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The document has been developed by Ms Shahiba Ali, Education Consultant, UWI School of Education, in collaboration with the University of the West Indies Seismic Research Centre (UWI SRC).

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This document and any updates to it are available at [www.cdema.org](http://www.cdema.org), [www.weready.org](http://www.weready.org) and [www.uwiseismic.com](http://www.uwiseismic.com).

**CDEMA**

*The Caribbean Disaster Emergency Management Agency*

Caribbean Disaster Emergency Management Agency (CDEMA)
Building #1, Manor Lodge Complex
Lodge Hill, St. Michael, Barbados, West Indies

**UWI**

*Seismic Research Centre*

University of the West Indies Seismic Research Centre
St. Augustine, Trinidad and Tobago, West Indies

**USAID**

*From the American People*

United States Agency for International Development
US Embassy Complex
Wildey Business Park, Wildey, St. Michael, Barbados, West Indies

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<tr>
<td>CDEMA</td>
<td>Caribbean Disaster Management Agency</td>
</tr>
<tr>
<td>IOC</td>
<td>Intergovernmental Oceanographic Commission</td>
</tr>
<tr>
<td>ISDR</td>
<td>International Strategy for Disaster Reduction</td>
</tr>
<tr>
<td>ITIC</td>
<td>International Tsunami Information Center</td>
</tr>
<tr>
<td>SRC</td>
<td>The University of the West Indies Seismic Research Centre</td>
</tr>
<tr>
<td>TCHWS</td>
<td>Tsunami and Other Coastal Hazards Warning System Project</td>
</tr>
<tr>
<td>UNESCO</td>
<td>United Nations Educational, Scientific and Cultural Organization</td>
</tr>
<tr>
<td>UNICEF</td>
<td>United Nations Children’s Fund</td>
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<tr>
<td>USAID/OFDA</td>
<td>The United States Agency for International Development /Office of U.S. Foreign Disaster Assistance</td>
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Rationale for a Teacher Education Resource Kit

In an effort to increase resilience against tsunamis and other coastal hazards in the Caribbean, the Caribbean Disaster Emergency Management Agency (CDEMA) through funding from the United States Agency for International Development, Office of United States Foreign Disaster Assistance (USAID/OFDA) has implemented The Tsunami and Other Coastal Hazards Warning System Project (TCHWS). One component of the Project involves the production and dissemination of public awareness and educational material for the public and teachers to be utilized in CDEMA Participating States.

The Tsunami Smart Teacher Education Resource Kit comprises four (4) tsunami lesson plans with clear objectives, an accompanying Tsunami Smart Student Workbook, inquiry-based activities, teaching charts, a slideshow presentation and other resources designed to support the teaching of tsunami science and safety in the classroom. The lesson plans and activities are aligned to current school curricula for students of lower secondary schools (~11-14yrs) in the English-speaking Caribbean.

The Teacher Education Resource Kit has been reviewed by regional curriculum officers representing their respective Ministries of Education at The TCHWS Project Regional Public Awareness and Education Workshop for CDEMA Participating States convened in Port of Spain, Trinidad & Tobago (October, 2009). The Kit also incorporates feedback received from the TCHWS Project Public Awareness & Education Sub-Committee, two Tsunami Smart Teacher Workshops - comprising primary and secondary school teachers and principals; lecturers from teachers’ training colleges and Ministry officials - in Antigua & Barbuda (February, 2010) and Barbados (March, 2010). One lesson (Lesson 1 - Be Tsunami Smart!) was tested at Hillview College in Trinidad & Tobago in January 2010.

Teaching tsunami science and safety to young children fosters a culture of responsibility for disaster preparedness at an early age. It is hoped that the introduction of this Kit will ensure that a large number of young people in the Caribbean will be exposed to the characteristics and behaviour of tsunamis, their effects and strategies for facing them, should they occur. The overall goal of the Tsunami Smart Teacher Education Resource Kit is that of promoting tsunami awareness and preparedness. As such, the Kit may be used in the upper secondary school level to enrich material that is already being taught. It is also hoped that the Kit be disseminated and adapted by educators outside the formal school system.
How to use this book

This Teacher Education Resource Kit comprises:

1. A Teacher’s Guide consisting of four lessons on tsunamis and resources to be used with each lesson.

2. Tsunami Glossary

3. Frequently Asked Questions (FAQ) Section

4. Student worksheets and accompanying activities that focus on teaching essential skills of communication, research, problem-solving, social and co-operative skills; blank maps and graphic organisers

5. Resources to accompany lessons are:
   - *Tsunami Warning!* Cartoon Booklet, UNESCO-IOC-ITIC adapted for the Caribbean
   - *Tsunami Smart* Teaching Charts, UWI Seismic Research Centre (SRC):
     - Tsunami Science
     - Tsunami Safety
     - Tsunamis in the Caribbean
     - Tsunami Impact
   - Tilly Smith video

6. Resources for further investigation on tsunamis and other hazards.
   - *Tsunami Teacher (pdf)*, UNESCO-IOC-ITIC
   - Online game found at [www.stopdisasters.org](http://www.stopdisasters.org) from UN ISDR (See the appendix for a review of this learning tool that promotes decision-making and its effects).
   - List of useful tsunami web sites

7. Lesson Activities are represented by this symbol and can be found in the Tsunami Smart Student Workbook.

Teachers are encouraged to modify and adapt the lessons to suit the needs of their students. If there is time to teach only one lesson, it is strongly advised that students are taught *Lesson 4 – Preparing for tsunamis*.

Teachers are also encouraged to share the material with other classes and teachers, parents at PTA meetings and with the wider school community by displaying charts in a prominent location in the school.
### Useful Websites

<table>
<thead>
<tr>
<th>Agency</th>
<th>Website</th>
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| CDEMA (Caribbean Disaster Emergency Management Agency)                | ![http://www.weready.org/](http://www.weready.org/)  
                          ![http://www.cdema.org/](http://www.cdema.org/)                                                |
| UWI Seismic Research Centre                                           | ![http://www.uwiseismic.com/](http://www.uwiseismic.com/)                                       |
                          (FEMA for kids)                                                                                   |
| ISDR (International Strategy for Disaster Reduction)                 | ![http://www.stopdisaster.org](http://www.stopdisaster.org)  
                          for online game simulating tsunami and other hazards. Includes Tilly Smith video               |
| IOC (Intergovernmental Oceanic Commission)                            | ![http://ioc.unesco.org/itic/](http://ioc.unesco.org/itic/)  
                          ![http://www.ioc/tsunami.org/](http://www.ioc/tsunami.org/)  
                          *Five years after: the Tsunami in the Indian Ocean, From strategy to implementation* document  |
| National Geographic Society                                           | ![http://news.nationalgeographic.com](http://news.nationalgeographic.com)  
                          ![http://kids.nationalgeographic.com](http://kids.nationalgeographic.com)  
                          *(National Geographic for Kids)* for lesson, games and puzzles                                 |
| NOAA (National Oceanic and Atmospheric Administration)                 | ![http://www.tsunami.noaa.gov/education.html](http://www.tsunami.noaa.gov/education.html)  
                          ![http://wcatwc.arh.noaa.gov/deadlywaters.pdf](http://wcatwc.arh.noaa.gov/deadlywaters.pdf)   |
                          ![http://www.hurricanetrack.com/ncstormsurge/mainpg.html](http://www.hurricanetrack.com/ncstormsurge/mainpg.html)  
                          ![http://www.salemcountyava.org/Tsunamis.htm](http://www.salemcountyava.org/Tsunamis.htm)  
                          shorelines.dnr.state.md.us/downloads/Coastal%20Hazards_Intro.ppt  
                          *(Government of New Zealand)*                                                                 |

Teachers are urged to search these web sites for teaching resources for the classroom.
Overview

This lesson introduces students to basic information on the nature, causes, effects and preparedness for tsunamis; and how young persons can save lives.

Teachers are strongly encouraged to modify the lesson to suit the duration and number of periods, the range of ability of their students, and the subject discipline into which the lesson is to be integrated.

Age level: Form 1 / Grade 7 (11-12 years)
Duration: 40 minutes (suggested)
Subject areas: Social Studies, Geography, Science, English Language, Drama

Learning objectives:

Students should be able to:

- Define the terms, hazard, natural hazard, tsunami
- Extract information on the nature, causes, effects and preparedness for tsunamis from a cartoon booklet adapted for the Caribbean.
- Recognise the importance of learning about tsunamis and its value in saving lives.

Resources:

- Tsunami Warning! A Cartoon Booklet prepared by UNESCO-IOC-ITIC and adapted for the Caribbean by The University of the West Indies Seismic Research Centre
- Tilly Smith Video
- Tsunami Smart Teaching Charts from SRC
- Atlases, wall maps
- Blank maps provided in Student Workbook
- Frequently Asked Questions (FAQ) provided
Lesson 1 Content – Be Tsunami Smart

The teacher:

- Questions students briefly on their knowledge of natural hazards in the Caribbean and tsunamis in general and asks them to fill in the KWL chart provided on page 5 of the Student Workbook.
- Asks students to extract information on the nature and effects of tsunamis and ways to prepare for them from the Tsunami Warning! Cartoon Booklet.
- Mounts Tsunami Smart Teaching Chart series in classroom as reference for actions to take.
- Shows Tilly Smith Video to underscore the importance of learning about tsunamis.

DEFINITIONS

Hazard: A hazard is a source of danger or threat that can cause damage to property or lives to be lost.

Natural hazard: A natural hazard is a threat from phenomena that are not man-made, such as earthquakes, volcanoes, hurricanes and tsunamis in the natural environment, which poses a danger to human life and property.

Tsunami: The word, ‘tsunami’, is of Japanese origin, pronounced (tsoo-NAH-mee). The first part of the word, ‘tsu’ means ‘harbour’ and ‘nami’ means ‘wave’. Tsunamis are called ‘maremoto’ in Spanish and ‘raz-de-marée’ in French. Some people also refer to tsunamis as seismic sea waves. Tsunamis are no longer called ‘tidal waves’.

Natural hazards in the Caribbean: earthquakes, tsunamis, volcanic eruptions, hurricanes, floods, drought, landslides, storm surges, high winds, and tornadoes.

Suggested Lesson activities

Activity 1: Students indicate what they know, what they want to know and what they have learnt about tsunamis, in each of the columns, using the KWL worksheet provided in the Student Workbook.

Activity 2: Students locate Portugal and the Caribbean from an atlas or wall map and insert on map provided.

Activity 3: Read aloud or dramatisation of Tsunami Warning! Cartoon Booklet
Using copies of the *Tsunami Warning!* cartoon booklet and the *Tsunami Smart Teaching Charts* from the *Teacher Educational Resource Kit*, the teacher can read aloud or get students to dramatise the scenario depicted in the cartoon booklet.

