

Tsunamis Create Warning Centers



Overview:

Students research the history of current tsunami warning systems, and how specific tsunami events contributed to their development.

Targeted Alaska Grade Level Expectations:

Science

- [10] SE1.1 The student demonstrates an understanding of how to integrate scientific knowledge and technology to address problems by identifying that progress in science and invention is highly interrelated to what else is happening in society
- [11] SE1.1 The student demonstrates an understanding of how to integrate scientific knowledge and technology to address problems by researching how social, economics, and political forces strongly influence which technology will be developed and used.
- [10-11] SE3.1 The student demonstrates an understanding of how scientific discoveries and technological innovations affect our lives and society by researching a current problem, identifying possible solutions, and evaluating the impact of each solution.

Objectives:

The student will:

- research tsunami events that led to the development of tsunami warning centers;
- develop a PowerPoint presentation detailing the history of a tsunami warning center; and
- propose ways to educate people in tsunami-prone areas about both natural and man-made tsunami warnings.

Materials:

- Access to computer with Internet capability, Microsoft Office PowerPoint program (one per group)
- Sticky notes
- STUDENT INFORMATION SHEET: "Disaster Lessons"
- STUDENT WORKSHEET: "Tsunami Warnings"

Whole Picture:

Every time a tsunami catches a community off guard, causing devastation of property and loss of life, the need for a way to warn people becomes evermore clear. But reaching the globe with lifesaving messages is a daunting task.

The first tsunami warning center established in the United States was the Pacific Tsunami Warning Center (PTWC) in Ewa Beach, Hawaii. The center, originally known as the Honolulu Observatory, was established in 1949 as a direct result of the devastating tsunami of April 1, 1946, triggered by a magnitude 7.4 earthquake located in the Aleutian Islands. Since then, tsunami events continued to spur emergency management agencies and scientists to develop a worldwide system to warn tsunami prone areas.

The need for such a system was never more evident than during the 2004 Indian Ocean tsunami event where over 230,000 people lost their lives because they were unaware of or unprepared for the coming danger. Eighteen countries around the Indian Ocean were affected by the waves, impacting more than five million people and leaving well over one million people homeless.

Activity Procedure:

1. Give each student a sticky note. Ask students to write down a short sentence answering the following question: "How would you know if a tsunami was coming?" Have students pass the sticky notes to the teacher. Read the responses.
2. Hand out STUDENT INFORMATION SHEET: "Disaster Lessons." Read the account to students as they follow along or have them read individually or with a partner. The account highlights how important it is to know the natural signs of a tsunami as well as what can happen if there is not adequate warning or if people do not understand natural or man-made warnings.
3. Ask students:
 - a. What is the difference between the outcomes in these accounts?
 - b. Would you want to know the warning signs, and act on them when you thought a tsunami was coming, only to find it was a false alarm?
 - c. Would you be content not understanding the danger if it meant you would be unable to help yourself and others?
 - d. Who is responsible for getting the warning out to?
4. Divide students into five groups. Assign each group a research topic. (See STUDENT WORKSHEET: "Tsunami Warnings") Students must have Internet access to complete the research. In addition, the assignment requires students to create Microsoft Office PowerPoint slides to accompany the group oral presentation. If PowerPoint is unavailable, students may use chart paper and create visuals to accompany the presentation. In this instance, access to a printer would allow students to include pictures and graphics found on the Internet.
5. Once students have had adequate time to complete the research and put together a presentation, allow each group to present their findings to the class.
6. Review the following questions:
 - a. What were precipitating events that led to the formation of tsunami warning centers?
 - b. What were some of the issues faced in the development?
 - c. What issues do you think still need to be addressed?
 - d. How would you go about addressing those issues?

