Lesson #4: “Tsunamis are TITANIC!”

- Teacher Information
- Student Worksheet #1 “How Big are Tsunamis?”
- Titanic Tsunami Task (TTT) Cards
- Lesson #4 Titanic Tsunami Task Card Poster-Graph Rubric

LESSON #: 4

TITLE: "Tsunamis are TITANIC!"

OVERVIEW:

Lesson #4 takes place after visiting the Bishop Museum's program, "Science on a Sphere, Tsunamis: Walls of Water." The goal of Lesson #4 is to reinforce the experience students had at the Museum, emphasizing the large scale of tsunamis.

KEY CONCEPTS:

1. By whatever criteria chosen, tsunamis are powerful hazards of nature.
2. Graphing data is an appropriate technique to display differences between wind-generated waves and tsunamis.

STANDARD(S)-BENCHMARK(S):

Standard 1: Scientific Investigation

> Benchmark 6.1.2: Use appropriate tools, equipment, and techniques safely to collect, display, and analyze data.

NOAA ocean literacy:

Essential Principle #6: The ocean and humans are inextricably interconnected.

> Fundamental Concept (f) Coastal regions are susceptible to natural hazards (tsunamis, hurricanes, cyclones, sea level change, and storm surges).

TEACHER BACKGROUND:

Tsunamis are exceptional water waves generated by powerful forces near or under the ocean, primarily earthquakes and landslides, but also volcanic explosions, meteoroid impacts, and iceberg collapse. Tsunamis are usually not a single wave, but rather a train of waves that cross oceans at the speed of a jet plane. Individual tsunami crests are only a foot high while the waves travel through the deep ocean, but crests can be as much as 60 to 300 miles apart.

When tsunamis come ashore, they bring disaster, often traveling 20 to 30 mph, or faster than a person can run. Tsunami waves almost never have a curved face. Sometimes the wave is a bore or wall of water, darkened with seafloor sediment and laden with huge

pieces of debris. In other cases a tsunami wave is an inundating surge or flood of water. The power of the water, even ankle-deep, can knock people over.

A word about the Resources listed below…an attempt was made to list as many websites as might be useful for showing the power of tsunamis; however, these websites were especially appropriate for students:

- National Science Foundation website: http://www.nsf.gov/news/special_reports/tsunami/index.jsp

- Public Broadcasting System's Savage Earth website: http://www.pbs.org/wnet/savageearth/tsunami/index.html

- Public Broadcasting System's Nova website: http://www.pbs.org/wgbh/nova/tsunami/

In addition, the College of Exploration (http://coexploration.org/) requires a (free) membership/sign-up; it offers a tremendous site with lists of tsunami websites and book titles. The ITIC website's *Tsunami Teacher* is a downloadable Adobe PDF document of over 200 pages that offers a wealth of basic tsunami information.

DURATION: roughly 1 class period, or about 45 minutes

VOCABULARY:

- titanic = having great magnitude, force or power

MATERIALS NEEDED:

- Student Worksheet #1 "How Big are Tsunamis?" (one per student)
- Lesson #4 "Titanic Tsunami Task Cards," one classroom set (perhaps Xeroxes onto stiff paper and laminated)
- glue

Per student group:

- graph paper
- pencil & eraser
- colored markers, crayons, pencils
- 1 poster board

PROCEDURE:

1. The initial activity of Lesson #5 is to be something of a reflection, a way to debrief the Bishop Museum field trip experience, as well as to review what's been learned about tsunamis from the previous classroom lessons. It is recommended

that the activity be done as soon as possible after returning to the classroom from the field trip, while some of the images are still fresh in students' minds.

2. Pass out copies of Student Worksheet #1 "How Big are Tsunamis?"

3. Ask students what the word "titanic" means. Of course, they may immediately think of the movie with Leonardo DiCaprio and Kate Winslet. Tell students the reason why the ship was named Titanic is because of the meaning of the word, titanic. Perhaps have a volunteer student find the word in the dictionary or online. Merriam-Webster's Online Dictionary gives the definition of titanic as "having great magnitude, force, or power: colossal."

