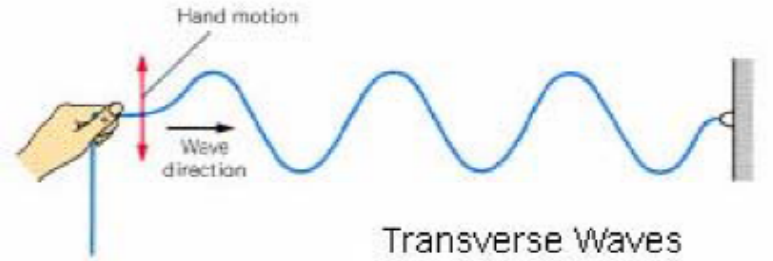
The Thomas Alleyne Academy

Knowledge Organiser - Sound waves

Science Department

Waves transfer energy from one place to another.
Waves are made by forcing something to vibrate or oscillate.
There are two types of waves; transverse and longitudinal.
Sound waves are longitudinal waves.
Light and waves on water are transverse waves.

If you throw a pebble into a pond, ripples spread out from where it went in. These ripples are waves travelling through the water. The waves move with a transverse motion. The undulations (up and down movement) are at 90° to the direction of travel.
For example, if you stand still in the sea, the water rises and falls as the waves move past you.
The diagram below shows a transverse wave.



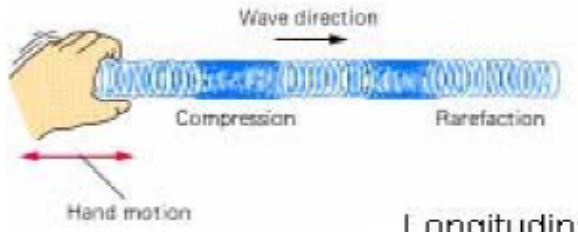
Transverse Waves

Sound travels faster through liquids and solids than it does through air and other gases. The table gives some examples.

Substance	Speed of sound
Air	343 m/s
Water	1493 m/s
Steel	5130 m/s

KPI 8PS 1: compare light, mechanical and sound waves

When an object or substance vibrates, it produces sound.
These sound waves can only travel through a solid, liquid or gas. They cannot travel through empty space.
Sound waves are longitudinal waves - the vibrations are in the same direction as the direction of travel.
The diagram below shows this.



Longitudinal Waves

Comparing Light and Sound waves

Similarities	Differences
• Both transfer energy • Both have a range of frequencies and wavelengths	• Travel as different type of wave • Sound waves need particles to carry energy but light waves do not • Different speeds – light travels up to a million times faster than sound

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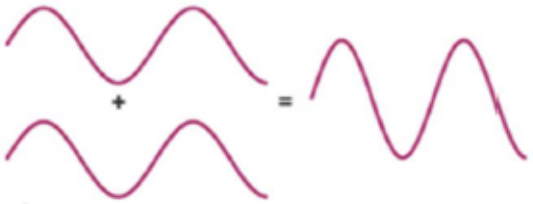
KPI 8PS 2: describe the process of reflection, absorption and superposition (add or cancel waves)

Sound waves can reflect off surfaces. We hear sound reflections as echoes. Hard, smooth surfaces are particularly good at reflecting sound. This is why empty rooms produce lots of echoes.
Soft, rough surfaces are good at absorbing sound. This is why rooms with carpets and curtains do not usually produce lots of echoes.

Where two waves meet, they affect each other. This is called superposition.

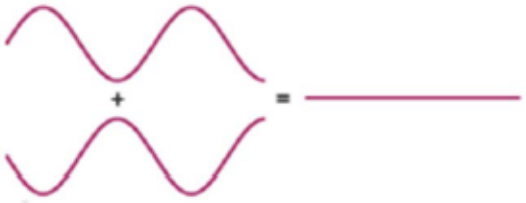
Adding

If two waves meet each other in step, they add together and reinforce each other. They produce a much higher wave, a wave with a greater amplitude.



