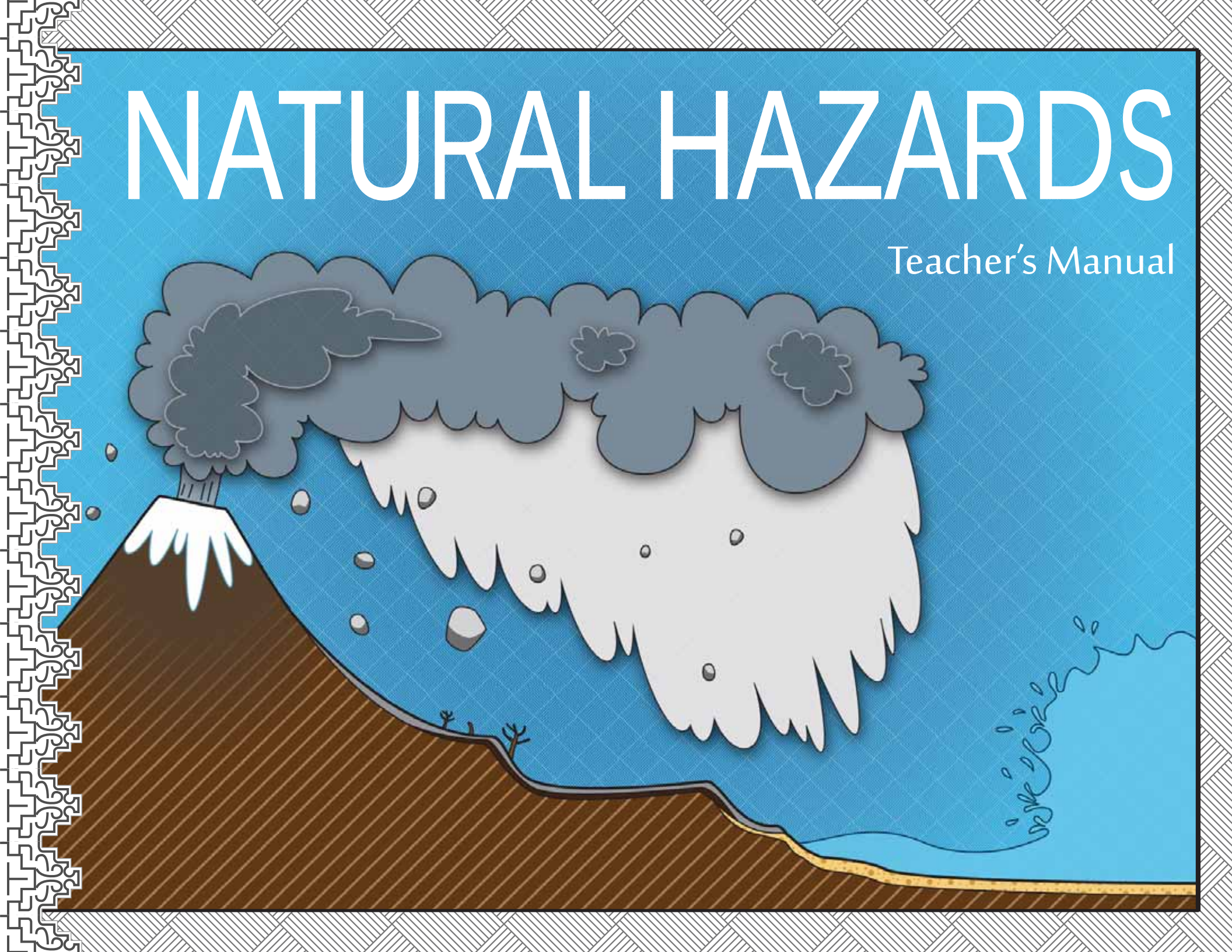
# NATURAL HAZARDS

## Teacher's Manual



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## Subjects:
Earth Sciences

## Duration:
Two class periods

## Class size:
10 - 30 students

**Note**

Approximately a week before this lesson, ask students to discuss the common natural hazards in Washington State with their family members, neighbors ,or other adults in their life. They should specifically ask for stories, photos, or information about events that people experienced. They should also write a report (half-page long) about these interviews to turn in on the day when oral and written records of natural disasters are discussed.

