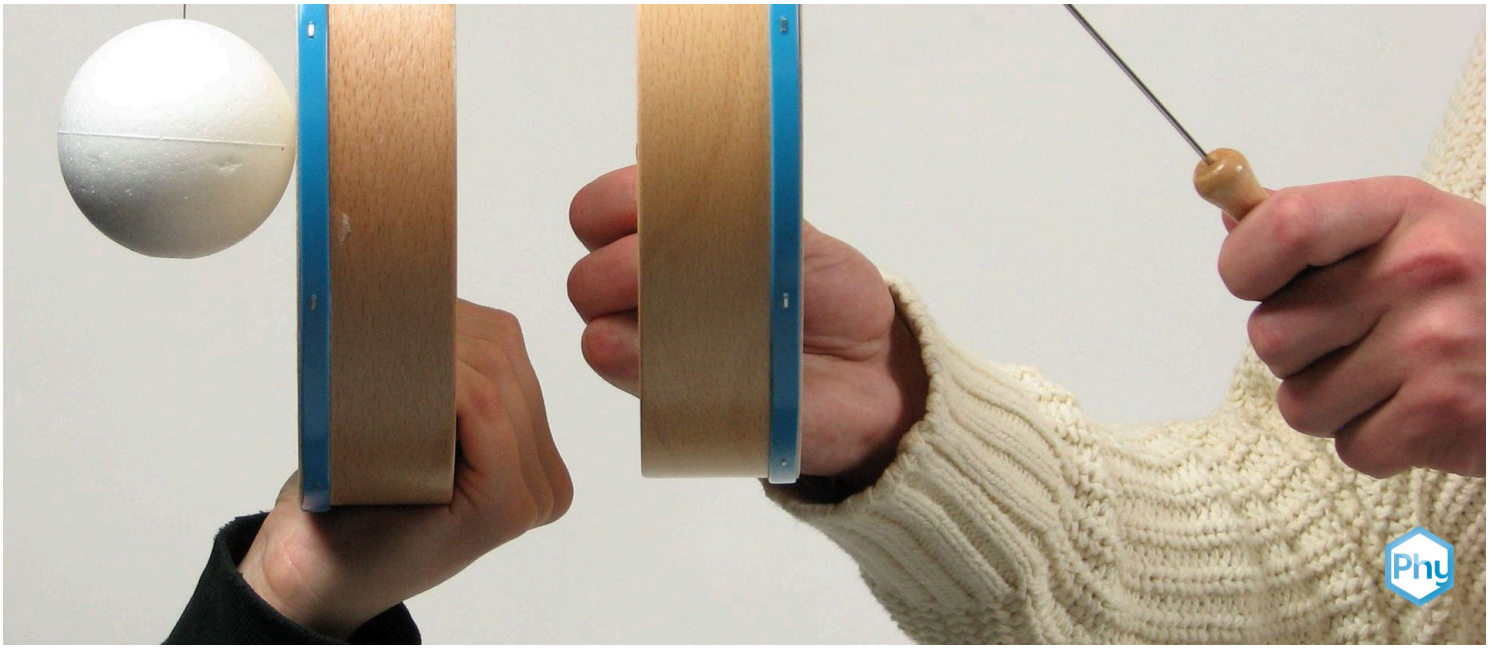
sound propagation in air



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/616415a4374f4f00038cbac9

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Teacher information

Application

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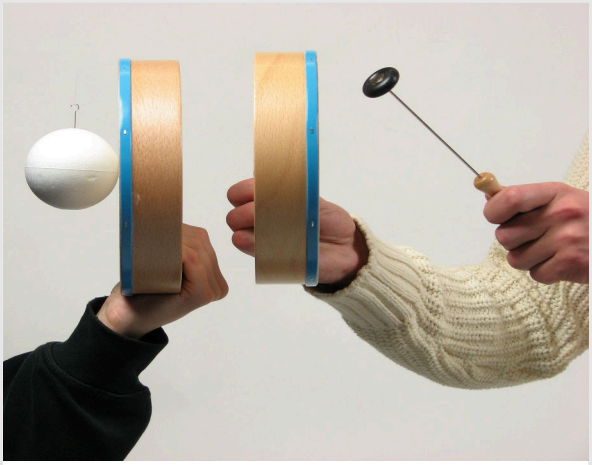

Test setup

This experiment clearly demonstrates the propagation of sound waves in air and the functioning of the eardrum, which is stimulated to vibrate by pressure waves.

Two vibrating membranes (drums) or walls are used for the experiment. The first is excited to vibrate by a blow with the rubber mallet.

The movement of the membrane is transmitted to the neighbouring air molecules, which in turn transmit it to neighbouring molecules.

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Other teacher information (1/4)

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Previous knowledge

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

Scientific principle

In this experiment, the air is made to vibrate by means of a drum and the propagation of the sound waves in space is visualized by a Styrofoam ball.

From the observations, statements are made about sound waves and human hearing.

