Sound

Proporties

Sound is a vibration of the air that we can hear.

A higher frequency generates a higher pitch.

Sound propagates in air and all materials.

Resonance is the phenomenon that an oscillating system is driven at one of its natural frequencies; maximum energy transfer to the system occurs.
An oscillation is caused by disturbing equilibrium.
A wave is the propagation of a vibration.

Standing waves: vibration + vibration may give stagnation.

The wavelength is the distance between two successive crests or troughs.

Frequency is the number of cycles per second

1. The singing tube

Material:
a ribbed flexible pipe

Action:
swing the pipe around
a)alternatively fast and slowly
b)close off one end with your hand while swinging

What?
a)you hear high and low pitches
b)you don't hear anything

Why?
The collision of the air against the ribs of the pipe generates vibrations. The faster the vibration, the higher the pitch. When closing the pipe, the vibration stops. The ribs are not supposed to be spiral.

2. The singing glass

Material:
a wide glass made of thin glass

Action
a)pass your wet finger over the border of the glass
b)repeat the action with a half empty glass
c)repeat action b), adding a small piece of paper to the glass

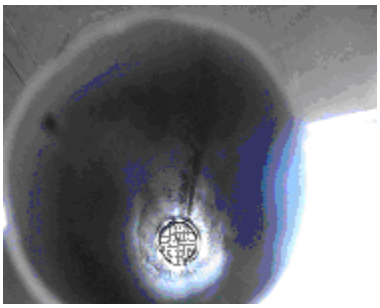
What?
a)you hear a monotonous sound
b)your hear a lower pitch and the water seems to be turning
c)see b) but the piece of paper doesn't turn

Why?

a) and b) the friction of the finger over the glass generates vibrations of the glass. The thinner the glass, the higher the pitch.

c) the water doesn't turn; there are standing waves in the water

3. Another singing pipe


Material:

a metal tube from the trunk. In the tube there is a small –mesh wire-netting

Action:

Warm up the wire-netting

a)hold the tube vertically
b)hold the tube horizontally

What?

Only when the tube is vertical, we hear a sound

Why?

The hot wire-netting warms up the air in order to make it rise in the pipe.
The collision with the cold air generates vibrations.
When the tube is held horizontally, the air can't rise, so there are neither collisions nor vibrations. Note that the net is at a quarter of the pipe

4. Propagation of sound

Material

A flexible plastic tube with a funnel on both ends. Mark the middle of the tube.

Action

Ask someone (1) to put the funnels over his ears. A second person (2) taps the tube .

What?

Does (1) hear the tap on the tube?

-while (1) is closing his eyes, person (2) taps the tube alternatively in the middle, more to the left and once more to the right.

-Can person (1) hear where exactly the tube was tapped?

Why?

Yes, he can, because sound propagates in the tube and reaches the nearer ear first.

The speed of sound in air is 340 m per second.

In solids and liquids the speed is higher.

5. Swinging sticks

Material:

-2 identical sticks threaded to a rope

-stretch the rope between two points

Action:

a)Have one stick swing

b)repeat, but make one stick heavier

What?

a)After a short time also the second stick starts swinging and the first one stops

b)The experiment doesn't succeed

Why?

The vibration of the first stick propagates over the rope to the second stick.

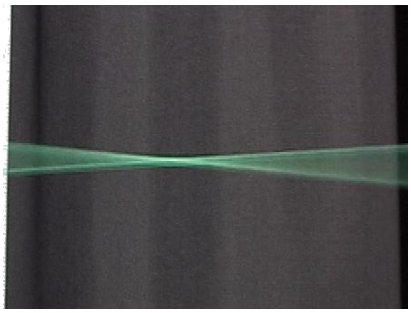
This is only possible when both objects have the same natural frequency.

This phenomenon is called resonance.

If there were no friction, the movement would continue.

Each object has a natural frequency and will vibrate to this frequency.

