

Lesson 9.4 Nature and Properties of Sound Waves.

Sound is a form of kinetic energy so like all energies it:

1. has a source.
2. travels from one place to another.
3. does work when it changes (transforms) to another form of energy
4. finishes up generally as heat.

Part A. Sources of Sound Energy

Q. Generally when is sound made?

Q. If a tree falls over in a forest, does it make a sound if there is no-one there to hear it?

Q. Can some sounds be made that we can't hear?

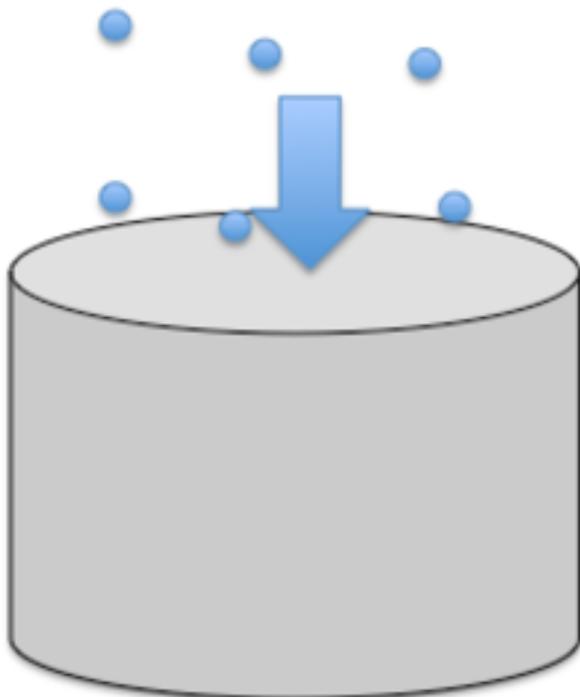
This begs the question “What is sound? Is it what we hear or what is made?”

Sound energy output varies in size (loudness) and pitch (frequency).

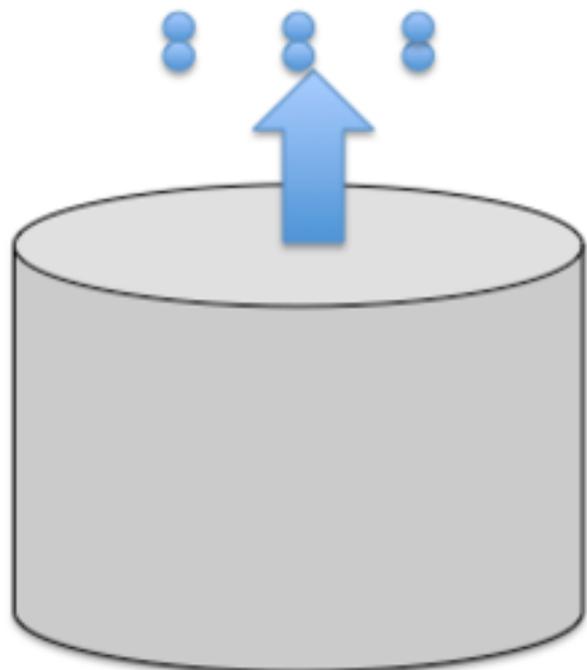
It is transmitted as a **longitudinal wave**

To understand how a longitudinal wave is made, imagine the tiny particles of air being successively squeezed and stretched by a **vibrating drum**

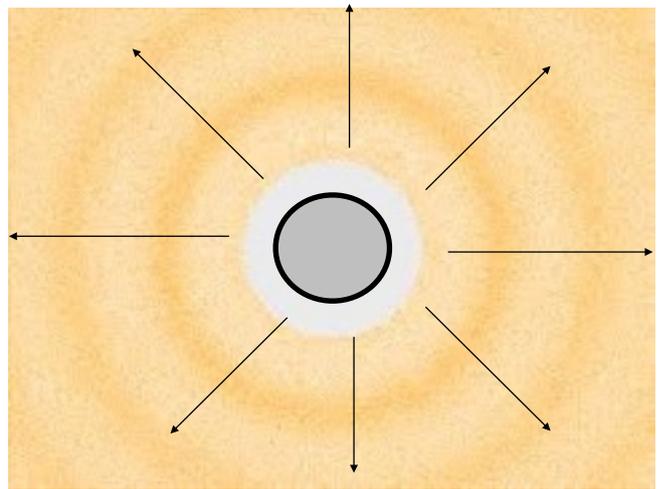
Drum skin pushed down air fills it up and expands



Drum skin bounces back up and squeezes the air together.



When this happens many times per second a succession of compressions and expansions take place and spread out away from the drum in all directions as shown in the diagram:



Loudness or Volume

This is where all the energy comes from.

By banging the drum skin harder, the skin bends more filling it up with more air and bouncing back stronger, squeezing more air particles together at one time making it louder. Louder means it also has more energy.

Q. *What does your larynx or voice box do to make a louder sound?*

Pitch or frequency

This is how high and low sounds are made. In fact all verbal communication and music works on combinations of pitch. Pitch is the rate or speed at which the object vibrates. The faster the pitch the higher the sound.

In the Drum, the rate at which the skin bounces back and forwards doesn't change the loudness but the pitch.

Q. *How do you change the pitch of a drum? There are two ways.*

1. tighter skin or 2. smaller drum

Do 9.5 Investigating Sound Part A. Producing sound

Part B. Sound Travel

Q *Can you travel faster than the speed of sound?*

Yes the speed of sound is not that fast. About 1200km/h often called Mach 1

Jet planes can go now over Mach 3 which means more than three times the speed of sound.

Q. In the old days or at school carnivals athletic races, timekeepers use the starters pistol to start the stopwatch. Sound cannot be used by the timekeepers because its too slow. You have to watch the smoke or use a digital timing device. Why is this?

So sound is slow compared to light. Speed of sound is not a constant however. Sound can travel through many different materials. If something lets sound through it is called a sound **medium**. It is faster when the medium is denser.

Q Which of the following materials would sound travel fastest:

1. hot air/ cold air
2. air /water /glass /metal

Hot air is faster in fact there is a formula for speed of sound:

$V_s = 331 + 0.6T$ where T is temperature in degrees celsius

Metals not only let sound through quicker, it loses less energy so sound travels further but the quality of the sound is poor because of the restriction in vibrations.

Do 9.5 Investigating Sound Motion B Sound Travel

Part C Sound Absorption

So sound can do one of three things when it hits an object:

1. It gets absorbed.
2. It travels right through
3. It reflects back (an echo)

Q, What factors about the object determines what it will do to the sound that hits it?

Important factors include the objects size, composition and density.

Think about the ways you stop sound or even enhance it. Have you been in a room that is very noisy because the sound is bouncing all over the place.

Q. What type of walls echo sound well?

Sound is good at getting through spaces or around corners so to absorb sound everything needs to be shut.

Q. How does sound compare to light in travelling around corners or through narrow holes?

Sound is better through large spaces

Of course even when everything is shut sound can travel through or be reflected. Fortunately many objects can absorb sound and not reflect much.

Q. Give some examples of good sound absorbers?

Q. What do they have in common?

Research

Acoustics is the study of sound waves. What acoustics is required for a good auditorium or concert hall?

Resonance

Because sound energy is transferred from one object or medium to another when it travels whole objects can vibrate. The shape and size of objects give them a certain vibration frequency where the movement is magnified and the sound amplified. It doesn't have to be sounds we hear but can be vibrations that are big enough to destroy the object.

Research

Can you find examples where sound resonance can destroy objects?

Do 9.5 Investigating Sound Motion C Sound Absorption