# Summary

## Overview:

Humans primarily care about natural hazards when events affect individuals by destroying or disturbing habitation, livelihoods, food resources, and daily activities. Natural hazards contribute to difficulties encountered in surviving in the remote, harsh landscapes of the Kurils. This module teaches students to understand how environment (with a focus on natural hazards) contributes to daily life, human activities, and cultural decision-making. It builds on the foundation students get in the Tsanami and Stratigraphy module, as well as geology classes which provide material on natural hazards, but allows the class to focus more on how people cope with the natural hazards and pass on information about them.

Students will be introduced to the natural hazards that occur in the Kuril Islands, including volcanic eruptions, earthquakes, tsunamis, and landslides, including how and why these events occur. Students will learn to assess hazard potential and relate this to where/how one would want to live. Students will practice communication skills, including distilling and relaying complicated information.

## Objectives:

- Students will learn to assess hazard potential and relate it to where/how one lives or wants to live.
- Students will practice distilling complicated information, effectively conveying it to their classmates, and discussing decision-making.
- Students will consider the difference between oral and written histories.
- Students will practice reading and interpreting maps.

## Material Included in the Box:

- PowerPoint presentation for introduction
- Hand-outs with maps for each team of where they "live" and surrounding landscape, as well as information about each site
- Maps and questions related to natural hazards of Washington State

# Vocabulary

**Lahar:**
A mudflow or debris flow that starts on a volcano. Lahars can travel up to 95 kph and are very destructive.

**Oral history:**
Stories passed from one generation to the next through verbal communication

**Resilience:**
The ability of a person or community to recover readily from adversity such as a natural hazard

**Seal and sea lion haul-outs:**
Rocky outcrops and beaches where seals and sea lions come out of the water and are easy to hunt

**Tsunami:**
A wave generated by an impulse such as an earthquake, landslide, underwater volcanic eruption, or meteor impact

**Volcano:**
An opening in the earth's surface through which lava and gasses from below the earth's surface escape.

**Written history:**
Stories passed from one generation to the next through written communication

# Background Information

The Kuril Islands are one of the most geologically hazardous places to live in the world. Active volcanoes erupt many times in a single lifetime, large earthquakes and tsunamis occur ever few generations, and other natural hazards, such as flooding, lahars, and large storms, also are common. One of the goals of the Kuril Biocomplexity Project is to understand how people living in the Kuril Islands responded to catastrophic events, and how human interactions could reduce the vulnerability of the island population.

Today, many natural hazards (but not all) are continuously monitored by government agencies around the world using seismometers, Global Positioning Systems, many types of satellites, and oceanographic buoys. Volcanologists monitor volcanoes to see if they are becoming more active while seismologists and oceanographers can immediately register on seismometers when an earthquake has occurred and use buoys around the ocean to determine if a tsunami was generated. See the list of websites below to learn more about recent events and see if there are any active volcanic or tsunami warnings.

Before the technological innovations of the 20th and 21st centuries, monitoring of natural hazards was not easy. Written records, especially historical archives, provided some estimates of how frequently a nearby volcano might erupt, how often earthquakes or tsunamis occurred, and how large those events were.

In the absence of written records, such as was the case in the Kuril Islands for thousands of years, the only means of knowing the hazards of a region is through the oral exchange of knowledge. Children can be taught to read the signs of increasing activity of a volcano, and can be told through stories what happened during past eruptions. Large earthquakes can be followed by big tsunamis, so children can be taught to vacate the beach. Oral traditions are a means of protecting settlements, especially in the situations where the recurrence of events spans more than one generation. Often myths and legends can contain a kernel of truth on how to survive natural hazards. In our techno-savy culture, this can be a hard idea to grasp— that ancestors we never met could instruct us how to survive (or what to expect) in a natural disaster through a story that our parents and grandparents repeated.

