Presenter: Jo Anne M Harris
Stafford High School Falmouth VA 22405
quark372@yahoo.com

Standing Wave Apparatus

Va Sol: Standard PH.9 b,c

The student will investigate and understand how to use models of transverse and longitudinal waves to interpret wave phenomena. Key concepts include:

(b) fundamental wave processes (reflection, refraction, diffraction, interference, polarization, Doppler effect); and

(c) light and sound in terms of wave models

Topic/Concept

There are pictures of standing waves in textbooks, but students may have difficulty visualizing them. This piece of apparatus can be constructed with minimal skills and at low cost. Students can not only see different numbers of standing waves, but they can easily change the number of nodes and antinodes, using a finger or a pencil. Using this model, the students can determine the number of waves present at a given time.

Materials:

- PVC pipe (6 ft, _ " diameter)
- PVC pipe cutter
- 8 elbow pieces
- 3/8 inch dowel (2 pieces, 1 cm each)
- 2 Radio Shack motors (1.5-3.0 V DC)
- 0.5 m cord
- 3 D cells
- 15-_ resistor
- alligator clips (4)
- duct tape
- 2 elastic bands

Safety Considerations: None noted

How the Physics is Demonstrated:

Two arms of PVC pipe hold the 2 motors facing each other. A string or cord connects them. As you complete the circuit, a wave is sent from each motor through the string. Since the waves are identical and moving in opposite directions, interference occurs and a standing wave can be formed. It may be necessary to adjust the tension by pulling the arms farther apart. When the crest of one wave overlaps the trough of the other wave, destructive interference is noted. This results in a node. When crest meets crest, or trough meets trough, constructive interference occurs. This forms an antinode. To create more nodes and antinodes, place a pencil or finger under the cording and allow it to barely touch the cord. The pinching will cause a node to form.

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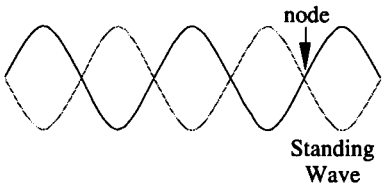
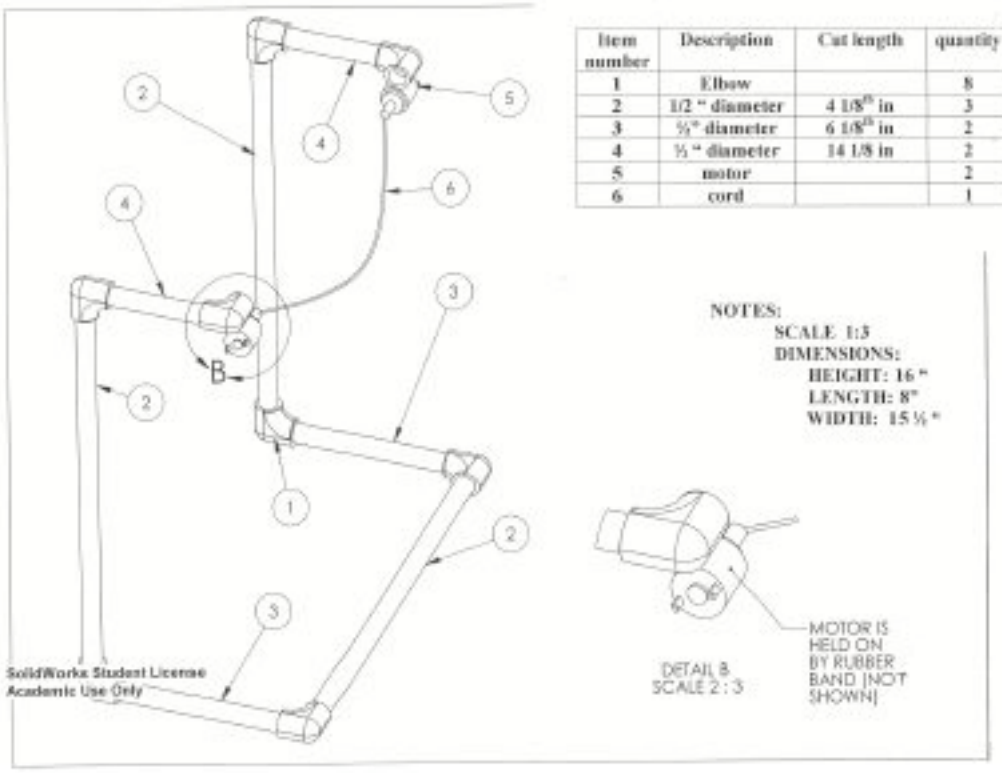


Construction:



- The dowel helps the string to stay attached to the motor. Drill a small hole in the dowel to slip it over the top extended piece of the motor. It only needs to be about 1-2 cm. You want it to fit snugly and allow the motor to turn. The string is attached at the dowel or around the base of the dowel. You simply need some spot to "grab it." Once the cord is attached to the motor, you may want to use duct tape to "encourage" it to stay in place. (Duct tape is such a standard physics tool!)
- The motor is then attached to the PVC pipe by wrapping an elastic band around both the motor and the PVC pipe.
- Obviously, the number of cells and the size of the resistor can vary. These work well for me, but you may choose to use a variable resistor with a different amount of cells.
- Two alligator clips are attached to each motor. One end connects to the battery pack. The other clip is attached to the resistor.

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- Make sure that the motors are turning the same way to set up the standing wave. If not, you may need to reverse the alligator clips.

Sources and references: I did not develop this idea but viewed one, made by another physics teacher. I have been unable to find her source, although I have been searching the Internet.