**Activity 4:** Students extract information on causes, effects and preparing for tsunamis to answer questions provided in *Student Workbook* after reading *Tsunami Warning!* They can answer the questions either orally or in writing.

**Closure:** Teacher reviews main points of lesson.

**Evaluation:** Teacher can use Activities 4, 5, 6 and 7 for Lesson 1 in the *Student Workbook*; by oral questioning throughout the lesson and use of the KWL worksheet.

**Follow-up activities:** 1. Students research the most recent tsunami event that has taken place in the world, by visiting the website of the Seismic Research Centre (SRC) or any of the other web sites listed in the Resource Kit.

2. Students are asked to share their knowledge with their parents/guardians and provide feedback to teacher for next class.

**Follow-up Lesson:** Lesson 4- Preparing for tsunamis

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**Lesson 2 – Experiencing a Tsunami**

**Overview**

The aim of this lesson is to sensitise students to the emotional issues that are faced by children who are survivors of natural disasters, and to learn that they can assist in disasters.

Teachers are strongly encouraged to modify the lesson to suit the duration and number of periods, the range of ability of their students, and the subject discipline into which the lesson is to be integrated.

**Age level:** Form 2 /Grade 8 (12-13) years

**Duration:** 80 minutes

**Subject areas:** Social Studies, Geography, Art, English Language and English Literature, Drama
Learning objectives:

Students should be able to:

- Describe the characteristics, causes and effects of tsunamis
- Explain why they can occur in the Caribbean
- Extract information on the nature of tsunamis and the devastating effects they can have on people’s lives from two pieces of creative writing provided
- Locate on a map the countries mentioned in the stories
- Appreciate that children can be heroes

Resources for lesson:

- *Tilly Smith* video
- Frequently Asked Questions (FAQ) provided
- *Tsunami Smart* Teaching Charts

**Lesson 2 Content – Experiencing a tsunami**

Teacher mounts *Tsunami Smart Teaching Charts* in classroom and uses information from the FAQ section in the Teacher’s Guide to explain the possibility of a tsunami occurring in the Caribbean.

**Objectives**

- Describe the characteristics, causes and effects of tsunamis
- Explain why they can occur in the Caribbean

Definitions of tsunamis, their causes and impacts, and an explanation of the likelihood of a tsunami in the Caribbean are to be taken from the FAQ section of the Resource Kit and the *Tsunami Smart* Teaching Charts.

**Closure**

- Teacher reviews main points of the lesson.

**Evaluation:** Activity 1 for Lesson 2 from *Student Workbook*

Teacher selects from the three stories provided in Appendix for students to read.
Objective

- Extract information on the nature of tsunamis and the devastating effects they can have on people’s lives from two pieces of creative writing and an article from a newsletter published by UNICEF.

The effects of tsunamis on people and the environment are to be taught through the use of two creative writing pieces based on the experiences of two children from different backgrounds from the 2004 Indian Ocean tsunami. The stories, ‘Colours’ written by Narinder Dhami and ‘A Christmas Angel’ written by Cliff MacNish were made freely available from the UNICEF web site.

The story, ‘Colours’, is a very emotive one that tells the true story of a girl who lost her family in the devastating tsunami event of 2004 in the Maldives. She is asked to draw what she feels like drawing in a class. She chose to draw the picture of the tsunami destroying the village and her family, expressing herself through the choice of various colours.

The piece appeals to the affective domain of learning, and gives students the opportunity to explore their feelings about the story and to imagine what it would feel like if they had lost their parents that way. Often the trauma experienced by such devastating natural disasters is not dealt with In Teaching About Hazards And Disasters.

The Third Story, Making Heroes Out Of Children With A New Emergency Preparedness Programme, is an article from UNICEF about a young girl who saved the lives of her mother and brother during the 2004 tsunami event, and how important it is for schools to teach disaster preparedness.

Children’s and young people’s capacities in emergencies

What children and young people have done at different ages:

**Children aged 5-10 years:**
- Making toys for younger children

**Children aged 9-12 years:**
- Providing first aid
- Playing and supporting children who lost family members
- Talking with and supporting friends who were sad
- Collecting food and rations for old people
• Helping prepare food
• Helping to clean camps
• Making representation to adults

**Children aged 12 years:**
• Teaching younger children
• Caring for younger children
• Working as part of emergency task group

**Children aged 12-17 years:**
• Rescuing and saving younger children
• Caring for younger children
• Teaching younger children and peers
• Treating wounds and caring for injured people
• Clearing up after an emergency
• Collecting bodies
• Helping to trace families
• Helping old people to collect food and rations
• Helping families with small children to collect food and rations
• Packing food for distribution
• Providing information about milk powder needs
• Cleaning camps
• Cleaning and painting buildings
• Developing businesses

**Young people aged 18 and older:**
• Rescuing and saving younger children
• Organizing entertainment
• Developing businesses
• Providing community communications
• Negotiating with outsiders on behalf of a community

(Drawn from several sources, especially Plan International, 2005)


Evaluation: Oral or written answers to questions asked in Activities 2, 3 or 4 and 5 for Lesson 2 in the Student Workbook.

Follow-up Activities:

1. Teacher asks students to write a poem, rap, or song to reflect the story of ‘Colours’.

2. ‘Christmas Angel’ is not a true story but it could well be as in real life a ten-year old schoolgirl, Tilly Smith, saved many lives of people who chose to listen to her when she shouted to run from the beach and into the highest floor of their hotel building during the 2004 Indian Ocean tsunami. Students can read more about Tilly Smith and how her geography class taught her to recognize the signs of an approaching tsunami at http://news.nationalgeographic.com.

3. Teacher shows the video on Tilly Smith.

Follow-up Lesson: Lesson 4 – Preparing for tsunamis

Lesson 3 – Teach your elders about Tsunamis

Overview

The lesson provides detailed factual information on tsunamis in general, and specifically on the possibility of a tsunami in the Caribbean. It emphasizes tsunami preparedness and the sharing of this information with elders at home and in communities.
Should time be a constraint, teachers are advised to give the main points in the topics, along with the *Understanding Tsunamis* Powerpoint presentation and the *Tsunami Smart Teaching Charts*, which contain a variety of informative illustrations.

**Teachers are strongly encouraged to modify the lesson to suit the number and duration of periods, the range of ability of their students, and the subject discipline into which the lesson is to be integrated.**

Topics covered:

1. Nature of tsunami hazard  
2. Characteristics of a tsunami  
3. (a) Causes of tsunamis  
   (b) Types of tsunamis  
4. The behaviour of tsunami waves as they approach shallow water  
5. Tsunami occurrence in the Caribbean  
6. Likelihood of a tsunami in the Caribbean  
7. Scientists and warning systems in the Caribbean  
8. Warning Information

**Age level:** Form 3 / Grade 9 (13-15 years)  
**Duration:** 80 minutes

**Subject areas:** Social Studies, Geography, Art, Science, English Language, Drama

**Learning objectives:**

Students should be able to:

- Describe the characteristics, causes and effects of tsunamis  
- Explain why they can occur in the Caribbean  
- Locate on a map the countries mentioned in the stories.  
- Prepare an evacuation plan for their school in the event of a tsunami  
- Play the online simulation game, if Internet access is available

**Resources for lesson:**

- *Understanding Tsunamis*, a PowerPoint presentation from Seismic Research Centre (SRC)  
- Tilly Smith video  
- Frequently Asked Questions (FAQ) provided in Teacher’s Guide  
- *Tsunami Smart* Teaching Charts  
- Online game from ISDR available at [www.stopdisasters.org](http://www.stopdisasters.org) (See the Appendix for a review of this interactive learning tool.)
Prior knowledge is to be assessed using the KWL chart presented for Lesson 1.

Lesson 3 Content – Teach your elders about tsunamis

Teacher can start lesson with the Tilly Smith video, and use the KWL chart to assess student’s prior knowledge and misconceptions that they may have about tsunamis.

Teachers are strongly urged to read the FAQ section and the information provided in the Appendix, on Caribbean tsunamigenic events that must accompany Tsunami Smart Teaching Chart #4, Tsunamis in the Caribbean.

1. Nature of tsunami hazard

Definition of the term ‘tsunami’

A tsunami is a series of waves caused by a sudden disturbance of the ocean floor that displaces a large amount of water. Tsunami waves are different from large waves brought by storms. They usually look like a surge of sea inland rather than breaking waves. Tsunamis bring many surges that can last for hours, arriving every ten to sixty minutes

What is a wave? A wave is a movement of energy that takes a particular form of a curve having a peak or crest and a trough. Sound wave forms are described by the same terms of ‘amplitude’ and ‘wavelength’ as for a tsunami.

Wave Characteristics

Diagram illustrating wave characteristics.

---

1 “Preparing Your Community for Tsunamis.” GeoHazards International (2008)
The word ‘tsunami’ is of Japanese origin, pronounced (tsoo-NAH-mee). The first part of the word, "tsu" means ‘harbour’ and "nami" means ‘wave’. Tsunamis are called ‘maremoto’ in Spanish and ‘raz-de-marée’ in French. Some people also refer to tsunamis as seismic sea waves and tidal waves.

**Distinguish between tsunamis and tidal waves**

‘Tidal wave’ is a term that was once used to describe tsunamis as the waves looked like a violent tidal change with no cresting waves that people usually see at the beach. However, since tsunamis are not actually related to tides the term is considered misleading and its usage is discouraged by oceanographers.

**2. Characteristics of a tsunami**

A tsunami is a series of long waves moving as fast as a jet plane, as much as 800 km/hr within the ocean. At the coast they can be as high as 30 metres. Tsunamis become a hazard if people’s lives are lost and their property is damaged.

As a tsunami approaches the coast, the first thing that may happen is that the water may withdraw drastically exposing the shore more than even at the lowest tides.

Image of wave retreat exposing extensive sea floor at the coast, Sri Lanka, December 2004
Source of image: www.digitalglobe.com
This major withdrawal of sea water should be taken as a warning that the first of the tsunami waves will arrive shortly. This is the time to move immediately to higher ground. Another wave begins when the level of the sea water grows higher. The first wave is often not the biggest wave. It is usually the second or third wave in the tsunami that is the most destructive.

3 (a) Causes of tsunamis

- **Earthquakes**
  Earthquakes are caused by the movement of plates (huge slabs of rock) making up the surface of the Earth. The region where two or more plates meet is called a plate boundary. The plates are constantly moving but this plate movement is neither smooth nor continuous, rather the plates often lock together at plate boundaries causing a build-up of energy. When the plates eventually move out of this locked position the energy that is released may be felt as an earthquake. Most tsunamis are caused by earthquakes.

A tsunami can be generated by any disturbance that rapidly moves a large mass of water.

Most tsunamis occur after a large earthquake under the ocean, and are due to vertical changes in the sea bottom where there are faults or cracks in the Earth’s crust. This was the case for the memorable tsunami disaster in the Indian Ocean on Boxing Day of 2004.

