CULMINATING TASK AND ASSESSMENT

You learned how sound energy is produced, transmitted, and received, and how sound can undergo reflection, refraction, and interference.
You have also learned about various applications, such as ultrasonic sounds and supersonic speeds. To summarize the ideas found in this chapter, draw two quarter-sized circles far apart on a page. In one circle put *"SOURCES"* and in the other put *"RECEIVERS."*
Add as many concepts as possible to the page, and show how the concepts link to one another. For example, you can start by showing the production of sound from a tuning fork (the source), the transmission of the sound through the air, and the receiving of the sound in a human ear (the receiver).
You also learned that all sound waves are caused by vibrations. Sound stimulates the auditory nerve and Humans can hear a range between 20 and 20 000 Hz.

Another activity that I would introduce to my students is measuring the speed of sound inside & outside.

Measuring the Speed of Sound Outside

To perform an experiment outside to determine the speed of sound in air, you will need a loud source of sound such as two pieces of hardwood to be struck together, a stopwatch, and a thermometer.
Procedure
1. Locate a high wall with a clear space at least 150 m deep in front of it.
2. Clap two boards together and listen for the echo. Repeat until you have determined the approximate time interval between the original sound and the echo.
3. Now clap the boards after the echo so that the time between the previous clap and the echo is the same as the time between the echo and the next clap. In other words, clap the boards so that a regular rhythm is set up: clap ... echo ... clap … echo.
4. When you have achieved the correct timing, have your partner record, with the stopwatch, the number of seconds required for 20 or more clap intervals. (Remember to start counting with zero!)

5. Determine the average interval between claps. This interval is equal to the time taken for the sound to travel four times the distance between you and the wall.
6. Measure the distance to the wall in metres and the temperature of the air in degrees Celsius.
7. Calculate the speed of sound in air using two different methods.

Analysis
How does your value for the speed of sound in air compare with the value you would expect for air temperature when you collected your data? What you would expect for air temperature when you collected your data? What was the percentage difference between the two values?

Measuring the Speed of Sound in the Classroom

Now that you have measured the speed of sound outside, we can apply the same concepts to the measurement of the speed of sound in the classroom. But, in the classroom the space is much smaller and the apparatus used to measure the reflected sound needs to be much more accurate. This is achieved by using an oscilloscope and microphone or a microphone connected to the appropriate computer interface. Your instructor will give you specific instructions on the use of the equipment.
Question
What is the speed of sound in the air in the classroom?*1*
Prediction
(a) Predict the speed of sound in the classroom. You may use the equation for the speed of sound given at the beginning of this section.
Materials
cardboard mailing tube (closed at one end)
thermometer
button microphone
tape measure
oscilloscope and amplifier, or computer interface
Procedure
1. The tube can be mounted securely either horizontally or vertically.
2. Place the button microphone securely at the open end of the tube.
3. Prepare the equipment so the microphone can measure both the source of the sound and the reflected sound.

4. Snap your fingers or create a sharp sound adjacent to the microphone.
5. Record the time between the incident and reflected sounds.
6. Repeat steps 3 and 4 for at least three more trials.
7. Eliminate any aberrant readings and, if necessary, do more trials.
8. Measure the distance from the microphone to the bottom of the tube.
9. Measure the temperature of the air in the tube.

Analysis

(b) Find the average value for the time it takes the sound to travel up and down the tube.

(c) Calculate the speed of sound in the tube.

Evaluation

(d) Determine the percentage difference between your predicted value and the experimental value.

(e) Account for the sources of error in this investigation and explain how they could affect the results.

(f) Suggest changes to the procedure that would help reduce error.

Synthesis

(g) How would you use the same apparatus to measure the speed of sound in carbon dioxide? Try this investigation using the same equipment and dry ice.

(h) Design and carry out an experiment to measure the speed of sound in wood, using the same equipment, the wooden top of a lab desk, and a small hammer.

Vibrating Tuning Fork

Tuning forks are often used as a source of sound energy in scientific activities. You will use a tuning fork, a Styrofoam cup, a rubber hammer, and a pith ball to look at some properties of sound waves.

(a) Strike a low-frequency tuning fork with a rubber hammer, and touch the prongs to the surface of water in a cup. Describe what happens and why.

(b) Touch a vibrating tuning fork to a suspended pith ball .
Describe what happens and why.

I would also prepare a quiz to keep my students' understanding fresh.

1. An A-string on a violin is played at 8.8 × 102 Hz, and the wavelength of the sound wave is 4.1 × 10–1 m. At what speed does the sound travel in air?
2. Calculate the frequency of a sound wave from a clarinet if the speed of sound in air is 3.40 × 102 m/s, and the wavelength of the sound wave is 1.7 × 10–1 m.

3. Do compressions and rarefactions of a longitudinal sound wave travel in the same or opposite directions? Explain.

4. As mentioned in this section, pitch is different from frequency. Pitch is subjective, unlike frequency, which is objective. What is one subjective property of pitch?