## U.S. websites for monitoring volcanoes, earthquakes and tsunamis:

Smithsonian and USGS Global Volcanism Program - Weekly Volcanic Activity Report
http://www.volcano.si.edu/reports/usgs/

USGS - U.S. Volcanoes and Current Activity Alerts
http://volcanoes.usgs.gov/

USGS - Cascade Volcano Observatory Weekly Update
http://volcanoes.usgs.gov/cvo/current_updates.php

USGS - Latest Earthquakes in the World
http://earthquake.usgs.gov/earthquakes/recenteqsww/Quakes/quakes_all.php

NOAA - Pacific Tsunami Warning Center
http://ptwc.weather.gov/

NOAA - West Coast/Alaska Tsunami Warning Center
http://wcatwc.arh.noaa.gov/

USGS booklet -
"Surviving a Tsunami - Lessons from Chile, Hawaii, and Japan"
http://pubs.usgs.gov/circ/c1187/

## Lesson Activity 1: Students learn how decisions about settlement placement would have made by prehistoric inhabitants of the Kuril Islands.

**Note**

Approximately a week before this lesson, ask students to discuss the common natural hazards in Washington State with their family members, neighbors, or other adults in their life. They should specifically ask for stories, photos, or information about events that people experienced. They should also write a report (half-page long) about these interviews to turn in on the day when oral and written records of natural disasters are discussed

### Warm Up:

Ask students to imagine life in the Kuril Islands 1,000 years ago. Tell them they will get food on the island by hunting, gathering, and fishing. Have students make a list of 5-10 things they need around their settlement and 5-10 things they would not want on the island. Think about landscape features and desirable resources. Do not list items that you could bring with you or build such as dwellings or tools.

• Ideas for want: Food resources: fish, game, berries, wood or stone for building, animals or plants to make clothing, favorable weather, proximity to other islands (not isolated), nice beaches for landing boats, protected harbors, fresh water for drinking

• Ideas for unwanted things: Natural hazards (tsunamis, earthquakes, tornadoes, landslides, etc.), predatory animals, bad weather, angry neighbors

### Procedure:

1. Use the slideshow included to review the following natural hazards:
    a. volcanic eruptions
    b. earthquakes
    c. tsunamis
    d. other hazards, such as flooding, lahars, storms, etc.
2. Break the class into small groups of 2-3 students, and assign each group an island by handing out one of the laminated island maps. Ask students to discuss their village location on the island. Do they have everything on the list they made in the warm-up? Do they have things from their undesirables list (hazards, for example)?
3. Because of population growth all villages have to send a group to live in another location (i.e. there are now too many people in every location to live comfortably and not run out of their available resources). Have each group pick an explorer who will set out to interview other groups about the resources and hazards on other islands (the explorer should take detailed notes).
4. Explorers return to the group and relay the information to their fellow citizens. Together the group, after a discussion, makes a decision where to create a new settlement. Ask students to be respectful to each other as they discuss options and opinions.

### Conclusion:

Come back together as a class and discuss what students chose as their new homes. What are the most frequent natural hazard events? The least frequent? Did anyone pick the same location? Discuss how they could negotiate living there together (peacefully, by sharing, or by protecting resources from intruders?).

## Lesson Activity 2: Natural Hazards of the Home State

In this activity students will discuss the natural hazards hazards of Washington State or another home state (this material is prepared for Washington State; teachers may modify if they are not in Washington).

### NOTE:

Approximately a week before this lesson, ask students to discuss the common natural hazards in Washington State with their family members, neighbors, or other adults in their life. They should specifically ask for stories, photos, or information about events that people experienced. They should also write a report (half-page long) about these interviews to turn in on this day.

### Warm Up:

Review material from the previous day. Collect half-page write-ups from the interviews that students conducted in preparation. Read the Legend of the Trout and discuss what its cultural significance would be.

### Procedure:

Have students get into groups and answer the worksheet questions, using the information they gathered from family members or neighbors. Come back as a class and discuss the answers. Ask students what their family members and neighbors remembered about the events, what they did to prepare for them, how and how long were they affected? What were the impacts to individuals, towns, cities, states? What was the process of recovery like?