- **Volcanic eruption**
  Tsunamis can also be caused by volcanic eruptions, e.g. Krakatau, Indonesia in 1883. A volcano is an outpouring of lava, gases and rock material from a vent in the Earth’s crust. The rush of material down the sides of a volcano, like a landslide, can also cause a tsunami when this material enters the sea and displaces large volumes of water, as in Indonesia in 1883. You can read more about this event in the Tsunami Smart Information Kit for Caribbean Media at www.weready.org.

- **Landslides**
  Landslides along the coast can also cause tsunamis as was the case in Papua New Guinea in 1998. This event led to the death of at least 2000 people.
3 (b) Types of tsunamis- There are three types of tsunamis, **local, regional and distant.**

A **local** tsunami is one in which the affected coastlines are relatively close (<100 km) to the source of the tsunami. Generally, local tsunamis may reach the shores of nearby islands in less than ten minutes which is insufficient time for local authorities to receive and issue an official warning. This is important to know in preparing for the tsunami hazard.

A regional tsunami is one in which the affected coastlines are generally more than 100 km but less than 1000 km away from the source of the tsunami.

**Distant** tsunamis (or tele-tsunamis) are those whose effects are produced hours after the earthquake’s (or other tsunami triggering mechanism) occurrence in a very distant location, ie. more than 1000 km away from the impacted coastline. The long distances over which the waves travel can reduce their impacts and allow ample time for warning to be received and disseminated. A tele-tsunami was generated following the Chilean Earthquake on February 27th, 2010. The tsunami traveled across the Pacific Ocean and impacted several countries including Hawaii and Japan.
Countries surrounding the Pacific Ocean experienced major earthquakes (red dots) that generated tsunamis causing damage or casualties more than 1000 km away. Source: Pacific Tsunami Warning Center.

4. The behaviour of tsunami waves as they approach shallow water

As a result of their long wavelengths in deep ocean, tsunamis tend to be small in the deep ocean (you can barely notice them while travelling over open water). As a tsunami approaches shore, it begins to slow down as the wave form comes into contact with the seafloor. The water is drawn back into the sea, and the sea begins to recede abnormally. The water then rushes onto the coast with tremendous force (about as fast as a jet plane) because the height of the waves increases like a wall of water as they reach the sloping seafloor near land masses.

A tsunami is really a series of waves and the first wave may not appear to be large. Since tsunamis can travel very far without losing much energy, they can affect places far from their source. There are more large, destructive tsunamis in the Pacific Ocean because of the many major earthquakes along its margins and also because parts of the Earth’s crust in that region move vertically rather than horizontally.
When the water rushes onshore, it can flood or inundate areas up to 3 km inland going above the typical high-water level that people use as a reference for building to avoid being flooded by storm surges. The area experiencing this flood is called the inundation zone. The powerful flow of water associated with the incoming tsunami can crush homes and other coastal structures. Tsunamis can sweep boats onto the shore, drown people and animals, and strip beaches of sand that may have taken years to accumulate. The powerful waves can also remove trees and other coastal vegetation.

5. Tsunami occurrence in the Caribbean

In the Caribbean, tsunamis can be generated from volcanic eruptions, landslides off the sides of volcanoes and earthquakes. Tsunamis generated from earthquakes have occurred most frequently in the Leeward Islands, Jamaica, Cuba, Puerto Rico, Barbados, Antigua and Dominica. These occurred over a period of time from 1690 to 1969. (See Tsunami Smart Teaching Chart on tsunami occurrence in the Caribbean and Caribbean Tsunamis in the Appendix.)

There are two groups of earthquakes that may generate tsunamis in the Caribbean. These are earthquakes that occur within the region to produce local and regional tsunamis and distant earthquakes occurring outside the region that may generate distant tsunamis or tele-tsunamis. A regional tsunami is one which occurs about 1000km from its source.

Four conditions usually favour the generation of a tsunami by an earthquake:
(1) The earthquake occurs at shallow depth – less than 70 km.
(2) The earthquake is greater than magnitude 6.5.
(3) The fault is submarine and ruptures the Earth’s surface or causes material to collapse into the ocean.
(4) The earthquake causes vertical movement of the fault and sea floor (up to several metres).

In the past 500 years, there have been about 50 local earthquakes that could have generated tsunamis in the Caribbean, but only 10-20% of these actually generated tsunamis that resulted in noticeable flooding of coastal areas. For distant earthquakes, the Great Lisbon earthquake of November 1st 1755 occurred near Portugal and resulted in a tele-tsunami that crossed the Atlantic and was noticed throughout the Eastern Caribbean, from Cuba to Barbados. The map below shows the travel time and the approximate height of the waves as the tsunami approached Barbados.
The wave height generated was about 2 - 4 metres (6.5 – 13 ft). No damage or casualties were reported. However, tsunamis generated from earthquakes in 1842 in Haiti, in 1867 in the Virgin Islands, in 1918 in Puerto Rico, and in 1946 in the Dominican Republic caused the deaths of some 350 people in total.

6. Likelihood of a tsunami in the Caribbean

The likelihood for tsunamis in the Caribbean is low, about one destructive tsunami every 100 years for local earthquakes and one destructive tsunami every 200 years for distant earthquakes. They, however, are likely to occur in the Eastern Caribbean where moderate earthquake activity occurs. For this to happen there must be shallow (less than 70km depth) earthquakes with a magnitude greater than 6.5.

Tsunamis can also be triggered by large volcanic eruptions at or below sea level. Kick-‘em-Jenny, the Caribbean’s well-known submarine volcano, is located 9 km northwest of Grenada and erupts about every 11 years. Two of those eruptions, in 1939 and 1965, are known to have generated small tsunamis that were witnessed on the north coast of Grenada. However, studies on Kick-‘em-Jenny in 2002-2004 show that tsunamis are not likely to occur anytime soon but may do so at some time in the future.

7. Scientists and warning systems in the Caribbean

At present, there is no comprehensive tsunami warning system in the Caribbean. Seismic monitoring and government agencies in the Caribbean and adjacent areas (Central America, South America) are in the process of developing a tsunami warning system for the region.
In the mean time, if an earthquake occurs that can or has triggered a tsunami that may affect the Caribbean, the Pacific Tsunami Warning Center (PTWC) will issue a warning to the Tsunami Warning Focal Point - TWFP, the official agency responsible for receipt of the warning message. The TWFPs for Puerto Rico and the Virgin Islands do not receive their warnings from the PTWC. Publicising this warning within countries, however, is the responsibility of key local agencies including the National Disaster Management Organisation.

Scientists at the UWI Seismic Research Centre in Trinidad and Tobago monitor around the clock earthquake events in the Eastern Caribbean while the Puerto Rico Seismic Network monitors mainly those events at the northern part of the Caribbean. The UWI Earthquake Unit monitors earthquakes in Jamaica and the Institut de Physique du Globe de Paris (IPGP) monitors seismic activity for the French West Indies (Martinique and Guadeloupe).

8. Warning Information

In the event of a potential or actual tsunami that may impact the Caribbean, the Pacific Tsunami Warning Center may issue the following messages to regional TWFPs. It is important that citizens know the meanings of these terms used for warning about an impending tsunami.

**TSUNAMI INFORMATION BULLETIN/STATEMENT** advises of major earthquakes and gives general information about tsunami threats. In most cases, it indicates there is no threat of a destructive tsunami, and is used to prevent unnecessary evacuations as the earthquake may have been felt in coastal areas.

**A TSUNAMI ADVISORY** is issued due to the threat of a potential tsunami which may produce strong currents or waves dangerous to those in or near the water. The threat may continue for several hours after the arrival of the initial wave, but significant widespread inundation (flooding) is not expected for areas under an advisory.

**A TSUNAMI WATCH** is the second highest level of alert. Watches are issued based on seismic (earthquake) information without confirmation that a destructive tsunami is underway. It is issued as a means of providing an advance alert to areas that could be impacted by destructive tsunami waves.

**A TSUNAMI WARNING** is the highest level of alert. It is issued where there is imminent threat of a tsunami from a large underwater earthquake or following confirmation that a potentially destructive tsunami is underway.

**A CANCELLATION BULLETIN** is issued to ensure that the population knows that the wave threat is no longer there.
People assume that an early-warning system is the key to preventing damage and loss of lives but it has been found that education about a tsunami’s natural indicators or warning signs – strong earthquake, sea withdrawal in some places - has saved lives in the past and will continue to save lives in the future.

**Closure:** Teacher reviews main points of the lesson.

**Evaluation:** Conducted through questioning and discussion using any of the graphic organisers provided in the Teacher’s Guide and any of the suggested Activities 1-4 that are given for Lesson 3 in the Student’s Workbook.

**Follow-up activities:** Students can research the effects of tsunamis on the natural and human environment through case studies and group work, using resources provided with the Teacher Education Resource Kit.

**Follow-up lesson: Lesson 4- Preparing for a tsunami**

### Lesson 4 – Preparing for a Tsunami

**Overview**

This lesson focuses on using one’s senses of feeling, hearing and seeing to escape an impending tsunami. The important message is, ‘Let your senses be your own warning system!’ It also presents common-sense actions to take before, during and after a tsunami event.

**Teachers are strongly encouraged to modify the lesson to suit the duration and number of periods, the range of ability of their students, and the subject discipline into which the lesson is to be integrated.**

**Age level:** All age groups (11 and over)

**Duration:** 80 minutes

**Subject areas:** Social Studies, Geography, Art, Science, English Language, Drama
Learning objectives:

Students should be able to:

- Value the importance of trusting their senses in detecting tsunamis
- Take common-sense actions that could save lives
- List the actions to take before, during and after a tsunami
- Formulate an evacuation plan for their family.

Resources for lesson:

- Understanding Tsunamis, a PowerPoint presentation from SRC
- Tilly Smith video
- Frequently Asked Questions (FAQ) provided
- Tsunami Smart Teaching Charts from SRC

Prior knowledge is to be assessed using the KWL chart presented in Lesson One.

**Lesson 4 Content – Preparing for a Tsunami**

Teacher shows Tilly Smith video to sensitise the students to the dangers of a tsunami, followed by the PowerPoint presentation on Understanding Tsunamis to older students. The Tsunami Smart Teaching Charts are to be used to summarise the key points in the lesson.

**Important Tsunami Smart messages**

1) Tsunamis have occurred in the Caribbean in the past and can occur in the future.
2) If you are at the coast and you feel a very strong shaking leave immediately and head inland or to high ground.
3) If you are at the beach and the sea withdraws drastically exposing the seafloor, leave immediately and head inland or to high ground.
4) Recognizing these natural warning signs could save your life.
5) Do not wait for all natural warning signs to occur before moving inland or to high ground.
6) Do not wait for an official warning before evacuating as there may not be enough time to issue one.
7) If a Tsunami Warning is issued, NEVER go down to the beach to watch the waves.
8) A tsunami is a series of waves that can come ashore for hours and the first wave is not necessarily the largest or most deadly.
9) After the tsunami, stay out of the danger area until an "all-clear" is issued by the competent authority.

