Sounds

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Sounds are vibrations. We cannot see these vibrations, but we can see the way some sounds make things vibrate. For example, if you place some grains of rice on a drum that is very close to the speaker of a loud radio, you can see the grains of rice vibrating.

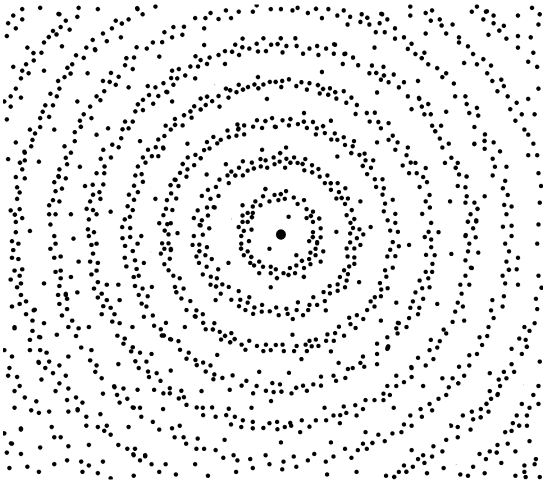
We can also make some things vibrate, feel and/or see how they vibrate, and hear the ‘sound vibrations’ (or ‘sound waves’) they produce. For example, when we pluck a string or hit an object like a tabla, we make the string or tabla vibrate (move up and down in a regular pattern). Although we can’t see it, the vibrating string or tabla also makes the air around it vibrate. It is something like what happens if you hit the surface of a bowl of water: waves start going out across the surface of water starting from where you hit it. When you hit a tabla, waves get made in the air surrounding the tabla. These waves go out in the air in all directions, not just the two dimensions you see in the water waves.

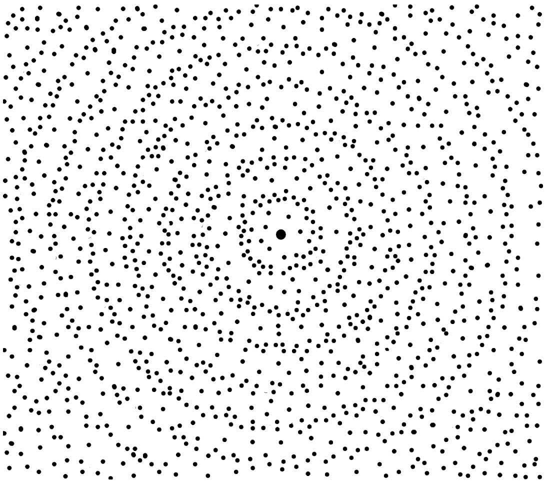
Just as each particle of water does not move much as waves move out across the surface (you can see this by watching an object floating on the water), each air particle does not move much as sound waves travel through air. But whereas in water the particles move mostly up and down to create the troughs and crests of waves, in air the particles move mostly back and forth in line with the direction the sound wave is moving. The sound waves consist of regions of compressed and rarefied air (see Figs(a) and (b)).

The different kinds of sound we hear are due to different types of sound waves.

The following pictures show what air particles might look like

(a) for a very loud sound, and (b) for a not so loud sound

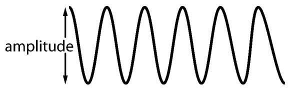




(Of course we can’t really see the air particles, but these are models to show what the air particles would look like if we could take a snapshot of them. Try to imagine that they are 3-dimensional, not like these 2-dimensional pictures.)

The above pictures of sound waves correspond to water waves of larger or smaller **amplitude** (amplitude means height). We can also use pictures like the ones shown below as models for sound waves. Here are pictures of the two different kinds of sound waves shown above: (Remember, bigger waves mean bigger (louder) sound, smaller waves mean smaller (softer) sound.)

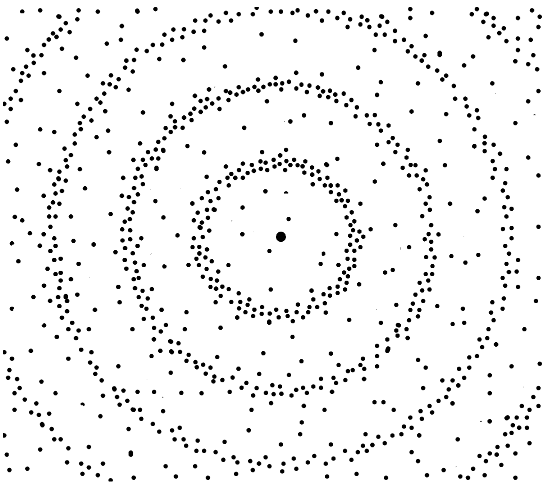
(c) louder sound

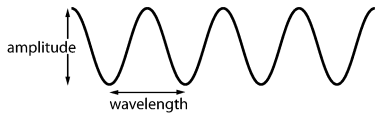


(d) less loud sound

If the distance between each wave is larger, we will hear a lower **pitch** sound (a sound of lower **swar**):

(e) a lower pitch sound than (a)   (f) the same sound as in (e)





The length between the crests of two adjacent waves is called the wavelength. If the distance between each wave is smaller, we will hear a higher sound (a sound of higher pitch, or higher frequency). The sound in (a) is of a higher pitch than the sound in (e).

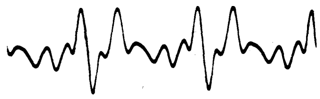
Since the speed of all sound waves in air is the same, the number of waves that hit our eardrum in one second will be fewer if the wavelength is longer. So we say that sounds of longer wavelength have a lower **frequency**. Sounds of shorter wavelength have a higher frequency. The sound waves in (c) and (f) have the same loudness, but (f) is of a lower pitch than (c).

Different sounds also have differently shaped sound waves. For example, when a note of the same loudness and the same pitch (e.g. Sa) is played on a flute and a sitar, the two notes will sound different. They have different qualities, which enable you to recognize which instrument they come from. This is because the sound waves they produce have different shapes. If you have a computer with a microphone, you can get software for it that will enable you to see pictures of the sounds you make into the microphone. (The computer will calculate the relative loudness and pitch of the sounds and draw a picture of a wave with this relative amplitude and frequency.) For example:

A note from a tuning fork

The same note from a violin

The same note from an oboe (which is similar to a shehnai)



Note: the above discussion is for teachers’ own edification, **not** to be passed on to the students. Students in Class VI or less will not be able to comprehend the physics of sounds at this level.

But young students can get experience listening to different sounds. They can start trying to differentiate between sounds that are loud and sounds that are not so loud, and between sounds of high pitch and sounds of low pitch. You might sing or play two notes on a musical instrument and ask the students to tell which one is of a lower pitch, or which one is louder, or what is the difference between the two. They can practice making different sounds with different objects and instrument and classifying them in different ways. For example, see if each student can tell the difference between a loud note at a low pitch and a not so loud note at a high pitch. After students have a lot of such experience with sound, they will be in a position to learn more about the physics of familiar sounds when they are in upper classes (and when they have also learned more mathematics).