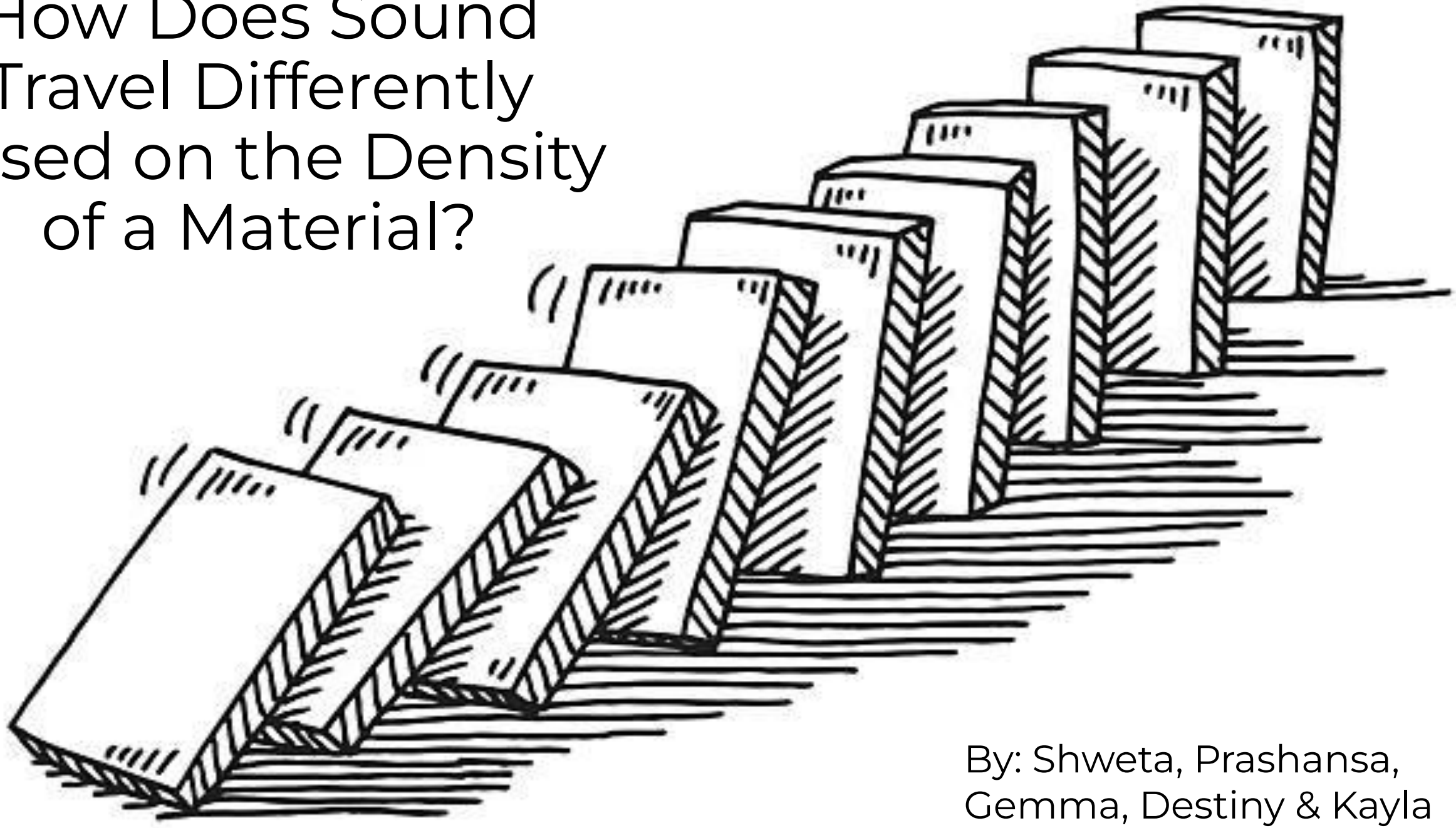
How Does Sound Travel Differently Based on the Density of a Material?



