COMMON MISCONCEPTIONS

Sound

Amanda Poole

Amanda Poole, PSTT Fellow, tells us how she addresses children's misconceptions about sound.

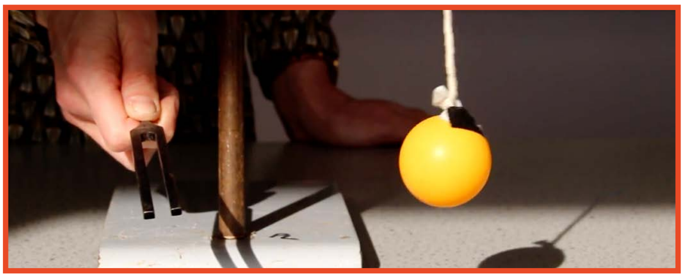
What children need to know:

- Our ears detect sounds so that we can hear.
- Loud sounds can damage our ears.
- Some materials are effective at muffling sounds.
- Sounds are made when something vibrates.
- Vibrations from sounds need a medium (solid, liquid or gas) to travel through to reach our ears.
- There is a link between the features of an object and the pitch of sounds that it produces.
- There is a link between the strength of the vibrations and the volume of the sound that is produced.
- Sounds get fainter as the distance from the sound source increases.

Common misconceptions:

1. Children do not always recognise that vibrations are the cause of a sound being produced.
2. Children may think volume and pitch of a sound are the same thing or mix them up.
3. Children may think that sound only travels through air, not solids or liquids.
4. Children may think sound is slowed down by physical obstructions.
5. Children may think that sound gets quieter as it travels further because it has 'faded out' or run out of 'energy'.

WHAT IS SOUND?



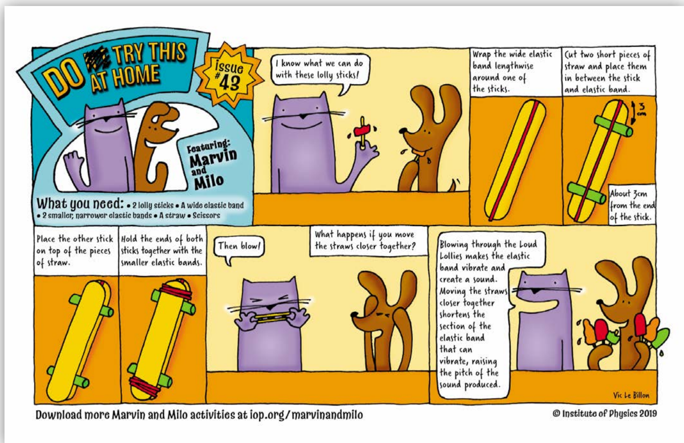
It can take some time for children to develop the idea that all sounds are caused by vibrations and they may hold ideas that sound is produced by an object because of its physical features, such as the tightness of a string or drum skin (Driver et al, 1994; Asoko, Leach and Scott, 1991). This is likely to be because of the abstract nature of the idea of vibrations, as they are NOT readily observed. Providing opportunities for children to observe the vibrations that are causing sounds can be effective in developing their understanding, through demonstrations such as rice on the surface of a drum, a tuning fork held so it just touches the surface of water or with a ping pong ball suspended by a string. The **Ogden Trust Phizzi Practical: Seeing Vibrations** describes how these demonstrations can make vibrations observable. I find that a large demonstration tuning fork is really effective for demonstrating how tuning forks produce sounds, as well as encouraging children's curiosity about hearing range.

Enquiry-based learning provides valuable opportunities to notice children's misconceptions and to address these. A good place to start with sound is by investigating musical instruments. Musical instruments are a fantastic resource for exploring how sounds are created and how they can be changed. Children can make and record their observations of materials from which the instruments are made; how they can produce louder and quieter sounds; and explore higher and lower-pitched sounds. A resource that I have found helpful is The Royal Society's **Brian Cox School Experiments,** which suggests other ways to explore sounds with home made instruments and interesting ways to relate learning to real world experiences.