4. Ask the students if they think the word "titanic" applies to tsunamis. Hopefully, they will!

5. Explain their assignment, as given on the Student Worksheet #1, is to list all the information they have off the top of their heads about the "bigness" of tsunamis. Allow perhaps 10 minutes. Perhaps give prompts: power, wavelength, height at coastlines, flooding inland, power to carry large objects, number of deaths. Perhaps some students would like to compose a poem, using creative analogies for tsunamis' "bigness."

6. If there's time right after the reflection, continue the lesson. If there's not enough time, begin the next day.

7. Take about 10 minutes for students to see photographs and/or video clips of tsunamis. Perhaps view segment #1 from the Justin Fujioka CD, although you might have shown this segment to the students during Lesson #3; see Resources. If you have access to computers with Internet capability, have students access some of the websites listed in the Resources.

8. Divide students into 6 or 7 groups; pass out a blank poster board and a blank piece of graph paper per group. Tell students to put the graph paper in the center of the poster board and carefully draw a light pencil line on the poster board around the graph paper. When the graph paper is removed, the poster board looks sort of like a picture frame.

9. Tell students they are going to do a graphing and drawing activity that will show how titanic a tsunami is. Each group will be given a Titanic Tsunami Task Card (TTT Card) that has data about tsunamis and wind-generated waves. They are to graph the data as a bar graph. While some people in the group are doing the graph, other students should be drawing pictures of tsunamis in the frame portion of the poster board.

10. <u>Graphing help: getting started --</u> If students need help getting started on their bar graphs, tell them most of their graphs should have the horizontal or X axis labeled

"Waves." The vertical or Y axis should be labeled properly for wave height, wave speed…or whatever variable their TTT Card is about. There will be 2 vertical bars; one for the wind-generated waves, and one for tsunamis. (The exception to this is the group doing TTT Card # 7 about Hawaii's worst natural disasters. In this case, the X axis should be "Kinds of Disasters;" the Y axis, "Lives Lost.")

11. Graphing help: special concerns about Y axes' scale -- Especially with TTT Card #3, students will probably come to you with questions about how to "do" the Y axis scale because the difference between wind waves and tsunamis. Actually, the realization by the students as to how much bigger…TITANIC!...tsunamis are than wind waves is the whole point of the lessons! Therefore, help students to realize that wind waves may average down to zero on a Y axis scale that can accommodate the size of tsunamis. Therefore, perhaps students can *barely* draw an entry for tsunamis.

12. Drawing help -- Be sure students know tsunamis should ***not*** be drawn with curved faces, since only a very small percentage of tsunamis have such a shape. Rather, it is more accurate to draw tsunamis as tall walls of frothy water, or a strong, steady surge pushing over large objects and floating cars.

13. Check graphs for accuracy, and then tell students to glue their graph in the center of their poster board. Hang poster-graphs around the classroom…or perhaps in the cafeteria or library, as a school service project, so that other children (& adults) may learn about the titanic power of tsunamis!

ASSESSMENTS:

Benchmark 6.1.2 -- Use Lesson #4 Titanic Tsunami Task Card Poster-Graph Rubric

RESOURCES:

- Web:

A special report: After the tsunami. (2005). Retrieved April 7, 2007, from the National Science Foundation's website: http://www.nsf.gov/news/special_reports/tsunami/index.jsp

Atwater, B. F. *et al.* (2006). *Surviving a tsunami -- Lessons from Chile, Hawaii, and Japan.* Retrieved April 7, 2006, from USGS Science for a Changing World Web site: http://pubs.usgs.gov/circ/c1187/

