Name _____ Class _____ Date _____

WAVES • SOUND • MEASUREMENT

Measuring the Speed of Sound

How fast does a sound wave actually travel?

sound is on the move!

01 Sound takes time

Sound may seem instantaneous, but it takes time to travel through air. When a sound reaches a surface, part of it can reflect back as an **echo**. By measuring how long that round trip takes, we can estimate the speed of sound ourselves.

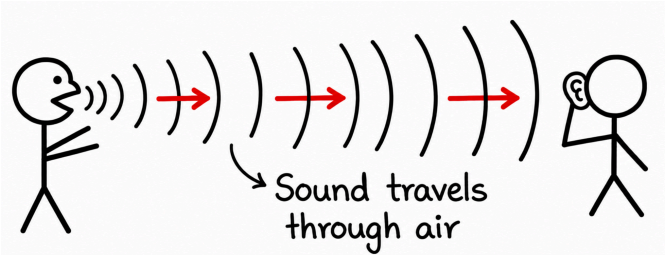
$$speed = \frac{distance}{time}$$

Did you know?

Sound travels through air at roughly

343 m/s

at room temperature



Vibrations pass from particle to particle, carrying energy through the air.

02 Your mission

Send a short sound through a simple paper tube, record its echo with PHYSBOX, and use the delay between the two signals to calculate the speed of sound.

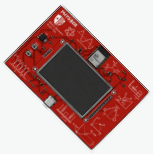
By the end, you will:

- Learn how sound travels and prove the speed of sound!
- Record a sound and its reflected echo.
- Measure the echo travel time.
- Calculate an experimental speed.
- Compare it with the accepted value.

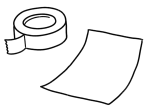
Build and Experiment

PHYSBOX

01 Gather your materials



PHYSBOX
Microphone and waveform recording



Paper and Tape
Roll several sheets into a long tube.

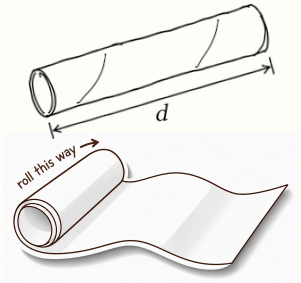
Book or Flat Surface
Used to cover the far end.

Also helpful: ruler or measuring tape • a partner

02 Build your tube

1. Tape sheets of paper together.
2. Roll them into a tube about **0.5–1 m** long.
3. Don't worry it does not need to be perfect.
4. With your ruler, measure its length and record L.

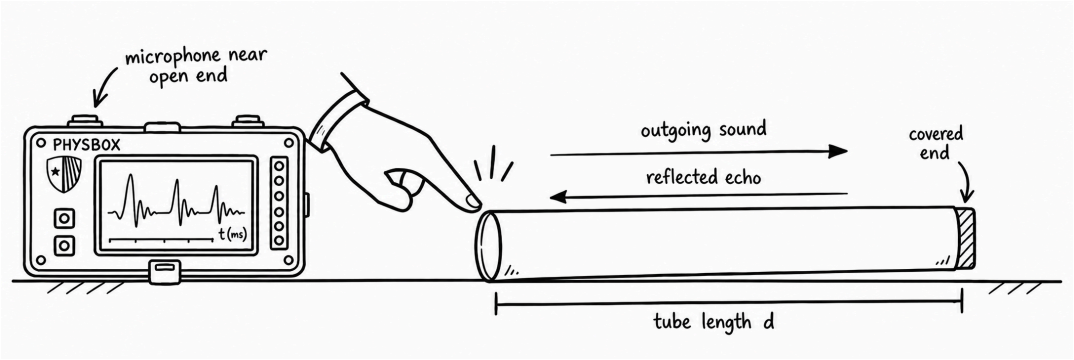
Tube length, L = _____ m



QUICK TIP

Longer tubes create a larger echo delay, which is usually easier to see on the graph.

03 Ensure setup



Same side
PHYSBOX and open tube end

Close the far end
Use a book or a friend's hand

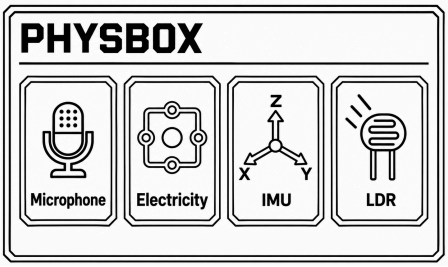
Keep it steady
Do not hit PHYSBOX itself

Record the Sound

PHYSBOX

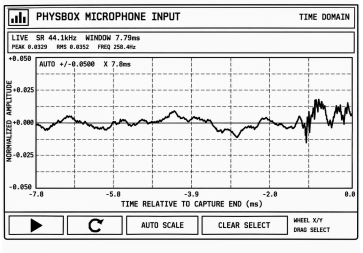
1. **Turn PHYSBOX on** using the switch on the top-right.

2 Tap the **microphone icon**.



MAIN MENU

3 Open the microphone plotter.



You should see this page. Don't worry if it looks complicated — you only need a few tools.

4. Put PHYSBOX close to the **open end** and press **Record** at the bottom-left.

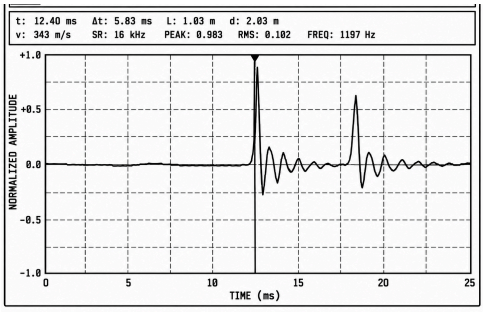
5. Make **5 clear, separated claps or taps** near PHYSBOX.

6. Stop after 5 sounds.

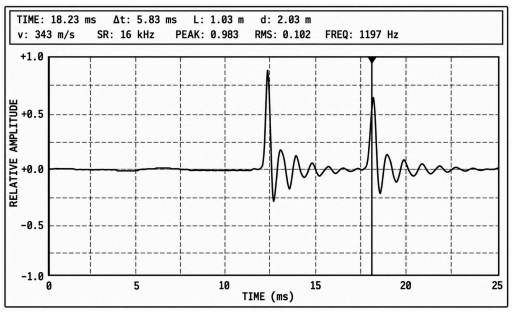
Each sound makes:
- larger first peak = original
- later smaller peak = reflection

07 Measure the first sound

Use the **zoom tools** to inspect the first sound.



Select the first/main peak with the stylus.
Record its time as t_1.



Select the reflected peak.
Record its time as t_2.

FIND THE ECHO DELAY

$$\Delta t = t_2 - t_1$$

Record t_1, t_2, and Δt in ms.

8. Repeat this for all **5 sounds**.

Calculate the Speed

PHYSBOX

Tube length, L = _____ m Use this same length for all five trials.

Sound goes to the closed end and back

$$d = 2L$$

FOR EACH TRIAL

$$v = \frac{2L}{\Delta t}$$

Before calculating:

convert Δt from **milliseconds to seconds**.

Record and calculate

Trial	t_1 (ms)	t_2 (ms)	Δt (ms)	v (m/s)
1				
2				
3				
4				
5				

$$v_{avg} = \frac{v_1 + v_2 + v_3 + v_4 + v_5}{5}$$

Average speed: _____ m/s

Compare your result

How close is your measured value to the expected speed of sound in room-temperature air, about **343 m/s**?