DAY 6 **TEACHER NOTES**

Estimation Game: Estimate the number of major volcanoes present in the Cascade Range. The answer is thirteen major volcanoes: Mt. Garibaldi (British Columbia), Mt. Baker, Glacier Peak, Mt. Rainier, Mt. St. Helens, Mt. Adams (Washington State), Mt. Hood, Three Sisters, Crater Lake (Oregon), Mt. Shasta, Lassen Peak (California).

Story Time: Journey of the *Oncorhynchus*-Chapter Six. Each student will need their Journey of the *Oncorhynchus* story book. Before starting the story, set up either the Journey of the *Oncorhynchus* mural by adding **section six** or the poster. Call attention to the mural/poster by having the students search for the hidden salmon in section six. The first student to find the hidden salmon will be awarded a prize.

TEACHER DEMO: **THE PRESSURE ZONE**

SCIENCE CONCEPTS/PROCESSES: Cause and Effect, Change, Cycle, Evolution, Force, Observe, Predict

OBJECTIVE(s): After completing the activity, students will be able to:

- to describe basic Plate Tectonics Theory and relate it to the Pacific Northwest.
- understand how the Cascade Volcanoes were formed.

MATERIALS:	
2-16 oz bottles of diet root beer	1 hot plate
1 five quart sauce pan	ice
2 medium size nails	hammer
2 rolls of paper towel	pumice rock samples
safety goggles for instructor(s)	

BACKGROUND INFORMATION:

Plate Tectonics/Continental Drift

The Plate Tectonic Theory states that the earth's crust or lithosphere is made up of several huge moving plates. The plate tectonic model of the earth looks like a huge jigsaw puzzle. The jigsaw pieces or crustal plates "carry" all the continents and the ocean floors. Scientists have been able to trace the movement of the earth's plates back into time. They have pieced together a picture of how the earth might have looked before the continents drifted apart to their present positions.

The process that supports this crustal plate movement is explained by the theory of Continental Drift. Approximately 200 million years ago scientists believed the earth's land was joined together to form a super continent called Pangaea (meaning all land). The rest of the earth was covered by the ocean called Panthalassa (meaning all seas). Then Pangaea began to split into two land masses, Laurasia in the north and Gondwana in the south. Between these two land masses the Tethys sea came into existence. Over time, the continents drifted to their present positions. One of the examples that is most often used to support this theory is the close fit of the South American continent and the African continent.

