

TSUNAMI DISASTER: TEACHER GUIDE

Subject: Earth Science

Grade Level: Middle School

Last Updated: May 31, 2006

Case Summary

UN Secretary General Kofi Annan needs your help. The devastating Indonesian tsunami of 2004 has many world leaders worried that a similar disaster could occur in their nations as well. As expert scientists, you and your colleagues need to compile and present a report to the UN General Assembly detailing the causes and effects of the 2004 tsunami and the areas of the world that are at greatest risk of a future tsunami.

Credits

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Learning Objectives

At the end of the case, students will be able to:

1. List and describe the various types of tectonic plate boundaries.
2. Explain what types of tectonic activity ultimately cause tsunamis.
3. Describe the formation and movement of tsunamis from the open ocean to shoreline
4. Describe the human impact of tsunamis, including public health, demographic, environmental and economic fallout.

Georgia Performance Standards

SCSh1. Students will evaluate the importance of curiosity, honesty, openness, and skepticism in science. (NSES Content Standard A)

S6E3. Students will recognize the significant role of water in earth process. (NSES Content Standard D)

- c. Describe the composition, location, and subsurface topography of the world's oceans.
- d. Explain the causes of waves, currents, and tides.

S6E5. Students will investigate the scientific view of how the Earth's surface is formed. (NSES Content Standard D)

- a. Compare and contrast the Earth's crust, mantle, and core including temperature, density, and composition
- d. Recognize that lithospheric plates constantly move and cause major geological events.

- e. Explain the effects of physical processes (plate tectonics, erosion, deposition, volcanic eruption, gravity) on geological features including oceans (composition, currents, and tides)
- S8CS9. Students will understand the features of the process of scientific inquiry. (NSES Content Standard A)
- SS7G9. The student will be able to describe and locate important physical and human characteristics in Southern and Eastern Asia. (NSES Content Standard F)
- b. Describe and locate the following nations in Southern and Eastern Asia: India, Bangladesh, Pakistan, Vietnam, Myanmar, Sri Lanka, Thailand, Indonesia, Malaysia, Philippines, Japan, China, North and South Korea, Russia and Georgia.

Assessment

At the end of the case, students will pass in their box charts, which will be graded based on completeness and clarity. Even though we go over these periodically in class, knowing that they will be passing the box charts encourages students to listen and efficiently take notes.

For their final assessment, students can choose from a number of possible products for their “presentations to the General Assembly.” These include, but are not necessarily limited to, brochures (for imagined distribution to the Assembly), informative posters, Power Point presentations, and speeches. Our students all chose posters as their preferred product.

Overall grading for the case is based on their combined grades for their box charts and products. Grading will be based on a 5-point scale (5=excellent, 4=very good, 3=good, 2=fair, 1=poor) that will be converted into a percentage and from there into total points depending on the weight of the assignment, for each of three criteria:

- Accuracy and depth of product components; attention to grammar and mechanics
- Individual contribution/participation within the team
- Individual research ability and effort – online, print, investigative questioning

The second and third criteria (participation, individual effort) will be judged not only by facilitator observations, but also by student evaluations to be completed at the end of the case (See **Self/Group Evaluation Worksheet** in Student Materials).

Implementation Strategy

This case is designed to take place over two 60-minute and three 120-minute class sessions. It has two scripted scenes, the second of which includes two handouts. This case can be facilitated by two facilitators or even a single teacher, because rather than placing a facilitator with every group, the students spend time brainstorming with their group and then as a whole class.

Students read, discussed and took notes in their groups, then reconvened as a whole class to volunteer their observations, questions, hypotheses and learning issues (learning issues are things that students say they need to know or look up to define unknown terms, answer their

questions, and/or test their hypotheses). During the group brainstorming, the teacher/facilitators floated from group to group, checking progress and helping students with any stumbling blocks they may have. During the whole-class volunteering time, the teacher/one of the facilitators took notes on an overhead or with a Smart Board. In this way, students learned to work as a team while still benefiting from sharing their information as a whole class or even competing with other groups for volunteering, while the teacher could make sure that all students were at the same point in the case at each step.

Teachers should find and print out archived articles that are relevant to the case from news websites such as www.cnn.com, www.nytimes.com, www.msnbc.com, www.bbc.com to distribute to students as the “included press releases” mentioned in the UN Letter (on Day 2).

Implementation Schedule

Day 1 (60 minutes total)

- Read UN Letter (10 min.); complete box charts (20 min.); share and discuss as a class (30 min.)

Finish box charts for homework

Day 2 (120 minutes total)

- Divide up learning issues among the group (10 min.)
- Read news article handouts and (selected) eye-witness accounts in class; take notes on aspects that address learning issues (45 min.)
- Computer lab: Research learning issues not addressed by news articles online for the remainder of class.

