**Tsunamis**

**Introduction**

The definition of a tsunami is: ‘a long high sea wave caused by an earthquake or other disturbance’[[1]](#footnote-1) and translates from Japanese to ‘Harbour wave’. Both of these sum up what a tsunami is. Yet both don’t truly present how they are formed, what they can do and what they have done.

**Tidal waves**

Tsunamis are often wrongly called tidal waves. Tidal waves will have the same effect, and obviously look the same, yet have a few differences. First of all, a tidal wave is caused by lots of water bought together because of gravitational forces produced by the sun and the moon. Plus, tidal waves are generally much smaller compared to tsunamis, due to the difference of origin. Furthermore, tidal waves are very different to tsunamis as they are predictable events and are a common occurrence[[2]](#footnote-2). However, this doesn’t mean that they are not a threat, as they still arrive with a lot of force and speed.

**The formation**

Most tsunamis are formed from when an earth quake occurs underwater, via two tectonic plates moving in certain directions. The movement underwater causes the water at the surface to dramatically rise. Then once the water has risen, gravity causes the water to fall. However, it is not only due to earth quakes, they can be caused by volcanic eruptions and any large movement underwater, such as a marine landslide. But often the largest tsunamis will be caused by a large a mass falling and displacing large amounts of water.

Next, tsunamis may seem to be just one large wave, which they more or less are. But they have a few differences to a normal wave. First, it goes without saying: the size and speed. Such as the tsunami in Japan 2011 was estimated to be 39 metres tall![[3]](#footnote-3) Secondly, the way they move. Unlike a wave that moves with the motion of water, a tsunami will move with the energy within the water from its formation. This is the cause of the speed and height of a tsunami, whereas a normal wave will get the energy from the wind.

As a tsunami is far from shore in deep water it can often seem much smaller and less of a threat than in reality. This is as the energy will move among a large mass of water, yet as the water comes closer to the shore the water is shallower. Here ‘wave shoaling’ occurs[[4]](#footnote-4), this is where the size of the wave will greatly increase and the speed will decrease. This is due to there still being vast amounts of energy within the wave its self, but less water is present. With these conditions all the energy is within less water causing it to rise and be incredibly destructive.

This can be proven by the equation ; where v is velocity, g is acceleration due to gravity and d is depth of ocean floor. Seen from this equation we can deduce that the velocity of a tsunami is only dependent on one factor, the depth of the ocean floor. So as the wave is very far out at sea, where the water is very deep, the tsunami will go at incredible speeds. Yet as it comes closer to shore where the ocean floor is much smaller, the velocity will deeply decrease. With this equation we can estimate the speed of the tsunami in Japan in 2011. The depth was approximately 29km deep, so square root of 29000x9.81, is about 533 metres per second!

As we can show that the kinetic energy of the tsunami will dramatically decrease as it reaches shallow water. Yet as the kinetic energy decreases this means that the potential energy will increase, thus causing the amplitude of the wave to continuously grow as

Often as a tsunami approaches at angle refraction can occur. This happens due to the crest that is closest to the shore line will slow down, due to shallower water. Because it slows down, the rest of the wave which is still at the same speed will catch up. This can often repeat until the whole wave is almost parallel with the shore[[5]](#footnote-5).

**Examples**

On boxing day 2004 a giant earth quake caused one of the most disastrous tsunamis we have seen in modern history. An earth quake which came to be 9 upon the Richter scale caused a giant tsunami that took the lives over 200,000 people. Yet in deep water, it only came to be 1-metre-high, however as it got closer to shore it came to be about 30 metres high[[6]](#footnote-6), a clear example of water shoaling. However just to say 9 on the Richter scale doesn’t truly present the power of this earthquake. To put it in context it created an equivalent amount of energy to about 99,000,000 tonnes of TNT[[7]](#footnote-7), and one tonne of TNT is equivalent to 4.2 Gigajoules of energy, thus creating 4.2e8 Gigajoules of energy. This is more energy than 25,000 nuclear bombs or every bomb used in the second world war.[[8]](#footnote-8)1. Tsunami definition: <https://www.google.co.uk/search?q=tsunami+definition&oq=tsunami+def&aqs=chrome.0.0j69i57j0l4.4614j0j7&sourceid=chrome&ie=UTF-8>

2.Tidal wave:

<https://www.youtube.com/watch?v=AbismM8mkwk>

3.Japan Tsunami size:

<https://www.google.co.uk/url?sa=t&rct=j&q=&esrc=s&source=web&cd=3&cad=rja&uact=8&ved=0ahUKEwjQjpa2mpPWAhUSZVAKHdRhCegQFggxMAI&url=https%3A%2F%2Fwww.livescience.com%2F39110-japan-2011-earthquake-tsunami-facts.html&usg=AFQjCNFF8Ei-qZKLwWwF-Po73_hDU97sMg>

4.Shoaling

<https://www.youtube.com/watch?v=Wx9vPv-T51I>

5. Refraction:

<http://www.coastal.udel.edu/ngs/waves.html>

6. Boxing Day Tsunami:

<http://www.bbc.co.uk/schools/gcsebitesize/geography/natural_hazards/tsunamis_rev2.shtml>

7-8. Energy

<https://www.youtube.com/watch?v=7oaGUg7ik_c>

<http://ffden-2.phys.uaf.edu/212_spring2005.web.dir/justin_priest/Tsunami%20Physics.htm>

<http://science.howstuffworks.com/environmental/energy/energy-hurricane-volcano-earthquake3.htm>

1. Tsunami definition: <https://www.google.co.uk/search?q=tsunami+definition&oq=tsunami+def&aqs=chrome.0.0j69i57j0l4.4614j0j7&sourceid=chrome&ie=UTF-8> [↑](#footnote-ref-1)
2. Tidal wave:

   <https://www.youtube.com/watch?v=AbismM8mkwk> [↑](#footnote-ref-2)
3. Japan Tsunami size:

   <https://www.google.co.uk/url?sa=t&rct=j&q=&esrc=s&source=web&cd=3&cad=rja&uact=8&ved=0ahUKEwjQjpa2mpPWAhUSZVAKHdRhCegQFggxMAI&url=https%3A%2F%2Fwww.livescience.com%2F39110-japan-2011-earthquake-tsunami-facts.html&usg=AFQjCNFF8Ei-qZKLwWwF-Po73_hDU97sMg> [↑](#footnote-ref-3)
4. <https://www.youtube.com/watch?v=Wx9vPv-T51I> [↑](#footnote-ref-4)
5. Refraction:

   <http://www.coastal.udel.edu/ngs/waves.html> [↑](#footnote-ref-5)
6. Boxing Day Tsunami:

   <http://www.bbc.co.uk/schools/gcsebitesize/geography/natural_hazards/tsunamis_rev2.shtml> [↑](#footnote-ref-6)
7. Energy of an Earthquake: <http://science.howstuffworks.com/environmental/energy/energy-hurricane-volcano-earthquake3.htm> [↑](#footnote-ref-7)
8. <https://www.youtube.com/watch?v=7oaGUg7ik_c>

   <http://ffden-2.phys.uaf.edu/212_spring2005.web.dir/justin_priest/Tsunami%20Physics.htm> [↑](#footnote-ref-8)