Project:

"From hearing to vibrating and back"

Noise has nowadays a negative environmental impact. The permanent noise levels caused by roaring cars, low-flying aircraft or the neighbour's stereo equipment do not only rob us of our sleep but can also lead to serious diseases and hearing damage. In spite of this: how much would we miss in a world without any sound, without noise, without language or music.

Before starting the experiments described below you could test which objects can be set swinging and how.

Table of contents:

Name:

Sound tree

Category:
Physics
Acoustics, sound, air resistance

Age:
5 to 6 years

For how many?:
Ca. 10 to 11 children

Where:
Outdoor premises

How long:
Ca. 60 minutes

Preparation/materials:

- Selected trees on outdoor premises.
- Inform the children one week in advance that they should bring along materials.
- Thread, scissors, sounding materials (for ex. pots, spoons)

Aims for the children:

- Have the children decide by themselves which materials they want to hang into the tree.
- The children attach strings to the materials and then hang the materials into the branches of the trees.
- Children who do not have any materials borrow some from other children.
- Children shall understand the wind and its characteristics, make their own experience and see the effect.

Scientific explanation:

Sound or noise:
This issue was studied in 1802 by the natural scientist Ernst Florens Chladni in his work ‚Acoustics', the first major research about sound. Chladni distinguishes between two types of sound, i.e. 'sound' and 'noise'. All clearly musical sound events are classified as 'sound'. All other forms of sound events produce noise. According to Chladni the difference between both types is cause by their different vibration curves. When music is produced regular vibrations develop. Noise, however, is caused by irregular vibrations:".
In music an **interval** is defined as the frequency spacing between two tones. These tones do not necessarily have to sound at the same time (for ex. in a chord); even successive tones in a melody are called an interval. There are consonant (euphonious) and dissonant (non-euphonious) intervals.
In music **tuning** is the adjustment of the pitch of instruments.

Steps:

- Introduction into the topic of wind! What is wind, where does it come from, what happens when it is windy?
- Look at the materials brought along together with all children.
- Attach the strings to the materials.
- Go to the outdoor premises, hang the materials into the tree and design them in a way that the tree produces sounds due to the wind.

Possible variations:

You could hang different materials into the tree or make a mobile. It only has to produce sounds due to the wind.

Be aware of:

Do not attach any pointed materials to the tree so that there is no risk of injury for the kids.

References:

In detail:	

Name:

Plastic cup telephone

Category:
Physics
- sound

Age:
4- 6 years

For how many?:
6- 10 children

Where:
Group room

How long:
ca. 15 min.

Aims for the children:
The children learn to pierce the bottom of the cup cautiously taking care that it does not brake. The children learn to make a knot. The children learn to thread in a string, and their patience is enhanced. They are given an understanding regarding the topic of sound. The children learn to help each other and to ask for support.

Preparation/materials:
Get the material. Prepare it for work.
Every child gets two plastic cups, one drawing-pin and a long string
Plastic cup, drawing-pin, string for parcels

Scientific explanation:
Every sound has a certain duration (long, short) and a certain intensity (loud, soft). We also distinguish between the pitch (high, low) of each tone and its tone colour (a piano and a guitar sound differently at the same pitch). Sound emerges from vibrations (= regular coming and going movements) of elastic bodies. Vibrations of objects which are triggered by hitting the object or knocking on it (= source of sound) are led to our ear by solid, liquid or gaseous substances (for ex. walls, water or air). In a vacuum there is no sound!

A full vibration consists of coming and going. The number of vibrations per second is called vibration frequency or frequency. The unit of frequency is 1 vibration per second. It is named after the German physicist Heinrich Hertz (1857-1894) as 1 hertz (hz). Sound waves are compression and dilution of air which expands spherically to all sides. Whenever a sound wave hits our eardrum this also starts vibrating. These vibrations are forwarded through the auditory canal all the way up to the ends of the auditory nerves coming from the brain. The human ear can only hear tones with a frequency range of between 20 hz and 20 000 hz.