Preparedness actions

Before a Tsunami

- Find out if your home, school or office is in a danger area by knowing the distance it is from the coast.
- If you live, work or go to school in a low-lying area – for instance near to the beach – learn the quickest way to get to high ground. A safe area would be at least 30m (~100feet) above sea level and 3km (~ 2miles) inland. Teach and practice your evacuation plan with all family members and work colleagues.
- Ensure that all family members, students and work colleagues know how to detect natural tsunami signs.
- Discuss tsunamis with your family, friends, students and work colleagues.
- **Gather disaster supplies:**
  - Flashlight and extra batteries
  - Portable, battery-operated radio and extra batteries
  - First Aid kit and manual
  - Emergency food and water (at least a 3-day supply)
  - Medication for chronic conditions
  - Cash and credit cards
- Develop an emergency plan in the event that family members are separated (e.g. during the workday when adults are at work and children are at school). Agree on a close friend or relative that should be contacted if children cannot reach their parents and vice-versa.

During a Tsunami

Sensing a tsunami

Tsunamis are often accompanied by natural signs that can be sensed by an alert person. Recognizing **any** of these tsunami warning signs at the beach may save your life.

**FEEL**

Do you FEEL the ground shaking strongly?

Strong earthquakes at the coast may cause tsunamis. If you feel a strong earthquake **RUN** to high ground after the shaking stops. Do not wait for an official warning to be issued. You may have less than 10 minutes before the first tsunami wave arrives.
SEE
Do you SEE an abnormal withdrawal of water?
As a tsunami approaches land, the ocean may pull back a long way from the shore, exposing the ocean floor, reefs and fish. **RUN** to high ground if the sea withdraws abnormally.

HEAR
Do you HEAR a strange roar?
A roaring sound from the ocean is sometimes heard before a tsunami arrives. **RUN** to high ground if you hear the roar.

- Sometimes tsunamis may occur without the initial withdrawal of the sea. In this case, a massive wall of water may be seen approaching land.
- If you are unable to move to higher ground go to an upper floor (3rd storey or higher) or roof of a building. As a last resort, climb a strong tree if trapped on low ground.
- If swept up by a tsunami, look for something to use as a raft.
- Abandon belongings. Save your life, not your possessions.
- **Never** go down to the beach to watch for a tsunami. If you can see the wave, you are already too close to outrun it.

A tsunami is **not a single wave**, but a series of waves that can come ashore for hours.

- The first wave may **not be the largest**. During the 2004 Indian Ocean tsunami it was the second wave that killed people, not the first.
- Heed official warnings. Play it safe, even if warnings seem ambiguous or you think the danger has passed.
- Stay out of danger zones until an “all-clear” is issued by a recognized authority e.g. your National Disaster Organisation.
- If possible, listen to the radio for official updates and instructions.
- Have the telephone number for your National Disaster Organisation at hand.
After a tsunami

- Stay tuned to a battery-operated radio for the latest emergency information.
- Help injured or trapped persons and persons requiring special assistance (infants, elderly people and persons with disabilities).
- Do not move seriously injured persons unless they are in immediate danger of fatal injury.
- Stay out of damaged buildings. Return home only when authorities say it is safe to do so.
- Shovel mud while it is still moist to give walls and floors an opportunity to dry.
- Check for electrical shorts and live wires. Never attempt to move live wires.
- Check for gas leaks.
- Keep out of stagnant water.
- Open windows and doors to help dry buildings.
- Check for damage to sewer and water lines.
- Check food supplies and have tap water tested by the local health department if possible.
- Fresh food that has come in contact with flood water may be contaminated and should be discarded.
- Expect the waves to leave debris. A tsunami will leave behind sand, the remains of houses and bodies.
- Expect earthquakes to lower coastal land. A large earthquake can leave nearby coastal areas lowered, allowing tidal water to flood them.

Closure: Teacher reviews main points of the lesson.

Evaluation: Oral or written presentation of answers to Activities 1-9 of the Student’s Workbook.

Follow-up activities: Teacher can choose any of the Activities 1-6 in the Additional Student Activities section of the Teacher’s Guide.
Frequently Asked Questions

What is a tsunami?
A tsunami is a series of waves caused by a sudden disturbance of the ocean floor that displaces a large amount of water. Tsunamis are caused generally by earthquakes, less commonly by submarine landslides, infrequently by submarine volcanic eruptions and very rarely by large meteorite impacts in the ocean.

Why is it called a tsunami?
The word tsunami is taken from two Japanese words which mean harbour (tsu) wave (nami).

Are tsunamis and tidal waves the same thing?
No. Strictly speaking, a tidal wave is related to ocean tides while a tsunami is triggered by earthquakes, landslides or volcanic events.

How are tsunamis different from normal ocean waves?
• Ocean waves are related to changes in the atmosphere while tsunamis are related to changes within the Earth.
• Tsunami waves are distinguished from ordinary ocean waves by their long wavelengths (distance between two crests or highest point of the wave), often exceeding 100 kilometers in the deep ocean and by the long amount of time between the arrivals of these crests, ranging from five minutes to an hour.
• Most tsunami waves do not break like normal surf waves at the beach that curl over as they approach shore rather they come in much like a very strong and very fast wall of water. Those that do break often form vertical walls of turbulent water called bores.

Is it wise to surf on a tsunami wave?
Absolutely not! Tsunami waves should not be surfed as they possess tremendous destructive power from BOTH the strength and size of the waves. The large amount of seafloor material (mud and sediment) caught up in the wave makes them very dangerous for surfing.

Do all earthquakes cause tsunamis?
No, all earthquakes do not cause tsunamis. Four conditions usually favour the generation of a tsunami by an earthquake:
(1) The earthquake occurs at shallow depth – less than 70 km.
(2) The earthquake is greater than magnitude 6.5.
(3) The fault is submarine and ruptures the Earth’s surface or causes material to collapse into the ocean.
(4) The earthquake causes vertical movement of the fault and sea floor (up to several metres).
Can an earthquake from outside of the Caribbean region cause a tsunami?
Yes, a tsunami may be generated from earthquakes occurring both within and outside of the region. In 1755 the Great Lisbon earthquake near Portugal caused a tsunami “as high as the upper storey’s of houses” on the east coast of Martinique. Waves 2m high were also observed at the east coast of Barbados.

How do volcanic eruptions cause tsunamis?
Although relatively infrequent, violent volcanic eruptions may displace a large volume of water and generate tsunami waves in the immediate source area. In this case, waves may be generated by the sudden displacement of water caused by large volumes of volcanic material displacing the ocean.

Can an eruption from the Kick ’em Jenny submarine volcano cause a tsunami?
Kick ’em Jenny is a submarine (underwater) volcano located 9 km northwest of Grenada. Currently, scientists consider that there is a very small chance that an eruption of the volcano would trigger a tsunami. Any tsunamis triggered by underwater eruptions are a potential hazard for neighbouring islands.

Can tsunamis be predicted?
Current understanding does not allow the date, time, magnitude and precise location of a future earthquake to be specified and so scientists cannot predict when an earthquake or landslide-generated tsunami might occur. However, tsunamis that are triggered by volcanic activity (e.g. underwater volcanic eruptions or pyroclastic flows) may be forecast if the volcano is carefully monitored as is the case with volcanoes in the Eastern Caribbean.

If a tsunami is detected by scientists how much time will they have to warn the public?
Following an earthquake, scientists need 5 – 20 minutes before a tsunami warning can be issued. However, if you live in Jamaica and a local tsunami is generated by an earthquake near Haiti, waves could impact your island in less than 15 minutes with little or no time for an official warning. This means that coastal residents must be able to recognise a tsunami’s natural warning signs. Alternatively, if an earthquake were to occur off the west coast of Africa, a tsunami generated by that earthquake (tele-tsunami) would take several hours before reaching the Caribbean, allowing ample time to issue an official warning.

Is there a tsunami early warning system in the Caribbean?
Currently, there is no Caribbean tsunami early warning system. Seismic monitoring and other technical agencies in the Caribbean and adjacent areas (Central America and South America) are in the process of developing a tsunami warning system for the region but it may be several years before this is complete. This system is being coordinated by the ICG/CARIBE the Caribbean chapter of UNESCO’s Intergovernmental Oceanographic Commission (IOC).

In the mean time, if an earthquake occurs that can or has triggered a tsunami that may affect the Caribbean, the Pacific Tsunami Warning Center (PTWC), which currently provides interim services, will send a warning to specific government agencies in the Caribbean (except those in Puerto Rico and the Virgin Islands). Although a Caribbean Tsunami Warning Centre with specific responsibility for issuing tsunami bulletins for the Caribbean is to be established, communicating this warning within countries, however, is the responsibility of key local agencies including the National Disaster Management Organisation.
Is it possible for a tsunami of similar amplitude and strength to the one that occurred in the Indian Ocean to occur here in the Caribbean?
The magnitude 9.0 earthquake which occurred on December 26th 2004 off the west coast of northern Sumatra, was the fourth largest earthquake in the world since 1900. The tsunami triggered by that earthquake killed over 220,000 people in at least eleven countries. While it is possible for a similar tsunami to occur in the Caribbean, scientists currently believe that there is a very small chance of this happening. As far as we know, the largest tsunami to affect the Caribbean in the past 500 years was 8 m in height.

What can we do to prepare for a tsunami?
If you live in a low-lying area make yourself familiar with the quickest way to get to higher ground. Make sure all family members know the evacuation plan. **If you are close to the sea and the water retreats or pulls back by an abnormal amount, move to high ground at once.**

For more answers to frequently asked questions and information on tsunamis in the Caribbean, visit:

[www.weready.org](http://www.weready.org)

[www.cdema.org](http://www.cdema.org)

[www.uwiseismic.com](http://www.uwiseismic.com)
ARIVAL TIME
Time of the first maximum of the tsunami waves.

ESTIMATED TIME OR ARRIVAL (ETA)
Time of tsunami arrival at some fixed location, as estimated from modeling the speed and refraction of the tsunami waves as they travel from the source. ETA is estimated with very good precision if the bathymetry and source are well known (less than a couple of minutes).

HISTORICAL TSUNAMI
A tsunami documented to occur through eyewitness or instrumental observation within the historical record.

INUNDATION
The horizontal distance inland that a tsunami penetrates, generally measured perpendicularly to the shoreline.

INUNDATION (MAXIMUM)
Maximum horizontal penetration of the tsunami from the shoreline. A maximum inundation is measured for each different coast or harbour affected by the tsunami.

INUNDATION AREA
Area flooded with water by the tsunami.

INUNDATION LINE
Inland limit of wetting, measured horizontally from the mean sea level (MSL) line. The line between living and dead vegetation is sometimes used as a reference. In tsunami science, the landward limit of tsunami runup.

LOCAL TSUNAMI
A tsunami from a nearby source for which its destructive effects are confined to coasts within 100 km of the source. A local tsunami is usually generated by an earthquake, but can also be caused by a landslide, or a pyroclastic flow from a volcanic eruption.

MAGNITUDE OF AN EARTHQUAKE
A number assigned to a quantity by means of which the quantity may be compared with other quantities of the same class.

MEAN HEIGHT
Average height of a tsunami measured from the trough to the crest after removing the tidal variation.

PALEOTSUNAMI
Tsunami occurring prior to the historical record or for which there are no written observations. Paleotsunami research is based primarily on the identification, mapping, and dating of tsunami deposits found in coastal areas, and their correlation with similar sediments found elsewhere locally, regionally, or across ocean basins. As work in this field continues it may provide a significant amount of new information about past tsunamis to aid in the assessment of the tsunami hazard.

POST-TSUNAMI SURVEY
Tsunamis are relatively rare events and most of their evidence is perishable. Therefore, it is very important that reconnaissance surveys be organized and carried out quickly and thoroughly after each tsunami occurs, to collect detailed data valuable for hazard assessment, model validation, and other aspects of tsunami mitigation.

RECESSION
Withdrawal of sea level prior to tsunami flooding. The shoreline moves seaward, sometimes by a kilometre or more, exposing the sea bottom, rocks, and fish. The recession of the sea is a natural warning sign that a tsunami is approaching.

REGIONAL TSUNAMI
A tsunami capable of destruction in a particular geographic region, generally within about 1,000 km of its source. Regional tsunamis also occasionally
have very limited and localized effects outside the region.

**RUN-UP**

1) Difference between the elevation of maximum tsunami penetration (inundation line) and the sea-level at the time of the tsunami.

2) Elevation reached by seawater measured relative to some stated datum such as mean sea level, mean low water, sea level at the time of the tsunami attack, etc., and measured ideally at a point that is a local maximum of the horizontal inundation.

**SEICHE**

A seiche may be initiated by a standing wave oscillating in a partially or fully enclosed body of water. May be initiated by long period seismic waves (an earthquake), wind and water waves, or a tsunami.

**SEISMIC SEA WAVES**

Tsunamis are sometimes referred to as seismic sea waves because they are most often generated by earthquakes.

**TELE-TSUNAMI OR DISTANT TSUNAMI**

A tsunami originating from a far away source, generally more than 1,000 km away.

Less frequent, but more hazardous than regional tsunamis, are ocean-wide or distant tsunamis. Usually starting as a local tsunami that causes extensive destruction near the source, these waves continue to travel across an entire ocean basin with sufficient energy to cause additional casualties and destruction on shores more than a 1,000 kilometres from the source. In the last 200 years, there have been at least 21 destructive ocean-wide tsunamis.

The worst tsunami catastrophe in history occurred in the Indian Ocean on 26 December 2004, when a M9.3 earthquake off the northwest coast of Sumatra, Indonesia produced an ocean-wide tsunami that hit Thailand and Malaysia to the east, and Sri Lanka, India, the Maldives, and Africa to the west as it traversed across the Indian Ocean. Nearly 250,000 people lost their lives, and more than 1 million people were displaced, losing their homes, property, and their livelihoods. The magnitude of death and destructiveness caused immediate response by the world's leaders and led to the development of the Indian Ocean tsunami warning and mitigation system in 2005.

**TIDAL WAVE**

1. The wave motion of the tides.

2. Often incorrectly used to describe a tsunami, storm surge, or other unusually high and therefore destructive water levels along a shore that are unrelated to the tides.

**TRAVEL TIME**

Time required for the first tsunami wave to propagate from its source to a given point on a coastline.

**TSUNAMI AMPLITUDE**

Usually measured on a sea level record, it is:

1) The absolute value of the difference between a particular peak or trough of the tsunami and the undisturbed sea level at the time,

2) Half the difference between an adjacent peak and trough, corrected for the change of tide between that peak and trough. It is intended to represent the true amplitude of the tsunami wave at some point in the ocean. However, it is often amplitude modified in some way by the tide gauge response.

**TSUNAMI BORE**

A steep, turbulent, rapidly moving tsunami wave front, typically occurring in a river mouth or estuary.

**TSUNAMI GENERATION**

Tsunamis are most frequently caused by earthquakes, but can also result from landslides, volcanic eruptions, and very infrequently by meteorites or other impacts upon the ocean surface. Tsunamis are generated primarily by tectonic dislocations under the sea which are caused by shallow focus earthquakes along areas of subduction. The upthrusted and downthrusted crustal blocks impart potential energy into the overlying water mass with drastic changes in the sea level over the affected region. The energy imparted into the water mass results in tsunami generation, i.e. energy radiating away from the source region in the form of long period waves.

**TSUNAMIGENIC**

Having generated a tsunami: a tsunamigenic earthquake, a tsunamigenic landslide.
**TSUNAMI IMPACT**

Although infrequent, tsunamis are among the most terrifying and complex physical phenomena and have been responsible for great loss of life and extensive destruction to property. Because of their destructiveness, tsunamis have important impacts on the human, social and economic sectors of societies. Historical records show that enormous destruction of coastal communities throughout the world has taken place and that the socio-economic impact of tsunamis in the past has been enormous.

**TSUNAMI PREPAREDNESS**

Readiness of plans, methods, procedures and actions taken by government officials and the general public for the purpose of minimizing potential risk and mitigating the effects of future tsunamis. The appropriate preparedness for a warning of impending danger from a tsunami requires knowledge of areas that could be flooded (tsunami inundation maps) and knowledge of the warning system to know when to evacuate and when it is safe to return.

**TSUNAMI SOURCE**

Point or area of tsunami origin, usually the site of an earthquake, volcanic eruption, or landslide that caused large-scale rapid displacement of the water to initiate the tsunami waves.

**TSUNAMI WARNING**

The highest level of tsunami alert. Warnings are issued by the TWCs due to confirmation of a destructive tsunami wave or the threat of an imminent tsunami. Initially the warnings are based only on seismic information without tsunami confirmation as a means of providing the earliest possible alert to at-risk populations. Warnings initially place a restricted area in a condition that requires all coastal areas in the region to be prepared for imminent flooding. Subsequent text products are issued at least hourly or as conditions warrant continuing, expand, restrict, or end the warning. In the event a tsunami has been confirmed which could cause damage at distances greater than 1000 km from the epicenter, the warning may be extended to a larger area.

**TSUNAMI WARNING CENTRE (TWC)**

A Centre that issues timely tsunami information messages. The messages can be information, watch, or warning messages, and are based on the available seismological and sea level data as evaluated by the TWC, or on evaluations received by the TWC from other monitoring agencies. The messages are advisory to the official designated emergency response agencies. Regional TWC monitor and provide tsunami information to Member States on potential ocean-wide tsunamis using global data networks, and can often issue messages within 20 minutes of the earthquake. Local TWC monitor and provide tsunami information on potential local tsunamis that will strike within minutes. Local TWC must have access to continuous, real-time, densely-spaced data networks in order to characterize the earthquakes within seconds and issue a warning within minutes.

An example of a Regional Tsunami Warning Centre is the Pacific Tsunami Warning Center which provides international tsunami warnings to the Pacific. After the 26 December 2004 tsunami, the PTWC and JMA have acted as an Interim Regional TWC for the Indian Ocean.

Examples of sub-regional TWC are the NWPTAC operated by the Japan JMA, WC/ATWC operated by the USA NOAA NWS, and CPPT operated by France. These centres, along with Russia and Chile, also act as national TWC providing local tsunami warnings for their countries.

**TSUNAMI WATCH**

The second highest level of tsunami alert. Watches are issued by the Tsunami Warning Centres (TWCs) based on seismic information without destructive tsunami confirmation. The watch is issued as a means of alerting the affected populations located, for example, 1 to 3 hours tsunami travel time beyond the warned area. Subsequent text products are issued at least hourly to expand the watch and warning area, upgrade all areas to a warning, or end the watch and warning. A Tsunami Watch may be included in the text of the message that disseminates a Tsunami Warning.
Graphic Organizers

These are helpful tools that students can use to sequence and summarise information presented in the lessons.
Cause and Effect

**Directions:** Identify the causes and effects of events in the story.

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Fish Bones

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Thematic Web

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The Christmas Angel

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Stories taken from the 'Higher Ground' anthology (ed. Anuj Goyal)

www.highergroundproject.org.uk

Christmas on a hot sandy beach – can you imagine anything better? A clear blue sky, not a hint of cloud, and just enough breeze to keep you cool while you open all those presents. Perfect.

As a special treat, Dad had booked the four of us into a luxury resort on one of Thailand’s top beaches for the Christmas holidays. Me and my five-year-old brother, Jack, weren’t used to comfort like this. The hotel we were staying in seemed to have everything: not just pools and water slides, but saunas, games rooms, even a private stretch of beach. It was so luxurious that when we arrived there were lotus-flower petals strewn in the baths of our rooms. At first, Jack couldn’t decide whether to play with the petals or eat them.

On Christmas day, we all went down to the beach. I still remember everything about that morning, because it was so fantastic. Jack made us all laugh – you know the way you are when you’re little, so excited about your presents, tearing into the wrapping paper because you just have to know what you’ve got straight away? Well, he was doing exactly that, but Mum insisted on slapping suntan cream all over him while he was still opening his presents. So there’s Jack, squinting in the bright sun, with Mum holding his arms to put on the cream, and he got so annoyed with her that out of sheer frustration he started biting the wrapping paper off his presents. Pretty soon all these tiny bits of paper were blowing all over the beach, with me looking like an idiot, running around picking them up. Dad, meanwhile, stayed entirely cool throughout. I remember that. I can still picture him relaxing in his deckchair, eyes half-closed, sipping a pink drink with a titchy umbrella in it, and gazing with a big grin out at the sea as if nothing was going on around him at all.

That was a good day. The next day was the 26th December.

My name is Ann, and by the end of the 27th December a lot of people were patting me on the back and saying nice things about me. I was hailed as a heroine by some friends of my parents, which was weird considering the first reaction adults on the beach had to me when the tsunami struck. One of them afterwards even went as far as to call me The Christmas Angel.
It took me a while to understand why so much fuss was made about what I did that day, but I think I understand now. It was because they were still in shock. There wasn’t much good news coming out from Southeast Asia, and my little story was a snippet of happiness people could clutch onto. Over six thousand people were killed that day in Thailand. It was terrible. Even back at home, thousands of miles away, everyone was desperate for a story that wasn’t about people dying. They wanted a story about people living. They wanted a story where no one on a beach died or was even seriously hurt. And I think adults also liked the idea that it wasn’t one of them, not some clever man or woman, not even a tough boy dragging people off the beach, but a girl – an ordinary, eight-year-old girl – who’d saved them all.

Well, I’m that girl, but I’m no heroine. I played my part, but so did my Mum and Dad, warning the other parents, and so did all the staff at the hotel, risking their own lives to run down the beach to get everyone off it as fast as possible. I’m no heroine, and I’m no angel, either. An angel would have swooped down from the sky, collected all those people on its wings and swept them to safety. I didn’t do that. I just knew something. Here’s the truth about what happened.

We’d got up early that morning, around 8 a.m., so we could get a nice spot on the beach. Even so, there were about a hundred others already on the sand, mostly tourists like us, soaking in the sunshine. There wasn’t a cloud in the sky. It was humid, though, and the four of us, used to cold winter weather back home, were sweating just from the stroll from the hotel down to the beach front.

I remember thinking: I’ll let myself get really hot, and then go for a dip in the sea.

Jack sat there for ages, happily whacking parts of the beach flat with his spade. The rest of us were served frosted drinks – orange for me. Dad smoothed out our towels. Mum unfurled one of the hotel’s huge beige beach umbrellas and dabbed some more sun cream on my ears. Everything was peaceful and calm. In fact, the sea itself was unusually calm. There was barely a ripple on it. It was only afterwards I realized that this was the first sign that something was wrong.

I was lying down, feeling an irritating trickle of sweat running under the strap of my swimsuit, when the wind suddenly shifted. Then I noticed something else: the beach had suddenly become very quiet. People had been talking, but now they’d stopped. Even Jack, who’d been chatting merrily away to an empty seashell, had gone silent.

I shaded my eyes, and followed his open-mouthed gaze out over the water.

At first, I couldn’t believe what I was seeing. I thought our beach had disappeared.

Then I realized that the beach was just bigger than before.

It was ten times the size it had been.

The sea was leaving the shore.

It was incredible to watch. The water retreated, rushing backwards amazingly fast towards the horizon. For a moment no one on the beach said a word. We were all awe-struck. It wasn’t just that the water
had gone backwards. It was what was left behind. Dozens of sea creatures were now exposed on the beach. Tropical fish flopped around, gasping for air. Crabs and shellfish scuttled up and down the sand, looking for a place to hide.

You might have thought that everyone on the beach would be alarmed, but they weren’t. What had happened was just so weird that I don’t think anyone knew what to think. Little kids started to totter down the beach. The adults were equally mesmerized. Quite a few of them headed down the beach as well, to inspect all the live creatures left behind.

Afterwards, I was told that shortly before the tsunami struck animals all across southern Thailand behaved strangely, as if they knew what was about to occur. Owners of elephants reported them running for higher ground. Normally obedient dogs ran out of their homes and refused to go indoors. Flamingos left their low-lying breeding grounds. Million of other birds all across Thailand, and Indonesia and everywhere else the tsunami struck, took to the skies. In zoos, animals locked inside went berserk and nothing would calm them down.

Whatever instinct the animals had, we didn’t share it. Everyone was spellbound by the retreating waters. Mum joined several other adults, taking a few steps down the wet, glistening sand. No one seemed to be particularly worried. A few parents kept their children away from the more dangerous-looking stranded creatures, but no one suggested leaving the beach.

It was then that I remembered a documentary I’d seen, showing some shaky film footage of a tsunami that had hit Papua New Guinea a few years back. I couldn’t remember the details, but that had definitely started just like this – the sea retreating really fast.

For a few moments, I was too dazed by how similar this was to the disaster in the film to grasp what was happening. Then I found my voice, and rasped, ‘Tsunami, tsunami.’ Jack looked at me and laughed, repeating the strange word. Dad muttered ‘What?’ but he wasn’t listening. Mum was too far down the beach to hear me. The air was very still. Then, far out to sea, the water began to swell and rise up. Everyone watched it, fascinated. Some people actually walked towards it.

I stood up and yelled out to Mum to come back.

‘What’s the matter?’ she asked, shielding her eyes, still gazing out to sea.

‘We have to get off the beach,’ I shouted. ‘It’s a tsunami.’

She shook her head, staring at Dad as if he would understand what I was freaking out about. He shrugged, embarrassed. He spoke to another man near us. I snatched Jack up. He started play-fighting me, thinking it was a game.

‘We have to get away!’ I said, as loudly as possible. ‘We won’t have long!’
All the adults within earshot frowned or glanced sheepishly at each other, expecting one of them to explain what the mad girl on the beach was so upset about. I ran down the beach towards Mum, hauling Jack with me. ‘We’ve got to get off the sand,’ I shouted. ‘Why aren’t you listening to me? It’ll kill us all!’

‘What will?’ Mum held me. ‘Ann, what’s wrong? We don’t understand.’

‘The sea is rising! We’ve got to get away from the shore!’ I was screaming at the top of my voice by now. Jack, crying, slipped from my arms. Mum picked him up.

‘The wave will kill us!’ I yelled, over and over. Still no one moved. None of the adults believed I could know something they did not. I glanced out to sea, and pointed at the distant wave approaching the beach. No one understood the Japanese word tsunami.

‘Tidal wave,’ I rasped. ‘Tidal wave. Tidal wave.’

And this time they understood. They knew what tidal wave meant. You should have seen the look of horror that came over the adults within earshot. Mum put her hand to her mouth. At the same moment a yacht way out at sea was tipped over, suddenly, violently. It looked as if the entire sea was coming out of the water. Most people were still rooted to the spot, but not Mum. She said one word. I’ll never forget the way she said it. It came out like a scream, and for a moment I froze.

‘Run!’

Holding Jack tight against her shoulder, she grabbed my wrist and we sprinted from the beach. Behind us, Dad shouted warnings to those nearby, but the message wasn’t getting through. Instead of running for their lives, people started slowly packing up – putting away napkins, towels, finishing their drinks – as if there was all the time in the world! I yelled out more warnings, but most people still didn’t understand, or couldn’t hear me.

We rushed back to the pool of the hotel, and Dad breathlessly explained to the staff what was going to happen. And this – this – was the heroic part. Because the staff, understanding the risk, knowing that the wave might hit us at any time, and kill them if they were caught on the sand, ran out to the beach. They risked their own lives, rushed out and called out as loudly as they could in Thai and German and French and every other language they knew, telling everyone to get back to the hotel.

Mum, determined to make sure we were as high up as possible when the wave struck, dragged me up the hotel steps to the top floor. From there we watched dozens of shouting and frightened people running from the beach. Unbelievably, some of the adults were still trying to tidy things away and pack up. One woman couldn’t take her eyes off the ocean. I saw a boy – it must have been her son – desperately pulling her across the sand.

‘How high will it be?’ Dad gasped. ‘Ann, how high will the wave be?’

I knew what he was asking. He wanted to know if we would be safe on the top floor.
I had no idea, but we didn’t have long to wait to find out.

The first wave struck the beach only seconds after the last person made it to the hotel. I can’t begin to describe to you how terrifying the wave was to watch, not because it was so big – it was only about twice Jack’s height – but because it was so fast. One moment there was this wall of water frothing and bubbling out at sea. The next the wave hit the beach. The boom from it was incredible, like an exploding bomb. Later I discovered the wave struck the shore at around 800 miles per hour – faster than a jet aircraft. As soon as we saw what happened to the beach, we knew anyone left out there would have been killed. Sun beds were flipped over the roof of the hotel. Deckchairs were shredded. Heavy tables, yanked from the sand, crashed into the building. Trees – not little bushes but huge, mature palm trees – were thrown into the hotel pools. Cars and vans were picked up and carried inland. Power cables were ripped out. Wooden huts were torn to pieces as if they were made of paper. We had no idea who might be inside those huts.

All of us were frozen with terror, and then a few people ran around to the other side of the hotel to follow the wave. It flowed inland, carrying massive rocks and trees and boats for over a mile. Later we discovered that many local residents living outside the hotel survived the first wave, only to be pulled out to sea as the wave retreated, unable to find anything to hold onto to save themselves. We watched the first wave surge inland. Then it suddenly retreated again, almost as fast as it had come in, withdrawing like an animal back out to sea.

‘Is that it?’ a boy near me asked, and suddenly adults who had not been listening to me before were desperate for reassurance.

‘I don’t know,’ I said. ‘It depends on how big the earthquake was. The second wave is usually bigger.’

‘Bigger?’ someone murmured.

‘Is there time to get away from the shore, away from here?’ a woman asked.

‘No,’ I said. ‘We can’t go back down. We have to wait it out.’

‘But what if the second wave’s higher than the hotel?’

I didn’t answer that. I didn’t need to. We all knew what would happen if the wave reached our floor.

There was roughly half an hour between the first and second wave. During that time, all the hotel staff and guests huddled together at the top of the hotel. People were in shock, and coped in different ways. Some went completely quiet; others talked non-stop. But when we saw the next wave taking shape out at sea, all the talking ended.

The second wave wasn’t like the first one. That had been clean blue water, with a white, frothing top, like a surfer’s wave. The second was more than three times that size, and dark. It reared up like a cobra’s head out of the ocean, almost obliterating the sky, and flew across the sea towards the beach.

‘It’s going to kill us,’ someone whispered.
‘Why is it so dark?’ a man asked. ‘Why so black?’

No one knew. We found out afterwards that all the seabed mud from the earthquake zone was suspended in its waters. Million of tons of mud and silt. The wave was so powerful that it had managed to carry all that debris across thousands of miles of ocean.

Most people couldn’t watch what happened next. The wave was almost as fast as the first wave as it rushed towards us, but much bigger, the height of a house. By the time it hit the beach it had sunk a little, but I still felt Mum’s arm close around me and Jack scream as it slammed into our hotel. I’ve no idea how the walls took the impact. Looking around, the foundations of other buildings were being destroyed, and we saw not just cars but whole houses being carried inland this time, and twice as far as the first wave had reached.

What could we do? Nothing! We held onto each other, that’s all, and prayed the building would not collapse. There were huge blasts as the wave smashed again and again into the walls and flowed around them. Then the second wave retreated, and we breathed a sigh of relief, but it still wasn’t over. For the next two and a half hours, waves bigger than the first one continued to crash around us, and all we could do was wait and hope the next wave wasn’t going to be the one that killed us. During that time, it was weird, but almost all I could think about was the hotel walls. How strong were they? Were they built of cement, like our walls at home, or something softer? If one wall gave way, would all of them collapse? I became obsessed with those walls.

After it was all over for ages we were too terrified to leave the top of the hotel. We stayed there, hoping no more waves would come, and not daring to believe we were safe. Below us, as far as the eye could see, the whole world had been completely flattened. All the buildings except for our hotel were gone. Apart from a few steel girders or telephone poles, almost nothing was still standing. Every tree, every bush, every vehicle, every single home, lay in ruins. We didn’t want to look out at the destruction for long. We were afraid of seeing dead bodies. But we couldn’t help looking, and hoping not to see them, and after a while something weird happened: our throats started to feel dry and ticklish, and our eyes stung. It wasn’t from crying, though we’d all done plenty of that. It was from something else we didn’t understand until much later. You see, the waves had carried so much soil from the ocean depths, and then thrown it into the skies as they retreated, that choking dust filled the air. There was so much of it that for several days people had to hold cloths over their mouths to breathe, and for many weeks afterwards the sun, shining though all the dust, left hauntingly dark, beautiful sunsets across the country.

Our beach was one of the few places struck by the tsunami in the whole country where no one was killed. Afterwards, my dad discovered tourists from nearby resorts wandering around like zombies. Some of them had lost whole families, lost everyone. Just a few miles away, on another beach where there had been no warning of the tsunami, most people had died.

Afterwards, as I’ve told you, for a while some of the adults called me The Christmas Angel. But I hope you can now understand why I never liked that name. I wasn’t an angel. I just happened to know a piece of information that helped save some lives. If you had known, you’d have done the same as me. When I
arrived back home, and I realized how many in Thailand had died that day, I thought about all those who’d been lost. Did you know that more children died than adults? And very young children in particular, because they were simply not strong enough to hold onto anything when the waves struck, or were just too weak to swim for long. But many older children also died trying to cling onto their younger brothers and sisters. And many parents died too, needlessly. They could have saved themselves – many were strong enough – but they died trying to save their own children, and even other people’s children. This story is for all those angels.

Colours

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Stories taken from the ‘Higher Ground’ anthology (ed. Anuj Goyal)

www.highergroundproject.org.uk

Aaliya stared down at the large sheet of paper on the desk in front of her. The paper was clean and square and white, inviting her to cover it with pictures.

‘Draw whatever you feel like drawing,’ said the kind lady, who was standing at the front of the classroom, watching the children. But there was only one thing Aaliya could think about. The Black Day. She sat there quite still. She didn’t reach out for the coloured pencils that lay in front of her.

Yesterday, a boat had come across the water from Male, the capital of the Maldives, to the island school, bringing crayons, pencils and drawing books, skipping-ropes, footballs and bright, striped hula hoops. Aaliya could hear the shouts of the older children out in the playground. She wished she was with them. She wished she was anywhere but here.

There were eight pencils lined up on her desk. They were new, with neat, sharp, coloured tips. Aaliya had always loved to draw. Once, her bedroom walls had been covered with her drawings, bursting with joyful colours. Now, of course, the drawings were gone, and they had taken her love of colour with them.

Aaliya pushed aside her favourite pink and green pencils. Those colours had no part in her world now. The only colours roaring inside her head were purple, blue, red and black. What shall I draw? she asked herself. But she already knew the answer to her own question.

Aaliya picked up the black pencil. Immediately she was gripped by a fear so cold, so huge, that for a few seconds she could do nothing. Then, at last, she bent her head over the paper.

The Black Day had started like any other Sunday morning. The sky was blue, the sea was bluer, the sun a fiery yellow ball in the sky. The weather hardly changed in the Maldives. Sometimes there were heavy showers of rain, but Aaliya didn’t mind that. The rain left the island fresh and green. She had never seen snow, except in a picture book.

‘Aaliya.’ Aaliya could still hear her mother’s voice clearly inside her head, as the black pencil hovered over the white paper. And in her mind, she could see her mother’s pink shalwar kameez, her older sister Sara’s orange T-shirt, her father’s green shirt. ‘We’re going to the market. Do you want to come?’
No, Aaliya didn’t want to go. They went to the market every Sunday morning to buy tuna-fish and vegetables – it was nothing special. Today Aaliya wanted to stay in her bedroom and draw.

‘We’ll have breakfast when we get back,’ her mother told her. ‘Be good!’

The classroom was cool, the fan purring softly overhead. Aaliya put her finger on the paper, a third of the way down from the top. Then, carefully, she drew a thick black line from her finger to the other side of the paper. This was the line where the sea met the sky.

‘Bye, Mama. Bye, Papa.’

Aaliya tried not to think about her parents and Sara leaving the house for market that Black Day. They had been laughing and talking. She could hear their voices in her dreams. If she’d known what was going to happen, would she have said something more? She hadn’t even said goodbye to Sara. Would she have gone with them? Or would she have stayed at home?

When they’d gone, Aaliya had sat cross-legged on her bed, a blue colouring-pencil in her hand. I’ll draw a picture of the sea, she had thought. From the window of their coral-stone house, she could see the water in the distance. In the Maldives, with its hundreds of islands, you were never far away from the sea. Aaliya had grown up with water all around her. She wasn’t afraid of it. She never even thought about it. It was just there.

Aaliya clutched the black pencil tighter. Now she realised that sitting on her bed that Sunday morning was the last time she had felt happy. The very last time her world had been full of shining colours. Aaliya felt her throat closing up as if she couldn’t breathe. Pressing the black pencil to the paper once more, she drew the outline of a house. A one-storey, coral-stone house with a rusty red iron roof. But she drew it below the black line, in the sea, under the water.

‘I’m hungry…’

Aaliya remembered the empty, rumbling feeling in her tummy, as she sat on the bed, adding the finishing touches to her picture. The sky and sea were deep blue, birds above and fish below. There were fishing boats on the water and seaplanes in the sky. Palm trees and coral-stone houses. The picture was almost finished. All Aaliya had to do was add herself and her family in front of their house.

As Aaliya began to draw her father, she was hoping that they would have mas huni, her favourite breakfast of tuna-fish, onion, coconut and chili with bread and tea. Where were her parents and Sara? They seemed to have been gone for hours.

And then Aaliya heard it. The first sound of Black Day. The screaming.

Now, her head bent over the paper on her desk. Aaliya couldn’t stop the tears from pouring silently down her face. She began to draw. Boats, seaplanes, houses, palm trees. But now they were all under the sea, swallowed greedily by the water. Suddenly Aaliya’s hand seemed to be working by itself, almost as if she could go on drawing for ever and ever without thinking about it.

The loud screaming had brought Aaliya to her bedroom window to find out what was happening. The first thing she saw was people running in all directions. For a split-second, she couldn’t understand why. But, almost at the same moment, she realised that they were running from a solid wall of water. It towered above everything, taller than the houses, taller than the trees.

‘No,’ Aaliya had whispered to herself, shock freezing her limbs.

It couldn’t be possible. The sea and the land had their own space. The water didn’t belong here.
Pictures imprinted themselves on Aaliya’s mind in those few brief seconds, pictures she would never be able to erase. Some people had already climbed up onto the roofs of their houses. Others were clinging to palm trees, trying to stop themselves from being swept away. There were men and women and children in the water, being tossed and hurled this way and that, calling for help. Aaliya knew she would never forget the identical look of terror on all their faces. And still the menacing wall of water swept ruthlessly on its way, straight towards Aaliya’s house.

‘It’s coming for me,’ Aaliya gasped. ‘Help, Papa!’

There was no one to help. Aaliya ran towards the front door, but before she could open it and escape, there was an ear-splitting crash as the wave lunged towards the house. It smacked against the door, battering it mercilessly, trying to force its way inside.

Aaliya didn’t know if the roaring in her ears was the thump thump thump of the monstrous wave against the frail front door, or the wild pounding of her heart in her ears. As water began to seep menacingly underneath the door and into the house, her whole body was gripped with a terrible, black fear. She ran into her bedroom and slammed the door. She was trapped...

Aaliya put down the black pencil and picked up a red one. Other children in the classroom were crying, but she didn’t hear them. She was sobbing too much. Tears dropped onto the paper as Aaliya drew two stick figures, one tall, one smaller, half above and half under the sea. She coloured the top half of both figures red, but left the bottom halves, which were under the water, uncoloured, lifeless.

The water continued to swell under the front door. From her bedroom window, Aaliya could see waves rushing past, carrying away people, trees and cars as if they were toys and weighed nothing at all. Aaliya could hardly bear the noise – the roaring water and the screams, and the sound of houses collapsing and of trees being torn up by their roots.

Suddenly a red mist danced in front of Aaliya’s eyes.

‘Mama!’ she shouted. ‘Sara!’

Her words were snatched away by the tumbling torrents of water. Aaliya had seen her mother, unmistakable in her bright clothes, floating past the window. She had her arms wrapped tightly around Sara. Their eyes were closed and neither of them were moving. There was no sign of Aaliya’s father...

Aaliya gulped, trying to swallow her sobs. She changed the red pencil for the black again, and, gripping it tightly, began to colour in the sea under the line and around the drowned objects. As the water grew blacker and blacker, Aaliya felt her anger and hatred of the sea rise and swell, just as the water had risen and swollen inside her home on that Black Day...

Soon the water had started battering at her bedroom door, seeping then pouring underneath it and into the room. Terrified, tears streaming down her face, Aaliya had crouched on her bed. She had nowhere to go and no one to help her.

The water level rose higher. Soon the bed lifted off the floor, taking Aaliya with it. She watched as the water tore her pictures from the walls, turning them into a soggy, floating mess. Suddenly, and strangely, Aaliya began to feel calmer. As the bed rose higher, the waves tossing and buffeting it around the room, she lay back and closed her eyes, just like Sara and her mother. The water was so high now it was lapping over the top of the bed, washing over her shoulders.

‘Mama,’ Aaliya whispered. ‘I’m coming to you.’
Aaliya didn’t know how long she lay there soaked through, eyes closed, waiting for the water to carry her away. It could have been minutes; it might have been hours. At first she didn’t know that the water, a wave bigger than any building on her island, bigger than any wave she’d ever seen before, was washing away, back into the sea. Then, at last, as the bed floated back down to the floor, she realised. The sea had rushed away, back to its rightful place beyond the land. And she was alive.

Aaliya had coloured in the sea so hard and so fiercely that not a speck of white paper could be seen underneath the line. But still she continued to make the black thicker and thicker.

Leaving the house that day, unable to understand what had happened on her island right in front of her, it was as if all five of her senses were dazed and confused. Outside there was a sickening smell of sodden, drowned bodies and the dead fish that littered the streets. Aaliya could taste the thick humid dust that hung in the air, making her eyes water. After the roaring of the water, there was an eerie silence, broken only by the sound of people crying. And Aaliya simply couldn’t make sense of what she was seeing. Streets of houses had been flattened into rubble. Trees had been swept aside. Most of what had stood upright was now destroyed and devastated. Desperate and alone, Aaliya had longed to feel her mother’s touch...

Aaliya stared down at her picture of the Black Day. She hadn’t seen her father since that morning. Her uncles were still searching for him. Suddenly she pressed the black pencil so hard against the paper, the tip broke off and the paper ripped from side to side. The sound echoed through the classroom.

‘Aaliya?’ The kind lady who had brought the pencils and paper to the school came over to her. She had a gentle voice. ‘Don’t you want to colour the sun in the sky?’

