(main sources:http://www.ducksters.com/science/sound102.php l
https://www.nidcd.nih.gov/health/noise-induced-hearing-loss)

What is sound?

Sound is a vibration, or wave, that travels through matter (solid, liquid, or gas) and can be heard.

The vibration is started by some mechanical movement, such as someone plucking a guitar string or knocking on a door. This causes a vibration on the molecules next to the mechanical event (i.e. where your hand hit the door when knocking). When these molecules vibrate, they in turn cause the molecules around them to vibrate. **The vibration will spread from molecule to molecule causing the sound to travel.** Just like the ripples in the water.

Sound must travel through matter because it needs the vibration of molecules to propagate. The matter that transports the sound is called the **medium**. Because outer space is a vacuum with no matter, it's very quiet.

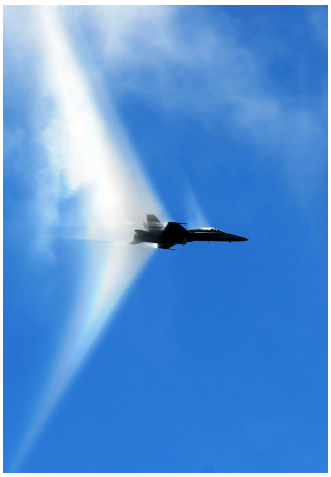
The speed of sound

The speed of sound is how fast the wave or vibrations pass through the medium. The type of medium (matter) has a large impact on the speed at which the sound will travel.

For example, **sound travels faster in water than air**. Sound travels even faster in steel.

1. In dry air, sound travels at 343 meters per second (768 mph). At this rate sound will travel one mile in around five seconds.
2. Sound travels 4 times faster in water (1,482 meters per second).
3. It is around 13 times faster through steel (4,512 meters per second).

What is the Sound Barrier?



When airplanes go faster than the speed of sound (also called **Mach** 1), it's called breaking the sound barrier. Most airplanes don't go this fast, but some fighter jets do. When they pass through the speed of sound, the airplane sheds water drops that have condensed on the plane creating a cool looking **white halo**. The white cloud is formed by decreased air pressure and temperature around the tail of the aircraft When planes break the sound barrier they also create something called a **sonic boom**. This is a loud noise like an explosion that is generated from a number of sound waves that are forced together as the plane is now traveling faster than sound.

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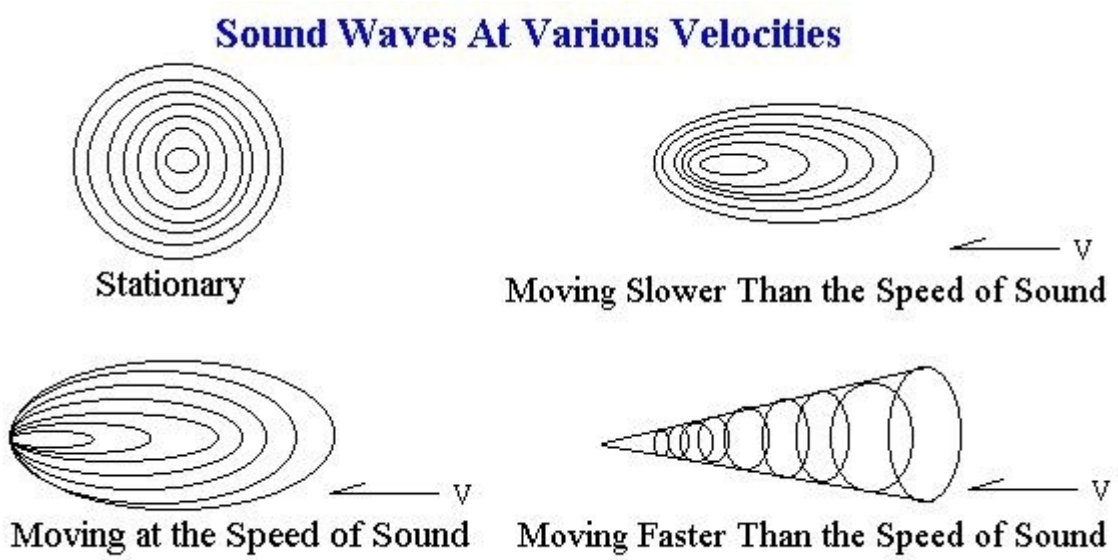