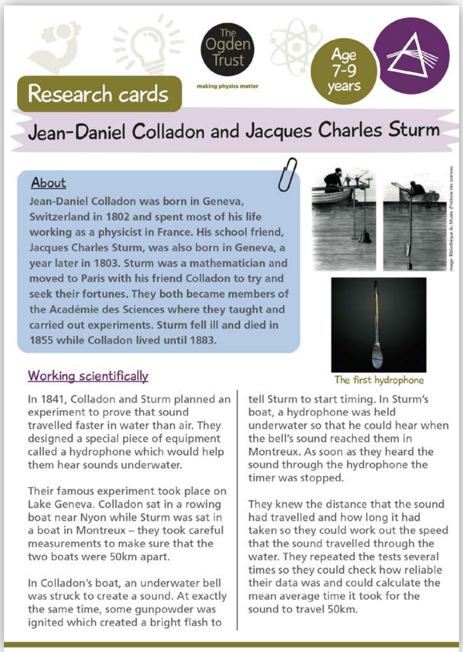
Even when children get the idea that sounds are caused by vibrations, there are still contexts where they will struggle to identify what is vibrating, such as air in a brass instrument, or two stones being hit together. It is really useful to provide opportunities for children to generalise their findings when investigating sound and apply their ideas about how sounds are created to a range of diverse real-life situations.

COMPARING SOUNDS

Once children understand that sounds are created by vibrations, they are ready to compare sounds. A pattern-seeking enquiry that explores the relationship between the size of a musical instrument and the sound it makes can build on prior learning and help develop an understanding of pitch. It is then valuable for children to plan and carry out their own investigations into pitch, such as filling bottles with different amounts of water and blowing across the top or tapping the side. There are some wonderful free measuring apps that can be used to collect data to compare sounds, such as Google Science Journal. This can be used to measure the volume of sounds in decibels or the pitch in hertz (where 1 hertz means one vibration per second). I find these really helpful for developing children's working scientifically skills while they answer their own scientific questions through data collection, recording and analysis.



The institute of Physics' Marvin and Milo resources also has a series of cards with simple practical activities that are effective for addressing children's misconceptions. **Loud Lollies** is a fantastic activity for children to compare sounds by changing variables. Changing the force with which they blow through the 'Loud Lollies' varies the volume of the sound made, whilst moving the straws closer together shortens the length of elastic band that can vibrate and changes the pitch of the sound. Children can make their own Loud Lolly and use it to make measurements and to collect data in the classroom; then they can take it home to share their learning with their family. Using the slo-mo video function of cameras on tablets/phones to make close-up observations of phenomena such as the Loud Lollies is another way of using technology to enhance children's understanding and curiosity.



The Ogden Trust
making physics matter

Research cards

Age 7-9 years

Jean-Daniel Colladon and Jacques Charles Sturm

About

Jean-Daniel Colladon was born in Geneva, Switzerland in 1802 and spent most of his life working as a physicist in France. His school friend, Jacques Charles Sturm, was also born in Geneva, a year later in 1803. Sturm was a mathematician and moved to Paris with his friend Colladon to try and seek their fortunes. They both became members of the Académie des Sciences where they taught and carried out experiments. Sturm fell ill and died in 1855 while Colladon lived until 1883.

Image: Bibliothèque du Musée d'histoire des sciences

The first hydrophone

Working scientifically

In 1841, Colladon and Sturm planned an experiment to prove that sound travelled faster in water than air. They designed a special piece of equipment called a hydrophone which would help them hear sounds underwater.

Their famous experiment took place on Lake Geneva. Colladon sat in a rowing boat near Nyon while Sturm was sat in a boat in Montreux – they took careful measurements to make sure that the two boats were 50km apart.

