

Bees buzz, bumblebees hum and butterflies...?

Acoustics for primary schools

Hearing sound

Generating sound

Exploring sound

Sound and health

Section 3: Exploring sound

Air, water and solid materials can transport sound.



Students are shown a small plastic bucket covered with a silicone cover. On the other side is a hole in the bottom of the bucket. The teacher tugs at the cover and a student holds his hand under the hole.

Discovery 3:
I hear a sound and almost simultaneously feel a movement of air. The sound has spread across the air.

Exploring sound

Speaking cup

Card 1



Instruction speaking cup:

Material per pupil: paper cup, transparent film, rubber band, paper horn, scotch tape, semolina.

- Cut a hole into the cup.
- Pull the transparent film across the opening of the cup and secure it with a rubber band.
- See supplement for instructions.
- Tape the paper horn onto the cup.

Task

- Put some semolina onto the transparent film and speak into the horn.
- What do you see?
- How is the sound transmitted?

Exploring sound

A cup to talk into
Card 1



Solution / Discovery

The semolina grains begin to jump.
Their movement varies according to
loudness and pitch.

- Sound waves occur through speaking.
- The sound waves are transported **through the air** and cause the transparent film to vibrate.
- The vibration causes the grains to jump.

Exploring sound

Dancing milk rice

Card 2



Rice drum

- Stretch a piece of transparent film over a container.
- Put grains of milk rice on the film.
- Hold a hand drum directly above the rice and beat the drum.
- What do you observe?
- How is the sound transmitted?

Exploring sound

Dancing milk rice Card 2



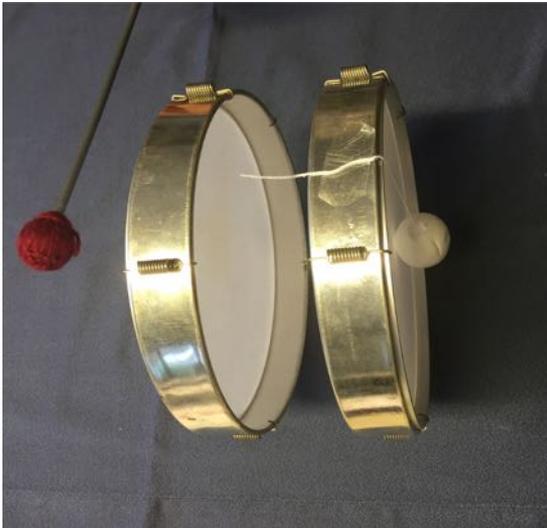
Solution / Discovery

- The rice starts to bounce on the foil. He moves differently depending on the volume.
- Sound waves occur when you beat the drum.
- The sound waves are transported **through the air** and cause the film to vibrate.
- This causes the rice to bounce.

Exploring sound

Ball drum

Card 3



Ball drum (partner work)

- One child takes the prepared hand drum. A ping pong ball is attached to the drum by a string.
- Take a second hand drum and beat it with a drumstick.
- Beat the drum hard and lightly with the drumstick.
- What do you observe?
- How is the sound transmitted?

Exploring sound

Ball drum
Card 3



Solution / Discovery

The ball begins to jump on the surface of the drum. Depending on the strength of the beat the ball jumps more or less.

- By beating the first drum sound waves occur.
- The sound waves are transported **through the air** and cause the second drum to vibrate.
- This, in turn, causes the ping pong ball to jump.

Exploring sound

Stones in the water

Card 4

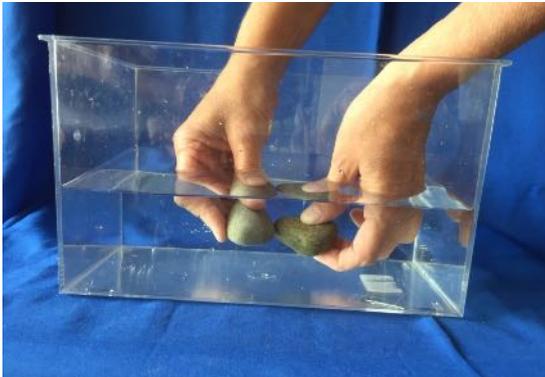


Student experiment (partner work)

- You need a container filled with water and two stones.
- One student takes the two stones and hits them carefully against each other in the water.
- Put your ear to the outside wall of the container.
- What do you hear?
- How is the sound transmitted?