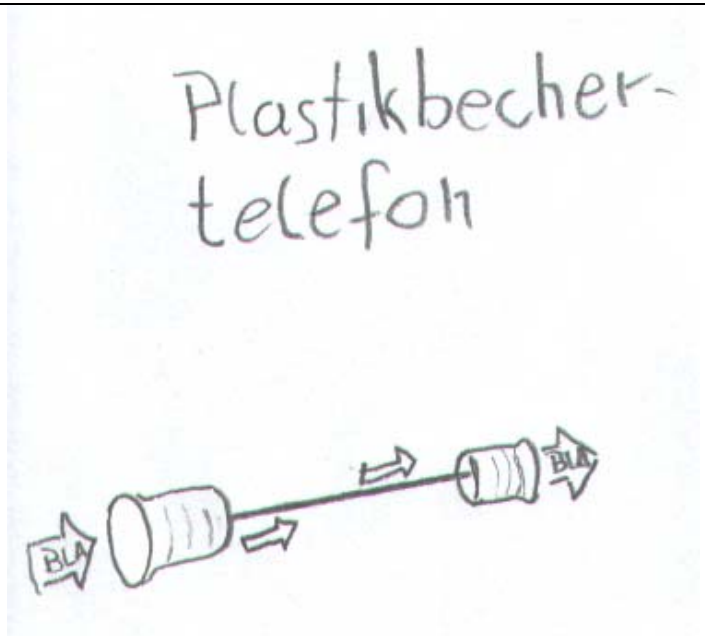
Steps:
1. Use a drawing-pin to pierce a hole into the centre of the bottom of the cup.
2. Stick through each hole one end of the string and make a knot inside the cup.
3. Now find a partner and look in twos for a place where you have a lot of space, and try how the telephone works.
4. Make sure that the string is tight.

Possible variations:
To make the plastic cup more beautiful you can use special pencils to paint on it (edding, …), or you can stick something to it.
The telephone can also be built from a yoghurt tub or from cans.

Be aware of:
The holes in the cup can also be pierced with a hot knitting needle.
When piercing the hole make sure that the cup doesn't break. (which easily happens)

References:
Internet: www.Physik-for-kids.de (Labor- Schall)
http://home.eduhi.at/just4fun/sites/Akustik.html

In detail:
If you speak into the cup the sound waves set the bottom of the cup vibrating. The vibrations move through the string to the other end of the cup where they are retransformed into air vibrations. In fact, even a real telephone works in a rather similar way, only that here the sound is transformed into electrical vibrations which can be transmitted around the world via wire or wireless devices.



Name:

Water music with glasses

Category:
- Physics - sound

Age:
6- 10 years

For how many?:
Ca. 8 children

Where:
Group room

How long: ca
20 min.

Preparation/materials:
- Get the material, prepare it for work
- Every child gets a thin glass.

Explain to the children how to handle the glasses - easily breakable

materials:
thin-walled glasses (wine or sparkling wine glasses), water

Aims for the children:
The children learn how to handle thin-walled glasses so that they do not break. They learn to keep their fingers on the rim and to produce friction by sliding their fingers in circular movements around the rim. They learn to move the fingers of one hand on the rim of the glass and to use their second hand to keep the glass in the same position. (Enhancement of hand-eye coordination)

Steps:
1. Fill the glass with water, no matter how much.
2. Wet your index finger.
3. Slide the wet finger over the rim of the glass in circular movements. Put your second hand around the bottom of the standing glass to keep it in the same position.
4. Every glass which is filled with water to a different level produces a different tone. The less water in the glass, the higher the tone.

Scientific explanation:
By moving over the glass rim tones are produced. Every glass has a different tone. The glass containing most water produces the deepest tone. A high tone can be produced when moving a finger along the rim of a glass filled with little water. The highest tone develops when the glass is empty.
In addition, we can observe that the water and the glass are vibrating. The sound develops due to the fact that the finger rubs over tiny uneven spots of the glass and thus activates vibrations. The pitch depends on the quantity of water in the glass.
Once the glass has been set vibrating, the surface of the water is vibrating too. This co-vibration of two objects tuned-in to the same pitch is called resonance.
When you place eight wine glasses next to each other and tune them to the tones of the scale you can play songs

Possible variations:
Your can also experiment with a pencil by carefully knocking against the glass.
The children can test this experiment frequently with different quantities of water in the glasses.
Once all children have made the experiment they can form an orchestra by placing their glasses next to each other and playing music.
Fill two glasses in a way that their sound is identical.
Fill eight glasses so that you can play a scale

References:
Buch: 365 Experimente für jeden Tag
Verlag: moses ISBN 3-89777-113-6
Was ist Was Experimentierbuch Tessloff Verlag 1986

Be aware of:

In detail:
The glass vibrates when you knock against the glass or move a wet finger over its rim. The less water is in the glass, the faster the vibration is and the higher the tone.