Other teacher information (2/4)

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Learning objective

Students learn how sound waves travel through space and how human hearing works.

Tasks

The sound is produced by a powerful blow with the striking hammer on a frame drum or on the bottom of a box.

"Sound receiver" is a (second) frame drum, its movement is detected by means of a styrofoam ball pendulum.

The students should try out this detection method and then optimize it.

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Other teacher information (3/4)

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Notes on structure and implementation

The experiment is described in 2 variants.

1. Two groups work together so that 2 drums can be used for the experiment. The membrane expands when the first drum is struck. The resulting pressure wave causes the second drum to vibrate, which causes the Styrofoam ball to bounce about 1 cm away.

2. If a group is working alone, then the storage box is used as a "first drum". In this case it is better to carry out the experiment on a table on which the box (and possibly also the drum) can be placed. In this way it is easier to hold the box firmly when the blow is made with the rubber mallet. Since the bottom of the box is stiffer than the membrane of a drum, the Styrofoam ball will only bounce 3 to max. 5 mm away in this case, even with careful experimentation.

Other teacher information (4/4)

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- Two people are required to experiment with each variation.
- One student holds the second drum and the Styrofoam ball, the other performs the stroke on the first drum (or box).
- Make sure that the Styrofoam ball touches the drum only lightly and in the middle.
- Also, both drums must be well parallel.

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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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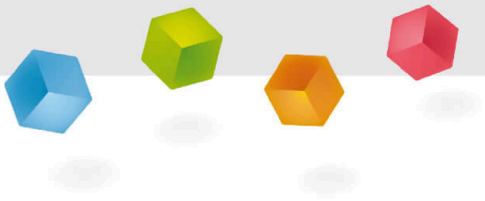

Student Information

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Motivation

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A violin

People experience their environment through the sense of hearing. With sounds we communicate, enjoy music and take in information that lies outside our field of vision.

Humans are familiar with countless different sounds, ranging from natural soundscapes to the world's many languages and music.

But how exactly does our hearing work and what are sounds actually from a physical point of view?

Tasks

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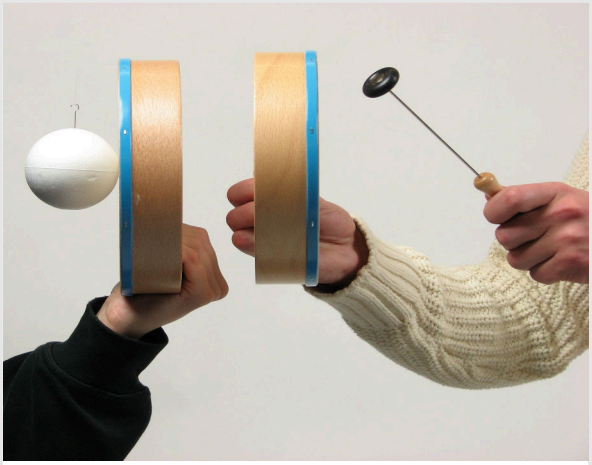

The experimental setup

Sound is produced by the vibrations of an object, e.g. a tuning fork, a string, a ruler or the membrane of a drum. This experiment is designed to show that sound propagates in air.

The sound is produced by a powerful blow with the striking hammer on a frame drum or on the bottom of a box. "Sound receiver" is a (second) frame drum, its movement is detected by means of a styrofoam ball pendulum.

Try this detection method and try to optimize it.

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Equipment

Position	Material	Item No.	Quantity
1	Impact hammer, rubber	03429-00	1
2	Styrofoam sphere with hook	13289-13	1
3	Frame drum, d = 20 cm	13289-11	1
4	Silk thread, l = 200 m	02412-00	1
5	Storage tray, 413 x 240 x 100 mm	47325-02	1

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Structure (1/2)

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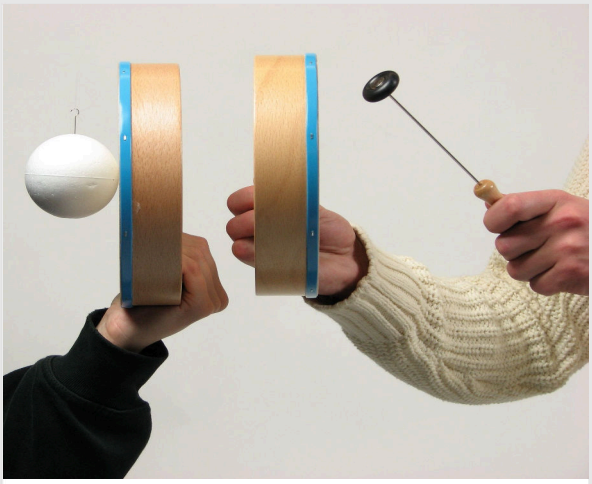

Figure 1

The experiment is possible in two variants. In both cases it is carried out by two students.