Exploring sound

Stones in the water Card 4

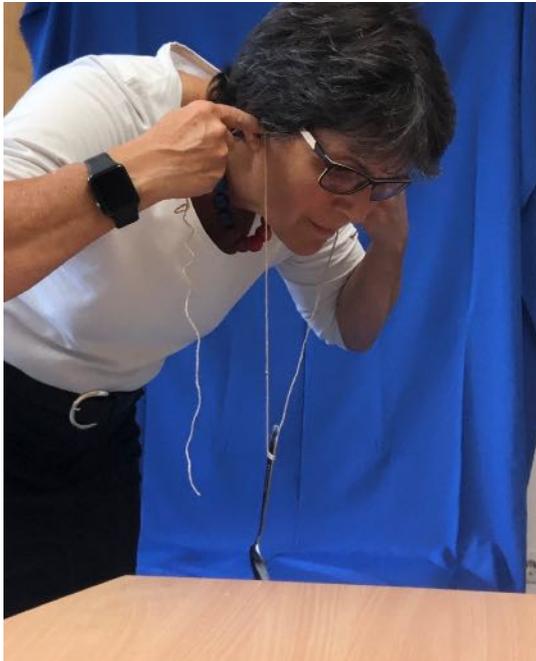


Solution / Discovery

- You can hear the sound of the stones **very well**.
- When the stones hit each other, the vibrations create a noise. The vibrations are transported by and through the water.
- The vibrations go to your eardrum and you hear the sound.
- The sound waves are transmitted **by and through** the water.

Exploring sound

A spoon on a string
Card 5



Student experiment

- You need a spoon that is tied up with a double parcel cord.
- Wrap the two ends of the cord around your index fingers and stick your fingers in your ears.
- Lean forward and let the spoon hit the edge of the table. (Careful: the spoon has to hang freely and the cord has to be tense).
- What do you hear? What do your classmates hear?
- How is the sound transmitted?

Exploring sound

A spoon on a string
Card 5



Solution / Discovery

- Hitting the edge of the table causes vibrations and thus a noise.
- The vibrations are passed on through the cords.
- The vibrations reach the eardrum via the fingers and you hear the sound.
- The sound waves are transmitted through a **solid material** (cords).

Exploring sound

Tin can telephone

Card 6



Student experiment (partner work)

- Take two tin cans with a cord.
- Stand far enough apart from your partner that the cord between you is tense.
- Partner A speaks first. When the sentence is finished say 'The end' as the last word.
- Partner B listens to the message until they hear the words 'The end'.
- Partner B answers. When the sentence is finished also say 'The end'.
- How does the tin can telephone work?
- How is the sound transmitted?

Exploring sound

Tin can telephone

Card 6



Solution / Discovery

When you speak sound waves occur.

The sound waves are transported by the cord.

Then the eardrum catches the sound waves and you can hear something.

The sound waves are transmitted **by a solid material** (cord).

Exploring sound

Hose telephone

Card 7

Pupil experiment (partner work)

- Take a hose with the funnels.
- Set yourself up with a partner (in the stairway?).
- Partner A speaks first. After the end of the sentence say 'The end'.
- Partner B listens until they hear the words 'The end'.
- Partner B now speaks and also says 'The end' when their sentence is finished.
- How does the hose telephone work?
- How is the sound transmitted?



Exploring sound

Hose telephone
Card 7



Solution / Discovery

- When you speak sound waves occur.
- The sound waves cause the air to vibrate.
- Then the sound waves are caught by the eardrum and you can hear something.
- The sound waves are transported **by the air** (in the hose).

Exploring sound

A clock on the
table/handrail
Card 8

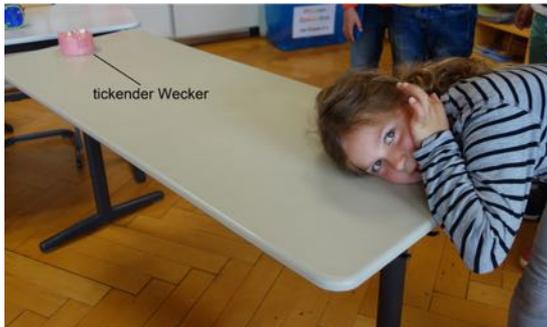


Pupil experiment

- A ticking clock is placed on a table or fastened to a staircase handrail.
- Place your ear on the table or on the other side of the handrail.
- Can you hear a sound?
- How is the sound transmitted?