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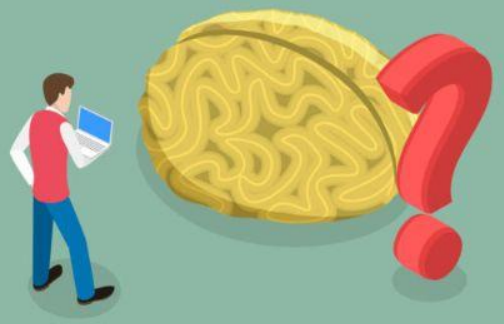
SCIENTIFIC METHOD

OBSERVATION



QUESTION

HYPOTHESIS

EXPERIMENT

CONCLUSION

RESULT

PURPOSE

The purpose of this experiment is to understand how the speed of sound depends on the ***stiffness*** of a material and to prove that, the propagation speed of sound is given by:

$$C = \sqrt{\frac{B}{\rho}}$$

where

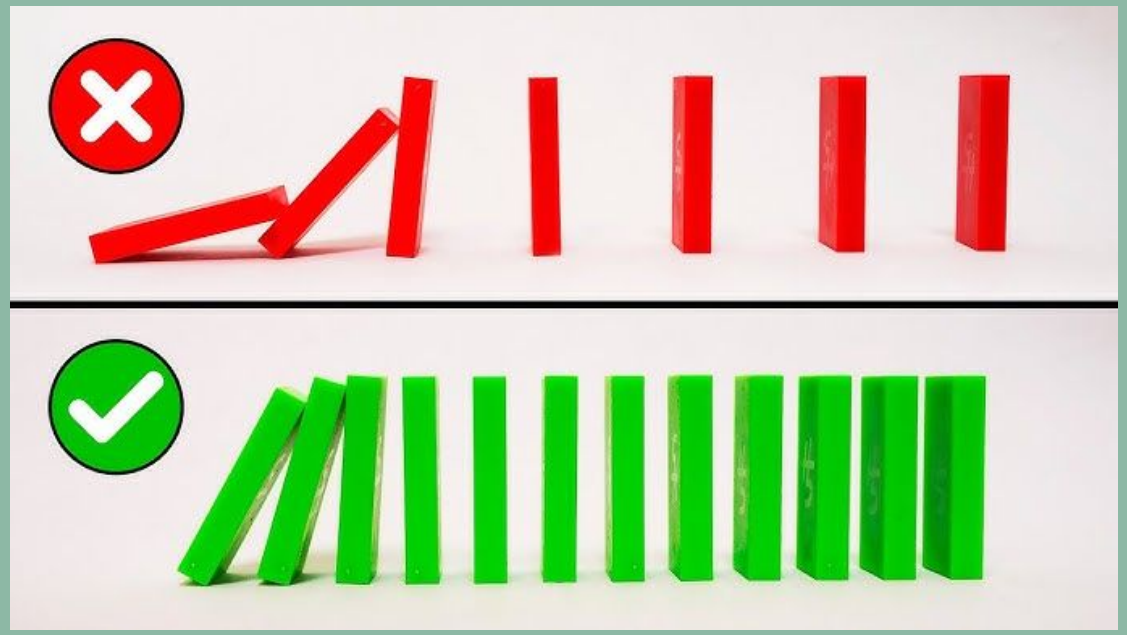
$B =$ bulk modulus

$\rho =$ density

By using dominoes as a model, we aim to understand how particle spacing influences wave propagation speed.

Hypothesis

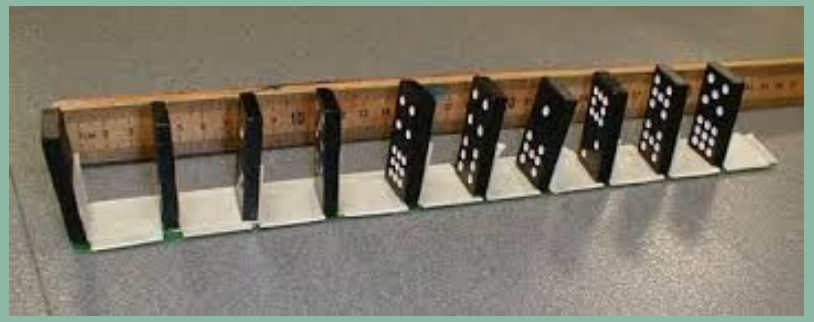
- If the dominoes are placed **closer together**, the wave (falling sequence) will travel **faster** because denser materials transmit sound more quickly.



