Lab 23a: ocean: tsunamis and waves

Tsunami is a Japanese word: from Japanese: □□ , lit. 'harbor wave'

https://en.wikipedia.org/wiki/Tsunami

Please read the wikipedia description for tsunami and then read below:

Waves can be transverse (movement sideways, perpendicular to the direction of motion) or longitudinal (along the same direction as the wave travel).

Part 1: Mapping tsunamis

1.1 Pacific Tsunamis

1. Create a huge map of the pacific "ring of fire"
2. Map out the active volcanoes on your map
3. Map out the severe earthquakes in the past 150 years on your map
4. Calculate the P-S time difference for each one
5. Look up the velocity of tsunami waves in the open ocean and calculate how much warning time we would have for each
6. Going back to the three major tsunamis on our island since 1946, calculate how much warning time we had for each
7. Why were so many people killed in Hilo during the 1946 tsunami?
8. Look up the tsunami simulation for a slide off of Mauna Loa
9. Look up the speeds here: https://www.noaa.gov/jetstream/tsunamis/tsunami-propagation

1.2 Physical oceanography

1. look up the Bali earthquake of 2004
2. what caused this?
3. look up the Puako earthquake of 2006 (called the Kiholo Bay quake)
4. how are these similar? different?
5. Do the same for the Japan tsunami: Fukushima Daiichi
6. if a quake causes plates to slide past each other, with no water displacement, should this cause a tsunami?
7. what does cause tsunami?
8. email your answers

1.3 Plate tectonics

1. On your ocean map, draw our island chain, starting with our island and moving NorthWest
2. Continue mapping the islands to those atolls and submerged islands
3. Are these in a straight line? Why?
4. The pacific plate is subducting under another plate-where does this happen?
5. Mark this subduction on your map (look at the map online for symbols)
6. Where else do you see this?
7. Look at the ocean where the plates go under-what is always there?
8. What sort of volcanoes are formed after this?

Part 2: Tsunami Waves

Tsunami as waves

1. Test out each of these types of waves using a long spring on the floor.
2. send a pulse from one person to the other end, and notice which side the pulse returns on
3. this is known as a hard reflection
4. repeat with a string holding the other end, what do you notice?
5. this is a soft reflection, notice the side the pulse returns on
6. repeat pulses to create a single wave between you and the other end
7. measure the frequency for your wave (count ten pulses, time, divide by ten)
8. measure the wavelength between you and the other end
9. if velocity = frequency * wavelength, calculate the velocity for your wave AT THIS TENSION
10. record a video of this experiment and email it to Dr Bill

Tsunami period

1. Look up the velocity of tsunami waves
2. are they transverse of longitudinal?
3. what is their velocity?
4. what is their wavelength?
5. what is their frequency?
6. 1/frequency is period, what is the period of a normal tsunami wave?
7. who cares? why do so many people drown in a tsunami by running out to capture fish?
8. you are sitting at the beach, and the water suddenly recedes. what do you do, and how long do you have to do it? (please don't say "I go out and get fish")
9. compare the wavelength, frequency and velocity to sound waves-why?
10. email your answers to Dr. Bill

Tsunami amplitude

1. how big above the surface is a tsunami in deep water?
2. where is the energy in a tsunami wave in deep water?
3. if a tsunami is huge in the harbor, why?

4. what happens to the velocity of a wave as it enters shallow water (surfers know this)
5. why is this relevant?
6. email your answers to Dr. Bill

Part 3: Sound waves

Sound waves

1. using a closed tube, find the frequency that resonates with the tube using a sound generator
2. measure the length of the tube and multiply by 4, this is the wavelength
3. calculate the speed of sound in the elab at that moment (changes with weather)
4. measure the distance in meters between the walls of the bathroom stall of your choice
5. this is the wavelength we will use: a multiple or fraction of this-you find out
6. using the speed of sound from above, calculate the frequency that will resonate in the bathroom stall
7. using a sound generator, find this frequency
8. why do singers find the acoustics of bathrooms so nice?
9. Look in GPAC at the sound reflectors above the stage-why are they shaped this way?
10. Look up refraction and look into why waves might change direction in the ocean
11. Look up Rogue waves and explain how superposition is part of this
12. How would you demonstrate rogue waves with the long spring?
13. record a video of your experiment and email to Dr. Bill

Challenges:

1. Make a video of a slinky, demonstrating P and S waves
2. Make a video of a longer spring, demonstrating hard and soft reflections
3. Make a video of a longer spring in a single standing wave-calculate velocity, wavelength and frequency
4. Make a video of a resonant sound tube, and calculate the speed of sound in the elab that day (see above)
5. Make a video of another resonant situation somewhere in the elab (bathroom, monlab speakers, etc.)

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