Volume

The volume of sound is the measure of loudness. To quantify volume we use decibels. The more **decibels**, the louder the sound is. A soft sound, like a whisper will measure around 15-20 decibels. A loud sound like a jet engine is more like 150 decibels. The **threshold of pain occurs at around 130 decibels**. Loud sound can actually damage your ears and cause loss of hearing. Even sounds as loud as 85 decibels can ruin your ears if you listen to them over a long period of time. For this reason, it's not a good idea to listen to loud music or have your headphones turned up too loud.

dBA	Example	Home & Yard Appliances	Workshop & Construction
0	healthy hearing threshold		
10	a pin dropping		
20	rustling leaves		
30	whisper		
40	babbling brook	computer	
50	light traffic	refrigerator	
60	conversational speech	air conditioner	
70	shower	dishwasher	
75	toilet flushing	vacuum cleaner	
80	alarm clock	garbage disposal	
85	passing diesel truck	snow blower	
90	squeeze toy	lawn mower	arc welder
95	inside subway car	food processor	belt sander
100	motorcycle (riding)		handheld drill
105	sporting event		table saw
110	rock band		jackhammer
115	emergency vehicle siren		riveter
120	thunderclap		oxygen torch
125	balloon popping		
130	peak stadium crowd noise		
135	air raid siren		
140	jet engine at takeoff		
145	firecracker		
150	fighter jet launch		
155	cap gun		
160	shotgun		
165	.357 magnum revolver		
170	safety airbag		
175	howitzer cannon		
180	rocket launch		
...			
194	sound waves become shock waves		

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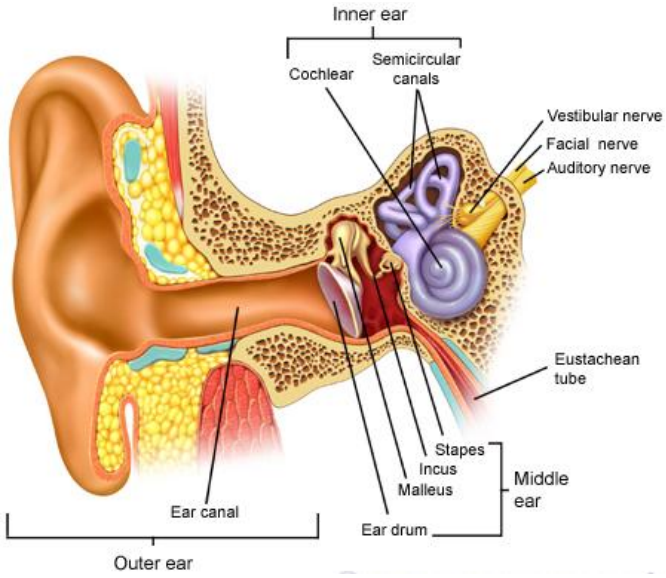
How can noise damage our hearing?

To understand how loud noises can damage our hearing, we have to understand how we hear. **Hearing depends on a series of events that change sound waves in the air into electrical signals.** Our auditory nerve then carries these signals to the brain through a complex series of steps.

1.**Sound waves** enter the outer ear and travel through a narrow passageway called the **ear canal,** which leads to the **eardrum**.



2.The eardrum vibrates from the incoming sound waves and sends these vibrations to **three tiny bones in the middle ear**. These bones are called the malleus, incus, and stapes.

3.The bones in the middle ear couple the sound vibrations from the air to **fluid vibrations** in the **cochlea of the inner ear**, which is shaped like a snail and filled with fluid.
An **elastic partition** runs from the beginning to the end of the cochlea, splitting it into an **upper and lower part**. This partition is called the **basilar membrane** because it serves as the base, or ground floor, on which key hearing structures sit.

4.Once the vibrations cause the fluid inside the cochlea to ripple, a traveling wave forms along the basilar membrane. **Hair cells**—sensory cells sitting on top of the basilar membrane—ride the wave.

5.As the hair cells move up and down, **microscopic hair-like projections** (known as **stereocilia**) that perch on top of the hair cells bump against an overlying structure and bend. Bending causes pore-like channels, which are at the tips of the stereocilia, to open up. **When that happens, chemicals rush into the cell, creating an electrical signal!!**

6.The auditory nerve carries this electrical signal to the brain, which translates it into a sound that we recognize and understand.

Most NIHL is caused by the damage and eventual death of these hair cells. Unlike bird and amphibian hair cells, human hair cells don't grow back. They are gone for good.