Raging Planet: Tsunami: Teacher's Guide

Grade Level: 6-8 | **Curriculum Focus:** Earth Science | **Lesson Duration:** Two class periods

Program Description

Dive beneath killer waves —tsunamis — to learn how they form, and survey the consequences when they barrel to shore. Plus, meet a man who once surfed a tsunami to safety.

Video Comprehension Questions

- Define a tsunami and explain its primary cause. (*The tsunami, one of the most powerful forces on Earth, is a wall of water stretching across the horizon that can cross entire oceans and cause enormous destruction on the shoreline. Underwater earthquakes are the cause of most tsunamis. Quakes occurring in deep ocean waters can violently jolt the seafloor. The whole ocean above is driven up and down with the quake, creating a wave that intensifies as it approaches land.*)
- How does an underwater earthquake cause such destruction upon landmasses thousands of miles away? (*The ocean above an underwater earthquake is moved up and down which creates waves that move across the ocean. Waves can travel as fast as 500 mph and be 100 miles from the next wave. The seafloor rises as the wave approaches shore and the energy of the wave pushes the water up to many feet above normal. This rising wave breaks into a huge surge that rushes onshore.*)
- What other events besides an underwater earthquake can create a tsunami similar to a tsunami? (*Besides earthquakes, three other causes for tsunamis are: (1) the impact of a large meteorite in the ocean (2) an underwater landslide and (3) a broken portion of an iceberg plummeting into the waters of a fjord- a narrow inlet of the sea with steep cliffs.*)
- What evidence do scientists search for to check whether or not a tsunami has hit an area? (*Scientists search for layers of sand deposit. In Washington mud flats there was evidence of a 300-year-old tsunami sand deposit buried three feet down in mud.*)
- How can a tsunami make it appear that there is no water in the ocean? (*With every wave there is a crest (peak) and a trough. If the trough arrives on shore first, the sea is sucked out before the wave comes in, giving the appearance that there is no water in the ocean immediately prior to the wave moving on shore.*)
- How can architecture aid in the survival of coastal buildings during a tidal wave? (*Buildings must be designed with the goal of surviving a tidal wave. This includes ideas such as using the first floor for parking so that there are pathways in that area through which water can pass. Walls are constructed in a way to allow water to pass through rather than to create a force against the water. Upper stories are constructed so people can take refuge there, thus providing for vertical evacuation.)*

- What is the Deep Sea Pressure Monitoring System and how does it work? (*The Deep Sea Pressure Monitoring System was developed by the Pacific Marine Environmental Lab in Seattle, Washington, to measure changes in pressure from the ocean depths. At a depth of 3 miles, this pressure gauge can detect a tsunami of approximately 1 millimeter in height. The gauge transmits its measurements to a buoy on the surface, which then sends the information to a satellite. A computer collects the information from the satellite and looks for patterns that indicate the formation of a tsunami.*)
- What evidence from a tsunami was found that supports the current meteorite impact theory on the extinction of the dinosaurs? (*Scientists have found evidence of a devastating tsunami from a 3-foot-thick deposit of sand in the Brazos River in Texas. This deposit was the result of a huge wave that crossed the Gulf of Mexico about 65 million years ago. Scientists have also identified a huge impact crater in the Yucatan Peninsula region of Mexico, caused by a meteorite falling to Earth at about the same time. The impact and resulting tsunami may be linked to the extinction of the dinosaurs.*)

Lesson Plan

Student Objectives

Students will understand:

- Tsunamis, huge tidal waves, in both oceans and fjords (narrow inlets of the sea with steep cliffs on either side) can create massive destruction.
- Ocean tsunamis and fjord tsunamis behave differently, due to the difference in width.
- Ocean tsunamis are caused by undersea earthquakes, volcanic eruptions, or landslides; or by the impact of a large meteorite falling into the ocean. Fjord tsunamis are caused by broken portions of icebergs plummeting into the waters.

Materials

- *Raging Planet: Tidal Wave* video and VCR, or DVD and DVD player

For each group:

- Two plastic containers of the same length but different widths. (One should be significantly narrower than the other.)
- Water
- Small rock, ball of clay, or other object that can be dropped into the water-filled containers
- Ruler or tape measure

Procedures

1. Review with your students what they already know about tsunamis, sometimes called tidal waves. Discuss the possible causes of an ocean tsunami: undersea earthquakes, volcanic eruptions, or landslides; the impact of a large meteorite falling into the ocean.