Exploring sound

A clock on the table /
handrail
Card 8



Solution / Discovery

The ticking clock causes vibrations.

The vibrations are transported by the table / handrail.

Your ear catches the vibrations and passes them on to your ear drum.

The sound waves are transported by **a solid material** (table / handrail).

Exploring sound

Packing a timer Card 9 (Supplement)



Pupil experiment

- You need a loud timer, 3 containers with various materials (paper, gravel, cotton).
- Does the volume (loudness) change?
 - a) Timer in the empty container
 - b) Timer packed in cotton
 - c) Timer packed in gravel
 - d) Timer packed in strips of newspaper
- Try it again and measure the volume with the I-Pad.

Exploring sound

Packing a timer

Card 9 (Supplement)



Solution / Discovery

The ticking timer produces vibrations.

The vibrations are transported to the material in the boxes.

If the material transports the vibrations well the sound is preserved.

If the material transports the vibrations poorly or almost not at all, the sound will be very quiet or almost not audible. Such materials are very useful in noise prevention.

Exploring sound

The falling coin Card 10 (Supplement)



Pupil experiment

- Place two wine glasses of the same size next to each other.
- Place a one-cent coin onto the rim of the glass.
- Moisten your finger (bowl of water) and with your finger go around the rim of the other glass until you hear a tone.
- Watch the coin. What might happen? Why?

Exploring sound

The falling coin
Card 10 (Supplement)



Solution / Discovery

The motion (friction) causes a tone → vibrations.

The vibrations move through the air and cause the second wine glass to vibrate.

The second wine glass vibrates and sets the coin in motion. The coin loses its balance and falls down.

Research question / Supplement

**What can you hear in a vacuum?
Where might this problem arise?**

Experiment:

A ticking timer in a vacuum box.

Pupils think about what might happen and give reasons for their assumptions.



Sound experiment in a vacuum

Items needed:

- a vacuum container
- a loud timer on a piece of foam rubber

Conducting the experiment

Turn the timer on and place it on the foam rubber in the vacuum container.

Close the container by placing the lid onto it.

→The ticking can still be heard distinctly.

Then the air is pumped out of the container with the accompanying pump.

The teacher stops the process repeatedly.

→ You can hear that the ticking becomes quieter and quieter.

With this simple vacuum pump it is not possible to pump the air out completely, thus creating an airtight space, but the reduction of sound is astounding to the children and not predictable.

By opening the valve (stopping at intervals) the air is let into the container again and the children hear the sound of the timer.

An interesting consideration: In space there is no air. Is there a noise if two pieces of stone collide?
How do astronauts communicate?



Research question / Supplement

**What can you hear in a vacuum?
Where might this problem arise?**

Solution / Discovery

In order for humans to perceive sound (a noise), the sound must be transmitted through the air, water, or a solid material.

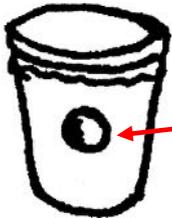
Without a suitable means of transport, sound cannot be transmitted and thus we cannot hear anything.

For this reason communication in space, for example, is impossible.

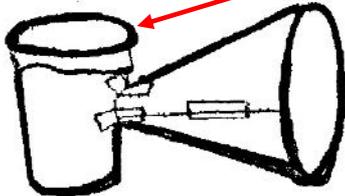
Instructions for constructing a cup you can talk into

Materials needed:

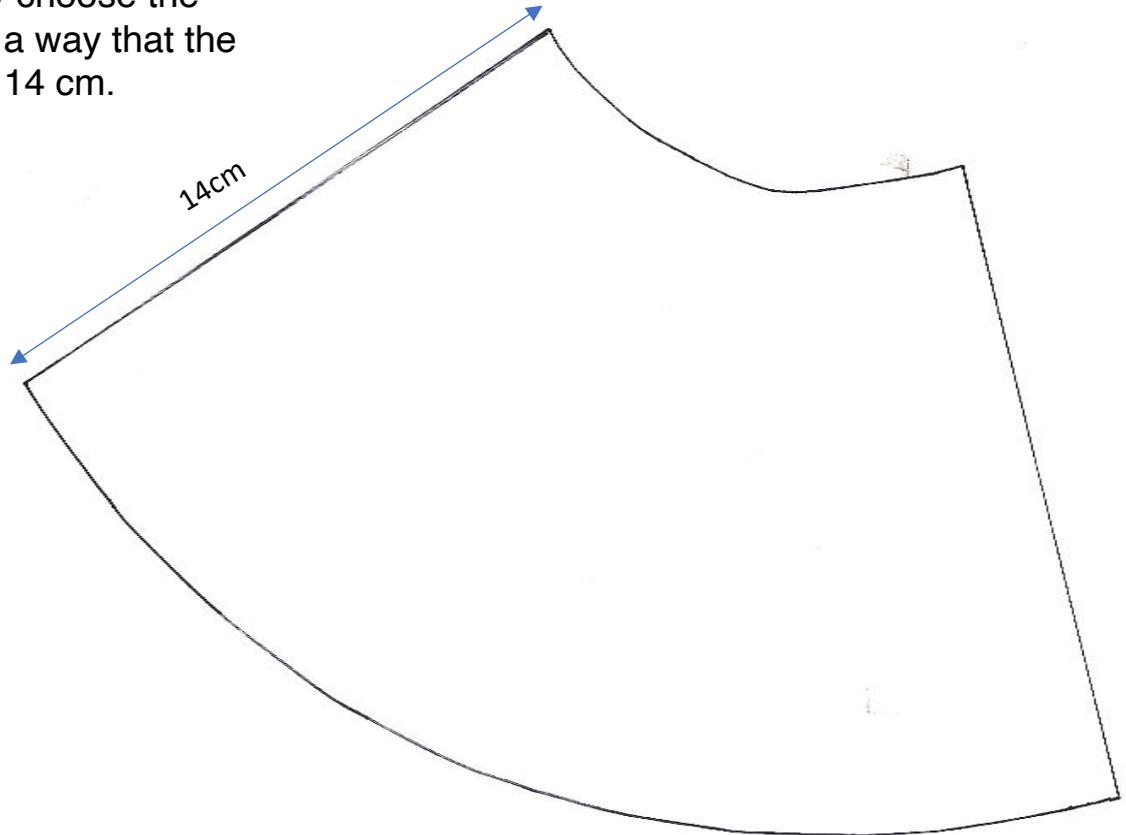
Paper cup, nail scissors, transparent film, rubber band, master copy for paper horn, scotch tape



- Using the nail scissors, cut a hole into the paper cup (see illustration).
- Stretch a piece of transparent film over the opening of the cup and fasten with a rubber band.
- Construct the paper horn (master copy on next slide)
- Fasten the paper horn onto the cup with scotch tape.



Master copy for the paper horn:
When making a copy choose the
enlargement in such a way that the
side edge measures 14 cm.



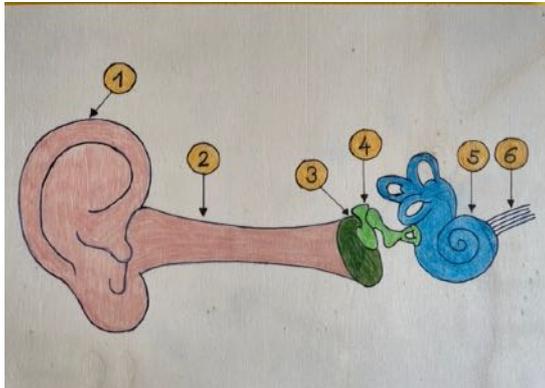
Exploring sound

Summary



This is what I know now

Every sound is spread by sound waves. **Air, water** and **solid materials** can transmit sound waves. Some materials transport sound better than others.



How are sound waves transmitted in my ear?

