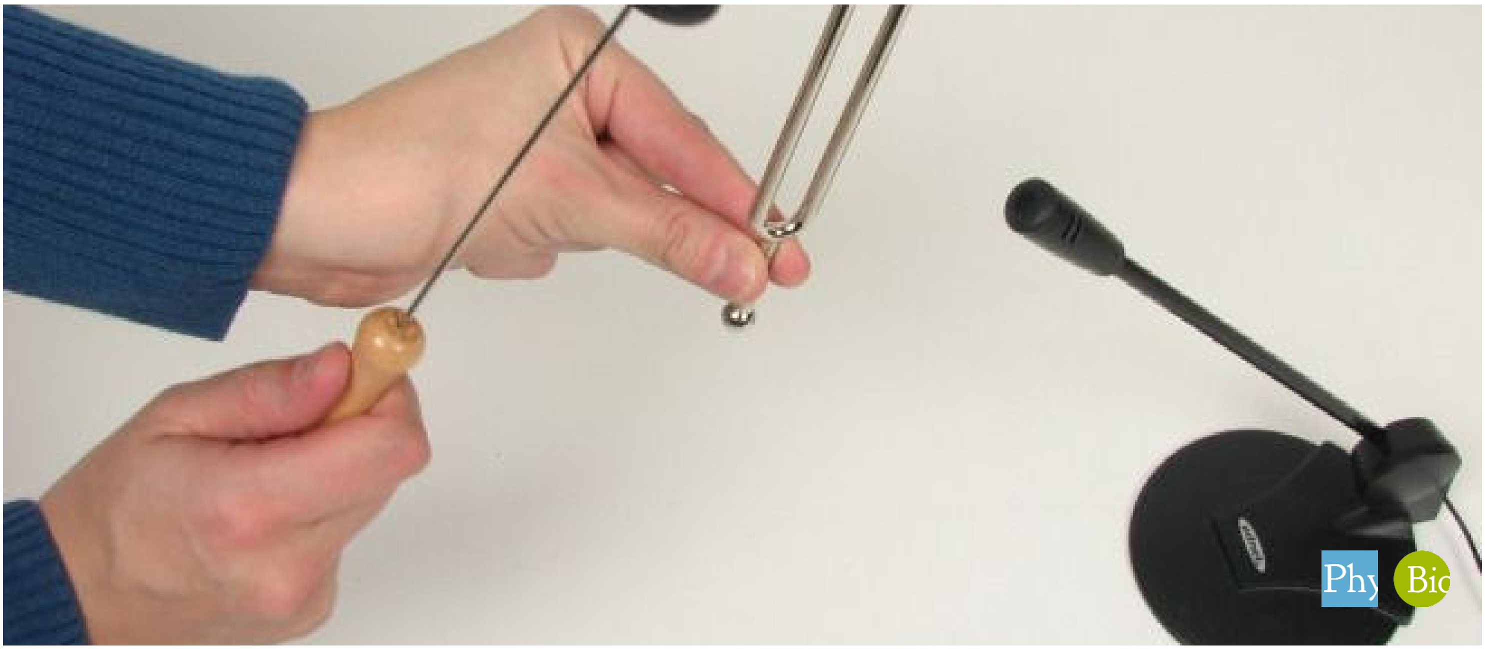
Sounds and noises

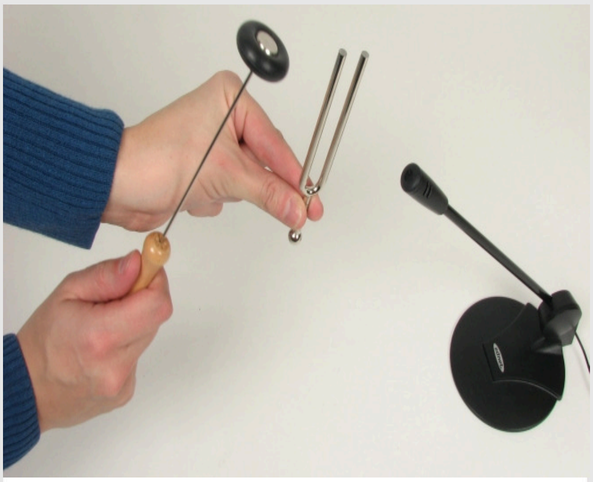


Physics	Acoustics	Sound generation & propagation
Biology	Human Physiology	Other Senses

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

General information

Application



Experiment setup

In this experiment, students analyze the acoustic signals of different sound sources.

