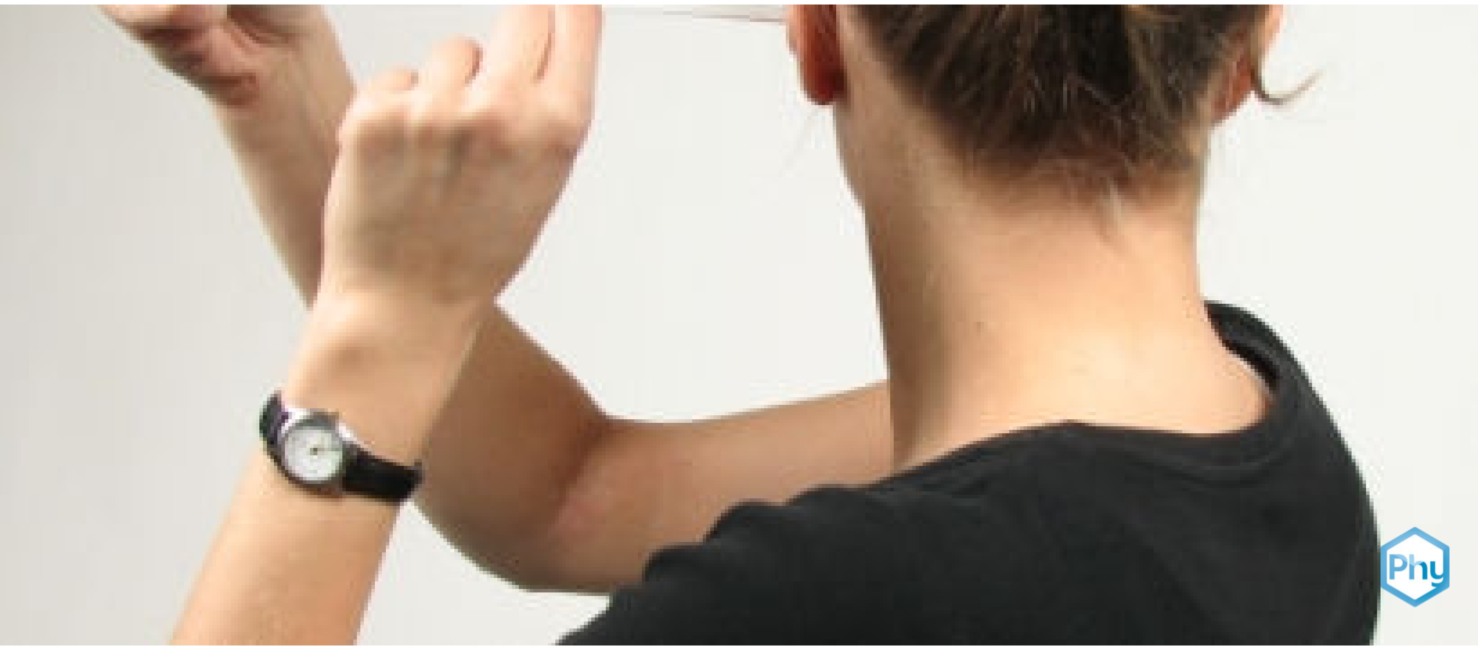
Propagation of sound in solid bodies



Physics | Acoustics | Sound generation & propagation

Difficulty level	Group size	Preparation time	Execution time
easy	1	10 minutes	10 minutes

This content can also be found online at:

http://localhost:1337/c/616415b2374f4f00038cbacd

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Teacher information

Application

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Experiment setup

Transmission (or conduction) of sound through a solid means: one end of the solid is set into vibration (e.g. by the application of a tuning fork) and this vibration propagates through the solid to the other end of the solid. In this experiment, the transmission through the solid is heard as a vibration of the other end directly or through the air.

The experiments will also show that at greater distances (approx. 20 cm) the sound of the tuning fork can no longer be heard through the air, or can only be heard very softly. However, via conduction through solids, the sound is transmitted so well at comparable distances that it can be heard clearly.

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Other teacher information (1/3)

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Previous knowledge

Students should be familiar with the basic concepts of waves and oscillations.

