

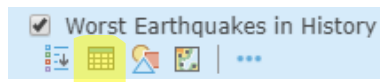
2004 and 2011 Earthquake Case Study

Lesson Map: <http://esriaustralia.com.au/education/SpatialActivity29>

Engage

Prior Knowledge

- Since 2000, just over 800,000 people have tragically lost their lives to one of Earth's biggest killers. Earthquakes bring huge devastation to communities around the world. Due to their nature, earthquakes are not always easy to predict, making it difficult to manage or mitigate the damage.
- Click on the Lesson Map URL above to open the map. In the 'Details' pane, under 'Content', tick the first checkbox to turn on the layer 'Worst Earthquakes in History'. Turn off all other layers.
- Click on the layer name, then select the box icon as seen below.



- ? Click on 'Rank' in the table, then 'Sort Ascending'. What is the worst recorded earthquake in history? **The worst recorded earthquake was the 1960 Valdivia Earthquake in Chile, with a magnitude of 9.6.**
- In this lesson, we will be comparing the 2004 and 2011 earthquakes. Use this table to find what historic rank and magnitude they were. **The 2004 earthquake is ranked third, with a magnitude of 9.3, whilst the 2011 earthquake is ranked fourth, with a magnitude of 9.1.**
- Click on the layer 'Earth's Tectonic Plates'. What is the spatial relationship between earthquakes and plate tectonics? **Earthquakes occur on plate tectonic boundaries as they move over time.**

Explore

Hazard zones

- Click on layer 'Top 15 Countries Exposed to Natural Hazards'. These hazards are not just earthquakes, but a wider variety including but not limited to sea level rise, hurricanes, cyclones and flooding. It is important to understand that natural

Download student worksheet [here](#).

Time
45 minutes

Activity

Investigate GIS data available for major earthquakes.

Learning Outcome

Students will be able to:

- Locate historic earthquakes
- Analyse vulnerability data
- Identify location of 2004 and 2011 earthquakes
- Look at key factors including deaths, displaced persons, aid given and other events
- Compare data on both earthquakes

ACARA Curriculum Link

Year 11 Geography

[ACHGE004](#) | [ACHGE014](#) | [ACHGE018](#) | [ACHGE019](#) | [ACHGE026](#) | [ACHGE027](#) |

Teacher Feedback:

To share your feedback on this, or any Spatial Activity, please contact education@esriaustralia.com.au

hazards may be prominent in different areas.

- ? Click off the previous layer. Turn on the layer 'Top 15 Countries Most At Risk From Natural Hazards'. This layer refers to a country's vulnerability to natural hazards. What kind of elements would make a country vulnerable? **These factors include disaster preparedness, economic and government stability, access to medical services.**
- ? It is important to understand that while some countries may be exposed to natural hazards more than others, all of these factors influence the total damage and death that can occur. This case study will be looking at the 2004 earthquake and the damage it caused to Indonesia, in comparison to the 2011 earthquake in Japan. Which of these countries do you think is more vulnerable than the other? Why? **Students own answer – but should be based around which country is more developed than the other.**

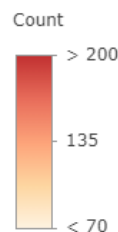
Skills

Case Study Comparison

- ? Turn on the layer '2004 Epicenter'. Where did the epicenter occur? **The epicenter of this earthquake occurred off the coast of Indonesia.**
- ? This earthquake triggered a wide scale tsunami in the Indian Ocean. Turn on the layer '2004 Epicenter Radius'. The impact of this tsunami was felt all the way in South Africa. How many kilometres away is this from the epicenter? **8000 kilometres away.**
- ? Turn on the layer '2004 Total deaths'. In which countries was the highest death rate? **Indonesia had 130,736 deaths, whilst Sri Lanka and India had 35,322 and 12,405.**
- ? Turn off all layers. Turn on the layer '2004 Deaths per 10000'. In which countries was the highest death rate per 100,000 persons? **Sri Lanka had the highest deaths per 100,000 at 18.**
- ? In addition to the wide scale death across many countries, hundreds of thousands were forced from their homes. Turn on the layer '2004 Total displaced persons'. Which country experienced the highest amount of displaced persons? How many displaced persons did Indonesia have? **India had 647,599 total displaced persons, whilst Indonesia had 500,000.**
- ? Lets compare to the 2011 earthquake. Turn off all layers. Turn on the layer '2011 Epicenter'. Which country was the 2011 earthquake near? **The earthquake was**

near Japan.

