Doppler Effect

Equipment

- Various tuning forks
- Microphone

Objective

Data collection

- Quantitative analysis of (moving) sound wave

Data analysis

- Determine frequency shifts

Physics Concepts

- Superposition and Standing Waves
- Doppler effect

Conceptual (C-Level)

Two trains are approaching each other along two parallel tracks. You are on train "1" and train"2" starts to blow its whistle. Sketch a picture and/or diagram depicting the wavelength or frequency you observe. Qualitatively describe what is observed. (Assume speed of sound is 340 m/s)

- As the trains approach.
- As the trains recede.
- If train "1" (your train) blows its whistle, is the frequency shift noticeable?

EXPLORE: Play with the following simulations to gain a better understanding of waves and the Doppler effect.

- Standing Longitudinal Waves - http://www.walter-fendt.de/ph14e/stlwaves.htm
- Reflected wave - http://www.walter-fendt.de/ph14e/stwaverefl.htm
- Build a Doppler ball (virtual lab) - http://199.6.131.12/en/scictr/lab/doppler/index.htm

Basic Lab (B-level)

You are on a train with a 1 kHz whistle. Determine the frequency shift due to the Doppler effect for the following situations.

- An observer standing beside the track. (Plot observed frequency vs distance.)
- An observer moving toward the train at ½ the train's speed.

The train has a 20 kHz whistle (don't ask... okay it is used to scare the deer off the tracks).

- Compare the frequency shift for the two cases.
- Is the observed the frequency shift independent on which object (source or observer) is moving?
- What happens if you are moving faster than the speed of sound?

Advanced/Extended Lab Ideas (A-level)

- Determine the expected frequency for someone listening to a sound source spinning around in a circle. Assume the person is sitting on the edge of the circle. Comment.
- Demonstrate wave addition by recording two tuning forks separately and together. Compare the theoretical interference pattern with the experimental (HINT: Using LOGGERPRO you will need to construct manual and calculated columns)