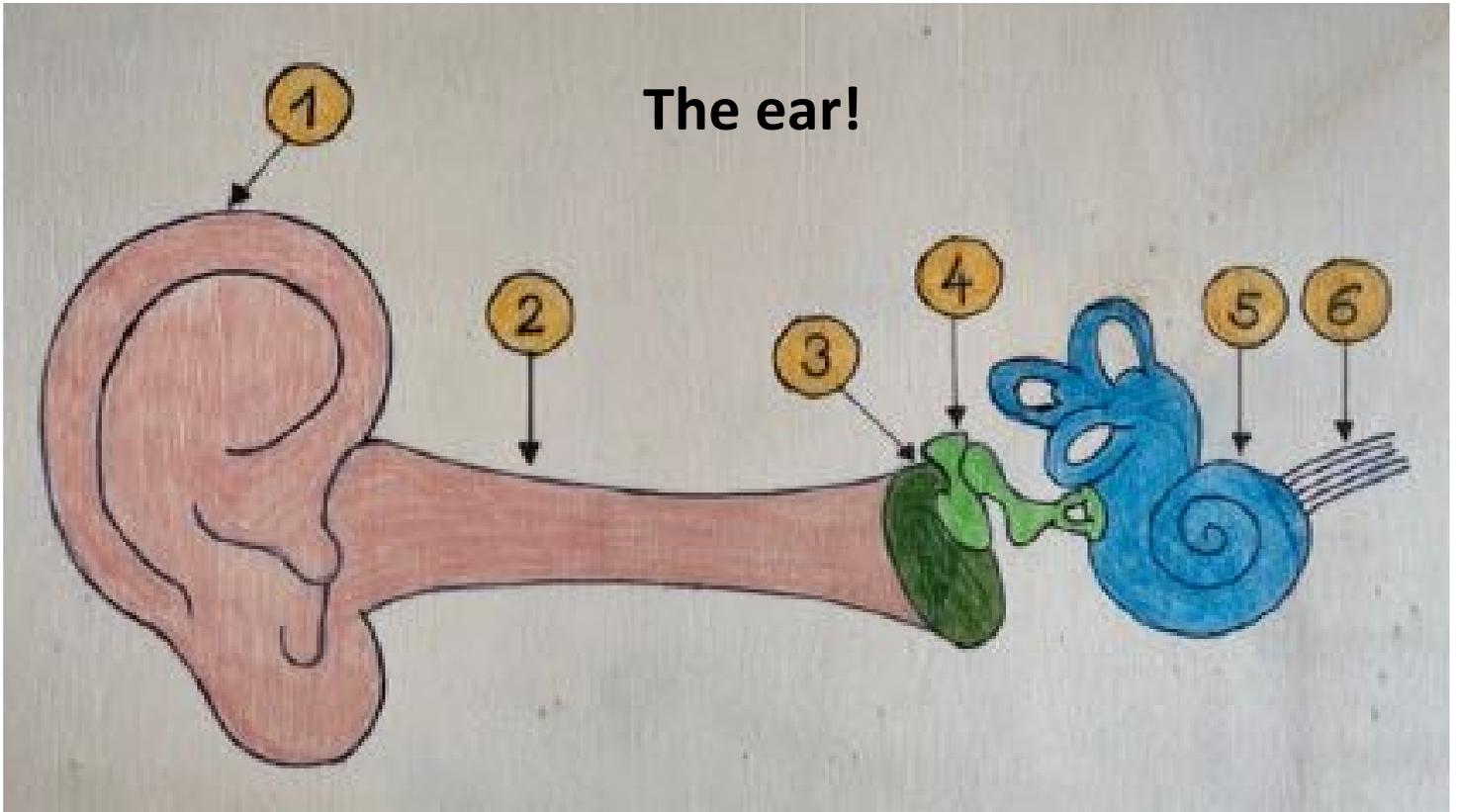
In the pinna (1) and auditory canal (2), sound waves are transmitted **through the air**.

After that it continues **through the solids**, the eardrum (3) and the auditory ossicles (4).

Then the sound is transmitted **via the fluid** in the cochlea (5) to the _____.

- 1) pinna 2) ear canal 3) eardrum 4) auditory ossicle 5) cochlea 6) auditory nerve

The ear!



1 pinna 2 ear canal 3 eardrum 4 auditory ossicle 5 cochlea 6 auditory nerve