



WASHINGTON STATE DEPT OF  
**NATURAL  
RESOURCES**  
WASHINGTON  
GEOLOGICAL SURVEY

# TSUNAMIS

An Interactive Web Guide  
for Middle Schoolers



## Introduction and Overview

Washington State is susceptible to tsunamis from multiple water bodies. Tsunamis can come from just off the Washington coast or travel across the Pacific Ocean. They can also travel up rivers from the coast, and smaller tsunamis can happen in lakes. In fact, there have been about 30 tsunamis that have impacted Washington in the last 200 years! This interactive web guide will lead you through videos, graphics, and pictures on the Washington Geological Survey (WGS) website. You will learn what defines a tsunami, the different types of tsunamis and their causes, read tsunami hazard maps, and learn how to be prepared for tsunamis when they occur.

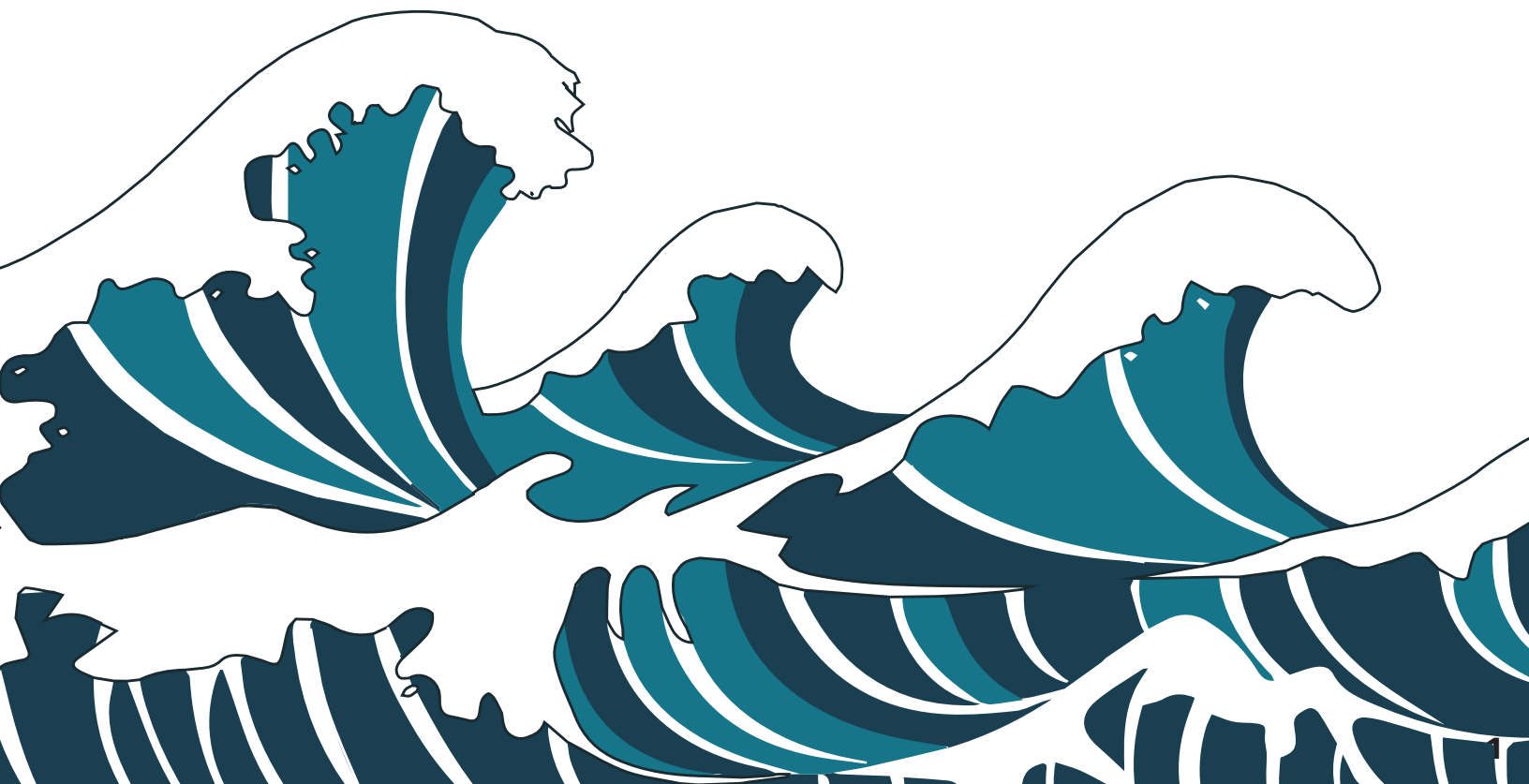
This interactive web guide is aimed at students in grades 6 through 8 but is useful for all ages. The content includes four sections, anticipated to be worked through in multiple sessions. Each section is 1 to 3 pages long.