- ? Turn on the layer '2011 Total Deaths'. How many persons died in Japan during the earthquake? **19,575 total deaths.**
- ? In that same pop up, it should list the total displaced persons. How many Japanese were displaced during the earthquake? **228,863 people were displaced.**
- One of the most horrific events that occurred in the 2011 earthquake was the shutting down of nuclear plants. Turn on the layer '2011 Nuclear Power Plant'. This is the Fukushima Power Plant, which was the main plant which melted down. The earthquake caused the active reactors to shut down, whilst the tsunami caused the emergency generators to shut down too, causing nuclear material to breach into the atmosphere. Turn on the layer '2011 Nuclear Power Plant – Radius for serious injury and death' (You need to zoom in on the plant to see this). This was the immediate area that was evacuated due to fears of a meltdown.
- ? Turn on the layer '2011 Japan Nuclear Readings (past 200 nsv – the legal limit for nuclear workers)'. Zoom out. This is the average radioactive reading for each location in 2011. Did the evacuation zone work effectively in protecting Japanese citizens? **No, radioactive presence was measured all over Japan.**
- ? Many people have criticised the nuclear power plant company (TEPCO) for their lack of organisation. Based on this spatial evidence, do you think the evacuation was effective? **Students own answer.**
- Without government aid from other countries, it would be very hard to recover. Turn on the layer '2004 Government Aid – from Country'. These flows represent the total dollar value that was donated to the 2004 earthquake as a whole (not just to Indonesia). Which countries donated the most? **Australia, who donated one billion dollars, closely followed by the United States and Germany.**
- ? Why do you think Australia donated so much? **Students own answer.**
- Turn off all layers. Turn on the layers '2011 Countries that sent rescue teams' and '2011 money donation'. During the 2011 earthquake, many countries sent rescue teams or other forms of aid such as gas, food, water, fuel, machinery, and medicine. This data set is not complete or a true representation (the total aid often includes both private and governmental) but still shows the wide support that was available for Japan.



Extend

Comparison

- ? Japan has an Earthquake Warning System, which is believed to have saved many lives. The 2004 earthquake had an extremely high amount of deaths. At that time, there were no early warning systems installed in the Indian Ocean, and as a result many people were still on the beach as the tsunami hit. The lack of early warning systems in the Indian Ocean was because more typically occur in the Pacific Ocean. Do you think there should have been detectors used in the Indian Ocean? Refer to the layer 'Worst Earthquakes in History' for support.

Students own answer.

- ? Let's compare the two earthquakes based on the information in this lesson. Complete the below table (You may need to research or use layers provided).

	2004	2011
Developing or developed country	Indonesia Only* Developing mainly	Developed
Total deaths	Indonesia Only* 250000	15895
Displaced persons	655000	228863
Historic rank	3	4
Early warning system	No	Yes
Total damage caused	Indonesia Only* 19 billion	360 billion
Vulnerability of countries (preparedness, population density, infrastructure)	High population density, lack of preparedness and lack of stable infrastructure	High population density, but some degree of preparedness. Vulnerability increased due to infrastructure such as nuclear plants.
Type of aid	Mostly money	Money and other types of aid

- ? Based on these two earthquakes, which country (Indonesia or Japan) is more vulnerable to natural hazards such as earthquakes? What have these historic earthquakes taught us about preparedness for earthquakes? Students own answer.

Next Steps:

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