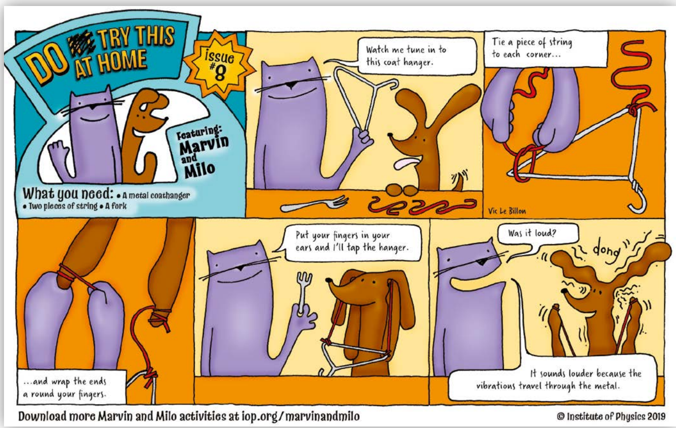
In Colladon's boat, an underwater bell was struck to create a sound. At exactly the same time, some gunpowder was ignited which created a bright flash to tell Sturm to start timing. In Sturm's boat, a hydrophone was held underwater so that he could hear when the bell's sound reached them in Montreux. As soon as they heard the sound through the hydrophone the timer was stopped.

They knew the distance that the sound had travelled and how long it had taken so they could work out the speed that the sound travelled through the water. They repeated the tests several times so they could check how reliable their data was and could calculate the mean average time it took for the sound to travel 50km.

The more time that children can have to use scientific vocabulary to describe and compare sounds, the more likely that language will be secured, so developing further opportunities for enquiry that draws upon these ideas is important. Children could use secondary sources to research the hearing ranges of different animals and use graphs to compare with the hearing ranges of humans. Additionally, children could research how scientific ideas have changed over time using the Ogden Trust research cards as secondary sources of information: **Research Cards: Helping us hear** explores the history of hearing devices and **Research Cards: Sound** explores how various scientists worked scientifically to develop new ideas about sound.

SOUNDS AND MATERIALS

Research suggests that it is common for students to think of sound as a material substance that moves from one place to another (Barman, Barman and Miller, 1996) and many children develop the misconception that sound travels through air but not liquids or solids. Identifying and classifying materials that sound can travel through helps children develop their understanding that sounds need a material through which to travel. As well as the 'string telephone', the Institute of Physics' Marvin and Milo activity, Musical Coat Hanger, can be easily adapted for children to investigate the materials that sound can travel through. Replacing the two pieces of string with other materials such as foil, wire, wool, thread, paper or plastic provides an effective simple test to classify materials. In addition, the Ogden Trust's Phizzi Practical: Make a hydrophone provides an interesting way for children to observe that sounds also travel through liquids.



A simple way of demonstrating that the only occasion when sounds cannot travel is in a vacuum is to use a good quality vacuum food container. If you place a sponge at the bottom of the food container and then place a mobile phone playing music (or similar) on top of this, then place the lid on top and pump out all the air, children will observe that the more air is pumped out, the quieter the sound becomes, and when all the air has been removed, the music can no longer be heard. When the valve is opened and the air is allowed back into the container, the music can be heard again.

Children develop their thinking further by investigating the ability of different materials to muffle sound. This can be achieved by wrapping a sound-making object, such as an alarm clock, in different materials and using a sound sensing app such as Decibel X, or a data logger, to measure the volume of the alarm clock outside each of the materials.

TRAVELLING SOUNDS

Research shows that children often think sound becomes become quieter as they travel further from the source because it 'faded and died out' or 'ran out of energy'; very few give the correct explanation, which is that sound spreads out. Children should investigate this property of sound themselves and this is an ideal opportunity to take learning outdoors where children can use data loggers or sound sensors to measure the volume of a musical instrument at various distances away, measured with a tape measure. By having one source of sound, and children measuring its volume in different directions from the source, children will observe that the sound is travelling out in all directions, spreading out over a larger and larger area.

REFERENCES

Asoko, H. M., Leach, J. and Scott, P. H. (1991).

Barman, C. R., Barman, N. S. and Miller, J. A. (1996).

Driver, R., et al. (1994).

Whittaker, A. (2012).

Don't forget our previous 'Common Misconceptions' articles are still available. Click links below:

Autumn 2017 - Light

Spring 2018 - Electricity

Summer 2018 - Evolution

Spring 2019 - Levers, gears and pulleys

Summer 2019 - Changing materials

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