Additional Resources:

NOAA Center for Tsunami Research

Dart II® References: http://nctr.pmel.noaa.gov/Dart/dart_ref.html

National Weather Service Pacific Tsunami Warning Center

<http://www.prh.noaa.gov/ptwc/>

International Tsunami Information Center

<http://ioc3.unesco.org/itic/>

National Weather Service West Coast and Alaska Tsunami Warning Center

<http://wcatwc.arh.noaa.gov/>

Cooper, A. 2006. *Dispatches from the edge*. Harper Collins, New York, NY.

University of Southern California Tsunami Research Center

<http://www.usc.edu/dept/tsunamis/2005/index.php>

NOAA Center for Tsunami Research (animations)

<http://nctr.pmel.noaa.gov/index.html>

National Weather Service TsunamiReady

<http://www.tsunamiready.noaa.gov/>

Pacific Tsunami Museum

<http://www.tsunami.org/index.html>

Wikipedia – Tsunami Warning system

http://en.wikipedia.org/wiki/Tsunami_warning_system

Lesson Information Sources:

Cloyd, W. (2009). [Interview with William Knight, Tsunami Warning and Science Officer, West Coast and Alaska Tsunami Warning Center].

Disaster Lessons

Student Information Sheet



Disaster Lessons: What You Don't Know Can Kill You

Published October 14, 2005.

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Something remarkable happened on the island closest to the epicenter of the great Sumatra-Andaman earthquake last December [2004]: Only seven of the island's 78,000 inhabitants died. This is despite the fact tsunamis hit the island only eight minutes after the quake, despite the destruction of many Simuelue villages, and despite the lack of an official tsunami warning system and little in the way of telecommunications.

Why were the lives of Simuelue islanders spared when all around the Indian Ocean, coastal villages, towns, and cities hit by the tsunamis experienced near-total annihilation? The answer, says Humboldt State University geology professor Lori Dengler, is knowledge.

"The single most important lesson for anyone anywhere is that what you know can save your life and what you don't know can kill you," said Dengler, who was part of an International Tsunami Survey Team of scientists that visited the tsunami destruction zones in April. What she and others discovered in the western coast of Aceh province, Simuelue and the Nias Islands of Indonesia is that there are a number of vital lessons emergency planners and every human being can learn from the 26 December 2004 Indian Ocean catastrophe.

The knowledge the people of Simuelue had was simply this: Once in a while large earthquakes are followed by large killer waves, so it's always wise to run to high ground and wait a while, just in case.

"They have a long oral tradition that remembers what happened in 1907," said Dengler. That's the year Simuelue was last was struck by an earthquake-induced tsunami, she said. The survivors of that disaster learned their lesson and wisely didn't let their descendents forget it. "It doesn't matter that the information is a century old," said Dengler. "They don't ignore it. They take great pride in getting it perfectly. You don't fret about false alarms." They even have a word for the 1907 tsunami in their local language: "*smong*."

In stark contrast, the populations of other coastal areas where there was far more time between the quake and the tsunami's arrival to respond were nearly wiped out. "The west coast of Indonesia had fifteen to twenty minutes of warning time and had casualty rates upwards of ninety percent," Dengler said. "It was absolutely horrific." Survivors interviewed in those places had little or no knowledge of tsunamis or what caused them before the disaster, she said.

The Simuelue story was reenacted that day in other places around the Indian Ocean. A merchant marine in a Sri Lankan fishing village remembered the near-shore signs of an approaching tsunami from years ago when he witnessed another in Chile. His warning saved hundreds of lives. Near Phuket in Thailand, a 10-year-old English girl on holiday with her family remembered a geography lesson covering tsunamis given two weeks earlier. She also recognized the danger and is credited for saving at least 100 lives, including her own.

Yet other coastal communities received calls warning them of the coming wave, said Dengler, but the warnings were not understood and were not heeded. The tragedy underlines a problem that's often overlooked by the public and even emergency planners: A warning is of little use if the public doesn't understand how to respond to it.