- Section 1** "Understanding Tsunamis" covers the basics of tsunamis, and begins on page 2.
- Section 2** "Tsunamis in Washington", covers evidence of past tsunamis in our state, and begins on page 5.
- Section 3** "Tsunami Model Videos and Maps", covers tsunami modeling products, and begins on page 7.
- Section 4** "Evacuation and Preparation", covers emergency preparedness and begins on page 9.

To begin, go to the **Tsunamis webpage** found here:



<https://www.dnr.wa.gov/programs-and-services/geology/geologic-hazards/tsunamis>





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## What is a tsunami?

In this section you will read about what tsunamis are, why they happen, why each tsunami is unique, and what causes them. **GO** to the following webpage:



<https://www.dnr.wa.gov/programs-and-services/geology/geologic-hazards/Tsunamis#understanding-tsunamis.1>

Scroll down and **READ** the information under the tab **What is a tsunami**. Then answer the question.

1) Compare and contrast tsunami waves and wind-blown waves in the table below.

Similarities		
	Tsunami wave	Wind-blown wave
Differences		



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Next, **CLICK** on the tab for **What causes tsunamis** found here: <https://www.dnr.wa.gov/programs-and-services/geology/geologic-hazards/tsunamis#understanding-tsunamis.2>. **READ** about the various causes for tsunamis.

2) In the areas below, draw and label the five sources that cause tsunamis.

1

2

3

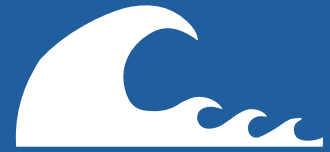
4

5



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Next, **CLICK** on the tab for **Local and distant tsunamis** found here: <https://www.dnr.wa.gov/programs-and-services/geology/geologic-hazards/tsunamis#understanding-tsunamis.3>. **READ** about the how tsunamis are classified based on the distance they travel. Now **THINK** back to the previous page, question 2 about the causes for tsunamis. Do you think there is a relationship between the tsunami cause and how far it can travel? Do you think there is a relationship between the tsunami cause and the size or impact of the tsunami once it reaches shore?

3) Complete the table below and briefly (1–3 sentences) explain your reasoning.

Tsunami cause	Do you think this type of tsunami produces local or distant tsunamis, or both?	How large of an area do you think this tsunami would impact? The whole state, multiple cities, one city?
Earthquakes		
Landslides		
Volcanic eruptions		
Meteorite impacts		
Weather disturbances		



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## Tsunamis in Washington

In this section you will learn about Washington's history with tsunamis. You will learn about what clues scientists have uncovered about past tsunamis and where in Washington is susceptible to tsunamis. **GO** to the following webpage:



<https://www.dnr.wa.gov/programs-and-services/geology/geologic-hazards/tsunamis#tsunamis-in-washington>

**READ** the text, **READ** the table about 'Types of tsunami risk', and **LOOK** at the map titled 'Tsunamis in Washington'. The map shows previous local tsunamis that were principally caused by landslides.

4) Based on the map 'Tsunamis in Washington', do tsunamis only occur along Washington's coast? Explain your answer. Hint: what types of water bodies can have tsunamis?

5) What clues do you think scientists look for to study past tsunamis?

Now scroll down to the section for **Evidence of past earthquakes and tsunamis**. **READ** the text.

6) Based on what you read, were any of the methods that scientists use to study tsunamis surprising? Why?



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## Tsunami Hazards Brochure

Click the link below to **READ** a brochure about tsunamis in Washington. Then **ANSWER** the questions.



[https://www.dnr.wa.gov/publications/ger\\_tsunami\\_hazards\\_brochure.pdf](https://www.dnr.wa.gov/publications/ger_tsunami_hazards_brochure.pdf)

7) The following statements are fake news. Correct them and explain why they are wrong.

a) Tsunamis are more likely to happen during the summer than during the winter. (pg. 1)

b) A tsunami produced in Alaska would reach Washington's shores in 5 minutes. (pg. 3)

c) The third tsunami wave is usually the biggest. (pg. 4)

d) Tsunami waves impact all coastlines in the same way. (pg. 4)

e) Tsunamis only include one wave. (pg. 4)

f) When the water recedes at the beach and exposes fish, this is a safe time to go fishing. (pg. 6)

g) Tsunamis are always preceded by strong ground shaking. (pg. 2, 3, or 6)





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## Tsunami Simulation Videos

In this section, you will look at simulation videos for tsunamis caused by a large, magnitude 9 earthquake on the nearby Cascadia subduction zone. Go to the following link:



<https://www.dnr.wa.gov/programs-and-services/geology/geologic-hazards/tsunamis#tsunami-simulation-videos>

When you scroll down you will see a video called 'Tsunami wave simulation for Washington State', but you should first **READ** the text below the video and then **WATCH** the video. You can click to 'Watch on YouTube' so that you can make the video fullscreen. Make sure to pay careful attention to the video from 0:07 to 0:38 seconds so that you understand what the simulation is showing you.

