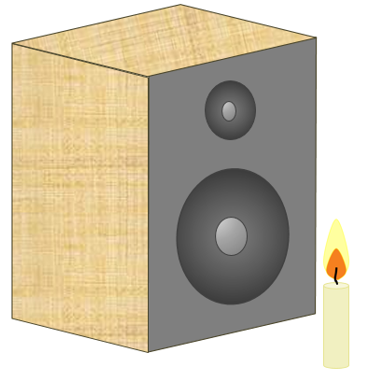
**Candle sound**

A lighted candle is put in front of a speaker

The speaker vibrates to make a sound.



**Predict**

What do you think will happen to the flame when the speaker is turned on?

**Explain**

Explain why you think this will happen.

|  |
| --- |
| **Now watch the demonstration** |

**Observe**

Describe what happens.

**Explain**

Were your prediction and explanation correct?

If not, can you explain what you observed?

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

|  |
| --- |
| **Diagnostic question** |
| **Candle sound** |

**Overview**

|  |  |
| --- | --- |
| Learning focus: | Sound needs a medium to travel through. It radiates out from a source in straight lines in all directions and when it strikes an object or new material it is transmitted, reflected, scattered or absorbed – or a combination of these. |
| Observable learning outcome: | Describe how particles vibrate to transmit sound. |
| Question type: | Predict, explain, observe, explain - demonstration |
| Key words: | Particles, vibrations |

**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; Whittaker, 2012). 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.

This question builds on students’ understanding of how sound travels and gives them the opportunity to apply their ideas of how sound travels through air to a new situation.

**Ways to use this question**

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.

To begin, each group should discuss the activity and use their scientific understanding, firstly to predict *what* they think will happen, and then to explain *why* they think they are going to be right. If students in any group cannot agree, you may be able to direct them with some careful questioning.

Students now watch a demonstration.

After the demonstration each group should be given the opportunity to change, or improve their explanation. A good way to review your students’ thinking might be through a structured class discussion. You could ask several groups for their *explanations* and put these on the whiteboard. Then ask other groups to suggest which explanation is the most accurate and the most clearly expressed, and through careful questioning work up a clear ‘class explanation’.

A useful follow up is for individual students to then write down explanations in their own words – without reference to the class explanation on the board (i.e. cover it up).

*Differentiation*

The quality of the discussions can be improved with a careful selection of groups; or by allocating specific roles to students in the each group. For example, you may choose to select a student with strong prior knowledge as a scribe, and forbid them from contributing any of their own answers. They may question the others and only write down what they have been told. This strategy encourages contributions from more members of each group.

**Equipment**

For the class:

* Loud speaker – without a grill on the front
* Signal generator (use a low frequency to observe more clearly)
* Candle supported so the flame is level with the middle of the speaker

**Expected answers**

The candle flame ‘wobbles’ forwards and backwards in time to the vibrating speaker that makes the sound. This shows how the particles in the air are moving.

**How to respond - what next?**

Some students may think that sound is a material substance travelling through the air, and they might predict the candle will blow out or lean forwards as the sound passes.

Other students may think that sound is transmitted by the ‘surfer model’ with a ‘lump of sound’ being pushed through the air by a wave of air particles. They might predict the correct answer and describe the air particles vibrating, but they may also describe the sound being pushed forwards by the particles.

If students have misunderstandings about how air particles vibrate to transmit sound, it can be helpful to demonstrate what is happening with a student model. A line of students spaced well out represent air particles. If the student at one end is made to vibrate (for example by an imaginary loudspeaker), the vibration is passed on from student to student without the students moving across the room.

The following BEST ‘response activities’ could be used in follow-up to this diagnostic question:

* Response activity: It’s quiet in space
* Response activity: Sound model

**Acknowledgments**

Developed by Peter Fairhurst (UYSEG).

Images: UYSEG

**References**

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