Brocko, R. (2007). *Tsunami data at NGDC.* Retrieved April 7, 2007, from NOAA National Geophysical Data Center (NGDC) Web site: http://www.ngdc.noaa.gov/seg/hazard/tsu.shtml

December 26, 2004 Indonesian Sumatra earthquake and tsunami web link compilation and data. (n.d.). Retrieved April 7, 2007, from NOAA Center for Tsunami Research's Web site: http://nctr.pmel.noaa.gov/sumatra20041226.html

Effect of Hurricane Katrina on New Orleans. (2007). Retrieved April 6, 2007, from Wikipedia the Free Encyclopedia's Web site: http://en.wikipedia.org/wiki/Effect_of_Hurricane_Katrina_on_New_Orleans

Halabrin, N., & Valdes, R. (1998-2007). *How tsunamis work.* Retrieved April 6, 2007, from HowStuffWorks, Inc.'s Web site: http://science.howstuffworks.com/tsunami.htm

Home. (2007). Retrieved April 7, 2007, from Pacific Tsunami Museum Web site: http://www.tsunami.org/

Merriam-Webster online. Retrieved May 6, 2007, from http://www.m-w.com/

NOAA and tsunamis. (n.d.). Retrieved April 6, 2007, from NOAA' Tsunami Web site: http://www.publicaffairs.noaa.gov/grounders/tsunamis.html

Paine, M. (n.d.). *Tsunami from asteroid/comet impacts.* Retrieved April 7, 2007, from Australian Spaceguard Survey's Web site: http://users.tpg.com.au/users/tps-seti/spacegd7.html

Svitil, K. (n.d.). *Tsunamis.* Retrieved April 7, 2007, from Public Broadcasting System WNET Channel 13 New York Web site: http://www.thirteen.org/savageseas/neptune-side-tsunamis.html

The national tsunami hazard mitigation program history. (n.d.). Retrieved April 7, 2007, from The National Tsunami Hazard Mitigation Program's Web site: http://nthmp-history.pmel.noaa.gov/index.html

Tsunami. (n.d.). Retrieved April 7, 2007, from National Oceanic and Atmospheric Administration's Web site: http://www.tsunami.noaa.gov/

Tsunami and earthquake research at the USGS. (2007). Retrieved April 7, 2007, from USGS Western Coastal and Marine Geology Tsunamis and Earthquakes Web site: http://walrus.wr.usgs.gov/tsunami/index.html

Tsunami Education Resource Kit (TERK). (2006). Retrieved April 9, 2007, from NOAA's Office of Education Web site: http://www.oesd.noaa.gov/terk_intro.htm

Tsunami facts: How they form, warning signs, and safety tips. (2007). Retrieved April 7, 2007, from National Geographic Society's News Web site: http://news.nationalgeographic.com/news/2007/04/070402-tsunami.html

Tsunamis. (2007). Retrieved April 7, 2007, from National Oceanic and Atmospheric Administration's Web site: http://www.noaa.gov/tsunamis.html

Tsunami teacher. (2005). Retrieved April 7, 2007, from International Tsunami Information Centre (ITIC) Web site: http://www.tsunamiwave.info/

Wave that shook the world. (2005). Retrieved April 7, 2007, from Public Broadcasting Nova Science Programming on Air and Online Web site: http://www.pbs.org/wgbh/nova/tsunami/

Waves of destruction: Tsunamis. (n.d.). Retrieved April 7, 2007, from Public Broadcasting System Savage Earth Web site: http://www.pbs.org/wnet/savageearth/tsunami/index.html

- Print:

Bryant, E. (2001). *Tsunami: The underrated hazard.* Cambridge: Cambridge University Press.

Dudley, W. C. & Lee, M. (1998). *Tsunami!* Honolulu: University of Hawai'I Press.

Sorenson, M. (1997). *Tsunami! Death wave.* Logan, IA: Perfection Learning Corporation.

Smith, C. B. (2006). *Extreme waves.* Washington DC: Joseph Henry Press.

