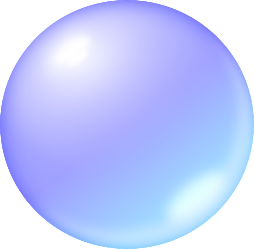
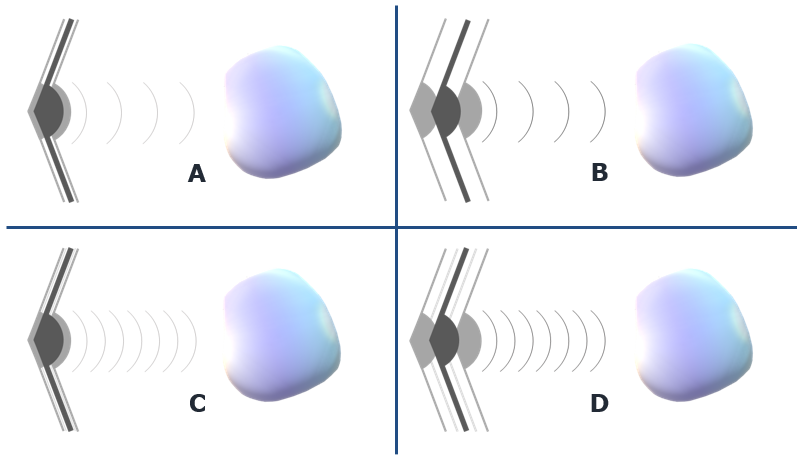
**Sound bubble**

A soap bubble is very delicate.

A sound wave can make the surface of a bubble vibrate.

The sound wave transfers energy to the bubble.

**a.** Which sound wave transfers energy to the bubble most quickly?



**b.** What is the **best** reason for your last answer?

*Put a tick (✓) in the box next to the best answer.*

|  |  |  |
| --- | --- | --- |
| **A** | This sound wave contains most energy. |  |
|  |  |  |
| **B** | This sound wave hits the bubble with most force. |  |
|  |  |  |
| **C** | This sound wave makes the bubble vibrate the most. |  |
|  |  |  |
| **D** | This sound wave moves the most air particles. |  |

*Physics > Big idea PSL: Sound, light and waves > Topic PSL4: Waves > Key concept PSL4.2: A wave model of sound*

|  |
| --- |
| **Diagnostic question** |
| **Sound bubble** |

**Overview**

|  |  |
| --- | --- |
| Learning focus: | As a sound wave (longitudinal wave) travels it transfers energy, as particles of the medium through which it travels are successively made to vibrate forwards and backwards along the direction in which the wave travels. |
| Observable learning outcome: | Compare the energy transferred by sound waves that have a different frequency or loudness to each other and are moving through a common medium. |
| Question type: | Two-tier multiple choice |
| Key words: | Sound wave, vibrate, vibration, amplitude, frequency, energy |

**What does the research say?**

When waves move through a medium students often describe the movement of some entity (perhaps mass, matter or force) through the medium. The scientific explanation involves no such movement. A wave moves forwards when a perturbation passes through a medium, and after it has passed the material of the medium returns to its original position. This is what distinguishes the motion of a wave from the motion of an object. (Fazio et al., 2008)

In the study by Fazio et al. (2008), some students explained that waves set off with a bigger amplitude moved faster because they had been given more energy or more force. When talking about energy students tend to use science terms loosely: Driver et al. (1994) describe evidence from several researchers that students often confuse ideas of energy with ideas of force, work or power and may use the terms interchangeably. (Rogers, 2018) emphasises the importance of teachers modelling accurate use of science terms and advises giving students opportunities to practise using language precisely to help them develop an accurate model of what is happening.

Generally people think of energy as a substance, with flow and conservation analogous to that of matter. Although not scientifically correct this is considered an acceptable analogy (Millar, 2011). When explaining how energy is transferred, (Tracy, 2014) recommends that we focus on describing the processes and mechanisms involved. He suggests that trying to identify the ‘energy’ in each step is just a labelling exercise that can get in the way of a clear understanding of what is happening.

**Ways to use this question**

Students should complete the questions individually. This could be a pencil and paper exercise, or you could use an electronic ‘voting system’ or mini white boards and the PowerPoint presentation. The follow on question will give you insights into how they are thinking and highlight specific misconceptions that some may hold.

If there is a range of answers, you may choose to respond through structured class discussion. Ask one student to explain why they gave the answer they did; ask another student to explain why they agree with them; ask another to explain why they disagree, and so on. This sort of discussion gives students the opportunity to explore their thinking and for you to really understand their learning needs.

*Differentiation*

You may choose to read the questions to the class, so that everyone can focus on the science. In some situations it may be more appropriate for a teaching assistant to read for one or two students.

**Expected answers**

a. D

b. C

**How to respond - what next?**

We know sound wave D transfers most energy to the bubble because it makes the bubble vibrate more than the other waves.

Sound waves A and C have less energy because the speaker cone is vibrating with a smaller amplitude and squashes fewer air particles into each compression. Sound waves B and D have the same amplitude, which means the same number of particles are squashed into each compression, but sound wave D has a higher frequency, so more compressions hit the bubble each second.

Answer A for *part b* is not the best answer, because it is simply labelling the wave as having a lot of energy that it passes on to the bubble. There is no description of how it transfers energy or how we know it has transferred energy. Explaining in ‘labels’ can hide misunderstandings about what is happening.

Answers B and D for *part b* are technically correct, but answer C is a better answer. Answer C describes the effect of the energy transferred to bubble and gives evidence that the most energy has been transferred.

If students have misunderstandings about the energy transferred by sound waves with different amplitudes and frequencies, moving through a common medium, it can help to reflect on how the movement of the ‘particles’ of air cause the movement of the bubble. Careful questioning can elicit the understanding that the particles in the sound wave move more quickly forwards and backwards if it has either a bigger amplitude or a higher frequency.

Giving students the opportunity to explain in their own words why more energy is transferred to the bubble by sound wave D can consolidate learning and check individual understanding.

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

* Response activity: Candle in the sound

**Acknowledgments**

Developed by Peter Fairhurst (UYSEG).

Images: Peter Fairhurst (UYSEG), original bubble: <https://pixabay.com/vectors/bubble-soap-bubble-ball-round-blue-1841301/>

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Tracy, C. (2014). Energy in the new curriculum: an opportunity for change. *School Science Review,* 96(354)**,** 11.