Waves and Sound Expectations

1. Students should understand what a wave is and how it is different from other ways of transporting energy (for instance, throwing a baseball). They should be familiar with the different types of waves (sound, electromagnetic, mechanical) and how they are created.

2. Students should understand the difference between transverse and longitudinal waves and be able to cite examples of each.

3. Students should understand the relationship between the velocity, frequency, and wavelength of a wave.

4. Students should understand what determines the speed of a wave, and how changing conditions effects wavespeed in different mediums (in air, on a spring).

5. Students should understand the principles of superposition, interference, constructive and destructive interference, and beat frequencies

6. Students should understand the concepts related to standing waves – harmonics, overtones, boundary conditions, nodes, antinodes.

7. Students should be able to predict, draw, and analyze standing waves in a variety of instruments (string, open tube, closed tube).

8. Students should understand how sound is produced by these instruments, why instruments have a characteristic sound, and predict the frequency of sound produced by an instrument given it's dimensions or visa versa.

9. Students should understand how to interpret a frequency spectrum diagram.

10. Students should understand the Doppler effect.

Practice problems:

1. What is a wave anyways?
2. Define wavelength, frequency, period, wave speed and give units for each.
3. What is the difference between transverse and longitudinal waves? What is sound? Could you make a transverse wave in the air? Why do certain media support transverse waves and others support longitudinal waves?
4. Is there sound in space?
5. When you yell at someone far away, which of the following is true (mark all that apply)?
    1. The air from your mouth travels to the other person and they hear that same air blast.
    2. Energy is carried by the sound wave to the person's ear, but air is not.
    3. Vibrations are created by your vocal cords.
    4. Vibrations are created by your tongue.
    5. The air near your mouth travels only a small distance, perpendicular to the direction of the wave travel.
    6. The air near your mouth travels only a small distance, parallel to the direction of the wave travel
6. What is the relation between wave speed, frequency and wavelength?
7. What determines the speed at which a wave travels? How can you change the wave speed on a string? In the air?
8. Explain the principles of superposition and constructive and destructive interference. Draw an example of each.
9. What is a standing wave? How is it different from a traveling wave? How is a standing wave created?
10. Describe the first three harmonic standing wave patterns for a guitar string, a closed tube, and an open tube. Provide careful illustrations for each.
11. Explain how it is that we are able to hear a guitar being played (talk about all the things which must occur for us to hear the sound).
12. Give all the lengths for a set of pan pipes that will play all the major notes from C3 to C4. They will be made out of bamboo with an inner diameter of 3.4cm.
13. You plan to make a guitar with a neck length of 60cm (from nut to bridge). Where do you place the first 5 frets?
14. Describe WHY the end effect occurs in wind instruments but not stringed or mallet percussion instruments.
15. What does resonance mean (in your own words)?
16. Describe how a glass could be broken with sound alone.
17. A string is tuned to play a frequency of 340Hz. Another string is played and you hear a beat frequency of 3 Hz. What is the frequency of the second string?