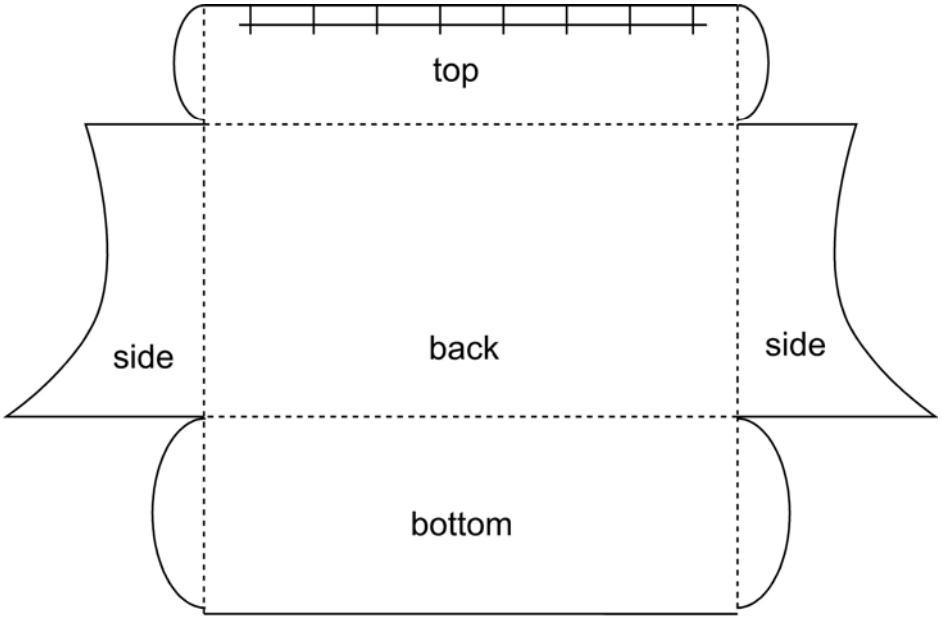
©http://www.salvator.net/salmat/physik/fu/glaeser.htm

<table>
<tr><td colspan="2">Name:

Music box</td><td>Category:
Physics
Sound, vibrations</td></tr>
<tr><td colspan="2">Age:
5-6 years</td><td>For how many?:
6 children</td></tr>
<tr><td>Where:
In a room</td><td>How long:
Ca. 30 – 45 minutes</td><td>Preparation/materials:
You could start by testing the water music with glasses.
Cardboard or card 475 x 310 mm
8 PET bottles or suitable small plastic tubes.
8 corresponding tops
Some cord string or similar
Adhesive
Knife</td></tr>
<tr><td colspan="2">Aims for the children:
➢ Training of differentiated hearing
➢ Describe the relationship between the filling level of the tube and the pitch of the tone
➢ Find matching tones</td><td rowspan="2">Steps:
Cut out the basic form from cardboard (cf. sketch) and fold it into a box. Cut out 8 bands of app. the same length. Fill the small tubes with water, a coloured liquid, sand, grain, or whatever you would like to hear. Attach the tubes or small bottles to the bottom side – cf. illustration 2. Now you can take a music stick or something similar to strike the tubes. You will hear music...

Tip: Open the top of the tubes and try again – the sound will be different.</td></tr>
<tr><td colspan="2">Scientific explanation:
In physics resonance is when the frequency of a stimulation and the natural frequency match. In an un-damped oscillatory system resonance leads to an infinite increase of the amplitude (catastrophic resonance?). In a damped system resonance is characterised by a maximum of the reaction of the system.
In acoustics for example the co-vibration of a guitar string when there is the sound of an instrument tuned in the same way.</td></tr>
<tr><td colspan="2" rowspan="2">Be aware of:
Cf. also the other experiments of the set „From hearing to vibrating“</td><td>Possible variations:
Water music with glasses</td></tr>
<tr><td>References:
http://www.kindergarten-workshop.de/</td></tr>
</table>

In detail:



Sketch for construction of the base

Abbildung 1

Abbildung 2

Abbildung 3

Name:

Weird sounds from the jungle

Category:
Physics
Acoustics sound and vibrations

Age: 3- 5 years

For how many?:
4 children

Where:
In a room

How long:
Ca. 30 – 45 minutes

Preparation/materials:
Large disposable plastic cup
Solid cotton string. About 30 cm long
Pencil or a long nail
Toothpick
Wet paper tissue

Aims for the children:

- Training of differentiated hearing
- Perception of vibrations produced by the generation of sound

Production of different animal sounds by experimenting with different cups.