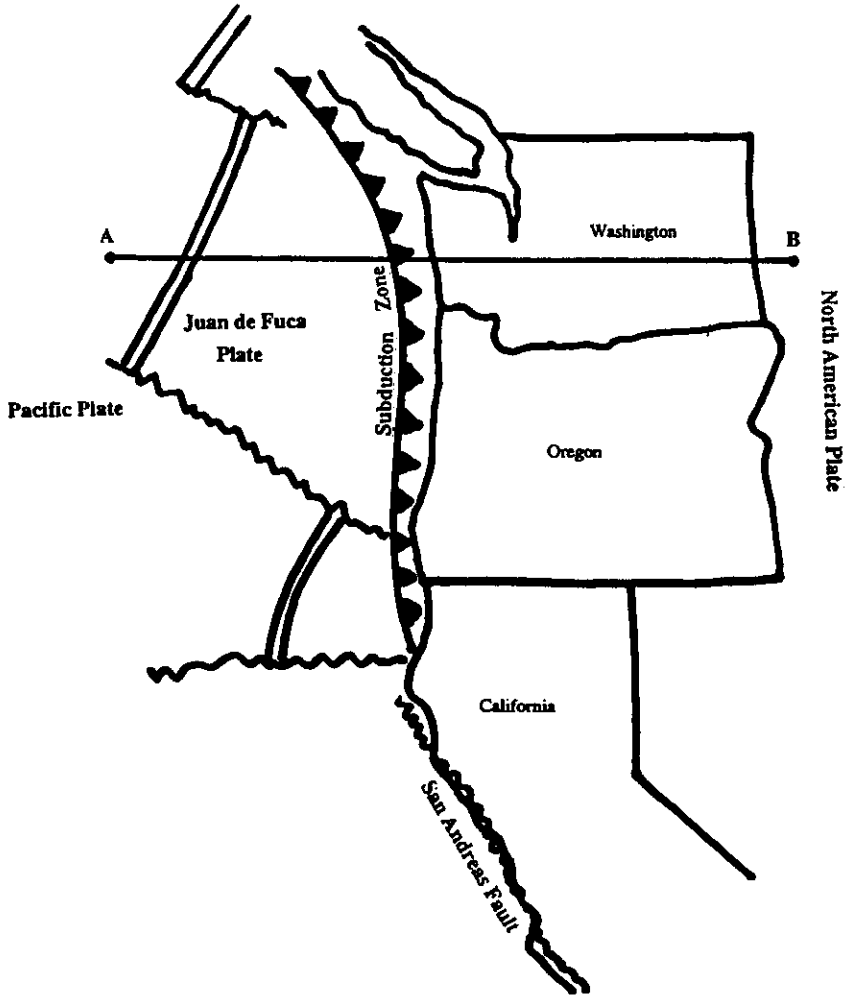
The Pacific Northwest

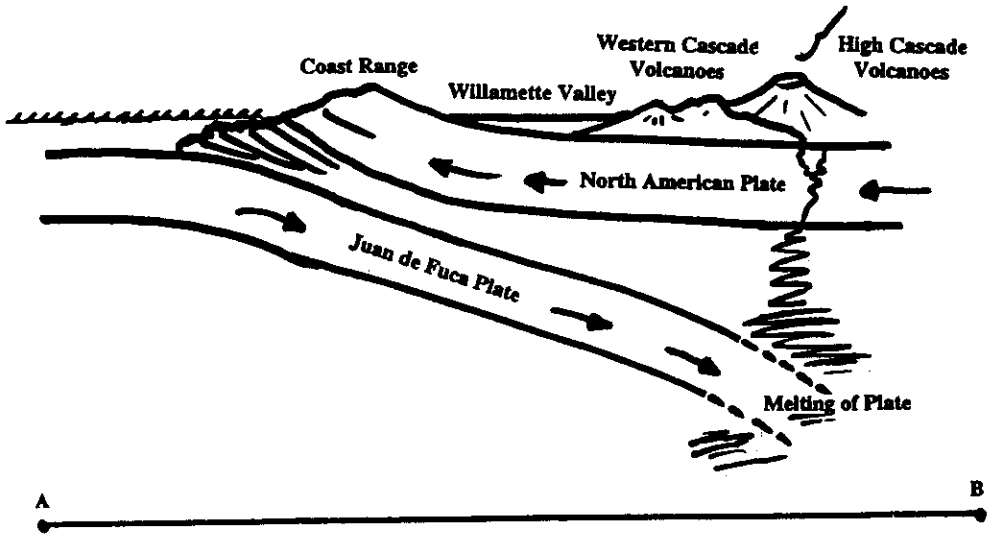
The boundaries of these plates are defined by locations of volcanoes and earthquake activity. In the Pacific Northwest, one of these boundaries is responsible for most of the volcanic and seismic activity in the area. The Juan de Fuca plate which is covered by the Pacific Ocean is moving towards and subducting under the North American plate. The North American plate carries the North American continent which includes Canada, the United States, and Latin America. Where these two plates meet a subduction zone is formed (see figure on page 6-5). The Juan de Fuca plate is going underneath or subducting under the North American plate. Earthquakes occurs as these plates move pass each other. As the Juan de Fuca plate descends deeper and deeper into the earth, the rock that makes up this oceanic crust heats up. This hot, molten rock rises to find an opening to release the pressure that has built up. This tremendous pressure is released when the molten rock or magma finds an opening or vent in the earth's crust. The structures that are formed around these pressure vents are called volcanoes.

The Cascade volcanoes are composite volcanoes. Composite volcanoes have very large symmetrical cones of alternating layers of solidified lava and rock particles. Mount St. Helens, Mount Hood, Mount Adams, and Mount Shasta are all composite volcanoes. Cinder Cone and Shield are the two other main types or forms of volcanoes.

The Juan de Fuca plate is named for a Greek who sailed in the service of Spain and may have visited the Juan de Fuca Strait passage in 1592. The Juan de Fuca Strait is a narrow passage of the eastern North Pacific Ocean between the Olympic Peninsula of Washington State, U. S. , and Vancouver Island, British Columbia, Canada. Part of the United States--Canadian international boundary lies in mid-channel.

PACIFIC NORTHWEST SUBDUCTION ZONE





PROCEDURE:

1. In this activity, students will learn about the Plate Tectonic Theory and how it relates to the Pacific Northwest volcanoes. They will also witness what can happen when pressure builds up underneath these volcanic vents.
2. Instructors should first discuss the Plate Tectonic Theory and the theory of Continental Drift and how they relate to the Pacific Northwest. Students should refer to their Student Activity Sheet 6-1 as you present this information.
3. During the discussion of the Plate Tectonic Theory/Continental Drift, the Pressure Zone demonstration should be set up. One diet root beer bottle should be placed in a 600 mL beaker of ice water. Another bottle of diet root beer should be placed in a 600 mL beaker of hot water. The root beer should be kept in the beakers for approximately 15 minutes before the demonstration. When ready, **this demo must be done outside!**
4. When outside make sure that the students are at a safe distance away (~3 to 5 meters away) from the bottles. The students should hypothesize what will happen to each of the bottles when you puncture the cap with a nail. Ask the students "What do you think will happen when the bottles are punctured and do you think the results of the two bottles will differ?" Then puncture the cap of the bottle in ice water with a medium size nail and hammer and observe the results. Puncture the cap of the bottle in hot water and stand back!! Were their hypotheses correct?
5. Many violent volcanic eruptions produce a rock called pumice. Pumice is a glassy rock with a lot of air holes. It weighs so little that it floats on water. Think about the froth produced in this demonstration, how do you think pumice is formed?
6. Allow the students to test this out with a few pieces of pumice and a tub of water.