They work out differences and similarities in the frequency spectra and temporal amplitude curves.

The recording and the analysis of the signals are done with the software measure Acoustics.

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Other teacher information (1/2)

Previous knowledge

Before carrying out the experiment, the students should be familiar with the basic concepts of oscillations and sound. They should be familiar with the measure Acoustics software and know what a sine wave is.

The students should not only know the software operation but also the meaning of frequency spectrum and temporal amplitude progression.

Scientific principle

In this experiment, different sounds are generated and observed as they are digitally visualized. From the observations, statements are made about the physical properties and their mathematical equivalent.

Other teacher information (2/2)

Learning objective

After performing the experiment, students should be able to assign the signals studied to the categories of tone, sound, noise, and bang.

Tasks

In this experiment, find out what other forms of sound there are besides the sine wave and how they differ from each other. Investigate different sound signals:

1. Tuning Fork
2. Vibrating string
3. Rustling paper
4. Banging ruler

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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 chirping bird

We constantly experience countless different sounds. From a chirping bird to construction work to music, sounds can not only take on different volumes, pitches and combinations.

This experiment takes a closer look at different types of sounds and shows how these sounds can be distinguished from each other not only by sound but also physically.

Tasks

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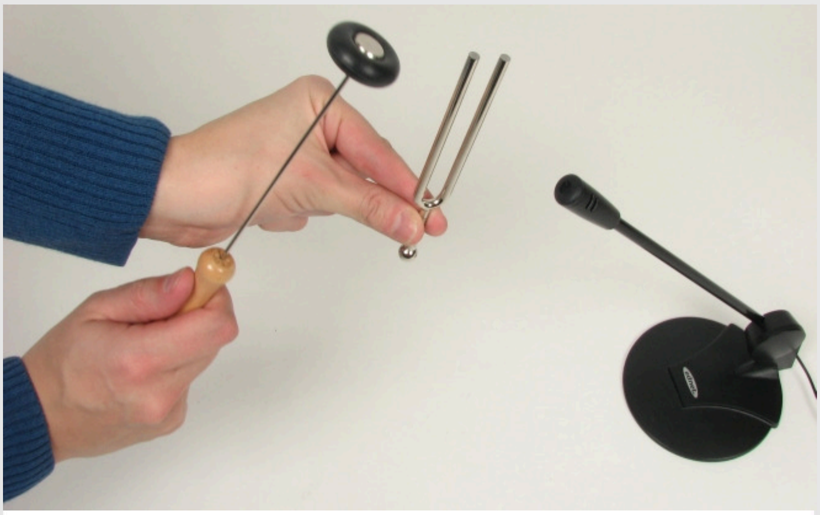

The experimental setup

In this experiment, find out what forms of sound there are besides the sine tone and how they differ from each other.

Investigate different sound signals:

1. Tuning Fork
2. Vibrating string
3. Rustling paper
4. Banging ruler

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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	Monochord kit for student experiments	13289-15	1
5	Storage tray, 413 x 240 x 100 mm	47325-02	1
6	Software "Measure Acoustics", single user license	14441-61	1

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Set-up

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1. Connect the microphone to the computer correctly. Place the microphone so that the microphone head is not covered by any object.

2.Start the measure Acoustics software.

3. Open experiment "1.6 Sound analysis".

4. Open the experiment overview (menu item "File" → "Open experiment" or select "Open experiment" in the menu bar).

5. Select the experiment "1.6 Sound analysis" from the folder "1 Generation, propagation and perception of sound".

Procedure (1/6)

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Figure 1

Part 1: Tuning fork

1. Both diagrams are activated after loading the experiment. This means that the audio signal of the microphone is displayed immediately.

