



Concept:

The audience will hear the buzzer's stationary frequency shifted up as the ball moves toward them, and down as the ball moves away.

The shifted frequency is given by

$$f' = \frac{v}{v \pm v_s} f,$$

where $v = 343$ m/s, \pm means source moves (+) away from or (-) toward the observer, and $f = 4.0$ kHz. With the ball moving at $v_s \approx 5$ m/s, the frequency shift, although no more than a few percent, is still clearly perceived.

Procedure:

1. Unzip ball, turn on buzzer, and re-zip ball.
2. Throw the ball a student located in the middle of the classroom.
3. Have that student throw the ball to another student
4. Ask the students to report whether they heard a higher or lower frequency than when the ball was stationary.
5. Discuss the correlation between the motion/location of the ball and their reports of frequency changes.

Equipment:

1. Foam Ball
2. Buzzer (4 kHz)