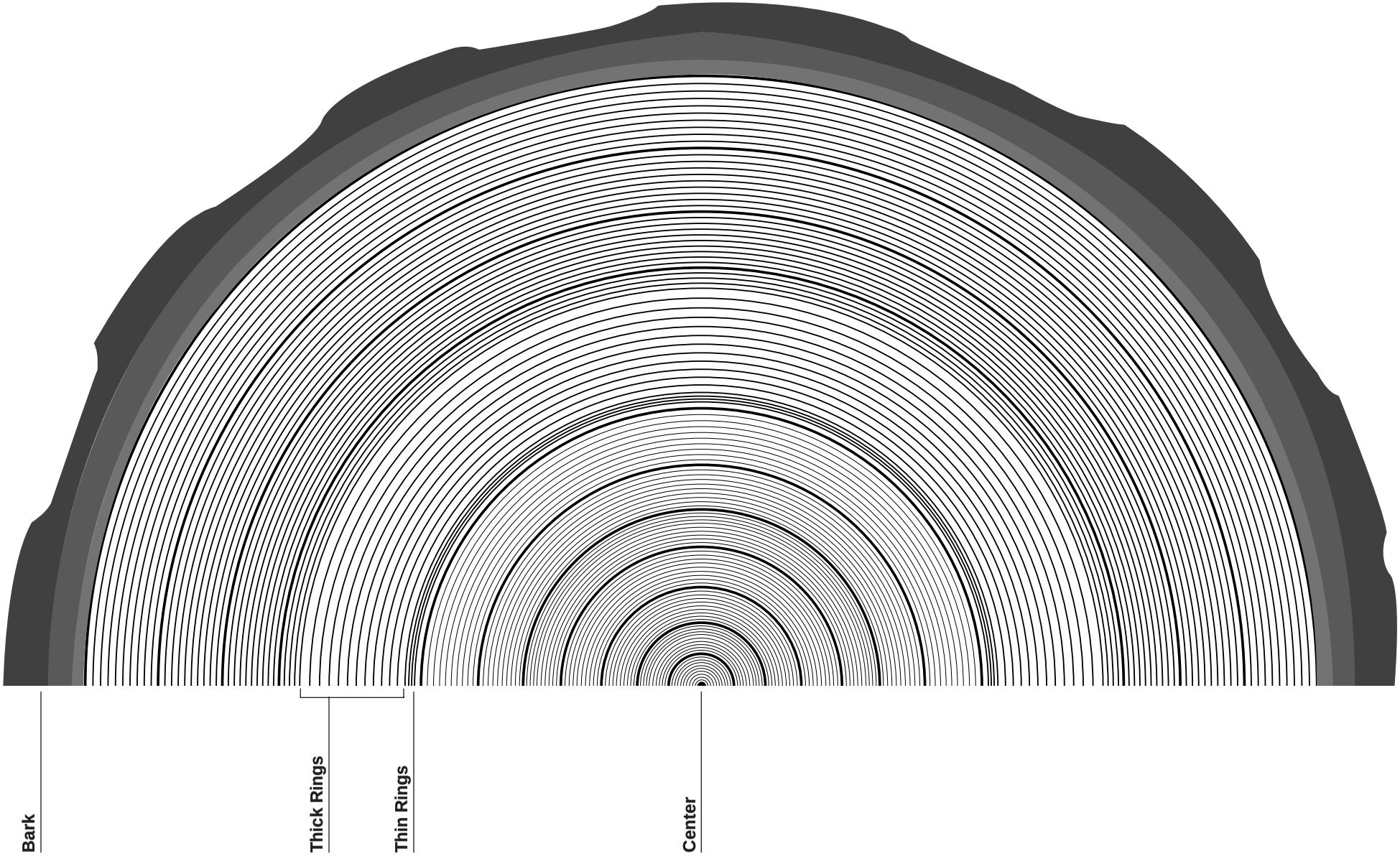
   _____

   _____

   _____

VOLCANOES!

Activity Sheet 5.1b
Dating A Volcanic Eruption



Activity Sheet 5.2a
Eyewitness Accounts

What to do

For each eyewitness, write in the spaces provided: the name, approximate location during the eruption, and important statements the eyewitness makes about the eruption.

These accounts were excerpted from the "Summary of Eyewitness Accounts of the May 18 Eruption," by J.G. Rosenbaum and Richard B. Waitt, Jr., in The 1980 Eruptions of Mount St. Helens, Washington, *USGS Professional Paper, 1250.*

Eyewitness #

Name

Location

Statements

Eyewitness #

Name

Location

Statements

VOLCANOES!

Activity Sheet 5.2b
Eyewitness Accounts

	Similarities	Differences
Eyewitness #1		
Eyewitness #2		
Eyewitness #3		
Eyewitness #4		
Eyewitness #5		
Eyewitness #6		
Eyewitness #7		
Eyewitness #8		
Eyewitness #9		
Eyewitness #10		