6. The clothes –line



Material :

a long rope stretched between two points, a cloth

Action

Rub the clothes-line with the cloth, as if you were cleaning it.
Ask someone to watch the movement of the line.

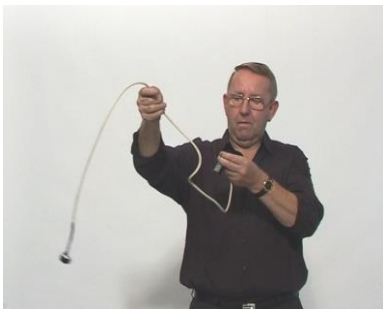
What?

The robe vibrates, but according to a certain model.

Why?

Friction of the cloth on the rope generates a vibration, which propagates in the rope. This wave is reflected on the end of the rope and interferes with the first wave .This interference can cause stagnation.
This phenomenon is called "a standing wave"
The points of maximum amplitude , where there is constructive interference, are called antinodes. The stationary points are called nodes.
At the end of the rope there's a node.

7. The buzzer



Material :

a buzzer (making a monotonous pitch)

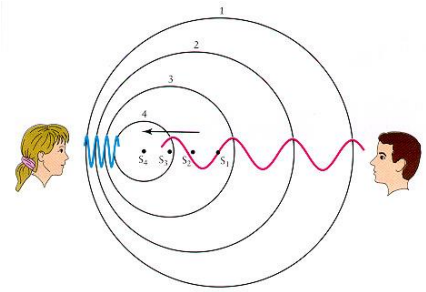
Action:

Have the buzzer swing in a horizontal, circular way so that it moves nearer and father from a spectator.

What ?

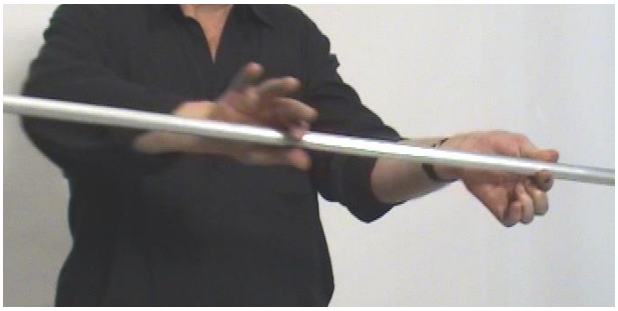
The spectator notices a change of pitch: a higher pitch (when the buzzer comes closer) and a lower pitch (when the buzzer is farther)

Why?



The buzzer has a monotonous pitch, but when it comes closer to the ear, the frequency of the arriving vibration increases, causing a higher pitch.
When the buzzer recedes, the pitch will be lower.
This phenomenon is called “Doppler effect”

8. The swinging bar



Material:
a metal bar, resin

Action:
a)take the bar in one hand in the middle. Put resin on two fingers of the other hand and rub over the bar
b)repeat the action, but hold the bar at a quarter of the length from the top

What?
You hear and feel the vibration in the bar

Why?
Rubbing causes standing waves.
We have held the bar in a node.
The end of the bar is an antinode.

9. The speaker

Material:
a speaker, a transformer and A.C.

Action:

In the speaker are: a magnet fixed to a membrane (thin cloth or paper) and a coil.
Link the speaker to the transformer with A.C.

What?

You hear a monotonous sound

Why?

The alternative current (A.C.) turns the coil into an alternative electromagnet, which alternatively attracts and repels the membrane.
The frequency of the A.C. is 50 Hertz; that's why the frequency of the pitch is 100 Hertz.

10. The speaking thumb

Material:

a balloon or a drum ,a ribbed strip of plastic

Action

a) strike the ribs of the strip with the nail of your thumb
b) repeat the action, but keep the strip against a balloon you blew up

What?

a) by striking the ribs you cause a vibration, a sound
b) the sound becomes louder

Why?

The balloon is the resonance-box and makes the sound louder.

11. The radio

See trunk electricity