Tsunami: Hope, heroes, and incredible stories of survival. (2005). Chicago: Triumph Books.

Tsunami: The great waves. (2005). Honolulu: UNESCO IOC (Intergovernmental Oceanographic Commission) ITIC (International Tsunami Information Centre.)

Wade, M. D. (2002). *Tsunami :Monster Waves.* Berkeley Heights, NJ: Enslow Publishers, Inc.

Walker, D. (1994). *Tsunami facts* .Honolulu: School of Ocean and Earth Science and Technology, University of Hawaii.

Walker, N. (2006). *Tsunami Alert!* New York: Crabtree Publishing Co.

- Media:

Fujioka, J. (April 2007). *Tsunami information.* KITV channel 4 evening news.

- 1st segment --Tsunami Survivors from Hilo 1946 tsunami (0:00-2:17)
- 2nd segment -- Tsunami Watch and Warning (2:18-4:16)
- 3rd segment -- Tsunami Evacuation Zones Online (4:17-6:06)
- 4th segment -- Big Island Community's Preparedness (6:07-8:18)
- 5th segment – Technology: DART buoys and NOAA weather radios (8:19-10:45)

Lesson #4 Student name: _____
"Tsunamis are TITANIC!"
Student Worksheet #1 "How Big are Tsunamis?"

List what you have learned, both from your Bishop Museum field trip and your classroom lessons, about the SIZE and STRENGTH of tsunamis, compared to wind-generated waves.

Lesson #4 “Tsunamis are TITANIC!”

TITANIC TSUNAMI TASK CARD #1 -- Deep Water Wave Speed

Directions:

Use graph paper, pencil and eraser to draw a bar graph of how fast waves can travel when they’re in deep water:

- The fastest wind-generated waves can move 60 miles per hour.
- The fastest tsunami wave can move 600 miles per hour.

Lesson #4 “Tsunamis are TITANIC!”

TITANIC TSUNAMI TASK CARD #2 -- Time between Waves

Directions:

Use graph paper, pencil and eraser to draw a bar graph of the time between waves:

- The time between wind-generated waves is at most 20 seconds.
- The time between tsunami waves can be as long as 2 hours (= 7200 seconds.)

Lesson #4 “Tsunamis are TITANIC!”

TITANIC TSUNAMI TASK CARD #3 -- Distance between Waves

Directions:

Use graph paper, pencil and eraser to draw a bar graph of the distance between waves:

- The greatest distance between wind-generated waves can be 600 feet.
- The greatest distance between tsunami waves can be 300 miles (1,584,000 feet.)

Lesson #4 “Tsunamis are TITANIC!”

TITANIC TSUNAMI TASK CARD #4 -- Wave Depth in Ocean

Directions:

Use graph paper, pencil and eraser to draw a bar graph showing how deep each wave is when it’s traveling over the deep ocean:

- The greatest depth for a wind-generated wave is 500 feet.
- The greatest depth for tsunami is the total depth of the ocean itself, which is an average of 12,000 feet.

Lesson #4 “Tsunamis are TITANIC!”

TITANIC TSUNAMI TASK CARD #5 -- Height Reached on Land

Directions:

Use graph paper, pencil and eraser to draw a bar graph of the highest vertical distance reached by the water, as it washed up on land, measuring from sea level:

- The category 5 Hurricane Katrina’s waves and surge flooded some parts of New Orleans to 20 feet above normal sea level.

- The highest run-up in Hawai’i from the 1946 tsunami was 54 feet on Moloka’i.

Lesson #4 “Tsunamis are TITANIC!”

TITANIC TSUNAMI TASK CARD #6 -- Wave Height at Coast

Directions:

Use graph paper, pencil and eraser to draw a bar graph of the height of waves, when they hit the coastline:

- The biggest non-tow surfing waves in places like Waimea on O’ahu are about 50 feet, measuring the front, trough to crest, on a breaking face.

