The NE_COSEE OSEI Wave Class

Plymouth Community Intermediate School
Teacher: Mary Lavin
Visitor: Ralph Stephen, WHOI
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Class Outline

1) Introduction (7.5 minutes) - Talking with some powerpoint slides and answering questions.
   a) Who am I?
   b) What is WHOI?
   c) What do I do? Life at sea.
   d) Students should consider "scientist" as a career.
   e) Education required.

2) Waves (7.5 Minutes) - Talking with some powerpoint slides and answering questions.
   a) Why do we care about waves? What would life be like without waves?
   b) Types of waves.
   c) Tsunamis as an example of waves. Tsunamis have small amplitude (few centimeters) in the deep ocean but the amplitude grows in shallow water (10's of meters) and the waves "break".
   d) Waves transport energy without transporting mass.
   e) Wavelength, amplitude, period and frequency
   f) The Plymouth Wave Lab.

3) Introduction to the demonstrations of different wave phenomena at five stations. (5 minutes)

4) Students work with the five hand-on demos in small groups (about 5 minutes each). Written instructions with questions at each station.

Station Questions for the NE_COSEE OSEI Wave Class

This is a list of questions for the five stations in the "wave class" on Friday, October 8 at the Plymouth Community Intermediate School. The stations can be run through in any order.

1) Simple Harmonic Motion Stand - This station shows a mass bouncing on a spring. It demonstrates frequency and period. Pull the mass down and release it so that it bounces up and down. With a stop watch or your own wrist watch measure the time it takes (in seconds) for the mass to return each time to the bottom position. The time it takes for each cycle is called the period. Start the mass bouncing again and count how many times it hits bottom in a minute. This is the frequency in cycles per minute.

Period - P _______ seconds

Frequency - f _________ cycles per minute

[*Further work:* Convert the frequency to units of "cycles per second" by dividing the "cycles per minute" number by 60. Why? Then take the reciprocal of f (1/f). Compare this to the period.

Frequency - f _________ cycles per second

Reciprocal frequency - 1/f ___________ seconds per cycle

Note: The unit of frequency is usually cycles per second. This unit is called Hertz (or Hz for short). The period should equal the reciprocal frequency. Does yours?]

2) Small Wave Tank - This tank contains a layer of (clear) lamp oil over a layer of (green) water. By tilting the tank slowly back and forth you can generate small amplitude waves that travel back and forth on the surface of the oil and at the interface between the oil and the water. These are like the wind-driven waves on the ocean far from the beach.

How do the waves that hit the beach differ from the waves that are farther offshore?

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[*Further work:* Are the wavelengths of the waves at the surface of the (clear) oil the same as at the interface between the oil and the (green) water? If not, how do they differ?]

3) **Slinky -** Stretch the slinky out on the floor. Stop all motion on the slinky. Move one end side-ways to generate a transverse wave. Measure how long it takes for the transverse wave to reach the end of the slinky. Stop all motion on the slinky. Compress the coils at one end of the slinky and release them quickly to generate a compressional wave. Measure how long it takes for the compressional wave to reach the end of the slinky.

Time for transverse wave - _______ seconds

Time for compresional wave - _________ seconds

Which type of wave travels fastest on a slinky - transverse or compressional?

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4) Elastic Bands and Washers - Equal Weights - Two students stretch the elastic band between them hanging in the air. On this string, the same number of washers has been added at each joint between the elastic bands. One student - the receiver - holds the cord steady at his/her end. The other student - the source - flicks his/her end to send a transverse traveling wave down the string. The other student(s) should stand back from the string so that they can see the wave travel down the whole string. How does the amplitude of the wave change as it travels down the string?

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[Further work: Can you excite a standing wave? How?]

5) Elastic Bands and Washers - Tapered Weights - Two students stretch the elastic band between them hanging in the air. On this string, a different number of washers has been added at each joint between the elastic bands. The mass of the string gets less towards the end with the cord. One student - the receiver - holds the cord steady at his/her end. One student - the source - flicks his/her end to send a transverse traveling wave down the string. The other student(s) should stand back from the string so that they can see the wave travel down the whole string. How does the amplitude of the wave change as it travels down the string?

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[Further work: How does the amplitude behavior of the two elastic band demonstrations - uniform and tapered - differ?)

6) The Plymouth Wave Lab - This is a computer simulation of waves on a string. The instructor will show some examples in class, and then you can go to the web site below to see other examples on your own. Attached is a sample output from Example # 1 on which the amplitude and wavelength are marked. Below are snapshots at two different times (0.25sec and 1.15sec) of a pulse wave traveling down a tapered string (like a whip, Example #3). Measure the amplitude and wavelength of the pulse at each time (units of inches or centimeters are fine).

Amplitude at 0.25sec. ____________________

Wavelength at 0.25sec ____________________

Amplitude at 1.15sec _____________________

Wavelength at 1.15sec _____________________

How do the amplitude and wavelength change as the string gets smaller?

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[Further work:

How is this like a tsunami? ____

How is this like a whip? ____

You can study these and other examples of waves on a string on the web at http://msg.whoi.edu/String_Lab/New_String_Movies.html .]