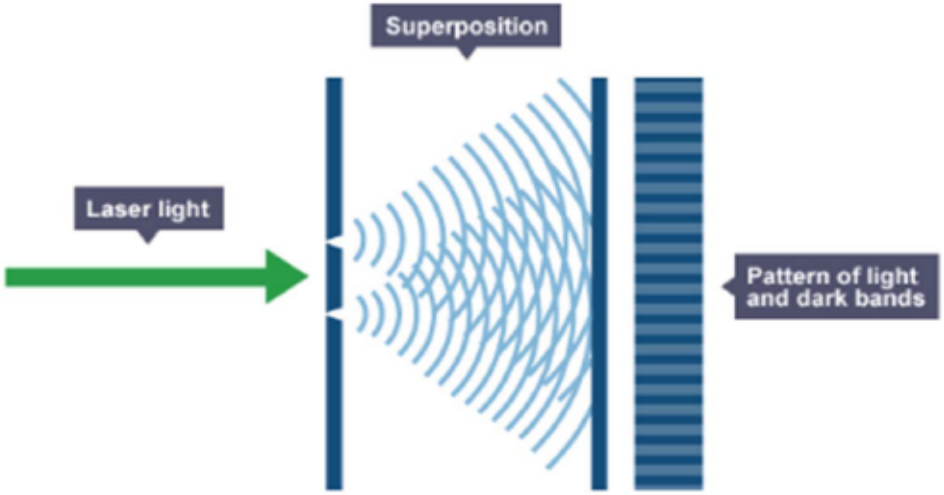
Cancelling

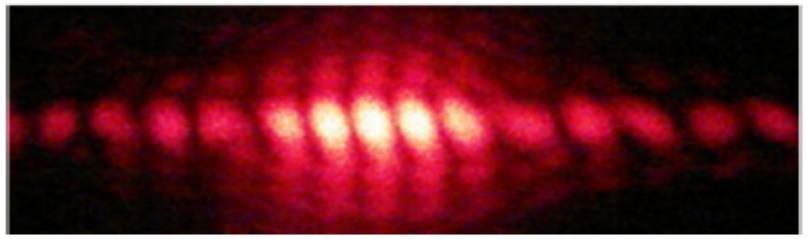
If two waves meet each other out of step, they cancel out.



Demonstrating superposition

We can see superposition using two different pieces of scientific equipment. A ripple tank is a tank full of water in which a vibrating needle produces a stream of ripples. We can watch superposition and reflection in the water waves.
A laser can also show superposition of light waves if it is shone through two narrow slits that are close together. A pattern of bright and dark banks is seen on a screen on the other side of the slits. The waves add together in the bright bands and cancel out in the dark bands.