‘No,’ Aaliya replied flatly, pushing the brightly coloured pencils away. ‘There was no yellow that day.’

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Making heroes out of children with a new emergency preparedness programme

By Lydia Lubon

http://www.unicef.org/emerg/malaysia_35589.html

KUALA MUDA KEDAH, Malaysia, 1 September 2006 – “I was watching TV when my neighbour came to my house to tell me to look at this long white line in the sea. When I saw the giant waves in the distance I thought to myself, how beautiful! I had never seen anything like it before. But as I stood watching the wave, I saw boats capsizing in the distance. I had no idea what was happening until a fisherman shouted at me to run, because the wave was coming towards us,” recalled 13-year old Siti of her terrifying brush with death.

Like so many other villagers in Kuala Muda Kedah, Siti had never heard the word “tsunami” before that day in December 2004. Unsure of exactly what was happening, the courageous young girl, who comes
from a single parent household, helped her ailing mother and younger brother to safety. Most villages around the Indian Ocean affected by this disaster were coastal fishing communities. Despite their relatively close ties to the sea, little was known about the killer waves or how to react in the face of this type of disaster.

**Practical guidelines for survival**
It was this lack of awareness that prompted Malaysia’s Ministry of Education and UNICEF to launch the Emergency Preparedness Programme in local schools. The programme offers practical guidelines to help students and teachers survive disasters such as flash floods, drought, earthquakes and landslides, all of which occur yearly in Malaysia.

Schools are an ideal setting to offer protection, education and awareness for children. Early warning systems are crucial. So, too, is a well-informed community ready to protect itself when a disaster strikes. “All the sophisticated technology won’t matter if we don’t reach real communities and people,” said UNICEF Representative to Malaysia, Gaye Phillips. “Satellites, buoys, data networks will make us safer, but we must invest in the training, the institution-building and awareness on the ground. People must understand how to prepare and respond to a disaster, as well as how to deal with the aftermath. What better place to start this education than at schools.”

**Children as heroes**
Recently, officials from the Ministry of Health, Ministry of Defense, Royal Malaysian Police, Fire & Rescue Services Department, and humanitarian relief organisations met for a three-day workshop on implementing emergency preparedness. At the end of the conference, Ms. Phillips and Director-General of the Ministry of Education, Dato’ Dr. Hj Ahamad bin Sipon officially launched the programme in schools at the Kuala Muda Kedah Secondary School. “In Thailand, children as young as 10-years old were heroes during the 2004 tsunami because they knew the early warning signs of a tsunami, and were able to alert beach goers around them in time. Lives were saved, including theirs. This is what we want to give to our children in Malaysia, the power to make informed decisions,” said Dato’ Dr. Hj. Ahamad.

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**Caribbean Tsunamis**
The Caribbean tsunami history is relatively short as it is largely based on historical data (newspapers, libraries, memoirs, Government and church archives). Earthquake catalogs, usually mentioned waves or inundations (flooding) only if they were exceptional in some way. More often, information was not included unless great damage was done and services were interrupted. In addition, few islands in the Caribbean were heavily populated. Reports of tsunami events would have been very localized and overshadowed by the triggering phenomena of an earthquake or volcanic eruption. The account of tsunamis provided in the teaching chart illustrate recovered and recorded evidence but may not, however, represent the absolute number of fatalities as the possibility still exists that tsunamis may have occurred prior to European settlement.

**1690 April 6**
Mag 7.5-7.8 – Earthquake generated tsunami between Antigua and Guadeloupe. Olsen (1988) quotes, “the sea receded so much that one could walk about 9 to 10 Fathoms (1 Fathom = 1.8 meters/6 feet)
into the sea and pick out fishes on dry land.” Tsunamis believed to have been generated by landslides into the sea in Antigua and Nevis.

1692 June 7
Mag 7.5 – Large waves were reported at St. Ann’s Bay, north coast Jamaica after the earthquake. Tsunami like waves were also reported in Kingston and Port Royal, however most of the damage in Port Royal resulted from liquefaction and coastal subsidence.

1842 May 7
Mag 8.3 – Tsunami waves reported on the north coast of Hispaniola and Haiti. Reports claim the sea receded 60 m and the returning wave covered the city of Port-de-Paix, Haiti, with 5 m of water. About 200-300 people were killed by the tsunami and earthquake. At Hispaniola there was destruction on the north coast by waves of 2m high.

1867 November 18
Mag 7.5 – Earthquake between St. Thomas and St. Croix, Virgin Islands and associated landslide generated a tsunami. About 15 minutes later the water receded nearly 100 m and returned as a 4.5 to 6 m tsunami swamping the harbor and inundating 76 m inland and claiming lives. At St. Croix waves swept 91 m inland damaging 20 houses. Waves up to 1.5m were also observed in Puerto Rico, British Virgin Islands, Saba, and Saint Martin. At St. Johns, Antigua, the wave had a height of 3 m and 1 m at Guadeloupe. Robson (1964) quotes, “a wave 60 feet high and 3 miles broad inundated the beaches and entered the houses in Guadeloupe.” Martinique, St. Vincent and Grenada also reported unusually high water.

1902 May 5 & 7
Volcanic eruption of Mt Pelée, Martinique generated local tsunami ~ 4-5 m in height when a 35 m³ lahar and pyroclastic flow from the violent eruption entered the sea. Waves allegedly impacted the town of St. Pierre killing 100 people. On May 7, submarine communication cables from the island of Martinique were cut. The cause of which is speculated to be associated with tsunami like waves observed at harbours in Grenada, Barbados and Saint Lucia.

1907 January 14
Mag 6.5 – Earthquake off north coast Jamaica triggered tsunamis possibly associated with submarine landslides. Waves up to 2.5 m affected the north coast from Buff Bay to St. Ann’s Bay and at Anotto Bay the sea receded up to 93 m and 69 m at Ocho Rios.

1918 October 11
Mag 7.5 – One of the most severe earthquakes known to strike off Puerto Rico and Dominican Republic triggered tsunami waves that lashed the northwest coast where the highest run-up of 6.1 m was observed. Observers noted “the ocean first withdrew from the land, exposing reefs never before visible, and returned with heights high above normal. The great wave was followed by smaller ones, especially in sheltered bays, water continued to ebb and flow for some time.” Western Puerto Rico experienced
extensive damage with inundation up to 100m inland, and claiming 29 lives. Waves reportedly rose and fell for up to 3 hours in Virgin Islands and Dominican Republic.

**1939 July 24**
The first recorded eruption of Kick ‘em Jenny submarine volcano generated numerous tsunami-like waves with maximum heights up to 2 m observed in northern Grenada, the southern Grenadines and Barbados.

**1946 August 4**
Mag 8.1 – Earthquake devastated the Dominican Republic, extending to the Virgin Islands and Haiti generated a 2.5 m tsunami on the northeast coast of Hispaniola. Loss of life occurred at Mantanzas (Matancitas) where one authority related “off the north coast…. The ocean had receded from the coast and people went to collect fish exposed. The wave entered a kilometer inland, swept the city and several villages into the ocean."

**1997 December 26**
Volcanic eruption of Soufrière Hills Volcano, Montserrat – sent debris avalanche of approximately 25 million cubic metres into the ocean, at White River Valley, Montserrat generated tsunami waves that inundated up to 80 m inland, 10 km from the landslide site. Impact marks up to 1 m high could be seen on palm trees facing the sea. Run-up was also reported in Guadeloupe.

**2010 January 12**
Mag 7.0. Devastating earthquake 25km SW of Port au Prince, Haiti (~222,570 fatalities). 4 people killed by a local tsunami in the Petit Paradis area near Leogane. Recorded wave heights (peak-to-trough) of 12 cm at Santo Domingo, Dominican Republic and 2 cm at Christiansted, US Virgin Islands. Investigations are continuing for this event. (USGS).

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“Stop Disasters” – An Online Game

Publisher:
International Strategy for Disaster Reduction (ISDR)

"Stop Disasters" Description:
Take charge of an area prone to natural disasters and help them prepare, and hopefully prevent at least some damage. "Stop Disasters" is a game aimed at children to teach them about prevention and show them what could happen. It's very easy to start playing and students can prepare for multiple types of disasters.

Disasters triggered by natural hazards destroy lives and livelihoods. They affect millions of people every year, rich or poor. With your help, we can reduce human, physical and financial cost of disasters by understanding the risks and applying the best methods of prevention and mitigation. Simple measures really do save lives!

Your role in this game is to plan and construct a safer environment for your population. You must assess the disaster risk and try to limit the damage when natural hazards strike. Expect advice along the way both good and bad.

Recommend Ages:
9 to 16 year olds

“Stop Disasters” Game Review:
Stop Disasters is a simulation based online game created by the International Strategy for Disaster Reduction (ISDR) and the Playerthree Company. This game is available online for free, but requires the use of the most to date version of Flash Player 7 or higher. It is a single player game where the goal is to try to prevent many natural disasters include earthquakes, floods, tsunamis, hurricanes and wildfires that effect different areas around the world. Each of these five scenarios take approximately 20 minutes to play, and the games can be played on easy, medium, and hard difficulty levels. The game was designed for the interest of children between the ages of 9-16, but it is suitable for all ages because of the educational content. There is no distinct end of the game so it can be played indefinitely, but the end could be considered when each of the five scenarios has been successfully completed on each of the three difficulty levels.

One of the unique characteristics of Stop Disasters is since it is on online based game the web site will save your best scores, and it allows you to play against people all over the world. Stop Disasters has a lot of educational value that it can offer to anyone who plays the game. The basic goal of the game is to protect the area from the natural disaster. This can be done by providing the locals with evacuation instructions, education, shelter, hospitals, and
certain defenses against the storm. This has to be done while operating within the $35,000 budget. In the game you not only have to protect the area from the hazard, but to also develop the area to meet the basic needs of the locals. This game may be very beneficial for an economics, science, or a social studies lesson that deals with natural disasters.

It does a good job providing information on geography, natural disasters, budgeting, and many other facts that can be used for educational purposes. This is a user friendly game because it gives a lot of key facts and is very simple format that makes the game easy to understand. Stop Disasters is a game that can provide a lot of educational value to many different classrooms.

Source: http://blogs.lib.ncsu.edu/contemporarsocialstudies/entry/stop_disasters_game_review1

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### References for Tsunami Smart Teaching Charts

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<th>Name of Teaching Chart</th>
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<td>Chart 2 - Tsunami Science</td>
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**Teachers involved in review of Tsunami Smart Teacher Education Resource Kit**

**Barbados Tsunami Smart Campaign – Teacher Training Session, March 3\(^{rd}\) 2010**

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<td>Joyann Inniss</td>
<td>Ann Hill School</td>
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<td>Farrah Gibbs</td>
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<td>David Ifill</td>
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**Antigua & Barbuda Tsunami Smart Campaign –Teacher Training Session, February 10\(^{th}\), 2010**

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