CONCLUSION

Instructors should bring closure to this activity by asking the following questions:

1. Which bottle has the least amount of liquid remaining?
2. Where was the gas before the bottles were opened?
3. Why did the gas rush out?
4. Why did one bottle produce froth more violently than the other?
5. In terms of pressure, what causes a volcano to erupt?

ACTIVITY 6-1: **VOLCANIC ACTIVITY**

SCIENCE CONCEPTS/PROCESSES: Model, Replication, Observe

OBJECTIVE(s): After completing the activity, students will be able to:

- build a model of a volcano.
- understand the relationship between a lava tube and a volcano.

MATERIALS:

40 volcano patterns	40-8 oz paper cups
40-4 oz plastic cups	40-1 oz plastic cups
5 pounds of modeling clay	40-11 inch plastic plates w/lip
clear dish washing detergent	red food coloring
5 pounds of dry ice	1 hammer
40 scissors	1 pair of leather gloves
20 packages of clear tape	

PROCEDURE:

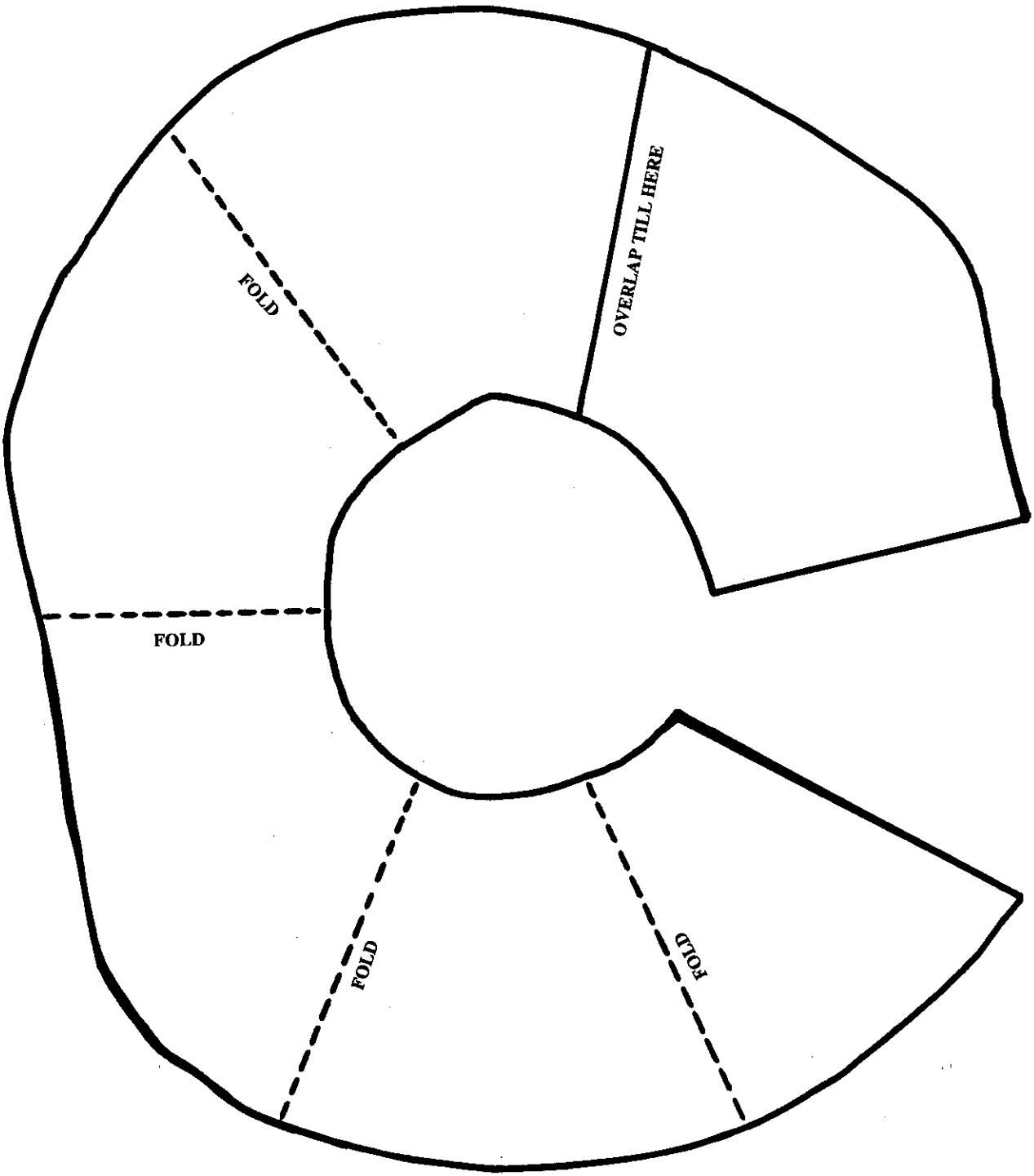
1. In this activity, students will build a model of a composite volcano. They will also include a lava tube in their model.
2. Each student will need a 4 oz plastic cup, 8 oz paper cup, a 11 inch plastic plate, a volcano pattern and directions to get started. Student will construct their volcano with these materials. After they are done, **they should name their volcano.**
3. The instructors should mix clear dish washing detergent, water and red food coloring together to make a magma solution. Be very careful while mixing to minify the amount of bubbles produced. Each student will need approximately 100 mL of the magma solution.
4. After pouring the magma solution into the caldera of their volcanoes, add a quarter-size piece of dry ice. (The dry ice should only be handle by an adult using leather gloves.) The addition of the dry ice will start the eruption.
5. The eruptions should be staggered so that the students can observe all of them.
6. The students will judge all of the eruptions, presenting prizes to the students who have constructed volcanoes that exhibit the following: best shaped volcano, best lava flow, best overall eruption, best of the show, etc.
7. After all eruptions are complete and clean-up has occurred, each student should obtain approximately 50 grams of modeling clay and a one ounce plastic cup. Students will shape the clay to create a lava tube and cave next to their volcano. Obviously created after that tremendous volcanic eruption which was very similar to how the Ape Cave was formed.