### Conclusion:

Ask the students to compare and contrast the hazards in the Kuril Islands and those in Washington State. Compare how much impact these hazards can have on small groups of hunter-gatherers and on the large cities. Discuss what individuals should do in an event of earthquake, tsunami, volcanic eruption.

## Optional extension:

Modern hazard planning.

Have students go to **http://www.stopdisasters-game.org/en/home.html** and play two different hazard games. This game gives students a good idea of different methods communities can use to protect themselves from different hazards.

### Questions:

1. Is there overlap in the measures you take to avoid different natural hazards? What worked the best?

2. What is a better plan - move buildings out of the hazard zone or upgrade the building to higher building standards? Why?

3. Based on the game, what are the most cost effective ways to make a community more resilient?

4. What natural hazards is your house susceptible to? What could you do to make your home more resilient to natural hazards?

"Before God made the world, there was nothing but swamp to be seen, in which, however, there dwelt a very large trout. This trout was indeed a mighty fish, for his body reached from one end of the swamp to the other. Now, when the Creator produced the Earth, He made this creature to become its foundation. There lies the living trout beneath the world, taking in and sending out the waters of the sea through his mouth. When he sucks the water in, the ebb of the tide takes place, but when he sends it out the tide flows"...

"The trout upon whose back the world is founded is the cause of tidal waves. Every now and again he takes in a vast quantity of water, and then with an extraordinary effort shoots it out of his mouth in one mighty blow of his breath. It is this which makes the tidal waves (tsunami).

"So, again, when he shakes himself the consequence is an earthquake. When he moves gently the earthquake is small, but when he is angry and moves furiously it is great. As this is such a dangerous fish, the Creator has sent two deities to stand one on either side of him, to keep him quiet. These divine beings always keep one hand each on him, to hold him down and prevent any severe movements. Whether they eat or drink they must each keep one hand upon him without fail; they may never on any account take it off."

*The Ainu and Their Folklore, by the Rev. John Batchelor (London: The Religious Tract Society, 1901)*

The Kuril Biocomplexity Project: www.kbp.org

## Questions about family interviews

The Kuril Islands are not the only location prone to natural hazards. Western Washington is also prone to natural hazards. This activity is designed to look at how we understand natural hazards in western Washington.

### Complementary information:

The goal of the first set of questions is to get the students thinking about 1) How natural hazards impact their lives; 2) The difference between high frequency, low impact events (like storms and landslides) and low frequency, high impact events (like large earthquakes and lahars); 3) There is a disconnect between the student's experience, the memory of their family and the range of natural hazards possible for where they live; 4) People who have recently moved to an area do not understand the range of natural hazards as well as people who have lived in an area for many generations that pass on knowledge.

## Oral history:

### Question #1:

How long have you lived in Washington? What natural hazards do you remember occurring here? How many of each type of event do you remember? (Storms, landslides, earthquakes, tsunamis, or volcanic eruptions)

### Complementary information:

Storms and landslides happen most winters. Every 5-10 winters, there are worse storms. Earthquakes happen ~every 20 years.

### Question #2:

Natural hazards are often more dangerous to transient populations. People who have recently moved to an area do not know the natural hazards an area is prone to or how to respond. During the 2004 tsunami in the Indian Ocean, very few people died on Simeulue Island. People in the village remembered stories of a large tsunami in 1907 and taught younger generations to run to high ground after strong earthquakes. On nearby islands, the populations near the coast did not have as long of a history and many people died. How long has your family lived in western Washington? Talk to some of your family that has lived here a long time. What natural hazards do they remember? How many of each type of event do they remember? (Storms, landslides, earthquakes, tsunamis, or volcanic eruptions) Based on your family's oral history, what do you know about all of the natural hazards in Washington?

### Question #3:

Based on your family's knowledge, what do you think are the most common natural hazards in western Washington? What do you think are the most severe?

### Complementary information:

**Most common:** Storms, landslides, floods
**Most severe:** Earthquakes, tsunamis, lahars

# Written history:

## Question #1:

The Puget Sound was first explored in 1792 by George Vancouver. The first permanent settlement was established in 1833 (Fort Nisqually). The transcontinental railroad arrived in 1888. How good do you think the record of natural hazards is before 1792? Between 1792 and 1833? Between 1833 and 1888? Since 1888?