8) After watching the video and pausing it multiple times, what do you notice about the tsunami waves? Record your observations. Here are some things to think about: wave directions, wave movement, etc.

## Observations



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## Tsunami Walk Time Maps

Now go to the following link to open a Tsunami Evacuation Walk Time Map for Port Angeles, WA:



[https://www.dnr.wa.gov/pictures/ger/ger\\_tsunami\\_walkmap\\_port\\_angeles\\_for\\_screen\\_150dpi.pdf](https://www.dnr.wa.gov/pictures/ger/ger_tsunami_walkmap_port_angeles_for_screen_150dpi.pdf)

The red arrows show the evacuation pathways that people should walk in order to get to high ground and be safe from the tsunami. The brown, red, orange, and yellow areas show how many minutes it would take a person to walk at a *slow pace* to evacuate those areas. There is text around the map that says "ESTIMATED WAVE ARRIVAL TIME". Pay attention to these estimated wave arrival times as you answer the following questions.

9) If you were at the Port Angeles Ferry Terminal in the middle of the map area, how much time would you need to evacuate to high ground? Is there enough time to evacuate before the estimated wave arrival?

10) If you were out on Ediz Hook at the US Coast Guard Air Station in the northeast portion of the map area, how much time would you need to evacuate to high ground? Is there enough time to evacuate before the estimated wave arrival here?

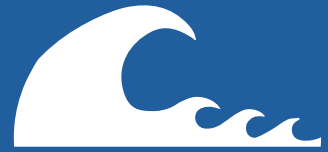
11) Reflect on your answers to the previous questions 9 and 10. Did you have enough time to evacuate in both of those places before the estimated arrival of the first tsunami wave? If you didn't have enough time to evacuate at a slow walk pace, what would you do? How else could you get to safety?





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## Preparation and Evacuation



<https://www.dnr.wa.gov/programs-and-services/geology/geologic-hazards/tsunamis#preparation-and-evacuation.4>

**GO TO** the link above and **READ** the text under the header. Then **CLICK** on the tab for 'Personal Preparedness' and **READ** that text, too.

12) How do you know if a tsunami is coming? List as many clues as you can think of.

13) What are three steps you can take today to be ready for a future tsunami?

**CLICK** the link below to go to another page with a video about the first vertical evacuation structure in Washington. **WATCH** the video and **ANSWER** the questions below.



<https://oceantoday.noaa.gov/fullmoon-strongerthanwaves/welcome.html>

14) What structural components are important for a vertical evacuation structure? In other words, how was the Ocosta school specially built for providing a safe haven from tsunamis?

15) Do you think your school/town could use a vertical evacuation structure? Why or why not?





## Glossary

**Tsunami**—Multiple waves caused by displacement of water. They are most commonly associated with undersea earthquakes.

**Tsunami source**—This is what causes the tsunami (what causes the ocean water to be displaced). This can be an undersea earthquake, a volcanic eruption, a landslide, or a meteorological (weather) event.

**Local tsunami**—A tsunami that only impacts the area nearby the source; it doesn't spread across the ocean.

**Distant tsunami**—A tsunami that impacts far away from its source; it does spread across the ocean.

**Inundation distance**—The inland distance that the tsunami waves flood.

**Runup/Inundation depth**—The depth of the water at a particular location once the tsunami comes onshore.

**Tsunami travel time map**—A map that shows how long it takes for a tsunami to travel from its source location to nearby shorelines.

**Wave speed**—How quickly the tsunami waves travel. This is usually very fast, on the order of 500 mph!

**Wave height**—The vertical distance of the wave from peak to saddle.

**Wave amplitude**—The vertical distance of the wave from peak to trough (half the wave height).

**Wavelength**—The horizontal distance of the wave from peak to peak, or trough to trough, or saddle to saddle.

**Wave frequency**—The spacing between successive wave peaks. If the spacing between successive peaks is shorter, the wave frequency is higher. If the spacing between successive peaks is larger, the wave frequency is lower.

**Wave period**—Similar to wavelength, this describes the time it takes to cycle from one peak to another peak.

**Plate tectonics**—The theory that explains how different pieces of land float on the surface of the Earth (think of a cracked eggshell). The pieces of land move around like bumper cars and when they collide, they can produce great earthquakes and tsunamis, as well as create volcanoes.

**Subduction zone**—One of the three types of plate tectonic boundaries where one plate sinks under another.

**Megathrust earthquake**—A very large earthquake that can only occur at a subduction zone boundary. At this type of boundary, there is a large surface area of contact between the two plates, and that large surface area creates a lot of friction when the two plates rub against each other. That large friction is released in a very big earthquake.