Scientific explanation:
The friction which is generated when you pull the cloth along the string generates vibrations which are transmitted from the string into the toothpick in the cup. From there on they are further transmitted into the bottom and the sides of the cup. During the transmission process the noise is getting louder because the cup has a megaphone effect leading the sound waves to the outside into the surrounding air molecules.
In reality, everything we perceive as tones are vibrations which are transmitted inside a medium until they reach our ear. Hereby, the air is the most frequent but also the slowest "sound carrier". In water, for example, sound waves expand four times faster than in the air! At higher temperatures sound waves are also transmitted faster; however, they get slower near mountain tops or even high up in the atmosphere – of course, because there are fewer air molecules which can set them vibrating.
Sound waves of swinging bodies expand in a uniform way into all directions. If we were able to see them they would look like round ripple waves produced when throwing a stone into a calm lake. The object generating the sound vibrations – or tones – would be situated right in the middle of these circles.
Sound is measured in decibel (db). The range varies from 1 db (hardly audible) up to 130 db and above. At a level of 120 db most people already feel a pain in the ear. Some sounds are that high that human beings cannot hear them at all – unlike some animals.

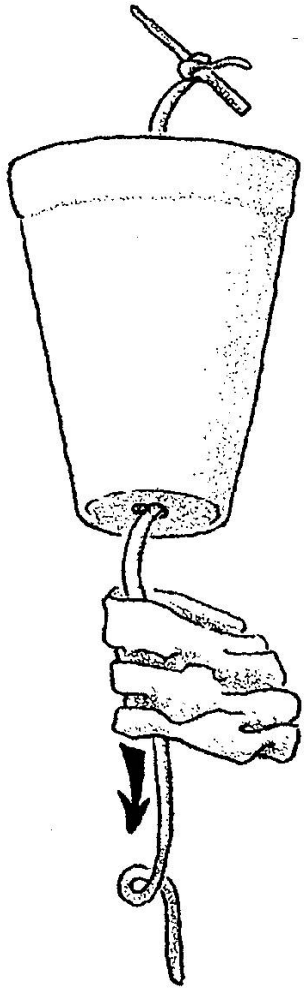
Steps:
Take the pencil or the nail and pierce a hole into the centre of the bottom of the cup. Push the string through the hole and attach the upper end firmly to the toothpick (tie a knot). Then you pull the string downwards until the toothpick lies directly on the hole (if necessary, shorten the toothpick so that it can lie straight). Then squeeze any surplus water out of the paper tissue (the string should not be too wet) and wrap the tissue around the string hanging out of the cup (underneath the bottom of the cup).
Now you firmly press the paper tissue together and pull it strongly downwards along the string.

Possible variations:
By using plastic cups of different size the weirdest "animal sounds" can be produced. The properties of the string also play an important role as to which type of tone is generated.

Be aware of:

References:
365 spannende Experimente: E.Richard Churchill/Louis V.Loesching/Muriel Mandell: illustriert Frances Zweifel, Verlagsgruppe Weltbild GmbH 2002

In detail:



<table>
<tr><td colspan="2">Name:

Musical cigar box</td><td>Category:</td></tr>
<tr><td colspan="2">Age:
3-5 years</td><td>For how many?:
4 children</td></tr>
<tr><td>Where:
In a room</td><td>How long:
Ca. 25 minutes</td><td>Preparation/materials:
Cigar box (or a similar box with stiff sides)
6 rubber bands of different strength
(among them a very wide and very thin one)</td></tr>
<tr><td colspan="2">Aims for the children:
➢ Clear perception of different tones
➢ Describe and assign high and deep tones
➢ Describe why any tones are high or deep</td><td>Steps:
Keep the top of the cigar box open or remove it. Place the rubber bands lengthwise around the open box in decreasing width order starting with the widest band. The distance between the bands should be a one finger width. Once you have positioned alls 6 “guitar strings” you can pluck them.</td></tr>
<tr><td colspan="2">Scientific explanation:
The widest rubber band produces a very deep tone, the thin one a very high tone, and the tones of all other elastic bands are somewhere in between.

The widest rubber band has only a low frequency and does not generate many sound waves.
The thin elastic band, however, has a considerably higher frequency and also generates more sound waves thus producing a higher tone.
But that’s not all. Because the pitch of a tone also depends on how tight a band is. A short and wide but very strongly tightened band can produce a higher tone than a thin one which is not very tight.</td><td>Possible variations:
Arrange the tones in pitch order and form a scale.
Take an empty fabric softener bottle and transform it into a guitar with strings of different strength (rubber bands).</td></tr>
<tr><td colspan="2">Be aware of:</td><td>References:
365 spannende Experimente: E.Richard Churchill/Louis V.Loesching/Muriel Mandell:
illustriert Frances Zweifel, Verlagsgruppe Weltbild GmbH 2002</td></tr>
</table>

In detail: