Cascade Volcano Timeline

Grade Level: 5-8

Learner Objectives:

Students will:

- Recognize that the formation of the Cascade Range is a relatively recent event compared to other events in Earth's history
- Understand that frequent eruptions over the past 200 years are evidence of a continuously active volcanic environment
- Understand volcanic events within an historical context

Setting: Classroom, hallway, or large open field

Timeframe: Two class sessions (80 minutes)

Touchdown to Geologic Time –15 minutes

Introducing a Timeline of Eruptions in the Cascades –15 minutes

Assembling the Timeline of Historical And Volcanic Events–40 minutes

Adding Human Genealogy to the Timeline–10 minutes

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

Cascade volcanoes are young in relation to other geologic events that have shaped the Earth. In this activity, timelines and a hypothetical genealogy illustrate the high incidence of eruptive activity when compared to other geologic and human events.

Teacher Background

Geologic processes transform the Pacific Northwest

The Pacific Northwest began taking shape one hundred million years ago, when dinosaurs roamed the earth and oceans covered all but the eastern margins of present-day Washington and Oregon. Then, as today, the continent of North America was gradually sliding westward. In doing so, it met face to face with several small continents. These small landmasses collided with North America in a series of slow-motion crashes, each event piling rocks against the continent's western edge. These repeated bump-and-dump episodes enlarged North America.

Today's Cascade Volcanoes are the current manifestation of volcanism in the Pacific Northwest

The first episode of Cascades volcanism began about forty million years ago, when ancient volcanoes punched through shallow ocean waters. Volcanoes erupted continuously during this period, assembling layers of volcanic rock several kilometers thick. Twenty million years of tectonic plate motion and volcanism eventually raised these ancient rocks to form the backbone of the Cascade Range. By ten million

Materials:

Touchdown to Geologic Time

- Graphic *"Touchdown to Geologic Time"*
- Copies of *"List of Geologic Events"* student page
- Calculators (optional)
- Pencil

Introducing a Timeline of Eruptions in the Cascades

- Copies of student page *"Eruptions in the Cascades"*
- Graphic *"Cascade Eruptions During the Past 4,000 Years"*

Assembling the "Declaration of Independence to Today" Timeline

Each student or group will need:

- Copies of *"Historical And Volcanic Events"* student page
- String
- Tape measure, meter stick, or ruler
- Masking tape, clothes pins, or binder clips
- Colored tape or colored clips (optional)
- Markers
- Copies of *"Historical And Volcanic Events"* cards

Adding Human Genealogy to the Timeline

- Copies of *"Eruptions through the Generations"* student page

Vocabulary: Eruption, eruptive period, volcanic ash

Skills: Calculating, measuring, recording, graphing

years ago, these ancestral mountains had eroded significantly, forming the foundation of current Cascade volcanoes. About two million years ago ***eruptions*** began construction of the ancestral cones in the vicinity of the present Cascade volcanoes. Mount Rainier's current volcanic cone began building around 500,000 years ago. Other volcanic edifices are much younger: Mount Baker began forming less than 30,000 years ago and most of the present cone of Mount St. Helens began forming only 4,000 years ago.

Today's cascade volcanoes are young

Cascade volcanoes may seem ancient, but their 40 million year history is a small percentage of Earth's history. Thus, geologists consider the Cascade Mountains rather young. Consider the weathered and eroded Appalachian Mountains that are 250 million years old; the eighty-million-year-old Sierra Nevada; and the seventy–million–year–old Rocky Mountains.

Cascade volcanoes–active during the past 200 Years

More than a dozen active or potentially active volcanoes crown the Cascade Range. Since the signing of the Declaration of Independence in 1776, at least seven Cascade volcanoes have erupted. The frequency of eruptions varies with each volcano. Volcanoes can sleep for several human generations before reawakening and erupting, or they may erupt several times within a few years as part of an ***eruptive period*** (a period of time, often lasting decades or more, when multiple eruptions occur). On average, a volcano will erupt in the Cascade Range once or twice per century. Lassen Peak in California (1914–1917) and Mount St. Helens in Washington (1980-1986, and at this writing in 2004–2008) erupted most recently. During recent millennia,

Benchmarks:

Please see the Mount Rainier National Park Education Program website for the most recent alignment of these activities with Washington State and nationally approved education standards.

http://www.nps.gov/mora/forteachers/curriculummaterials.htm

Mount St. Helens has erupted more often than any other Cascade volcano. Mount Rainier last erupted as a series of ash and steam blasts in 1894-1895. The frequency and recentness of eruptions illustrates that the Cascades are an active volcanic range. They are capable of erupting again, even within our lifetimes.

Stories about volcanic eruptions improve and skew our record of eruptions

Erosion or burial destroyed physical evidence of many eruptions, but accounts remembered or recorded by Native Americans and American settlers improve the eruption record. These accounts are fascinating, but can skew the chronological record by suggesting more eruptive activity during human occupation than throughout earlier millennia.

Teacher Tips

For more information on human history and volcanoes, see activities Fire, Flood, and Fury *and* Nineteenth Century News.

Procedure

What to do Before Class Begins:

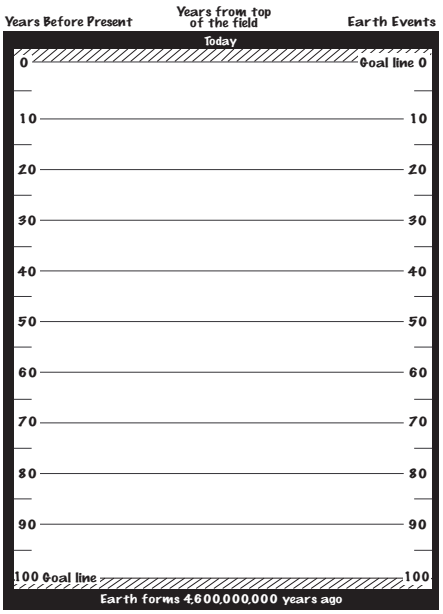
1. Make preparations for display of graphic ***"Touchdown to Geologic Time"*** and ***"Cascade Eruptions during the Past 4,000 Years."***

2. Make multiple copies of the blank cards for ***"Eruptions in the Cascades."***
   For each group, you will need 32 copies of the volcano event cards, and 25 historical event cards, that is, one for each volcanic and historical event listed on the ***"Historical And Volcanic Events"*** student page (note that there are two cards per page.) Instruct students to add volcanic and historical events on the blank cards or fill in the dates and events yourself, prior to class. Use the list on student page ***"Historical And Volcanic Events."*** You may wish to add some more recent cultural events as well.

3. Determine the space for the ***"Historical And Volcanic Events"*** timeline (see Procedure). Construct your timeline indoors or outdoors by taping string to a wall, or other object, such as wooden stakes in a field.

4. Measure the length of string intended to represent the timeline. Display the string in the location chosen for the lesson. If you have time before class, label the decades using tape or colored markers.

Touchdown to Geologic Time



Use the visual representation of a football field to demonstrate the recentness of eruptions in the Cascade Range in relation to other geologic events on Earth.

1. Explain that geologic time covers billions of years versus the measurement of human time. Geologically, the reign of dinosaurs and certainly the development of Cascade volcanoes are relatively recent events.

2. Distribute ***"Touchdown to Geologic Time"*** and ***"Some Significant Earth Events"*** student pages. Display the ***"Touchdown to Geologic Time"*** graphic overhead. Introduce the concept that the bottom goal line of the football field of geologic time represents the formation of Earth (4.6 billion years ago); the top goal line represents today. As a class, calculate the scale for the football field entitled ***"Touchdown to Geologic Time"***

Calculate Time Scale for *"Touchdown to Geologic Time"*

Years per yard = 4,600,000,000 years / Length of Football Field (100 yards)

Each yard represents 460,000,000 years; that is, the 10–yard line below the "present-day" end zone represents 460,000,000 years ago; the 20–yard-line represents 2*0.46=0.92 billion years ago, etc. On the left side of the football field, write the geologic time represented by each of the 10–yard–lines from the present day back to the formation of the Earth.

3. Students work individually or as a class to find the position of each geologic event on the football field entitled ***"Touchdown to Geologic Time."*** They can estimate location by ages calculated in instruction 2 above, or calculate positions precisely with the equation below.

Calculate Distance for Geologic events from Top of the ***"Touchdown to Geologic Time"***
Distance from top of football field = (100 yards)* (age in years ago)/(4,600,000,000 years)

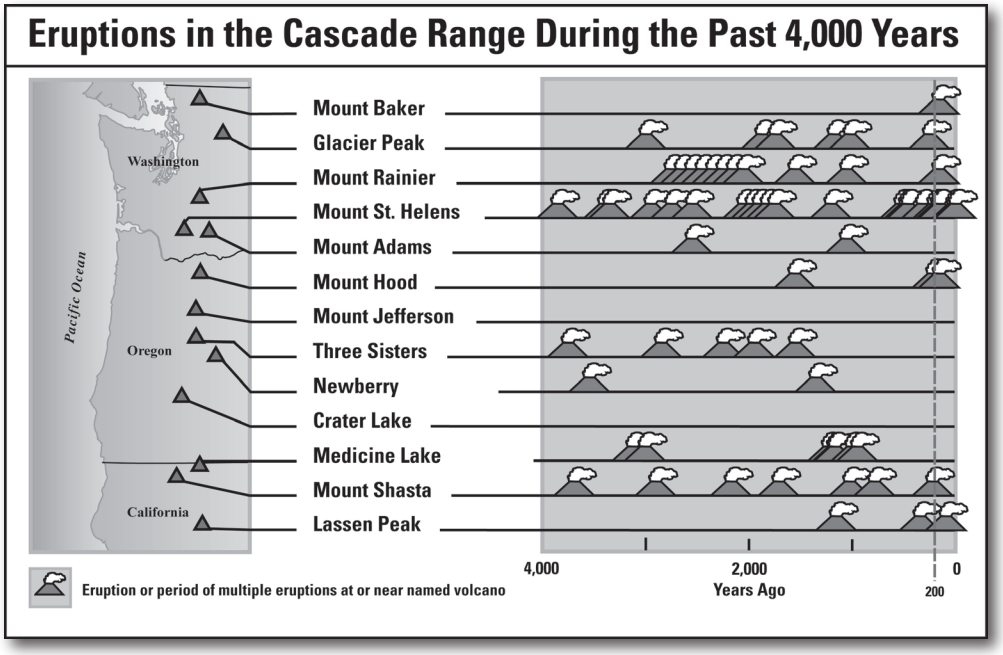
4. Plot each event on the graphic ***"Touchdown to Geologic Time."*** After all the events are marked, look at the timeline holistically. Ask students to consider the following questions. Did the geology of the earth change quickly or slowly? Is it easy or difficult to relate geologic events on the scale of human time? When did the majority of activity in the Cascade Range take place? What geologic events happened since the earliest humans inhabited the Earth? Emphasize that the 10,000 years of human history is but a small slice of the ***"Touchdown to Geologic Time "*** football field.

Introducing a Timeline of Eruptions in the Cascades

Use the worksheet to introduce students to the frequency of eruptions in the Cascades during the past 4,000 years.

1. Display the graphic ***"Cascade Eruptions during the Past 4,000 Years."*** Explain that each puffing volcano represents an eruptive period. The vertical dashed line represents 200 years ago, close to the time the Declaration of Independence was signed (1776).

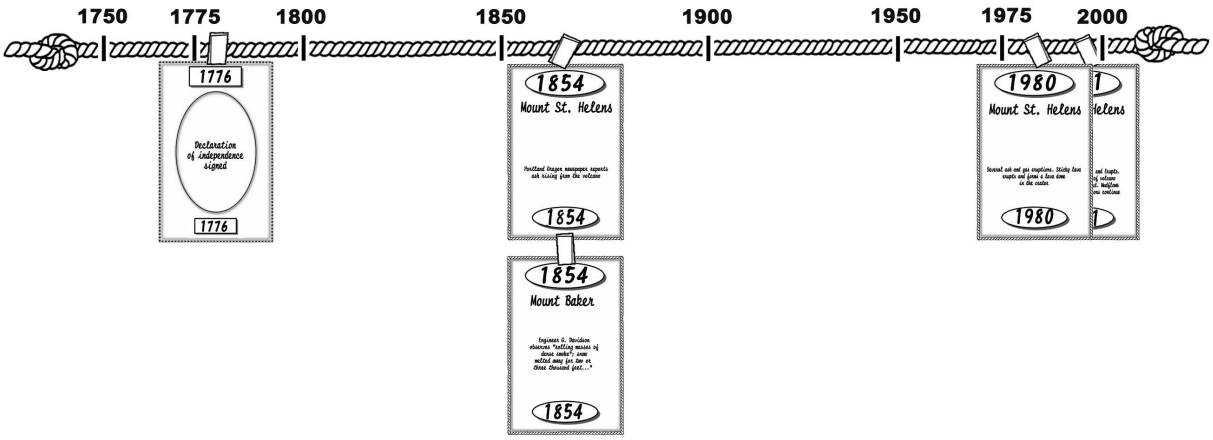
2. Answer the questions on the student page ***"Eruptions in the Cascades"*** individually or as a class.



Assembling the Timeline "Historical and Volcanic Events"

Illustrate the youthful and highly active nature of the volcanoes in the Cascade Range by constructing a timeline showing both human and volcanic events since the signing of the Declaration of Independence.

Explain to students that you are going to focus on some of the most recent events since the formation of the Earth. Students will develop a class timeline of historical events and Cascade eruptions that have occurred since the signing of the Declaration of Independence.



1. Measure and display a length of string (25, 50 or 100 feet) on the classroom wall or hallway. Label one end of the string with the date 1776 and label the other end with today's date.

2. With the students calculate the scale to be used on the timeline.
   Unit of Measure (i.e., 1 cm or 1 inch) = $\frac{\text{\# of years represented}}{\text{Length of Timeline (String)}}$

   To make it easier to find each year, use colored tape or colored clips to divide the timeline into decades and label them appropriately.

3. Provide each student with a copy of the student page ***"Historical and Volcanic Events,"*** and several blank volcanic and blank historic event cards. Divide the events on the list among activity on the cards. Students then place their cards on the timeline using tape, clothespins or binder clips.

4. After you have attached all cards to the timeline, discuss any observations about volcanic activity in the Pacific Northwest over the last 200 years. Which volcanoes were most active? Are all eruptions the same type? What types of volcanic eruptions have occurred over the last 200 years? Does each volcano have a set time or frequency of eruptions? Which volcano may show evidence today of an eruption in the past? Which years had both a significant historical event and a volcanic eruption? Point out to students that some cards represent single events with which we are acquainted, while others show eruptive periods when the volcano erupted on an unknown number of occasions.

Adding Human Genealogy to the Timeline

Compare human life spans to the frequency of eruptions in the Cascades by making a timeline representing five generations of Christina's family (a person the same age as the student).

1. Hand out an ***"Eruptions through the Generations"*** student page to each student.

2. Referring to the timeline ***"Historical and Volcanic Events,"*** instruct students to answer the questions on the ***"Eruptions through the Generations"*** student page.

3. Discuss the questions as a class emphasizing the frequency of eruptions in the Cascade Range.

Your School's Volcano Museum

Choose any or all of the above procedures for your students. After completion, display students' projects in a "school volcano museum" for viewing by other students and their families. Your museum can include emergency preparedness information and student projects from other activities, such as **A String of Volcanoes**, **Play-Dough Topo**, **Planning your Trip to Mount Rainier National Park!**, and **The Next Eruption of Mount Rainier**, and **Living Well with a Volcano in your Backyard**.

Adaptations

- For younger students, use fewer points on the timeline.
- People sometimes liken the Cascade volcanoes to humans, each with a distinctive personality. Some volcanoes erupt explosively; others erupt with less fanfare. Research other volcanoes using materials cited in the References. Instruct students to write a report comparing volcano "personalities."
- Students use library and Internet research to research and write a report about one historic natural event–volcano, earthquake, flood, hurricane, wildfire, etc.
- For older students, assign a fact–finding mission using the Internet or library resources to find additional information on volcanic events in the Pacific Northwest.
- Construct a geologic timeline on rolled paper–like that used on adding machines or cash registers.
- Instruct students to find new and creative ways to graph timeline data.
- Use sidewalk chalk to draw timelines on the playground or school sidewalk.

Extensions

- ***Make a Timeline of Your Family.*** Interview people in your family about their memories of geologic events (i.e., volcanic eruptions, earthquakes, large floods).
- ***Add Events from Other Disciplines.*** Add important historical events from other disciplines to your timeline–Social Studies, English, and Music.
- ***Add the History of Mount Rainier National Park to Your Timeline.*** Students research historical events in the history of Mount Rainier National Park. Use the Mount Rainier National Park website for historical dates and information.
- ***Make Timeline cards "permanent."*** Laminate the timeline cards for repeated use.
- ***Make a Tree Ring Timeline.*** Draw a picture of tree rings in a stump. Every tree ring equals one year. Mark important geologic and historic events during the growth of the tree by counting the tree rings.
- ***Age of the Earth Timeline Calculation.*** Instruct students to use the lengths of the "Historical Cascade Volcano Events" timeline to calculate the length of string needed to make a timeline that extends back to the formation of the earth (4.6 billion years ago).

Assessment

Cascade Volcano Timeline addresses the temporal aspect of eruptions in the Cascades, while **Surrounded by Volcanoes** addresses the spatial aspect. Use student pages to assess how students' knowledge of geologic time has grown over the course of this activity. Compare results to verbal predictions made at beginning of ***"Touchdown to Geologic Time."*** Identify their misperceptions. Do students express an improved understanding of the recentness of volcanic activity at Cascade volcanoes? Use student page ***"Touchdown to Geologic Time"*** to assess students' grasp of the recentness of the formation of Cascade volcanoes in geologic time, and student page ***"Timeline of Eruptions in the Cascades"*** to assess recognition that Cascade volcanoes have erupted frequently and recently during the past 4,000 years. Use ***"Eruptions Through the Generations"*** to assess students' skills at adapting this to a hypothetical family. Assess their knowledge of historical context of eruption events by observing students' ability to add historical events to the ***"Historical and Volcanic Events."*** Is this process difficult for them? If the timeline remains on display in the classroom throughout the school year, how readily can students add historical events as they learn about them? Do students speak of volcanic activity in the Cascades as a process of the past only, or as a process for the present and future as well?

References

Clynne, M.A., Christiansen, R.L., Felger, T.J., Stauffer, P.H., and Hendley II, J.W., 1999, Eruptions of Lassen Peak, California, 1914 to 1017: U.S. Geological Survey Fact Sheet 173–98, 2p

Clynne, M.A., Ramsey, D.W., and Wolfe, E.W., 2005, Pre-1980 eruptive history of Mount St. Helens, Washington: U.S. Geological Survey Fact Sheet 2005–784–544, 4p.

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Dzurisin, D., Stauffer, P., and Hendley, J., 2003, Living with volcanic risk in the Cascades (revised March, 2008): U.S. Geological Survey Fact Sheet 165-97, 2p.

Gardner, C.A., Scott, W.E., Major, J.J. and Pierson T.C., 2000, Mount Hood–history and hazards of Oregon's most recently active volcano: U.S. Geological Survey Fact Sheet 060-00, 4p.

Harris, S.L., 2005, Fire mountains of the West: the Cascade and Mono Lake Volcanoes: Mountain Press Publishing Company, 3rd edition, 454 p.

Major, J.J., Scott,W.E., Driedger, C.L., and Dzurisin, D., 2005, Mount St. Helens erupts again–activity from September 2004 through March 2005: U.S. Geological Survey Fact Sheet 2005-3036, 4p.

Myers, B., Brantley, S.R., Stauffer, P.H., and Hendley, J.W., 1997, What are volcano hazards? (revised March 2008): U.S. Geological Survey Fact Sheet 002-97, 2p.

Myers, B. and Driedger, C., 2008, Eruptions in the Cascade Range during the past 4,000 years: U.S. Geological Survey General Information Product 63, poster.

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

Some Significant Earth Events

Geologic Event	Years Ago Event Occurred
A. Earth is formed	4,560,000,000
B. Oldest known fossil of bacteria	3,250,000,000
C. Oldest known hard-shelled fossil	543,000,000
D. Oldest known plant fossil	470,000,000
E. Ancestral Appalachian Mountains are formed	250,000,000
F. Oldest known dinosaur fossil	228,000,000
G. Rocky Mountains formed	70,000,000
H. Dinosaurs become extinct	65,000,000
I. Ancestral Cascade volcanoes are formed	40,000,000
J. Uplift begins–Cascades, Coast Range, Olympics	10,000,000
K. Oldest fossil finds of Homo sapiens	100,000
L. First evidence of hunter-gatherers at Mount Rainier	8,500

Math Work Here:

Student Page

Name _____

Touchdown to Geologic Time

Years Before Present	Years from top of the field	Earth Events
	Today	
0	Goal line	0
10		10
20		20
30		30
40		40
50		50
60		60
70		70
80		80
90		90
100	Goal line	100
	Earth forms 4,600,000,000 years ago	

Teacher Page

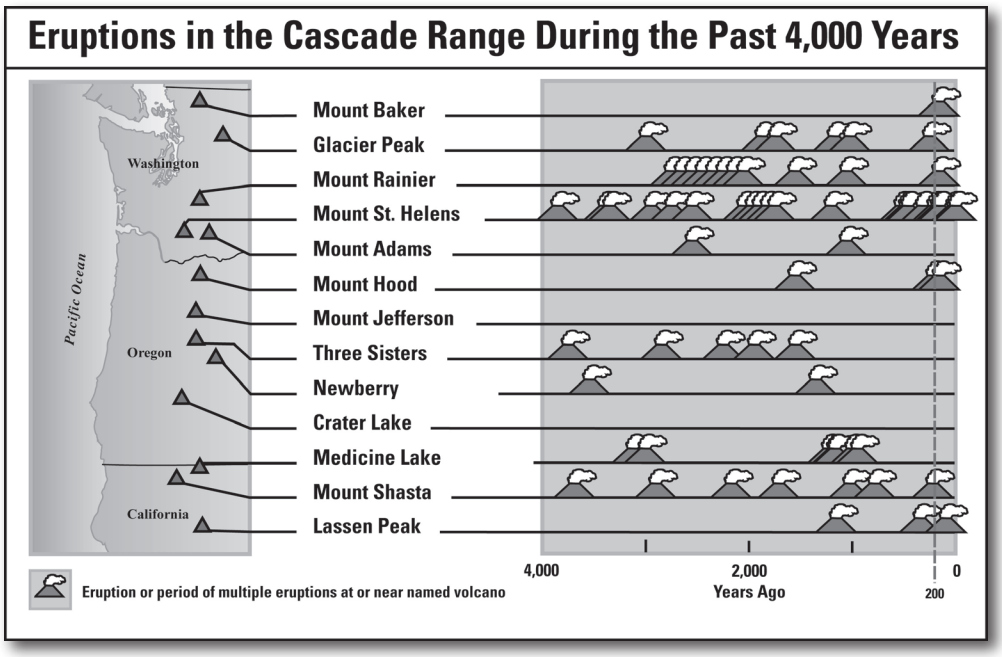
Touchdown to Geologic Time

Years Before Present	Years from top of the field	Earth Events
Today		
0		Goal line 0
	I J K L H 65,000,000	Dinosaurs extinct
	G 70,000,000	Rocky Mountains formed
	F 228,000,000	Oldest known dinosaur fossil
	E 250,000,000	Ancestral Appalachians formed
10		10
	D 470,000,000	Oldest known plant fossil
	C 543,000,000	Oldest known hard-shelled fossil
20		20
	L 8,500	Evidence of hunter-gatherers.
	K 100,000	Oldest Fossil finds-Homo Sapiens
	J 10,000,000	Uplift begins-Cascades, Coast Range, Olympics
	I 40,000,000	Ancestral Cascade Volcanoes formed
30		30
40		40
50		50
60		60
70		70
	B 3,250,000,000	Oldest known bacteria fossil
80		80
90		90
100 Goal line	A 4,600,000,000	Earth is formed 100
Earth forms 4,600,000,000 years ago		

Name _____

Eruptions in The Cascades

The diagram below shows how often each volcano in the Cascade Range has erupted over the last four thousand years. Each puffing volcano illustrates an ***eruptive period****–a time when the volcano had several lava or ash eruptions over a short period (days, months, or years). Use the diagram to answer the questions.*



1. Which volcanoes erupted during the past 200 years?

2. What does the diagram suggest about the likelihood of future volcanic activity in the Cascades?

3. Based on the eruptive history represented by the timeline, which volcano do you think is most likely to erupt next? Explain your answer.

Eruptions in the Cascades - Answer Sheet

1. Which volcanoes have had eruptions in the last 200 years?
   Mount Baker, Glacier Peak, Mount Rainier, Mount St. Helens, Mount Hood, Mount Shasta, Lassen Peak

2. What does the diagram suggest about the likelihood of future volcanic activity in the Cascades?
   The Cascade volcanoes erupted recently in geologic time and can erupt again.

3. Based on the eruptive history represented by the timeline, which volcano do you think is most likely to erupt next? Explain your answer. Many students might answer with ***Mount St. Helens, because it has erupted more frequently and more recently than other volcanoes in the Cascades. Many scientists contend that there are equally compelling reasons for other volcanoes to erupt next.***

Student Page

Historical and Volcanic Events

Instructions: *Use information on the list to construct cards for your timeline.*