CONCLUSION:

Instructors should bring closure to this activity by asking the following questions:

1. What type of volcano is Mount St. Helens?
2. Describe a composite volcano.
3. What shape are most of the volcanoes in the Pacific Northwest?
4. How are lava tubes formed?
5. Name one type of rock produced by Mount St. Helens.
6. What happens to the Earth before a volcanic eruption?

VOLCANO PATTERN



DAY 7 **TEACHER NOTES**

MOUNT ST. HELENS/APE CAVE FIELD TRIP

EMERGENCIES
Mount St. Helens Interpretive Center - (206) 274-2103
Toutle Salmon Hatchery - (206) 274-7757
Forest Service - (206) 750-3900

Estimation Game: Students estimate how high Mount St. Helens blasted ash into the atmosphere on May 18, 1980 (or use a comparable estimation game for students).

Bus Activities: Students may complete games and/or activities in their student workbook during the bus ride.

OBJECTIVE(s): After completing the activities on this field trip, students will be able to:

- apply what they have learned in the classroom to their local and regional communities.

MATERIALS:

35 film canisters	2-1 gallon size plastic bags
35 No. 2 pencils	35 adhesive name tags
15 lanterns (RESERVED at Ape Cave)	15 flashlights
candles/matches	

BACKGROUND INFORMATION:

MOUNT ST. HELENS

History

Mount St. Helens is one of the youngest composite volcanoes in the Cascade Range. It's smooth symmetrical shape is only slightly eroded by glacial ice and it's low timberline elevation are indications of recent volcanic activity. Even though the geologic history of Mount St. Helens goes back over 37,000 years, eruptions during the past 2,500 years have been mostly responsible for the mountain we see today. The volcano has produced basalt and andesite lava flows, as well as dacite domes and ash. About 1,900 year ago, fluid streams of pahoehoe (ropy) basalt flowed down the southern flank of the mountain and cascaded into the canyon of the Lewis River. Ape Cave and other lava tubes formed within the flow south of the volcano. In fact, most of the visible part of the cone was formed during the last 500 years.

It has only been since 1800 that eyewitness accounts of eruptions have been recorded. Early explorers recorded Indian accounts of eruptions before the coming of white men. Accounts of even earlier eruptions were handed down in Indian legends. Local Indians told explorers of a large eruption about 1800, when pumice accumulated to a depth of several inches many miles away from the volcano. The first authenticated eye-witness account of an eruption was made by Dr. Meredith Gairdner from Fort Vancouver in 1835.

May 18, 1980

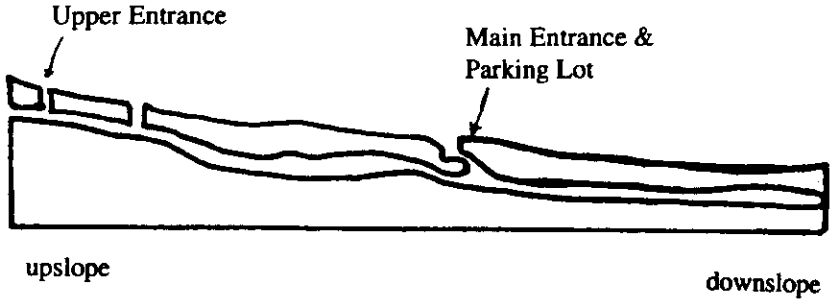
Silent for 123 years, Mount St. Helens awakened in the spring of 1980. By early Spring, the crater grew to 1,000 feet in diameter, and two giant crack systems broke across the entire summit area of the mountain. As thousands of earthquakes shook Mount St. Helens between April 1 and May 17, a giant magma "bulge" grew on its north flank. At 8:32 a.m., on May 18, 1980, within 15 to 20 seconds of a magnitude 5.1 earthquake, the entire north flank of the mountain slid away in a giant landslide. Explosions ripped through the sliding avalanche of debris, forming a laterally-directed blast of rocks, ash, gas and steam that swept as fast as 670 miles per hour down the North Fork of the Toutle River Valley. This lateral blast flattened four billion board feet of timber, enough to build 300,000 two-bedroom homes. In less than 10 minutes an enormous plume of pumice and ash thrust 13.6 miles into the stratosphere, and it continued for the next 9 hours. The prevailing winds carried 540 million tons of ash over 22,000 square miles across North America in three days, and circled the earth in 15 days. The ash clouds produced darkness during day light hours in many towns in Eastern Washington. As the hot blast (up to 300°C or 570 °F) spilled down all sides of the volcano, water from melting snow and ice mixed with loose rock debris to form mudflows. Mudflows poured down river valleys, ripping trees from their roots and engulfing roads, bridges and houses. On May 18, 1980, mudflows destroyed or damaged 27 bridges, 185 miles of road, approximately 200 homes and stranded 31 ships in upstream ports of the Columbia River. Thirty-six people are known dead and 21 are still missing.

The 1979 summit elevation of Mount St. Helens was 2,951 m (9,677 ft). It was reduced to 2,551 m (8,365 ft) and 2.5 km^3 (0.6 mi^3) of material was removed by the May 18 eruption.

APE CAVE

Ape Cave has a length of 3843 meters (12,810 feet) long and is the longest continuous lava tube discovered in the continental United States. While logging, Lawrence Johnson of Amboy, Washington discovered the cave in 1946. The cave was named for an outdoor group who called themselves the St. Helens Apes.

Ape Cave is divided into two portions, upslope and downslope, from the main entrance. The downslope portion of the cave extends for approximately 1200 meters (4,000 feet) before ending in a sand fill. The downslope portion is easily traveled, while the upslope portion is difficult. The upslope portion involving nearly 2100 meters (7,000 feet) of passage floored mostly by rock rubble caused by collapse of the passage walls and ceiling.



APE CAVE

The eruption which produced the Ape Cave 1,900 years ago was of a less explosive nature than the May 18, 1980 event. Lava tubes such as Ape Cave, form in flows of ropy pahoehoe basalt when the top of the flow cools faster than the lava below. When the eruption ceases, lava drains from the tube leaving an open tunnel. Since lava is an excellent insulator, it is possible for the lava to flow through the tube for many miles with little loss of heat. This hot lava stream is able to erode downward, cutting into the rock below. This cutting activity caused the cave to have passages with a high, narrow cross-section. As the lava level dropped, hot gases caused melting of wall surfaces (much like a very hot oven) forming a dark shiny glaze. Where sections of wall lining have fallen away, it is possible to see hard reddish soil which was baked red by the heat of the overlying lava. Once the eruption ceased and lava drained from the tube, the cave was left as we see it today.

Lava stalactites were formed on the ceiling and stalagmites were formed on the floor where globules of dripping lava fell from stalactites. These lava formations are not common in the cave and where they do occur are small and very fragile. Lateral "flow marks" (minor ledges) along the walls, mark stages of lava decline in the tube. When the lava level dropped then stabilized for a period of time, a flow mark was produced along the wall, much like a ring is produced in the bathtub.

In the lower portion of the cave, a block of solidified lava (called the lava ball), was carried along in the lava stream and was wedged in a narrow portion of the passage. This lava ball is approximately twelve feet above the floor surface today.

At the end of the downslope portion of the cave, a sandy floor has formed. This sandy floor is made up of volcanic ash, pumice, and other debris which have been washed into the cave through the lower entrance. The majority of the debris was deposited following an eruptive episode geologists call the Early Kalama Period, 450 years ago. Flooding has carried fresh ash and sediment from the recent eruptions across the lava flow above Ape Cave.

The cave wind you feel is nearly always present and is sometimes as great as seven miles per hour. The wind is caused by differences in air temperature inside and outside the cave. During the winter, warm cave air rises like warm smoke in a chimney and pours out the upper entrance. This chimney effect reverses during the summer when cool cave air drains down-slope through the cave and pours out the lower main entrance.

PROCEDURE:

1. **Mount. St. Helens Interpretive Center** - Students should use their workbooks to complete the Mount St. Helens Scavenger Hunt. Information to complete this activity can be found throughout the Mt. St. Helens Interpretive Center and by watching the 22 minute video at the Interpretive Center.

2. **Toutle River Fish Hatchery** - Students will tour the salmon fish hatchery. A large part of the rearing ponds are still covered with Mount St. Helens ash from the May 18, 1980 eruption. Students will be able to collect a small amount of ash in film canisters. On Day 9, the students will view the ash under a microscope using polarized film.

3. **Merwin Dam and Picnic Area** - This lunch stop is short (45 min). Students should use this time to eat and use the facilities.

4. **Ape Cave** - Students will be divided into two groups, Camp A and Camp B. A short presentation about Ape Cave and Mount St. Helens will be given to each group as they enter the cave by Forest Service personnel. Then students (with their counselor) will hike for approximately 20 minutes into the downslope section of the cave and return to the lower entrance. This hike will take approximately 40 minutes (40 minutes equals 20 minutes downslope and 20 minutes upslope back to the entrance). Students will need warm clothes and shoes for this hike. Challenge the students to estimate the size of the cave. Lanterns should only be operated by the counselors/adults. Students may share the flashlights.

STUDENT ACTIVITY SHEET 7-1

SCAVENGER HUNT-ANSWERS

(Mount St. Helens Interpretive Center)

Find the answers to the following questions as you view the museum.

Museum Entrance and the Mount St. Helens Film (22 min.)

1. In what national forest is Mount St. Helens located?
   Gifford Pinchot

2. On what day did the first earthquake take place?
   March 20, 1980.

3. On what day did the big eruption take place?
   May 18, 1980.

4. Mount St. Helens was 9,677 feet high before the eruption and

   8,365 feet high after the eruption.

Formation of the Earth

Birth of the Cascades: 5. What happened 200 million years ago (m.y.a.)?
First dinosaurs appeared.

Age of Man: 6. When did primitive man appear in Africa and India?
10 million B. C.

7. When did the first eruption of Mount St. Helens occur?
40,000 B. C.

Volcanic Events: 8. What happened 1200 years before the May 18, 1980 eruption of Mount St. Helens?
Mt. Mazama erupted (Crater Lake)

VOLCANOES AND THE EARTH'S CRUST

A Volcano Erupts:

9. What is the hot molten rock under the surface of the earth called?
   Magma
10. Name four kinds of volcanoes. a. Composite, b. Shield

    c.Cinder Cone, d._____

Man and the Mountain Part II

Native Americans:

11. Who is the keeper of the sacred fire?
    Loo-wit

12. What three Indian groups lived around Mount St. Helens?
    Cowlitz, Klickitat, and Upper Chinook.

13. Who was the husband of Mount St. Helens?
    Mt. Hood

14. According to legend, what river could the Indians cross without getting their feet wet?
    Columbia River

15. What fruit was important to the Native American diet?
    Huckleberries (also blackberries, strawberries, elderberries and salal berries.)

16. What is the name for the fish trapping devices the Indians made out of wood slats and cedar rope?
    Fish weirs

17. What were the two primary meat sources for Native Americans?
    Salmon and venison

Explorers & Settlers

18. Who gave Mount St. Helens it's name as we know it?
    Captain George Vancouver

19. What year did the explorer get to the Northwest?
    1792

20. From what country did he come?
    England

Spirit Lake camps and lodges

21. What were bola stones used for?
    Hunting

Mount St. Helens: During and After the Eruption

22. How much did the Oregon Journal cost in April 1980?

23. According to the Oregon Journal, on April 1, 1980, how much money did the United States Senate spend to improve salmon and steelhead fisheries in the Northwest?

24. Who was President on May 1, 1980?
    President Jimmy Carter

25. The ash from Mount St. Helens caused what type of pollution?
    Air pollution

26. How high were the temperatures around the mountain on May 18, 1980?
    300 degrees Celsius

Magma Chamber

Tree Ring Dating Technique

27. What can trees tell us about volcanic eruptions?
    When they occurred by observing their rings.

28. What type of tree is ideal for dating eruptions?
    Douglas Fir

MOUNT ST. HELENS
WORD SEARCH

M	A	S	Y	U	B	T	C	S	E	R	A	H	A	L
O	V	M	D	E	V	A	S	T	A	T	I	O	N	O
U	W	A	A	C	I	N	D	E	R	S	Q	O	P	E
N	O	D	R	E	K	A	L	T	I	R	I	P	S	B
T	L	A	P	E	C	A	V	E	S	T	R	H	N	U
S	F	T	B	K	V	D	T	D	P	F	E	I	P	T
T	A	N	W	D	X	I	E	U	G	O	G	M	B	A
H	V	U	E	Z	W	C	R	F	H	R	F	J	C	V
E	A	O	Y	O	C	E	G	E	K	F	H	R	X	A
L	L	M	O	Z	T	S	O	N	L	I	A	O	E	L
E	J	L	I	H	U	H	L	Q	R	T	L	O	V	Y
N	V	O	L	C	A	N	O	S	E	J	U	K	L	N
S	X	S	A	P	V	T	M	R	P	O	A	O	Z	A
B	V	O	L	C	A	N	I	C	A	S	H	L	T	W
W	T	Q	E	N	O	Z	T	S	A	L	B	U	M	O

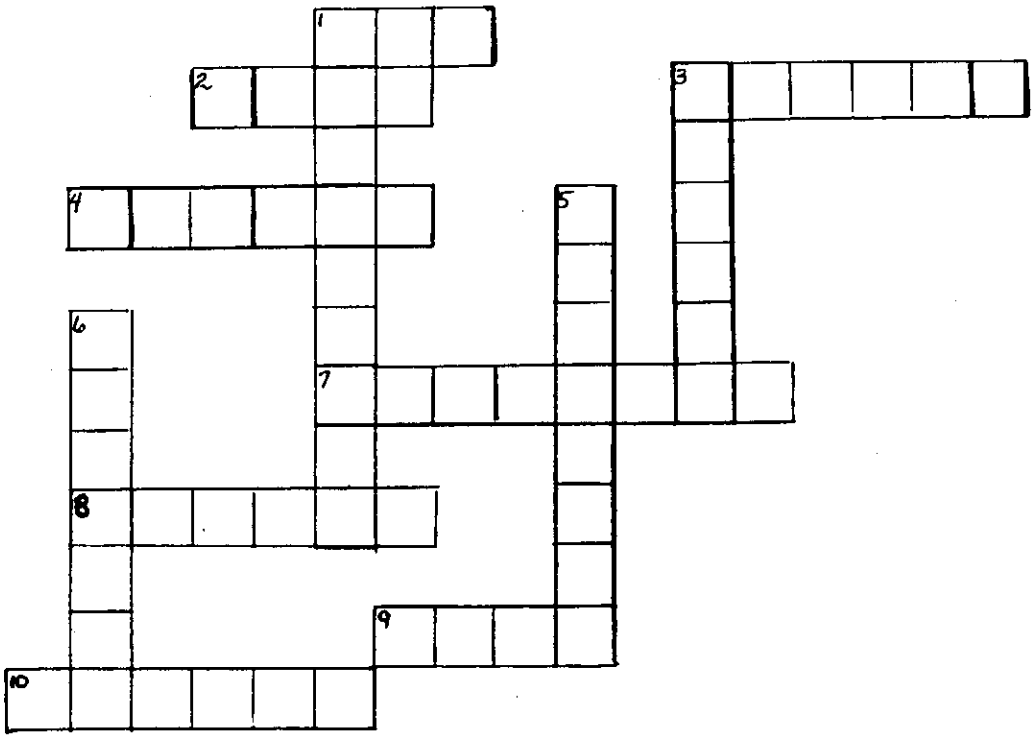
Cinders
Ape Cave
Lava Flow
Volcanic Ash
Crater
Mount St. Helens
Toutle River
Eruption
Lahar
Spirit Lake
Pahoehoe
Blast Zone
Lava Tube
Loo Wit
Volcano
Mount Adams
Devastation

MOUNT ST. HELENS
WORD SCRAMBLE

Directions: Unscramble the words below.

1. RLAAH	1._____
2. OLO TWI	2._____
3. OVNOALC	3._____
4. RCERTA	4._____
5. NEORIUTP	5._____
6. SCRIEND	6._____
7. EAP ECVA	7._____
8. CVIONLAC HAS	8._____
9. ALVA WFOL	9._____
10. EPOAHHEO	10._____
11. TSIPRI ELKA	11._____
12. TMNOU SAMDA	12._____
13. NDOEIVAASTT	13._____
14. TBSLA EZNO	14._____
15. ETLOTU RREIV	15._____

MOUNT ST. HELENS
CROSSWORD



ACROSS

1. Volcanic material that covered the area around Mt. St. Helens in May 18, 1980 eruption.
2. Magma that reaches the earth's surface.
3. The earth's crust is divided into many _____ (Juan de Fuca is one.)
4. The river that flows in the Toutle valley.
7. The mountain range that extends from California North into Oregon, Washington, and British Columbia.
8. The bowl-like hole in the top of a volcano.
9. The feature that built up in the crater of Mt. St. Helens prior to the May 18th eruption.
10. The native American name for Mount St. Helens.

DOWN

1. A large landslide that moves down a mountain.
3. A light weight rock that floats in water.
5. Ape Cave is an example of a _____ _____.
6. A mountain that explodes is called a _____.

PROCEDURE:

1. In this activity, students will prepare a wet mount slide of Mount St. Helens ash. By placing the slide between the polarizing film squares on the eyepiece and stage of a compound microscope, students will be able to see the particles of ash in a variety of colors.