2. Let students know that a tsunami can also occur in a fjord—a narrow inlet of the ocean with cliffs on either side. Fjord tsunamis are generally caused by portions of icebergs plummeting into the waters.
3. Tell students that they are going to perform an experiment to find out how falling icebergs might create different wave patterns in the ocean and in a fjord. Before they begin their experiment, have them write a hypothesis about how wave patterns might be different in the ocean and in a fjord.
4. Divide the class into groups and distribute materials to each group. Ask them how they might use these materials to test their hypothesis. Remind them that in their experiment, water depth should not be an issue. They should only be considering the different widths of water in an open ocean and in a fjord. (They should determine that the wider plastic container would represent the ocean, the narrow container can represent the fjord, and the small object would represent the falling iceberg. The ruler can be used to ensure the depth of water is the same in both containers.)
5. Have students fill each container with water so that the depth is the same in each one.
6. Next, have them drop an object from the same height into each container and observe the resulting wave patterns. Have students record their results.
7. Hold a class discussion about the experiment. In the discussion, ask students how they know that the difference in wave pattern was not due to difference in water depth. (The experiment required the depth of the water in each container to be the same.)
8. Continue the discussion by having students determine in which place – the ocean or a fjord – a falling iceberg would cause the most destruction.
9. Have each student draw a diagram that shows the experimental design and the results of the experiment. Each diagram should be accompanied by a brief paragraph explaining in words what the diagram shows visually.

Discussion Questions

1. Hypothesize why more tsunamis occur in the Pacific Ocean than in the Atlantic.
2. Compare the tsunamis that occur in a fjord as a result of an iceberg breaking apart and the tsunamis that occurs in the ocean as a result of an underwater earthquake.
3. Analyze the tsunami's wave as it approaches land and becomes a surge. Explain how undersea structures and coastline configuration affect the intensity of the wave.
4. Describe some of the ways tsunamis affect people who do not live on a coastline.
5. Describe architectural changes that would be required in order to tsunami-proof a beachfront home.
6. Explain how a tsunami alert warning system might function. Compare and contrast such a system to hurricane warning systems.

Assessment

Use the following three-point rubric to evaluate students' work during this lesson.

- 3 points: Student's diagram carefully executed; diagram clearly shows experimental design and results; paragraph clear, accurate, and error-free.
- 2 points: Student's diagram lacking in clarity; paragraph satisfactory, but with some errors.
- 1 point: Student's diagram unclear; paragraph vague with numerous errors.

Vocabulary

crest

Definition: The top of a wave.

Context: The crest of each wave may rise only a foot or two above normal.

fjord

Definition: A narrow inlet of the sea between cliffs or steep slopes.

Context: The falling ice sends out a wave that spreads rapidly across the fjord.

surge

Definition: A large wave or billow.

Context: The water builds and then breaks into a huge surge of water that rushes ashore.

trough

Definition: The lowest point between waves.

Context: For every wave peak there is a trough. If the trough comes first, then the sea is sucked out before the wave comes in. It is a classic danger sign.

tsunami

Definition: A great sea wave produced by a submarine earth movement or volcanic eruption.

Context: Tsunami is the word most scientists use for a big tidal wave.

Academic Standards

National Academy of Sciences

The National Science Education Standards provide guidelines for teaching science as well as a coherent vision of what it means to be scientifically literate for students in grades K-12. To view the standards, visit http://books.nap.edu.

This lesson plan addresses the following science standards:

- Earth Science: Structure of the earth system

Mid-continent Research for Education and Learning (McREL)
McREL's Content Knowledge: A Compendium of Standards and Benchmarks for K-12 Education addresses 14 content areas. To view the standards and benchmarks, visit http://www.mcrel.org/compendium/browse.asp.

This lesson plan addresses the following national standards:

- Science: Physical Science: Understands the sources and properties of energy.
- Science—Earth Science: Understands Earth's composition and structure.
- Geography—Physical Systems: Knows the physical processes that shape patterns on Earth's surface.

Support Materials

Develop custom worksheets, educational puzzles, online quizzes, and more with the free teaching tools offered on the Discoveryschool.com Web site. Create and print support materials, or save them to a Custom Classroom account for future use. To learn more, visit

- http://school.discovery.com/teachingtools/teachingtools.html