Volcanic Events

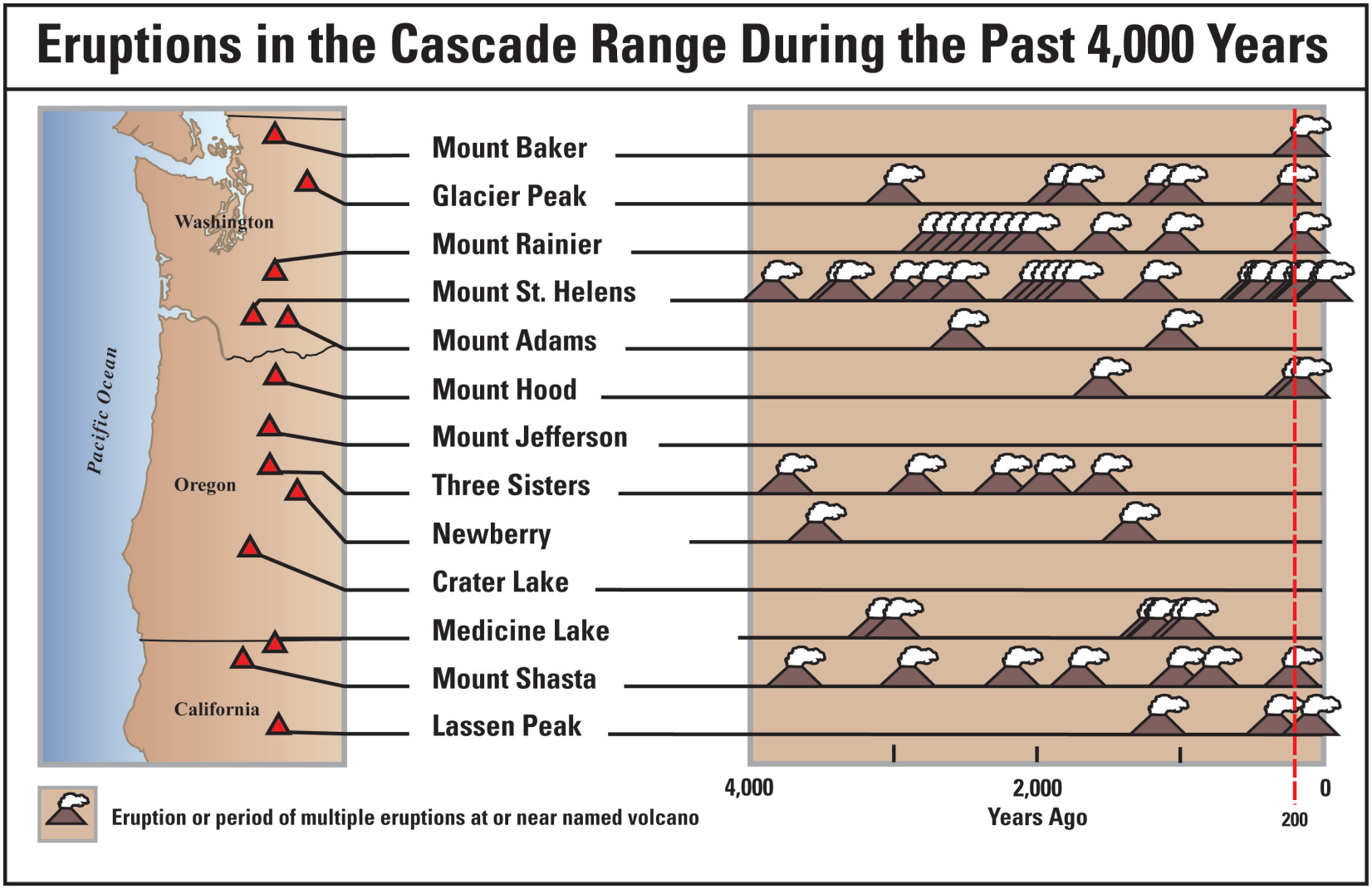
2004 to 2008 – Mount St. Helens lava-dome and steam and ash eruptions
1997 to present – Three Sisters volcanoes uplift
1989 – 1991 – Mount St. Helens steam and ash eruptions
1981 – 1986 – Mount St. Helens ash eruptions; lava dome continues to grow
1980 – Mount St. Helens A powerful landslide and blast, lahars, many steam and ash eruptions
1975 – Mount Baker thermal activity, steaming
1921 – Mount St. Helens steam eruptions reported
1914 – 1917 – Lassen Peak a powerful pyroclastic flow, lahars, multiple eruptions of ash and steam
1907 – Mount Hood reports of steam, ash, and glowing rocks
1903 – Mount St. Helens minor steam explosion
1898 – Mount St. Helens possible steam explosion
1894-95 – Mount Rainier steam and ash explosions
1880 – Mount Baker reports of ash eruption
1873 – Mount Rainier ash and steam explosions
1865 – Mount Hood steam and ash eruption
1859 – Mount Hood steam and ash eruption
1858 – 1860 Mount Baker reports of ash eruptions and lahars
1857 – Mount St. Helens ash and lava-dome eruption, lahars
1854 – Mount St. Helens ash eruption
1854 – Mount Baker report of an eruption
1854 – Mount Rainier reports of an eruption of steam and water
1847 – Mount St. Helens eruption on NW side of volcano noted by fur traders at Fort Vancouver
1843 – Mount Baker Native Americans note that ash eruption caused forest fires; landslides, lahars killed fish
1841 – 1843 – Mount Rainier reports of eruptions
1840 – 1845 – Mount St. Helens numerous ash eruptions and lahars; growth of lava dome
1835 – Mount St. Helens ash eruptions
1831 – Mount St. Helens ash eruptions
1820 – 1850 – Mount Rainier reports of small eruptions
1800 – 1801 – Mount St. Helens A series of lava flow and ash eruptions begins
1786 – Mount Shasta reports of ash eruption
1781 – Mount Hood eruptions of ash, lahars
1700's – Glacier Peak Native Americans report minor eruptions

Historical Events

Make some additional cards noting events that are significant to your students and your community.

2005 – Cassini-Huygens spacecraft reaches Saturn's moon Titan
1997 – Cassini-Huygens spacecraft launched
1990 – Internet language HTML invented
1987 – First 3D video games invented
1979 – Cell phones and roller blades invented
1972 – Video games and email invented
1969 – Man first walks on the moon
1945 – World War II ends
1936 – Bonneville Dam completed
1929 – Great Depression begins
1920 – First radio broadcast in Washington State
1910 – Washington women win right to vote
1903 – Wright Brothers' first powered flight
1899 – Mount Rainier National Park established
1889 – Washington enters statehood
1861 – American Civil War begins
1859 – Oregon enters statehood
1854 – Medicine Lake Treaty signed with Nisqually and Puyallup Indian tribes
1850 – California enters statehood
1843 – Migration begins on Oregon Trail
1832 – First school in Washington
1824 – Fort Vancouver founded by the Hudson's Bay Company
1805 – 1806 – Lewis and Clark view several Cascade volcanoes; name Mount Jefferson
1792 – Captain George Vancouver explores the Pacific Northwest; names Mounts Baker, Rainier, St. Helens and Hood
1776 – Declaration of Independence signed

Cascade Eruptions During the Past 4,000 years

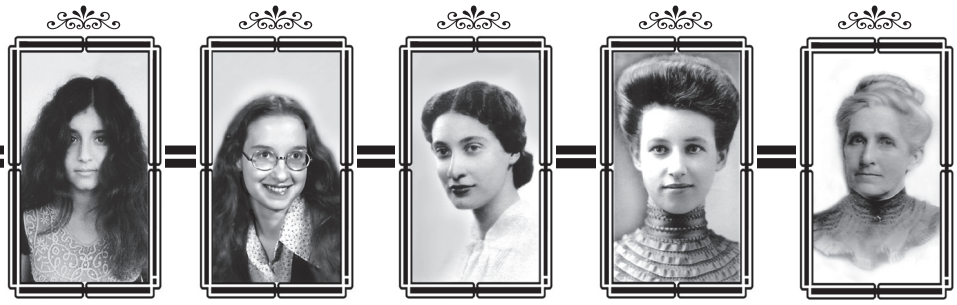


Volcanic Event Cards

Historical Event Cards

Name _____

Eruptions through the Generations



	Christina	Christina's Mother	Christina's Grandmother	Christina's Great Grandmother	Christina's Great-Great-Grandmother
BORN	Your Birth Year	1970	1940	1910	1890
DIED				1985	1950

Instructions: *Use your timeline to answer the following questions.*

1. Which Cascade volcano erupted during the lifetime of Christina's mother?

2. Which Cascade volcanoes displayed some activity while Christina's grandmother was alive?

3. Who in Christina's family might have seen Lassen Peak erupt?

4. Which Cascade volcanoes erupted during the lifetime of Christina's great-great-grandmother?

5. Based on the experiences of Christina's family, how many generations could have experienced some volcano-related activity in the Cascades?

Eruptions through the Generations - Answer Sheet

1. Which Cascade volcano erupted during the lifetime of Christina's mother?
   Mount St. Helens in 1980

2. Which Cascade volcanoes displayed some activity while Christina's grandmother was alive?
   Mount St. Helens, Three Sisters, and Mount Baker

3. Who in Christina's family might have seen Lassen Peak erupt?
   Christina's great Grandmother

4. Which Cascade volcanoes erupted during the lifetime of Christina's great-great-grandmother?
   Lassen Peak (1914-17), Mount Rainier (1894), and according to oral reports, Mount Hood (1907) and Mount Baker (1880, 1850-1860)

5. Based on the experiences of Christina's family, how many generations could have experienced some volcano-related activity in the Cascades?
   All five generations