- In places like Hilo Bay a tsunami can be 100 feet high.

Lesson #4 “Tsunamis are TITANIC!”

TITANIC TSUNAMI TASK CARD #7 -- Loss of Life

Directions:

Use graph paper, pencil and eraser to draw a bar graph of many people have lost their lives in some of Hawaii’s worst natural disasters:

Hawaii’s Worst natural Disasters		
Date	Event	Lives Lost
1992	Kaua’i, O’ahu; Hurricane Iniki	3
1987-88	East O’ahu; heavy rain, flooding	0
1983	Hilo; earthquake	0
1982	Kaua’i, O’ahu; Hurricane Iwa	1
1980	Statewide; heavy rain, flooding	0
1979	Hawai’i; heavy rain, flooding	0
1960, May	statewide; tsunami from Chile earthquake	61
1960, Jan.	Kapoho; volcanic eruption	0
1959	Kaua’i; Hurricane Dot	0
1946	statewide; tsunami from Aleutian Is. earthquake	173

Lesson #4 Titanic Tsunami Task Card Poster-Graph
RUBRIC

CATEGORY	Advanced	Proficient	Partially Proficient	Novice
Graph: Appearance	Graph paper used. Neat, excellent size. A ruler was used to draw straight lines.	Graph paper used. Neat, adequate size. A ruler was used to draw straight lines.	Graph paper not used. Neat, adequate size. A ruler was used to draw straight lines.	Graph paper not used. Appears messy and "thrown together" in a hurry. Lines are visibly crooked.
Graph: Title	Title clearly states what wave characteristic is being shown and is at the top of the graph.	Title is unclear OR is not at the top of the graph.	Title is unclear AND is not at the top of the graph.	Title is simply "graph" or is not present.
Graph: Setup	Data is plotted correctly; student followed directions to make a bar graph; variables are placed on the correct axes: X = independent; Y = dependent.	Data is plotted accurately in general, but student did not make a bar graph OR the variables are placed on the wrong axes: Y = independent; X = dependent.	Data is plotted accurately in general, but student did not make a bar graph AND the variables are placed on the wrong axes: Y = independent; X = dependent	Data is plotted inaccurately in general.
Graph: X axis	The X axis is labeled "Waves;" both bars are correctly labeled.	The X axis is labeled correctly, but one bar is labeled incorrectly.	The X axis is labeled correctly, but both bars are labeled incorrectly.	The X axis is not labeled.
Graph: Y axis	The Y axis is labeled with the correct characteristic; correct units	The Y axis is properly labeled; it is missing EITHER the correct units OR	The Y axis is properly labeled; it is missing BOTH the correct units AND an	The Y axis is not labeled.

	are labeled and there is an appropriate, consistent multiple.	an appropriate, consistent multiple.	appropriate, consistent multiple.	
Pictures: Appearance	Lines are clear; no smudges or stray marks; good color or effective black-and-white; overall, the quality of drawing is excellent.	There are a few smudges or stray marks, but they do not detract from the drawing; good color or effective black-and-white; overall, the quality of drawing is good.	There are a few smudges or stray marks OR color or black-and-white is not used carefully; overall, the quality of drawing is fair.	There are smudges or stray marks that detract from the drawing; using only pencil makes drawing less attractive; overall, the quality of drawing is poor.
Pictures: Scientific Accuracy	Tsunamis are accurately drawn & distinguishable from wind waves; many examples of tsunami disaster and wind wave enjoyment are creatively shown; the pictures are very informative.	Tsunamis are accurately drawn & distinguishable from wind waves; at least one tsunami disaster AND one wind wave enjoyment are shown; the pictures are informative.	Tsunamis are accurately drawn & distinguishable from wind waves; EITHER tsunami disaster OR wind wave enjoyment is shown.	Pictures do not clearly distinguish tsunamis from wind waves OR tsunami disaster and wind wave enjoyment is not shown.