

**Academic Activity
Chapter 2****Calculating a
Musical Project**

Suppose you are an engineer for a company that has been asked to design a fixed musical sculpture out of metal electrical conduit for a hands-on art park. The contracting company would like the pipes to play the notes from a popular song when struck with an object. You know that there is a mathematical relationship between the length of an open pipe, the frequency of the vibration it will make, and the velocity at which sound travels through air.

$$\text{Velocity of sound} = \text{wavelength} \times \text{frequency of the sound}$$

Some facts:

- The wavelength of a vibration (sound) created in an open pipe is twice the length of that pipe.
- Musical notes all have a specific frequency. Middle C is 254 Hz, or cycles per second.
- Sound travels through air at a velocity of 343 meters per second at sea level and 20° C.

You need to figure out how much pipe your company is going to need to create a sculpture that will sound the eight most common notes in a popular song.

Go online and do some research:

- Find the music to a popular song.
- Figure out the eight most common notes in part of the song. (If you do not know how to read music, ask a friend in band or a music teacher.)
- Determine the frequency of each of the eight notes you have chosen.

Now that you have done the research, you can calculate how many meters of electrical conduit it will take to make each note, how many total meters of electrical conduit you need, and the total cost if you have to buy the electrical conduit in 3.5 meter increments at the going rate of \$3.25 a meter.

Use the equation:

$$\frac{1}{2} \text{ wavelength} = \text{velocity of sound} / \text{frequency of the note}$$

Here is an example for the note middle C:

$$\frac{340 \text{ m/s}}{254 \text{ Hz}} = 1.33 \text{ m} (1/2) = 0.67 \text{ meters}$$

For an open pipe to make middle C when it is struck, it has to have an unimpeded length of 0.67 meters. It would cost \$11.38, because even though only 0.67 meters are needed, the pipe is sold in 3.5 meter increments.



Academic Activity Chapter 2

Calculating a Musical Project

Now it's your turn.

1. What song did you choose?

2. What are the 8 most common notes and their frequencies?

3. How many total meters of pipe will you need?

4. How much will it cost?