MATERIALS AND METHOD

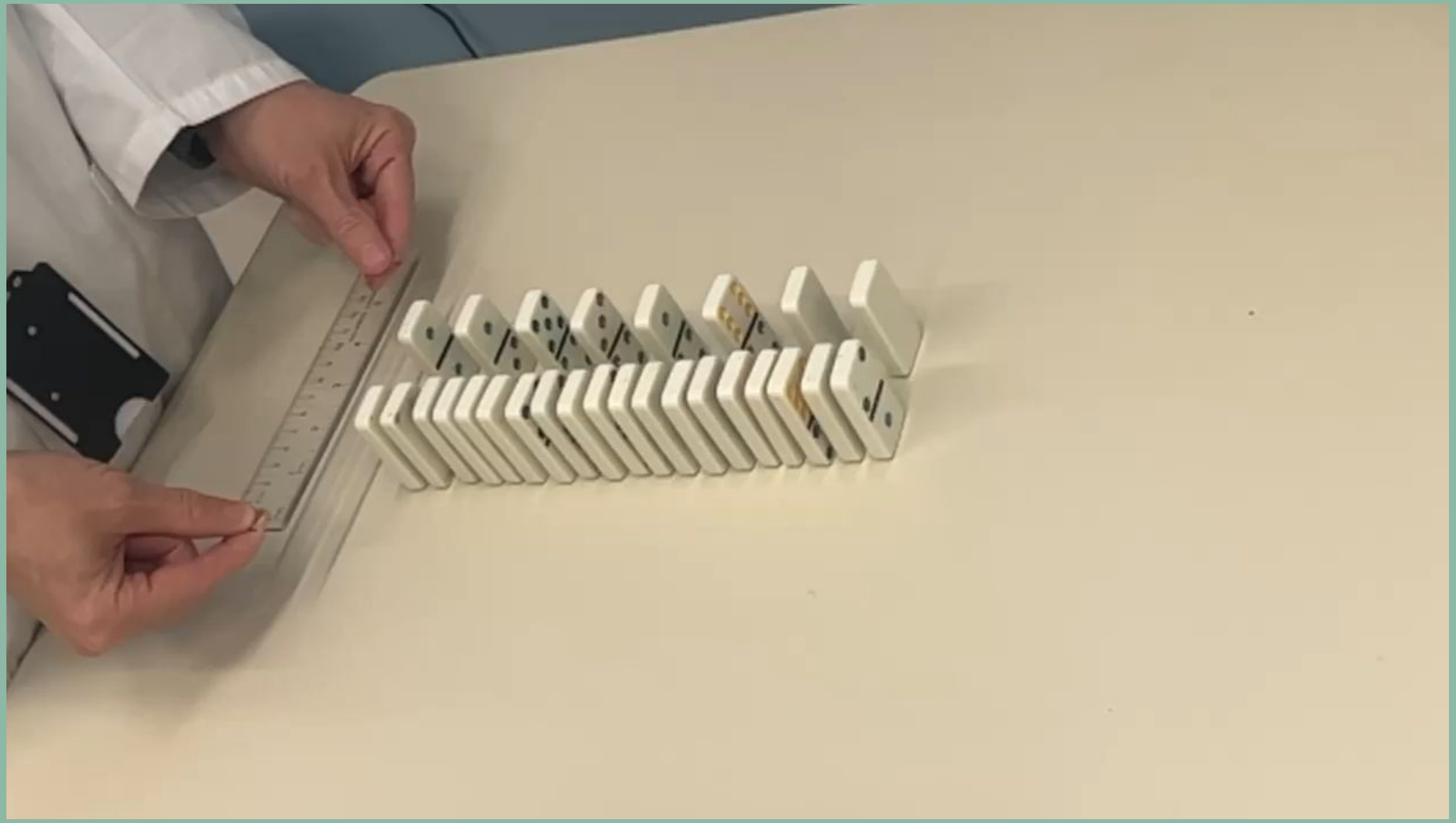
Materials:

- 15 dominoes
- Ruler
- Stopwatch
- Table



Method:

- Arrange 15 dominoes in a straight line, 0.5 cm apart.
- Push the first domino and measure the time it takes for the last one to fall.
- Rearrange the dominoes 1 cm apart and repeat the timing.
- Try another spacing at 1.5 cm apart and record the results.
- Compare the times recorded for different spacings.



OBSERVATION

- Closer spacing (higher stiffness) → Faster wave propagation
- Wider spacing (lower stiffness) → Slower wave propagation
- This behavior is similar to sound propagation—sound moves faster in solids than in gases because solid particles are packed closer together.