Day 3 (120 minutes total)

- Share and discuss findings from learning issue research; first within groups (20 minutes), then as a class (45 minutes).
- Tour “Asia’s Deadly Waves” website from the NY Times (see **Resources**) on an LCD projector onto a large screen, including “Hour by Hour,” “Plate Tectonics” and “Death Toll,” with a link to photos from Thailand, Indonesia, Sri Lanka and India. (remainder of class; this website fosters a lot of discussion and includes dramatic, sometimes graphic, photos of the aftermath)

Homework: Finish researching any remaining or new learning issues

Day 4 (60 minutes total)

- Outline presentation layout and content; divide up contributions to the poster among group members based on interest, skill, etc. (30 min.)
- Begin working on presentation to General Assembly (30 min.)

Day 5 (120 minutes total)

- Work on poster in groups (105 min.)
- Complete case evaluation; wrap up (15 min.)

Case Notes

What Went Well

1. The topic: Students readily referenced what they had seen or heard from various news sources, parents, etc. about the tsunami, and the framing of the letter was brief and to the point, which helped move the case along expeditiously.
2. The webpage: Unfortunately, the school computer lab was either down or reserved by other classes during our implementation. However, we hooked up an LCD projector to the teacher computer in the classroom and projected the webpage onto the screen, letting the students direct us where to go in the list of topic links. This may have been more productive than independent research for this case, given our narrow time frame (see below).
3. The NY Times “Asia’s Deadly Waves” webpages (see **Resources**: *Absolutely the BEST...*): This site may require Flash software to run, but it is a treasure trove of maps, plate tectonics overviews, hour-by-hour reconstructed timelines, death tolls by region, and incredible photos. If future implementation could only involve one website, this would be it.
4. The case product: Having the students explain the causes and effects of tsunamis and identify areas of the world that are at risk for tsunamis in the future helped expand the scope beyond the 2004 tsunami and hit on all of the content points of interest, without overloading the students with too much information. Having an immediate use for the topic (i.e. global advice on tsunamis) helped out a great deal and helped tie everything together.

What Could Have Gone Better

1. Time constraints: Because of academic schedules, assemblies, and spring break, we found ourselves needing to move the case along more quickly than originally intended. However, the case was still a success. However...
2. The students could have benefited from more time to work on their product, and while it was very useful to explore the web resources as a whole class, ultimately the students benefit more from being forced to take charge of their own research (within the framing and guidelines of the class webpage).
3. The letter: While the students enjoyed the UN Letter because it was a more direct, concise introduction to the case, an additional format such as an evening news report, acted out by student volunteers, may have helped foster more enthusiasm because our class very much enjoys play-acting. Given more time to implement, perhaps having students act out news briefings using the printed versions of online articles (noted below in **Resources** as useful to include, since the letter implies that news reports accompany) after reading the letter would add an additional element to the case.

Facilitator Guide:

UN Letter with key concepts underlined:



December 30, 2004

[The use of this date is intentional since the case is meant to take place within days of the original disaster]

Dear Drs. [Students in each group should enter their last names]_____.

As you know, several days ago a massive earthquake created a tsunami that swept through much of Southeast Asia, killing thousands of people and destroying huge tracts of land. The entire region is in chaos, and the entire world has been affected by this tragedy. Many world leaders are concerned that another tsunami like this one could happen elsewhere in the world and create a catastrophic situation in their countries as well.

You are all top researchers in seismology and oceanography, and so I am writing to you to ask for your help. The United Nations is creating a special task force to investigate the causes and effects of the tsunami, and to predict where this type of disaster could hit in the future. I want you to head this task force. You will report directly to me and to my advisors, and once you have compiled your findings you will present them to the UN General Assembly. Please be as thorough as you can, so we can know as much as we can about the tsunami disaster and how to predict them in the future. To help with your research, I have included several eyewitness reports and news transcripts.

Good luck, scientists. We need you to help make the world a safer place.

Sincerely,

Kofi Annan

Secretary General of the United Nations

Faciliator Box Charts With Key Concepts/Issues Included:

UN Letter Facilitator Box Chart

<p style="text-align: center;">Facts I read that...</p> <ol style="list-style-type: none"> 1. A tsunami struck S.E. Asia 2. Created by earthquake 3. Many deaths 4. Destroyed large land tracts 5. Can it happen in other parts of the world? 6. Has affected entire world. 7. Leaders want to prevent future tsunamis'. 8. We are seismologists and oceanographers. 9. We head the United Nations task force. 10. Inform us about the tsunami disaster and how to predict. 11. Report findings to U N general assembly. 	<p style="text-align: center;">Questions? I wonder ... or I want to ask...</p> <ol style="list-style-type: none"> 1. What is a tsunami? 2. Where do tsunamis occur? 3. Where is Southeast Asia? 4. What causes a tsunami? 5. How to predict a tsunami? 6. What causes earthquakes? 7. What is seismology? Oceanography? 8. What is the UN General Assembly? 9. What is a tract of land? 10. What is a task force? 11. How to minimize effects of a tsunami? An earthquake?
<p style="text-align: center;">Hypotheses I think... If (FACT), then...</p> <ol style="list-style-type: none"> 1. Parts of the world that are close to water are at risk of tsunamis 2. If the tsunami struck Indonesia and other islands nearby, then islands are especially at risk for more tsunamis 3. Other parts of the world are not at risk for future tsunamis. 	<p style="text-align: center;">Learning Issues I need to look up/learn more about...</p> <ol style="list-style-type: none"> 1. Tsunamis: definitions, causes 2. Where tsunamis occur 3. Location/countries in SE Asia 4. How to predict and respond to tsunamis 5. Earthquakes: definitions, causes 6. Seismology 7. Oceanography 8. UN General Assembly 9. Definitions: tract, task force

Resources

We found that assembling the most useful of the following online sources as links on a website that the students can access in the computer lab or at home is a very efficient way to structure group or independent research. Also, the students should be encouraged to utilize their textbooks or other resources. These are some helpful resources; a selection of these was included on the “Tsunami Disaster” page of the PRISM website under 8th grade Cases (www.prism.emory.edu/columbia).

The December 2004 Disaster

Sohn, E. (2005). Wave of destruction. Retrieved October 25, 2005 from <http://www.sciencenewsforkids.com/articles/20050119/Feature1.asp>

Wikipedia, The Free Encyclopedia. (2005). 2004 Indian Ocean earthquake. Retrieved October 25, 2005 from http://en.wikipedia.org/wiki/2004_Indian_Ocean_earthquake

Gupta, S., Haidar, S. & McCabe, K. (2005). Sisters see spouses die; mom makes wrenching choice. Retrieved October 25, 2005 from <http://www.cnn.com/2004/WORLD/asiapcf/12/31/tsunami.families/index.html>

Unicef. (2005). Tsunami: One year update. Retrieved November 15, 2005 from http://www.unicef.org/emerg/disasterinasia/24615_main.html

Facilitators are also encouraged to look at articles on news websites such as www.cnn.com, www.nytimes.com, www.msnbc.com, www.bbc.com to distribute to students as the included press releases mentioned in the UN Letter.

General Information

Department of Earth and Space Sciences. (2005). Welcome to *tsunami!* Retrieved October 25, 2005 from University of Washington <http://www.ess.washington.edu/tsunami/index.html>

Nelson, S. A. (2005). Tsunami. Retrieved October 25, 2005 from <http://www.tulane.edu/%7Eesanelson/geol204/tsunami.htm>

Earth and Space Sciences, University of Washington (2005) Tsunami! Retrieved October 26, 2005 from <http://www.ess.washington.edu/tsunami/toc.html>

Absolutely the BEST Tsunami resource online!!

McGhee, G., Schlieper, J., Owles, E., & Iaboni, L. (2005). Asia’s deadly waves. New York Times. Retrieved October 26, 2005 from http://www.nytimes.com/packages/khtml/2004/12/31/international/20041231_TIMELINE_FEATURE.html

A nice, clear step-by step animation of tidal waves

PBS Online. (2005). Savage earth animation: Tsunami attack. Retrieved October 26, 2005 from <http://www.pbs.org/wnet/savageearth/animations/tsunami/>

BBC Science & Nature: TV & Radio Follow-up. (2003). Mega-tsunami: Wave of destruction. Retrieved October 26, 2005 from http://www.bbc.co.uk/science/horizon/2000/mega_tsunami.shtml

Tsunami Disaster Prevention and Response

Useful information from officialdom (note also the sidebar links)

FEMA Disaster Assistance. (2005). Tsunami. Retrieved April 9, 2006 from <http://www.fema.gov/hazard/tsunami/index.shtml>

The National Tsunami Hazard Mitigation Program. (2005). Warning Guidance. Retrieved October 26, 2005 from <http://www.pmel.noaa.gov/tsunami-hazard/warning.html>

University of Alaska Fairbanks. (2005). Dangers of tsunamis. Retrieved October 26, 2005 from <http://www.uaf.edu/seagrant/earthquake/tsunami.html>

Misconceptions about Tsunamis

Al-Jundub, M. (2005). Professor explains tsunami misconceptions. Retrieved October 26, 2005 from <http://www.purdueexponent.org/interface/bebop/showstory.php?date=2005/03/01§ion=campus&storyid=TsunamiStory>

The Science of Tsunamis (A little advanced for middle schoolers, great for advanced high school students and facilitators)

Columbia University. (2005). Scientific background on the Indian Ocean earthquake and tsunami. Retrieved October 26, 2005 from <http://iri.columbia.edu/%7Elareef/tsunami/>

Department of Geophysics, University of Washington. (2005). The physics of tsunamis: The mechanisms of tsunami generation and propagation. Retrieved October 26, 2005 from <http://www.geophys.washington.edu/tsunami/general/physics/physics.html>

National Oceanic & Atmospheric Administration. (2006). Tsunamis. Retrieved October 26, 2005 from <http://www.noaa.gov/tsunamis.html>