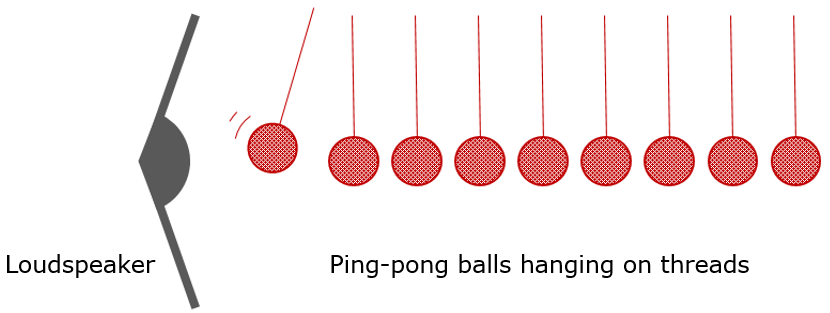
**Sound model**

A group of students make a model to show how we can hear a loudspeaker.



**To answer**

1. What do the ping-pong balls represent?
2. What happens to the ping-pong balls when the loudspeaker vibrates?
3. How is this model similar to what happens when sound moves through the air?
4. How is this model different to what happens when sound moves through the air?

*Physics > Big idea PSL: Sound, light and waves > Topic PSL1: Sound and light > Key concept PSL1.1: Production and transmission of sound*

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| --- |
| **Response activity** |
| **Sound model** |

**Overview**

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| Learning focus: | Objects and materials can be made to vibrate to produce a sound that becomes louder as the size of vibration increases and higher pitched as the rate of vibration increases. |
| Observable learning outcome: | Explain how vibrations are passed on to the surrounding air. |
| Activity type: | Critiquing a representation |
| Key words: | Vibrate, vibration |

This activity can help develop students’ understanding by addressing the sticking-points revealed by the following diagnostic question:

* Diagnostic question: Into the air

**What does the research say?**

The transmission of sound is difficult to understand. It is common for students to think of sound a material substance that moves from one place to another (Barman, Barman and Miller, 1996). Even at degree level Linder (1992) found that some students thought of sound as a ‘lump’ of material travelling through a passive medium, similar to a surfer on a water wave.

In his study of twenty-eight 11-14 year olds Whittaker (2012) found that fewer than 30% used the idea of vibrations to correctly describe how sound travels through air. Half the students believed a gap around the door was necessary for sound to enter from the outside, which indicates a view of sound as a material substance. Only 20% were able to explain how sound vibrations can pass through the wall.

40% of students in the same study thought sound got quieter as it travelled further because it ‘faded and died out’ or ran out of ‘energy’.

This activity gives students the opportunity to discuss ideas of how sound is transmitted, with reference to an appropriate model, in order to develop and consolidate their understanding.

**Ways to use this activity**

Students should complete this activity in pairs or small groups, and the focus should be on the discussions. It is through the discussions that students can check their understanding and rehearse their explanations.

Philosophically science can be said to be a description of the ‘best model’ we have for the world. In this activity students should identify ways in which this particular model is a good representation of the real world, and ways in which it is not.

Students should work together to answer the questions on either the worksheet or the PowerPoint. Giving each group one worksheet to complete between them is helpful for encouraging discussion, but each member should be able to report back to the class. Listening in to the conversations of each group will often give you insights into how your students are thinking.

Ending with the students completing the worksheet or questions from the PowerPoint individually, might help them to consolidate their learning.

*Differentiation*

You may choose to use simplified worksheets for some students, for example with gaps to fill in so they can focus on the science. In some situations it may be more appropriate for a teaching assistant to read and/or scribe for one or two students.

**Expected answers**

1. The ping-pong balls represent particles of air.
2. The loudspeaker bumps into the first ping-pong ball and knocks it to one side. The ping-pong ball bumps into the next one and so on until the last one is knocked. The sound (vibration) can be felt at the last ping-pong ball.
3. A loudspeaker vibrates air particles in much the same way. The air particles vibrate backwards and forwards, but don’t rush along in a wind and blow into your ear.
4. Air particles are free to move around and are not held in place. There are many, many times more air particles than there are ping-pong balls (in the order of 10 000 000 000 000 000 000 000 times as many). Air particles are too small to see.

**Acknowledgments**

Developed by Peter Fairhurst (UYSEG).

Images: UYSEG

**References**

Barman, C. R., Barman, N. S. and Miller, J. A. (1996). Two teaching methods and students' understanding of sound. *School Science and Mathematics,* 96(2)**,** 63-67.

Linder, C. J. (1992). Understanding sound:so what is the problem? *Physics Education,* 27**,** 258-264.

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