### Complementary information:

The record before 1792 is based on oral traditions of Native Americans. Exact dates are difficult to pinpoint. Some of this record is also known from geology. The record is spotty from 1792- 1833; most people with writing only passed through the area but did not stay. Lewis and Clark were present in 1805-1806. From 1833-1888, there is only one event recorded; if an event occurred far from Fort Nisqually it may not have been recorded. Also, the record is based on a few spotty journals, some smaller events may not have been recorded and the level of detail depends on the writer. Through time more people moved to the area and the record improved. From 1888-present, the arrival of the railroad opened up the area for people to quickly move to the region, and many records have been kept.

## Question #2:

Look at the chart. What kinds of natural hazards are not included in the list? Why? Based on the written records in the chart, what is the most common natural hazard in western Washington?

### Complementary information:

Frequent hazards such as storms, landslides ,and floods are not included because there are too many of them. Earthquakes are the most common.

## Question #3:

What natural hazards would we not know about if not for the geological record?

### Complementary information:

Lahars, Cascadia earthquakes

## Question #4:

The 1700 Cascadia earthquake is known from written records but the event occurred before there were written records in Washington. How do you think this occurred?

### Complementary information:

Written records are present in different areas at different times. There were written records in other areas (like Japan) that recorded the tsunami.

# Written history:

## Question #1:

Look at the natural hazards map of western Washington. It has been stylized to be similar to the maps you used in class. Given what you have learned about natural hazards, where would you build a village? Pick four locations for villages considering proximity to resources and natural hazards and mark them on the map.

## Question #2:

Which current city in Washington — Seattle, Tacoma, Everett or Bremerton — is subject to the greatest threat from natural hazards? Why?

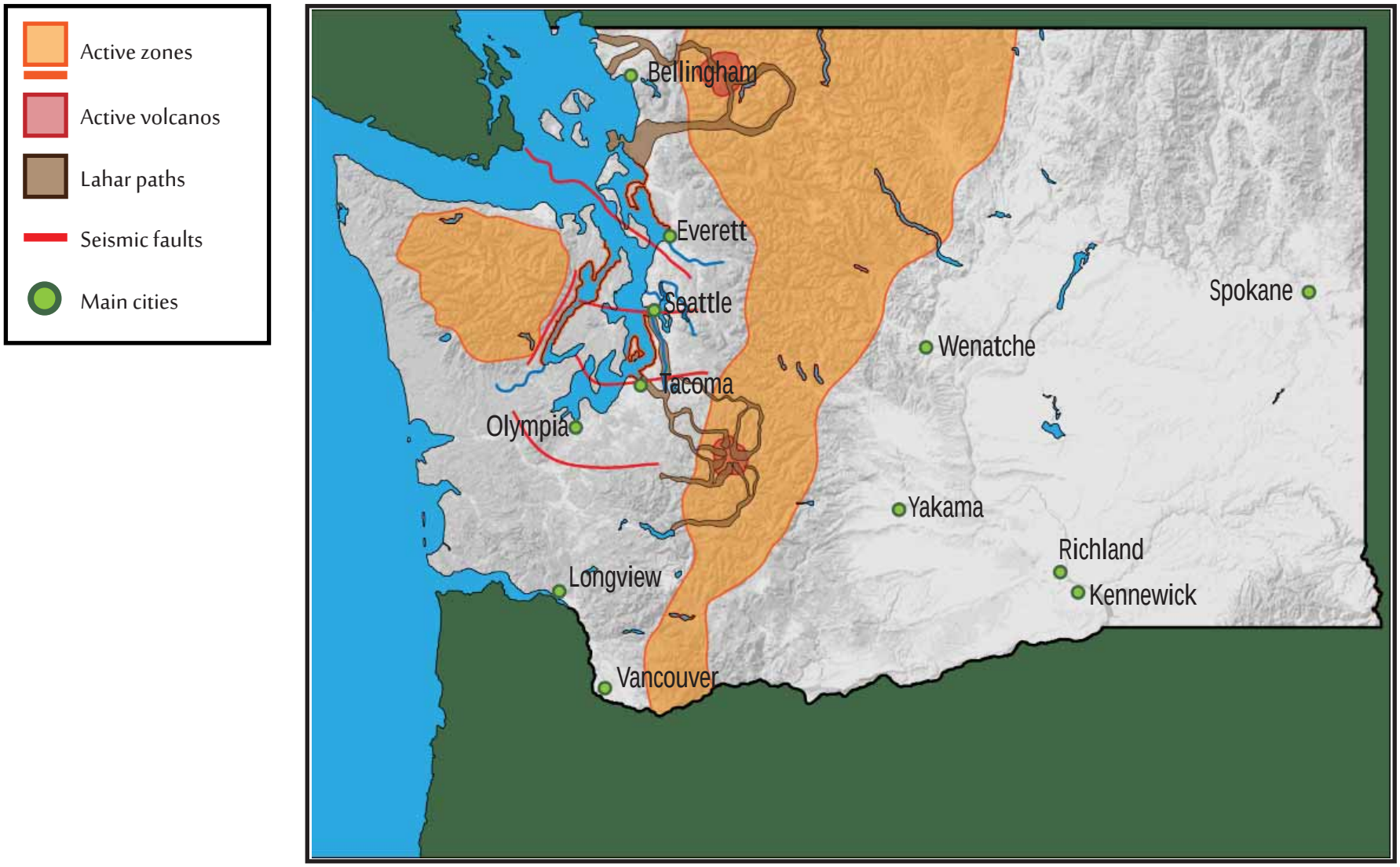
## Question #3:

The map shows zones of hazard for tsunamis, landslides, and lahars. What other hazards are we subject to in Washington? Are these events more frequent or less frequent? Do you think these events cause more or less damage? If you are building a town, what hazards would you consider a planning priority, one that happens every year but causes local damage (floods and landslides), or one that only occurs approximately every hundred years but causes widespread damage (large earthquakes and lahars)?

# Student Handout

Washington State Map

Available as a laminated handout



# Student Handout

Major events in Washington State
Available as a laminated handout

| Volcano | Tsunami | Earthquake | Lahar |
|---|---|---|---|
| AD 2004 Mt St. Helens | | | |
| | | AD 2001 | |
| AD 1980 Mt St. Helens | | | |
| | | AD 1965 | |
| | AD 1949 Tacoma | AD1949 | |
| | AD 1943 Tacoma | | |
| | | AD 1939 | |
| | | AD 1936 | |
| | AD 1894 Tacoma | | |
| | | | AD 1891 Mt. Baker |
| AD 1884 Mt Rainier | | | |
| | | AD 1872 Cascade Mountains | |
| AD1843 Mt. Baker | | | AD 1843 Mt. Baker |
| AD 1842 Mt. St. Helens | | | |
| | AD 1700 Cascadia | AD 1700 Cascadia | |
| *AD 1480 Mt. St. Helens* | | | |
| | | | AD 1420 Mt. Rainier |
| *AD 900 Mt. Rainier* | *AD 900 Pudget Sound*<br>*AD 900 Cascadia* | *AD 900 Puget Sound (4 events)*<br>*AD 900 Cascadia* | AD 900 Mt. Rainier |
| | *AD 700 Cascadia* | *AD 700 Cascadia* | |
| | *AD 350 Cascadia* | *AD 350 Cascadia* | |
| *400 BC Mt. St. Helens* | | | |
| | *500 BC Cascadia* | *500 BC Cascadia* | |
| *800 BC Mt. Rainier* | | | |
| | *900 BC Cascadia* | *900 BC Cascadia* | |
| *1000 BC Mt. St. Helens* | | | |
| | *1,400 BC Cascadia* | *1,400 BC Cascadia* | |
| *1900 BC Mt. St. Helens* | | | |

2,000 years of natural hazard history for western Washington. *Italic* events are known from the geological record. Cascadia events are earthquakes and tsunamis generated on the Cascadia subduction zone off the Washington, Oregon, and California coast.