

Common Student Ideas about Sound

Common Student Idea(s)	Scientific Explanation
1. Sounds are inside whatever makes them. You have to do something to make a sound come out of the object.	Implied in this common student idea is the belief that sound is a type of matter—a substance that can be released from an object—rather than a phenomenon that results from a pressure wave created by vibrations. The sounds we hear aren't contained in objects or released from them. Rather, a vibrating object (soundmaker) causes the air around it to vibrate. These vibrations travel through the air to our ears, causing our eardrums to vibrate. Our eardrums send a message to our brains, which translate the vibrations into sounds we can hear.
2. Pitch and loudness are the same characteristic of sound.	<p>Pitch and loudness are two different properties of sound. <i>Loudness</i> is a human perception of the loudness or quietness of sound. It's related to the amplitude or "tallness" of the wave. In a pressure wave, areas of higher pressure or density called <i>compressions</i> produce louder sounds, and areas of lower pressure or density called <i>rarefactions</i> produce quieter sounds. When we measure the loudness of a sound, we have to be less subjective so we refer to it as measuring the intensity of the sound. Sounds with greater intensity transfer more energy.</p> <p><i>Pitch</i> isn't related to the loudness of a sound. Instead, it refers to the highness or lowness of a sound and its frequency. <i>Frequency</i> is the rate at which waves travel through matter. High-frequency sound has a higher pitch, and low-frequency sound has a lower pitch. Humans can hear sounds with a pitch (or frequency) of 20 waves per second to 20,000 waves per second. Waves per second are often represented in units called <i>hertz</i> (Hz).</p>
3. Sound travels only to the person who hears it.	Sound waves are often depicted as traveling from the source to the listener, but they actually travel from the source in all directions like a three-dimensional sphere.
4. Sound moves between particles of matter (in empty space).	Sound waves move only when matter moves—or rather when tiny particles of matter move. Atoms and molecules of matter vibrate, creating areas of highly compressed matter (compressions) and areas of uncompressed matter (rarefactions). These pressure waves are the way sound moves through matter. Sound can't travel where there is no matter (such as in a vacuum).
5. Matter moves along with the sound waves.	In a sound or pressure wave, particles of matter move in a defined area <i>parallel</i> to the motion of the wave. They travel a short distance with the wave and then return to their rest position, repeating this pattern over and over. In other words, particles of matter vibrate back and forth. They don't travel the full distance of the wave.

References

- Operation Physics, American Institute of Physics. (n.d.). Children's misconceptions about science [compiled list for elementary and middle-school physics education].
- Driver, R., Squires, A., Rushworth, P., & Wood-Robinson, V. (2000). *Making sense of secondary science*. London: RoutledgeFalmer.