Name: _____

Tsunami Warnings

Student Worksheet (page 1 of 5)



GROUP 1: Pacific Tsunami Warning Center

Group one will create a presentation about the history of the Pacific Tsunami Warning Center, including the precipitating factors in its development. A six-slide Microsoft Office PowerPoint will accompany a ten-minute presentation.

The presentation must include:

1. An introduction stating the focus and purpose of the presentation.
2. A description of the precipitating event(s) that led to the development of the system.
3. A story or personal account of event(s) accompanied by pictures or graphics.
4. Possible challenges to creating the system as well as current problems or issues that may need to be addressed.
5. Animations/models of the event(s), if available, and/or pictures.
6. The current area of responsibility for the system.
7. A “what next” component (choose one item from the following):
 - a. What do you feel is the next logical step in the development of a worldwide tsunami warning system?
 - b. How would you propose warning those in areas without immediate access to media, like tourists who are visiting the beach or villages that are far less media dependent than urban areas?
 - c. How would you propose educating people about both natural and manmade warnings that a tsunami is possible?

Remember, your PowerPoint slides should support your oral presentation and should not be text heavy. Divide parts of the presentation between group members.

Begin by visiting: <http://www.prh.noaa.gov/ptwc/history.php>

Helpful Hint: Using a search engine, enter key words and phrases such as “tsunami animations”, “tsunami survival stories”, and “tsunami warning systems.”

Additional Internet Sources:

- Pacific Tsunami Museum
- University of Southern California Tsunami Research Center
- National Weather Service TsunamiReady
- NOAA Center for Tsunami Research (animations)

Name: _____

Tsunami Warnings

Student Worksheet (page 2 of 5)



GROUP 2: West Coast and Alaska Tsunami Warning Center

Group two will create a presentation about the history of the West Coast and Alaska Tsunami Warning Center, including the precipitating factors in its development. A six-slide Microsoft Office PowerPoint will accompany a ten-minute presentation.

The presentation must include:

1. An introduction stating the focus and purpose of the presentation.
2. A description of the precipitating event(s) that led to the development of the system.
3. A story or personal account of event(s) accompanied by pictures or graphics.
4. Possible challenges to creating the system as well as current problems or issues that still need to be addressed.
5. Animations/models of the event(s), if available, and/or pictures.
6. A description of the current area of responsibility for the system.
7. A “what next” component (choose one item from the following):
 - a. What do you feel is the next logical step in the development of a worldwide tsunami warning system?
 - b. How would you propose warning those in areas without immediate access to media, such as tourists who are visiting the beach or villages that are far less media dependent than urban areas?
 - c. How would you propose educating people about both natural and manmade warnings that a tsunami is possible?

Remember, your PowerPoint slides should support your oral presentation and should not be text heavy. Divide parts of the presentation between group members.

Begin by visiting: <http://wcatwc.arh.noaa.gov/thewcatwc/history.htm>

Helpful Hint: Using a search engine, enter key words and phrases such as “tsunami animations”, “tsunami survival stories”, and “tsunami warning systems.”

Additional Internet Sources:

- Pacific Tsunami Museum
- University of Southern California Tsunami Research Center
- National Weather Service TsunamiReady
- NOAA Center for Tsunami Research (animations)

Name: _____

Tsunami Warnings

Student Worksheet (page 3 of 5)



GROUP 3: DART II®

Group three will create a presentation about the DART II® system. A six-slide Microsoft Office PowerPoint will accompany a ten-minute presentation on the history of the system, including the precipitating factors in its development.

The presentation must include:

1. An introduction stating the focus and purpose of the presentation.
2. A description of the precipitating event(s) that led to the development of the system.
3. A pictures or graphic with an explanation of how the system works.
4. Possible challenges to creating the system as well as current problems or issues that still need to be addressed.
5. A description of the current area of responsibility for the system.
6. A “what next” component (choose one item from the following):
 - a. What do you feel is the next logical step in the development of a worldwide tsunami warning system?
 - b. How would you propose warning those in areas without immediate access to media, such as tourists who are visiting the beach or villages that are far less media dependent than urban areas?
 - c. How would you propose educating people about both natural and manmade warnings that a tsunami is possible?