Scientific principle

The propagation of sound in solids is investigated using three examples:

- Ruler (comparison with railway tracks)
- Conduction over the head (bone conduction)
- Silk thread (comparison with "cord telephone")

Other teacher information (2/3)

Learning objective

Students learn how sound waves propagate through a solid.

Tasks

Sound can be generated, for example, by the vibrations of a tuning fork and normally reaches the ear through the air. Here, the pupils use various examples to investigate whether sound propagates not only in air but also in solid bodies.

1. Is sound transmitted through a ruler made of plastic?
2. Can the human head transmit sound to the ear?
3. Is a thin thread sufficient for sound transmission?

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Other teacher information (2/3)

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Other teacher information (3/3)

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Notes on structure and implementation

The sound is transmitted through the vibrating lower end (the ball) of the tuning fork to the solid body (e.g. the ruler, the head, the thread or a table).

The easiest way to achieve this in the sound transmission in experiment 3 is to have the tuning fork hanging down by the thread.

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Safety instructions

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The general instructions for safe experimentation in science lessons apply to this experiment.

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Student Information

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Motivation

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A corded telephone

If you connect two cans that are open on one side with a cord on their closed side, you can talk into one can and be understood at the other can. This so-called cord telephone enables communication over the length of the cord, even over distances where normal conversation would no longer be possible.

But how is it possible that you speak into a closed container and the words are still transmitted more understandably than if you speak directly to the other person over the air?

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Equipment

Position	Material	Item No.	Quantity
1	Ruler, plastic, 200 mm	09937-01	1
2	Tuning fork 440 Hz	03424-00	1
3	Impact hammer, rubber	03429-00	1
4	Silk thread, l = 200 m	02412-00	1
5	Funnel, diameter = 75 mm, plastic (PP)	46895-00	1

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Set-up

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1.Get all the materials you need to experiment at your workstation.

2.Now read carefully the implementation.

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Procedure (1/5)

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Figure 1

Experiment with ruler

1. Strike the tuning fork using the striking hammer (Fig. 1).

2. First hold the tuning fork in the air and then move it away from your ear until you can no longer hear it. Estimate the distance you have reached and write it down.

Procedure (2/5)

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Figure 2

3. Strike the tuning fork again.

4. Place it on one end of the ruler and then bring the other end to your ear (Fig. 2).

5. Compare your observations from both experiments.

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Implementation (3/5)

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Figure 3

Experiment: Put tuning fork on the head

1. Strike the tuning fork using the striking hammer.

2. Place the tuning fork quickly one after the other at different places on your head (Fig. 3): at the top, at the back, directly at the ear, ...

3. Describe how the tone of the tuning fork changes when you put it on your head.

4. Note where on your head you need to hold the tuning fork to hear the sound loudest.

Procedure (4/5)

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Figure 4

Experiment with silk thread

1. First connect the funnel and the tuning fork with a silk thread (approx. 1 m) as follows: Pass the thread through the funnel from below and fasten it to the eyelet on the upper edge with a knot. (Fig. 4). Attach the tuning fork to the other end of the thread with another knot.

2. Strike the tuning fork with the hammer and hold it as far away from you as possible without stretching the thread. Note whether you can still hear the tuning fork.

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Procedure (5/5)

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Fig. 5

3. Then strike the tuning fork again with the striking hammer.

4. Let the tuning fork hang loosely from the thread and hold the funnel to your ear (Fig. 5). Note whether you can hear the tuning fork.

Report

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Report

Task 1

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Drag the words into the correct gaps

How well a sound wave is transmitted through a medium depends on its ______. ρ In general, solids are denser than ______, which in turn are denser than gases.
If a sound wave can propagate through a denser medium, it is intelligible to the human ______ over greater distances. A good example of this is whale song, which can be heard in ______ even over hundreds of miles.

- ear
- liquids
- density
- water

Check

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Task 2

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What describes the physical quantity density ρ?

- ○ The physical density ρ describes the mass m per volume V, so $\rho = \frac{m}{V}$.
- ○ The physical density ρ describes the product between mass m and volume V, so $\rho = m \cdot V$.
- ○ The physical density ρ describes the number of particles n per volume V, so $\rho = \frac{n}{V}$.
- ○ The physical density ρ describes the force F per area A, so $\rho = \frac{F}{A}$.

Check

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