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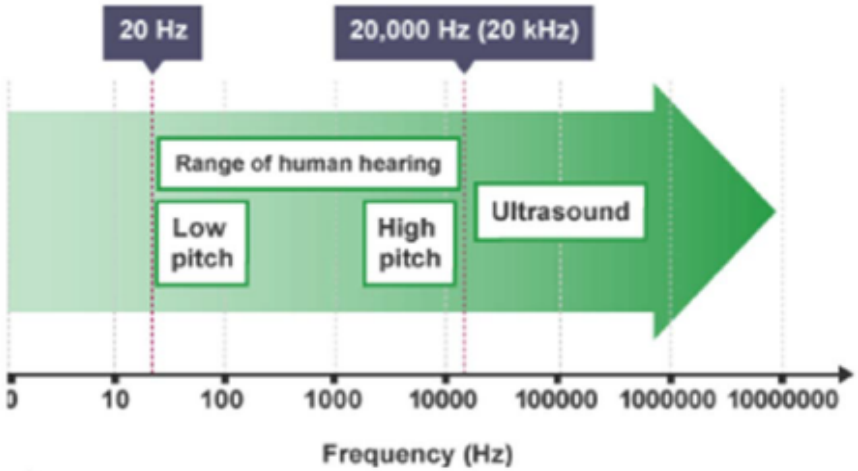
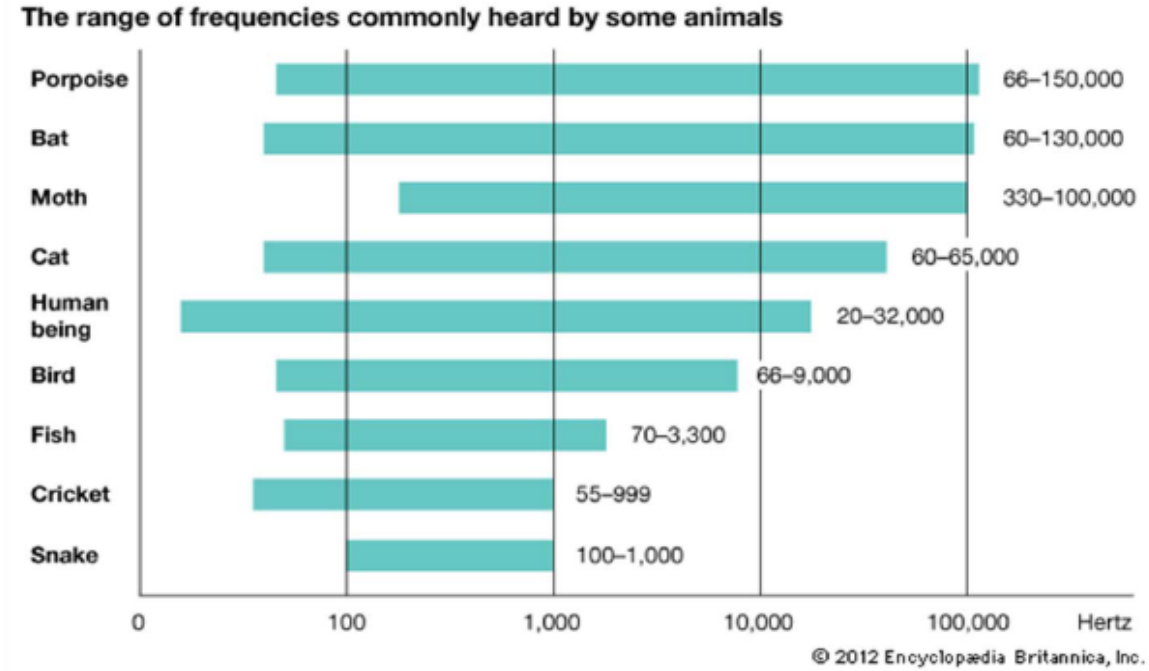
KPI 8PS 3: compare human and animal auditory ranges using appropriate units

The frequency of sound waves is measured in hertz, which has the symbol Hz. The bigger the number, the greater the frequency and the higher the pitch of the sound. Human beings can generally hear sounds as low as 20 Hz and as high as 20,000 Hz (20 kHz).





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KPI 8PS 4: describe uses of sound and ultrasound, including industrial and medical uses

Medical uses of Ultrasound

Sound with a frequency of more than 20,000 Hz is called ultrasound. It is too high pitched for humans to hear, but other animals (such as dogs, cats and bats) can hear ultrasound. Ultrasound has many applications in medicine, including ultrasound scans to check on the health of unborn babies.

An ultrasound image of an unborn baby

Ultrasound waves can also be used to break down deposits of calcium in your kidneys or gall bladder (kidney or gall stones) so they can be passed out of your body safely without an operation. They are also used for physiotherapy.

Industrial uses of Ultrasound

Ultrasound waves can be used in industry for:

- Detecting faults inside pieces of metal
- Cleaning jewellery
- Measure the purity of liquids
- Create a fine mist of water in a humidifier
- Ultrasonic welding for plastics

Loudspeakers

Sound waves are produced by all vibrating objects. Loudspeakers work by converting electrical energy into kinetic energy. This moves the cone which creates the sound waves.