2. Students should work in groups of three. Each student should make a wet mount slide of Mount. St. Helens ash. Using low or medium power, students should first bring the ash particles into focus. Then by carefully turning the eyepiece, students should be able to observe the ash particles changing colors.

3. Students should draw what they see in the microscope on Student Activity Sheet 8-3.

CONCLUSION:

Instructors should bring closure to this activity by asking the following questions:

1. What is the ash made of?
2. What shapes were most of the ash particles in?
3. Why did the ash particles change colors as you turned the eyepiece?
4. What would happen to your lungs if you inhaled a lot of ash particles?

ACTIVITY 8-3: MOUNT ST. HELENS ASH

SCIENCE CONCEPTS/PROCESSES: Observe

SKILLS: Microscope Technique, Drawing

OBJECTIVE(s): After completing the activity, students will be able to:

- prepare a wet mount slide.
- understand the dangers of inhaling volcanic ash after a volcanic eruption.

MATERIALS:	
12 microscopes	slides/coverslips
Mount St. Helens ash	polarizing film
12-8 oz plastic cups	12 medicine droppers

BACKGROUND INFORMATION:

MOUNT ST. HELENS ASH

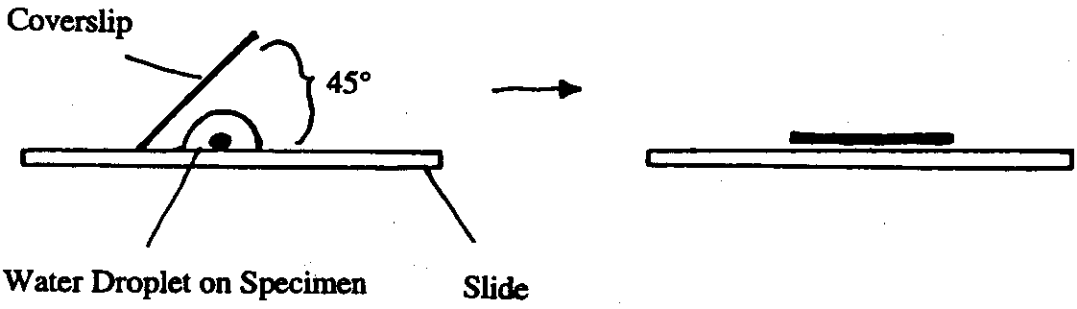
Volcanic ash is made up of fine-grained pyroclastic particles which are less than 2 millimeters in diameter. These fine particles of pulverized rock may be either solid or molten when blasted by an erupted volcano. By far the most common variety of ash is vitric ash which is composed of glassy particles. The temperature and force of the Mt. St. Helen's eruption produced this type of glassy ash particles.

A polarizing microsope allows you to see the different kinds of materials which make up the ash by allowing light in just one plane to pass through the eyepiece. Turning the polarizing filter changes the plane of light reaching your eye.

Mount St. Helens produced an ashfall which circled the globe. Volcanic ash that has fallen through the air from an eruption cloud forms well sorted and layered deposits (heavier/larger particles followed by lighter/smaller particles).

WET MOUNT SLIDE

To prepare a wet mount slide, place the specimen to be examined on a clean slide. If the material is dry, place it directly on the slide and add a drop of water. Then cover the specimen with a coverslip. To avoid trapping air under the coverslip, hold the coverslip at a 45° angle to the slide, and move the coverslip across the slide until it touches the water. Immediately lower the coverslip until it's parallel to the slide surface. Remove trapped air bubbles by gently tapping with a pencil.



Student Activity Sheet 8-3

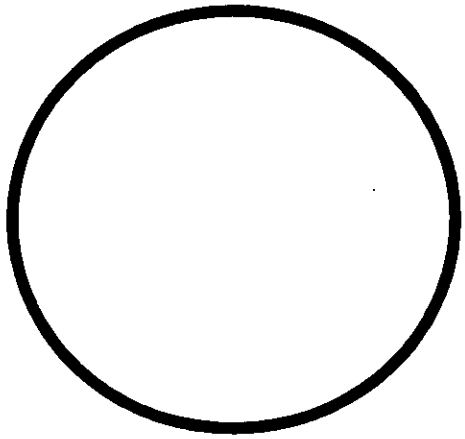
MOUNT ST. HELENS ASH

1. In groups of 3, obtain:
   - 1 cup of water
   - 1 medicine dropper
   - 3 slides
   - 3 coverslips
   - 1 microscope
   - Mount St. Helens ash

2. After your instructor demonstrates how to make a wet mount slide, each student in the group should prepare a wet mount slide of Mount St. Helens ash.

3. Focus on the ash particles using **low** or **medium** power.

4. Draw what you see in the microscope.



5. Describe the most common shape of the ash particles?

6. What do you think the ash is made of?

7. What would happen to your lungs if you inhaled a lot of ash particles?