Remember, your PowerPoint slides should support your oral presentation and should not be text heavy. Divide parts of the presentation between group members.

Begin by visiting: http://nctr.pmel.noaa.gov/Dart/dart_ref.html

Helpful Hint: Using a search engine, enter key words and phrases such as “tsunami animations”, “DART II”, and “worldwide tsunami warning system.”

Additional Internet Sources:

- Pacific Tsunami Museum
- University of Southern California Tsunami Research Center
- National Weather Service TsunamiReady
- NOAA Center for Tsunami Research (animations)

Name: _____

Tsunami Warnings

Student Worksheet (page 4 of 5)



GROUP 4: How do tsunami warnings work?

Group four will create a presentation about the way tsunami warning centers disseminate information. A six-slide Microsoft Office PowerPoint will accompany a ten-minute presentation that outlines the way warning centers determine if a warning is needed and what those warnings look like.

The presentation must include:

1. An introduction stating the focus and purpose of the presentation.
2. A description of how warning centers get information to the public, including local, state and national agencies as well as media.
3. A description of the four warning level messages that could be distributed.
4. A timeline that shows:
 - a. The precipitating earthquake
 - b. The arrival of a tsunami at the shoreline
 - c. When a tsunami warning center interprets the data to expect a tsunami
 - d. When the tsunami warning center alerts other agencies
 - e. When those agencies inform the public.
5. Pictures or graphics that help describe the system.
6. Possible challenges to the warning system.
7. A “what next” component (choose one item from the following):
 - a. What do you feel is the next logical step in the development of a worldwide tsunami warning system?
 - b. How would you propose warning those in areas without immediate access to media, such as tourists who are visiting the beach or villages that are far less media dependent than urban areas?
 - c. How would you propose educating people about both natural and manmade warnings that a tsunami is possible?

Remember, your PowerPoint slides should support your oral presentation and should not be text heavy. Divide parts of the presentation between group members.

Begin by visiting: <http://wcatwc.arh.noaa.gov/Products/msgdefs.htm>

Helpful Hint: Using a search engine, enter key words and phrases such as “tsunami warning systems”, “tsunami warnings”, and “worldwide tsunami warning system.”

Additional Internet Sources:

- Pacific Tsunami Museum
- University of Southern California Tsunami Research Center
- National Weather Service TsunamiReady
- NOAA Center for Tsunami Research (animations)

Name: _____

Tsunami Warnings

Student Worksheet (page 5 of 5)



GROUP 5: International Tsunami Information Center

Group five will create a presentation about the International Tsunami Information Center. A six-slide Microsoft Office PowerPoint will accompany a ten-minute presentation on the history of the center, including any precipitating factors in its development.

The presentation must include:

1. An introduction stating the focus and purpose of the presentation
2. A description of the purpose of the center, including where it is located.
3. A description of the types of resources the center offers and the information it provides to the public.
4. An example of the type of drills or exercises the center facilitates.
5. A description of one kind of research being conducted about tsunamis.
6. Pictures and graphics where appropriate.
7. Choose one item from the following:
 - a. How would you propose warning those in areas without immediate access to media, such as tourists who are visiting the beach or villages that are far less media dependent than urban areas?
 - c. How would you propose educating people about both natural and manmade warnings that a tsunami is possible?

Remember, your PowerPoint slides should support your oral presentation and should not be text heavy. Divide parts of the presentation between group members.

Begin by visiting: <http://ioc3.unesco.org/itic/>

Helpful Hint: Using a search engine, enter key words and phrases such as “tsunami”, “tsunami warning center”, and “worldwide tsunami warnings” and “tsunami research.”

Additional Internet Sources:

- Pacific Tsunami Museum
- University of Southern California Tsunami Research Center
- National Weather Service TsunamiReady
- NOAA Center for Tsunami Research (animations)