2. Strike the tuning fork with the striking hammer and hold it in front of the microphone (Fig. 1).

3. Observe the curves in the two diagrams. To do this, freeze the diagrams simultaneously during the recording.

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Procedure (2/6)

Help to freeze:

Select "Activate/freeze all diagrams" from the program menu bar.

4. Fit the chart sections for better viewing.

Viewing Help:

Select "Zoom" in the corresponding diagram window. Then drag a rectangle around the appropriate section of the diagram to zoom in: Hold down the left mouse button and drag a rectangle from the upper left corner to the lower right corner.

5. In the diagram window "Spectrum of the signal at the audio input (microphone)", look at the spectrum and note how many sound frequencies can be detected.

6. In the diagram window "Time function of the signal at the audio input (microphone)", look at the time curve and note which curve shape can be recognized.

Procedure (3/6)

Part 2: Vibrating string (guitar)

1. Produce the original diagram sections.

Help with the diagrams:

Select "Standard section" in the diagram windows.

2. Activate the diagrams in the software.

3. Freeze all diagrams again according to the freeze help.

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Procedure (4/6)

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4. Place the microphone in front of the guitar and pluck a string of the guitar (Fig. 2). Freeze the diagrams while recording. Adjust the diagram sections.

5. Note how many sound frequencies of the guitar can be detected.

Figure 2

6.Observe the vibration curve of the guitar and characterize it: Is the curve continuous (continuous course) or of short duration?

Is it periodic (repeating pattern) or non-periodic?

Record your observations in your experimental protocol.

Procedure (5/6)

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Figure 3

Part 3: Rustling paper

1. Put the original Diagram sections and activate the diagrams in the software (see Help 5).

2. Take a sheet of paper and crumple it with one hand in front of the microphone (Fig. 3). Observe the diagrams as you do this. Freeze the diagrams and adjust their sections.

3. Note the number of sound frequencies in the spectrum and characterize the vibration curve again.

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Procedure (6/6)

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Part 4: Banging ruler

1. Create the original diagram sections and activate the diagrams in the software.

2. Take a ruler in one hand and strike the ruler on the table near the microphone (Fig. 4).

Figure 4

3.Try to freeze the diagrams at the same time. Repeat the process as often as necessary until a deflection can be seen in the amplitude-time diagram. Then adjust the diagram sections.

4.Note the number of sound frequencies in the spectrum and characterize the vibration curve.

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Report

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Task 1

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Which parameters can be used to describe a sine curve?

- ☐ The straight line slope m
- ☐ Amplitude A
- ☐ The angular frequency ω
- ☐ The polynomial degree n
- ☐ The period duration T

Check

Task 2

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Sound waves can be visualized as sine curves. What do the parameters of the sine curve mean for the sound wave?

Amplitude A

Circular frequency ω

Pitch

Volume

Check

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Task 2

What makes a sound physically?

- [ ] It can be represented by a sinusoidal curve.
- [ ] A jackhammer produces sound waves that can be categorized as physical sound.
- [ ] It has a consistent period length over longer periods of time T.
- [ ] It has a consistent angular frequency ω.

Check

Task 4

How is a tone physically different from a sound?

- [ ] A sound is a superposition of several tones.
- [ ] It has several consistent, superimposed angular frequencies ω.
- [ ] It can be represented by a sinusoidal curve.
- [ ] The amplitude of a sound varies A and thus the volume continuously and extremely strongly.

Check

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Task 5

Noise is understood as arbitrary oscillation curves, which are the result of superpositions of many sinusoidal curves with strongly varying amplitudes. A and angular frequencies ω are.

This means that the period duration T also consistently inconsistent.

○ True ○ False

Check

Task 6

A bang is a sound whose amplitudes are A are rapidly diminishing.

So the bang is short-lived.

○ True ○ False

Check

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Slide	Score / Total
Slide 18: Vibration	0/3
Slide 19: Sound waves	0/2
Slide 20: Audio	0/3
Slide 21: Sound	0/3
Slide 22: Sound	0/1
Slide 23: Bang	0/1

Total 0/13

Solutions Repeat

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