Two groups work together, so that two frame drums are used for the experiment (Fig. 1).

Structure (2/2)

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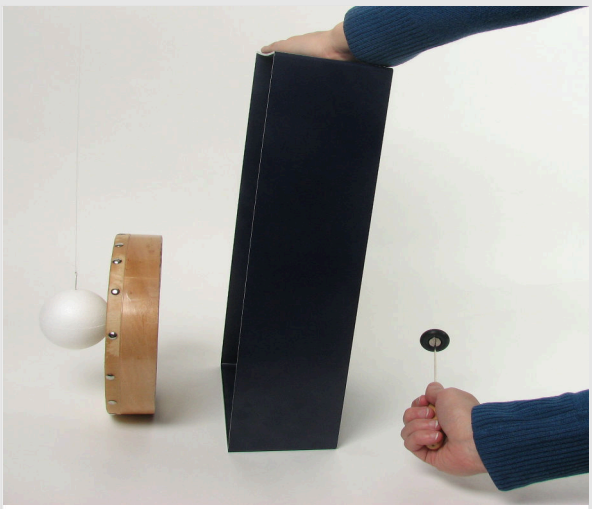

Figure 2

If a group is working alone, then the storage box is used as a "first drum". In this case it is better to carry out the experiment on a table on which the box (and possibly the drum) can be placed.

In this way it is easier to hold the box when the impact is made with the impact hammer (Fig. 2).

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Procedure (1/6)

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Variant 1 (Fig. 1)

Pupil 1

1. Knot a silk thread of about 50 cm length to the hook of the styrofoam ball.
2. Take the frame drum in one hand, the styrofoam ball on the silk thread in the other.
3. Hold the styrofoam ball so that it touches the drum in the middle.

Procedure (2/6)

PHYWE

Variant 1 (Fig. 1)

Pupil 2

1. Take the second drum in your hand and hold it exactly parallel to the first drum at a distance of about 10 cm. The open sides of both drums should face each other.
2. Hit the drum with the rubber mallet.

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Procedure (3/6)

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Variant 1 (Fig. 1)

Both students

1. Describes the behavior of the styrofoam ball.
2. Repeats the experiment and tries to optimize it. Describe (under Observations and Results, 2.) what is important: e.g.
   - How must the styrofoam ball be held?
   - How should the drums be held in relation to each other?
   - Is it possible to change the distance between the drums?

Procedure (4/6)

PHYWE

Variant 2 (Fig. 2)

Pupil 1

1. Knot a silk thread of about 50 cm length to the hook of the styrofoam ball.
2. Take the frame drum in one hand, the styrofoam ball on the silk thread in the other.
3. Place the drum on the table (Fig. 2 is a photo without the hand) and, if possible, lift it about 1 cm afterwards.
4. Hold the styrofoam ball so that it touches the drum in the middle.

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Procedure (5/6)

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Variant 2 (Fig. 2)

Pupil 2

- Take the storage box and place it on the table at a distance of approx. 5 cm exactly parallel to the drum. The open side should face the drum.
- Hold the box firmly and hit the lower part of the box with the rubber mallet.
- Describes the behavior of the styrofoam ball.

Procedure (6/6)

PHYWE

Variant 2 (Fig. 2)

Both students

1. Describes the behavior of the styrofoam ball.
2. Repeats the experiment and tries to optimize it. Describe (under Observations and Results, 2.) what is important: e.g.

- How must the styrofoam ball be held?
- How must the drum and the box be held in relation to each other?

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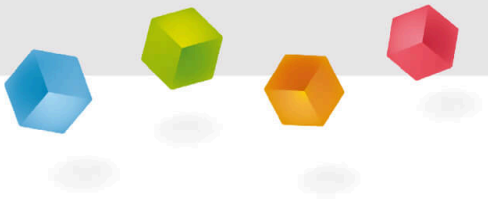

Report

Task 1

PHYWE

Drag the words into the correct gaps

When the drum is struck, the _____ is set into vibration. This vibration is transmitted to the surrounding _____ of the air, which also begin to vibrate. The vibration spreading through the room is called a _____. If the sound wave now hits the second membrane, it also starts to vibrate.
This visualized the _____ of the wave.

membrane
molecules
sound wave
propagation

Check

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Task 2

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Like which component of a drum does the human eardrum behave?

- The eardrum most closely resembles the cavity behind the membrane.
- The eardrum is similar to the fixation that tightens the membrane in a drum.
- The eardrum is similar in function to the vibrating membrane of a drum.
- The component that most resembles the eardrum is the wooden framework on which the diaphragm is stretched.

Task 3

PHYWE

Mark the correct word in the parenthesis

When a (*sound wave* / light wave) hits our eardrum, it begins to vibrate.

Our brain interprets the information from the vibration as (smell / sound).

The greater the amplitude of the vibration, the (louder / quieter) the sound.

The greater the frequency of the vibration, the (higher / lower) the tone.

Check

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Task 3

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