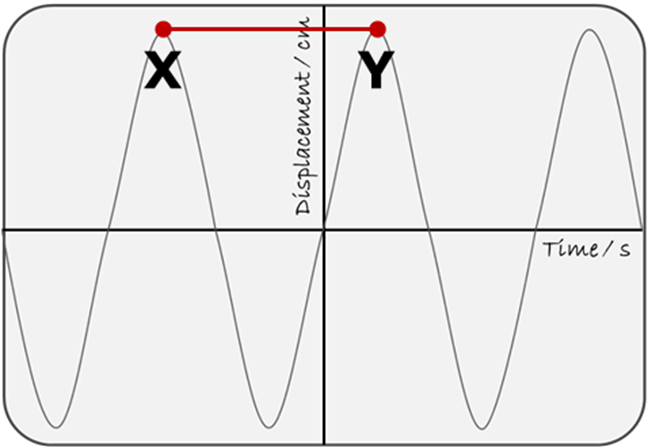
**Sound graph**

A sound wave can make part of a microphone vibrate.

The vibration can be shown on an oscilloscope.

As part of the microphone vibrates in and out, the displacement on the graph goes up and down.



What does the line XY represent on the displacement-time graph?

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

|  |  |  |
| --- | --- | --- |
| **A** | The wavelength of the sound. |  |
|  |  |  |
| **B** | The time for part of the microphone to vibrate once. |  |
|  |  |  |
| **C** | The time for air particles to move from X to Y. |  |

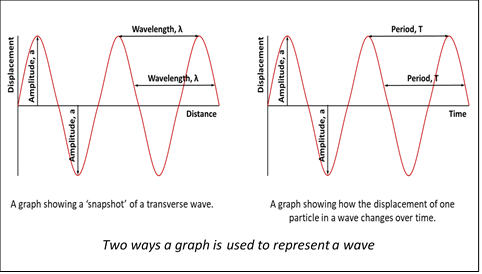
*Physics > Big idea PSL: Sound, light and waves > Topic PSL5: Measuring waves > Key concept PSL5.1: Visualising waves*

|  |
| --- |
| **Diagnostic question** |
| **Sound graph** |

**Overview**

|  |  |
| --- | --- |
| Learning focus: | The motion of particles in a wave can be represented by a displacement-distance or a displacement-time graph, from which the wave’s amplitude and wavelength or time period can be found. |
| Observable learning outcome: | Explain how a displacement-time graph relates to the wave it describes. |
| Question type: | Simple multiple choice |
| Key words: | Displacement |

**What does the research say?**

****There are two common ways to represent a wave in the form of a graph (Caleon and Subramaniam, 2010). The first shows either a snapshot of a transverse wave, such as a wave on a rope, or the forwards and backwards displacement of particles in a longitudinal wave. The second graph shows how the displacement of one particle of a wave changes over time. On this graph the peak-to-peak separation on the graph is the time period of the wave. Caleon and Subramaniam (2010) found that the majority of students aged 15 and 16 (n=598) do not clearly distinguish between these two representations.

Some students may think of a wave’s graph as a picture of the wave drawn to scale, which in most cases it is not. This way of thinking about graphs of waves can get in the way of understanding graphs of longitudinal waves and of interpreting displacement-time graphs.

**Ways to use this question**

Students should complete the question 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 answers to the question will show you whether students understood the concept sufficiently well to apply it correctly.

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 answer**

B

**How to respond - what next?**

The diaphragm of the microphone can be made to vibrate backwards and forwards by the vibrations of the sound wave reaching it. The line XY represents the time for the diaphragm to move from a backwards position – forwards and then backwards, back to where it started.

A It is common for students to not consider the x-axis and to identify the distance XY as the wavelength of a wave on a displacement-time graph like this one.

Other students may view the displacement-time graph as one of a sequence of snapshots of the wave taken over time, like a frame of a movie, with one of those images captured on the graph.

C A naïve and sometimes persistent misunderstanding of some students is that air moves forwards with a sound wave.

If students have misunderstandings about explaining how a displacement-time graph relates to the wave it describes, it can help to challenge students to think about how the graph on an oscilloscope is created. The following BEST ‘response activity’ helps to do this and could be used in follow-up to this diagnostic question:

* Response activity: Oscilloscope graph

**Acknowledgments**

Developed by Peter Fairhurst (UYSEG).

Images: Peter Fairhurst (UYSEG).

**References**

Caleon, I. S. and Subramaniam, R. (2010) 'So Students Know What They Know and What They Don't Know? Using a Four-Tier Diagnostic Test to Assess the Nature of Students' Alternative Conceptions', *Research in Science Education,* 40 (3), pp. 313-337.