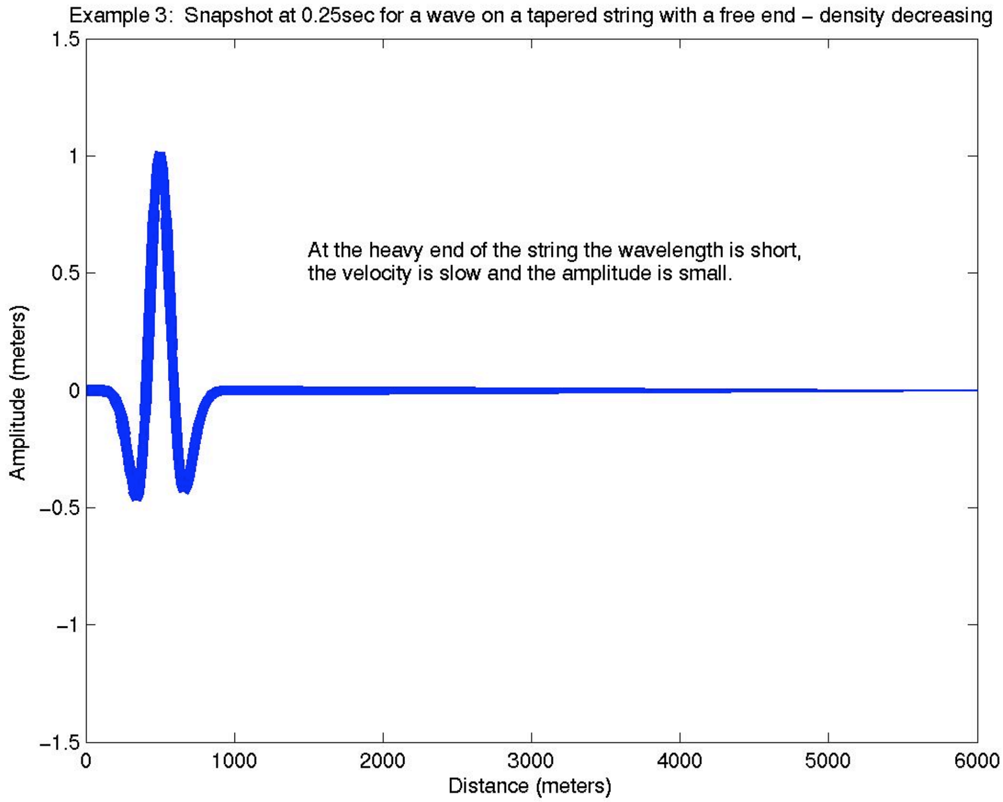

Figure 1: Snapshot at 0.25sec.

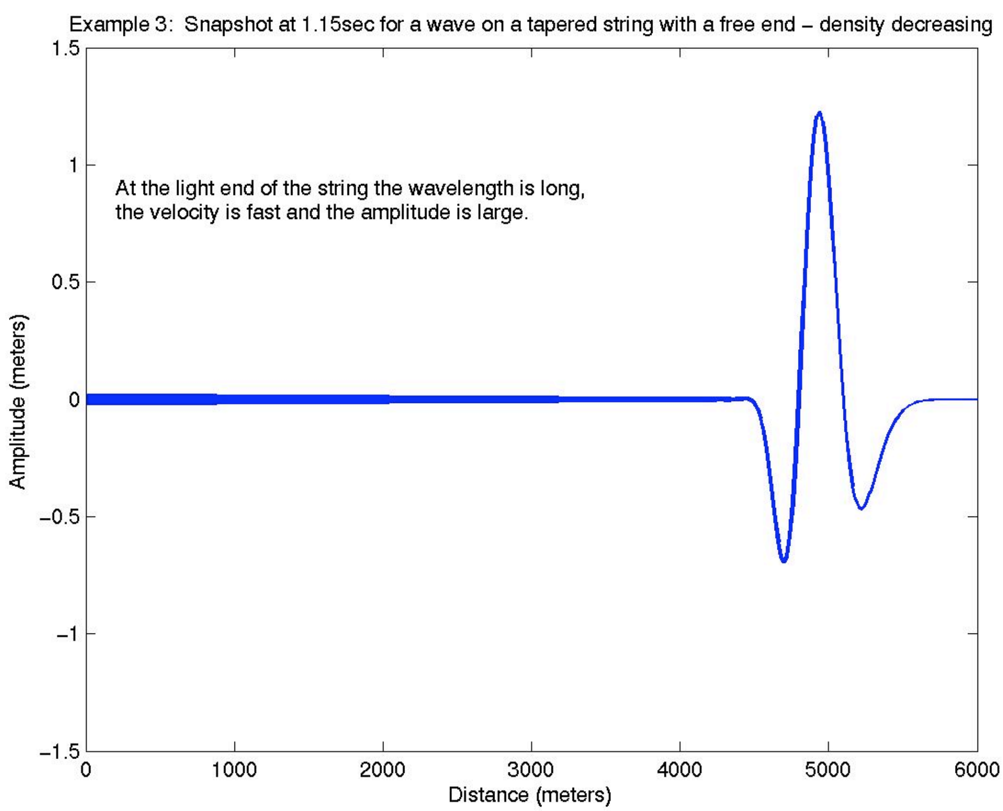

Figure 2: Snapshot at 1.15 sec.