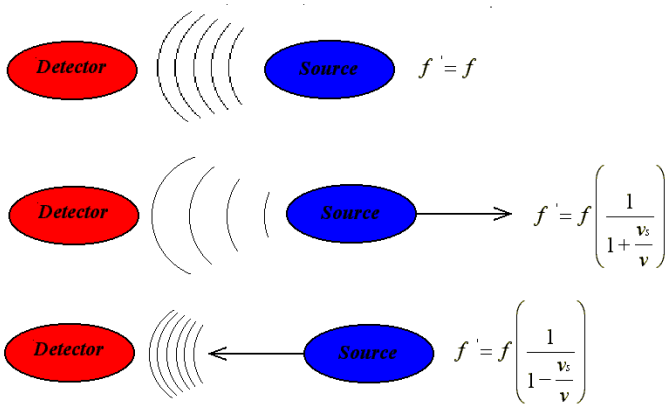
DEVICE Doppler Shift Demonstration

TOPIC Wave Mechanics

THEORETICAL BACKGROUND A Doppler effect is experienced whenever there is relative motion between a source and an observer. In principle, when the source and observer are moving toward each other, the frequency heard by the observer is higher than the frequency of the source. When the source and observer move away from each other, the observer hears a frequency which is lower than the source frequency. In a situation where the sound source is in motion and the observer is stationary, wavefronts become more compact as the source moves toward the observer. The observer hears an increase in frequency. Similarly, wavefronts become more interspersed as the sound source moves away from an observer who is stationary. The general expression for the observed frequency when the source is in motion and the observer is at rest is

$$f' = f\left(\frac{1}{1 \mp \frac{v_s}{v}}\right)$$

for which f' is the observed frequency, f is the frequency of the sound source, v_s is the velocity of the source, and v is the speed of sound. The $\mp$ sign indicates the direction of the sound source; negative if it moves toward the observer, positive if it moves away from the observer.



DESCRIPTION The apparatus consist of a swiveling lab stool and a meter stick extending out from the center of the seat. A noise box powered by a 1.5 volt battery is mounted on the far end of the meter stick.

PROCEDURE

1. Obtain a 1.5 volt size “D” battery and place it in the battery holder.
2. Rotate the stool once the speaker begins to produce a high pitch.
3. Observe the Doppler Effect.

SUGGESTIONS