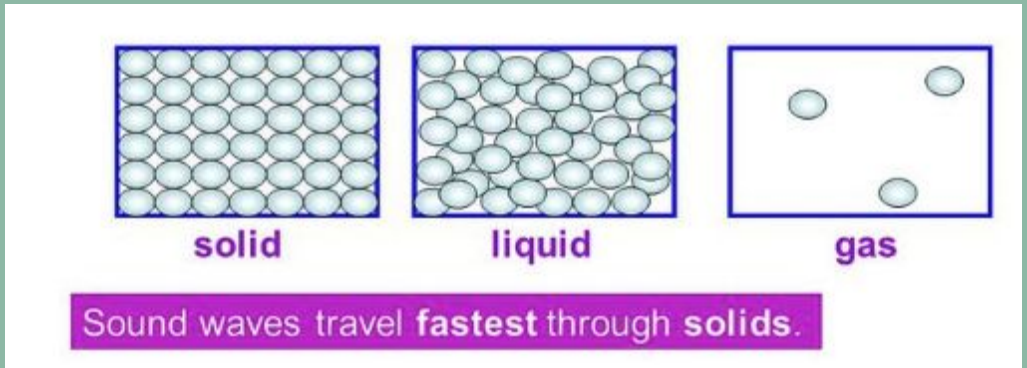


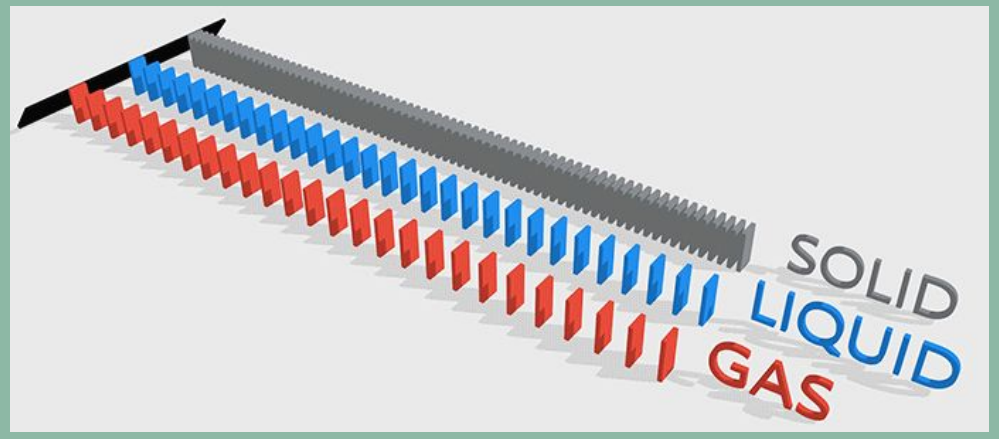
Table 1: Dominoes spacing vs. Time for wave to travel.

SPACING BETWEEN DOMINOES(cm)	TIME TAKEN FOR WAVE TO TRAVEL (s)
0.5 cm	1.2 s
1.0 cm	1.6s
1.5 cm	1.8s

CONCLUSION

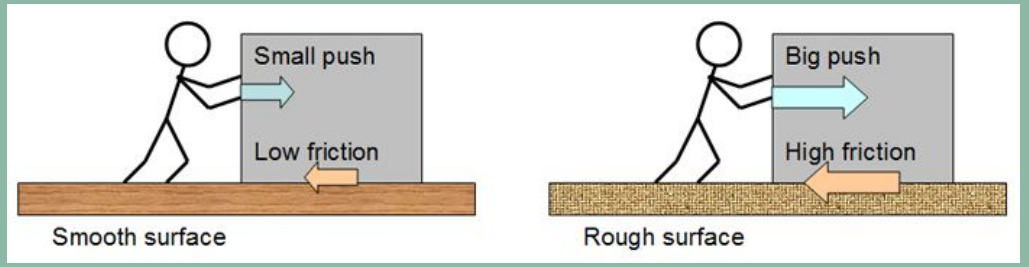
- Higher Bulk Modulus (B) → Faster Sound Propagation
- Sound moves fastest in solids
- Sound moves slowest in gases
- The experiment supports our hypothesis: **A stiffer material leads to faster wave travel.**

$$C = \sqrt{\frac{B}{\rho}} \quad \text{where} \quad B = \text{bulk modulus}, \quad \rho = \text{density}$$

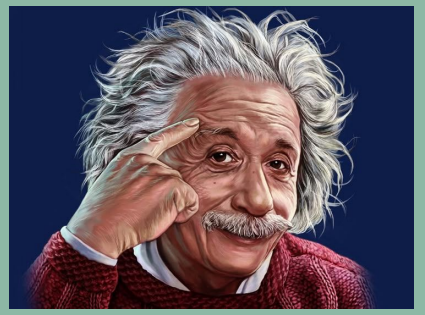


Possible Errors & Improvements

- **Timing errors** → Using a high-speed camera for better accuracy.
- **Uneven domino placement** → Using a precise measuring tool.
- **Surface friction differences** → Conduct trials on different surfaces.



What Experts Have Learned



- ***Stiffer*** materials transmit sound faster.

- This experiment models how sound wave propagates differently in solids, liquids, and gases.

For human body:

- Soft tissue: 1.54 mm/μs or 1540 m/s
- Bone: 3 - 5 mm/μs
- Fat: 1.45 mm/μs
- Air: 0.34 mm/μs