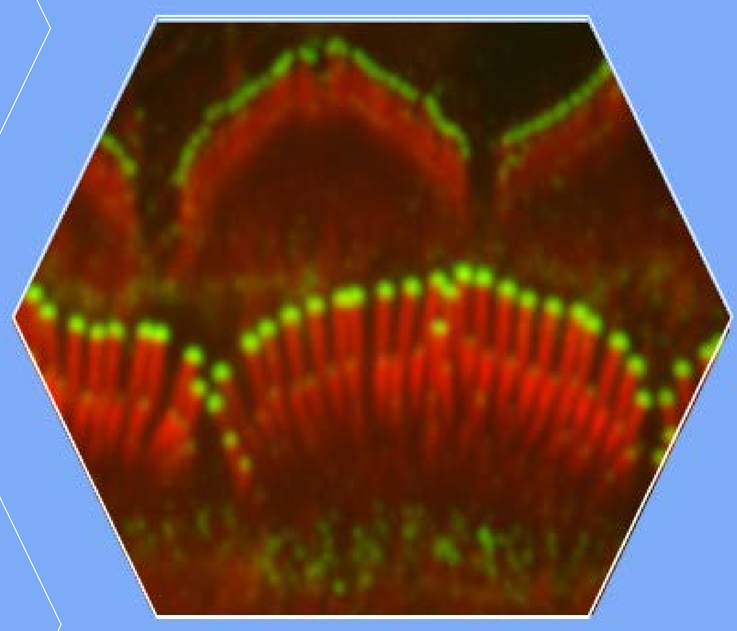
The University Of Sheffield.
Neuroscience Institute.

Sheffield NeuroScience



HEARING AND HEARING LOSS

MRC Medical Research Council

BBSRC

ACTION ON HEARING LOSS

wellcome

What is sound?

Sound is a form of mechanical vibration that travels through air, liquids and solids. The sound of leaves rustling in the breeze and the roar of a jet engine travelling through the air at about 760 miles per hour. Sound travels faster and more effectively in water, which allows whales to sing to each other across oceans. Sound travels even faster through solid materials like railway tracks.

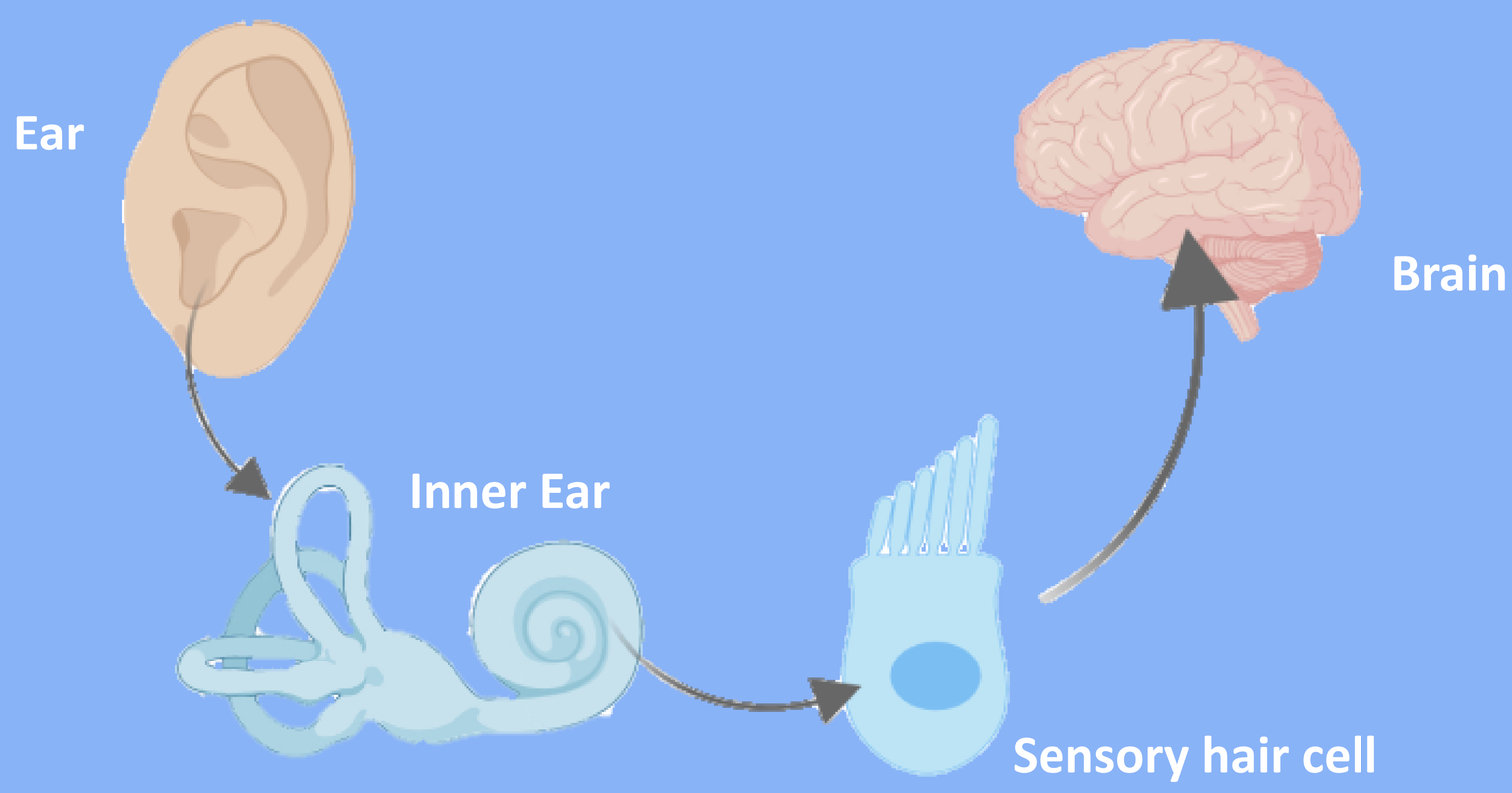
Why do we need to hear?

Language is a defining feature of human culture and the ear is best adapted for receiving human speech. Our brain uses the different positions and asymmetric shapes of our two outer ears to create 3D maps of the soundscape around us and we integrate this with our other senses to provide information about the pleasures (e.g. music) and dangers of the external world. The social isolation caused by hearing loss can be a deeply distressing human experience.

How do we hear?

The sound of a name travels inside the ears to a coiled structure in the inner ear called the cochlea, where sensory cells can detect incoming vibrations of less than a millionth of a millimetre. The cells convert these vibrations into tiny electrical signals a billion times smaller than those used to charge, for example, a mobile phone. These tiny electrical signals are perceived by the brain as loudness, pitch and a host of other features that enable it to reconstruct the name and to place it amongst all the memories associated with that name. This analysis is so complex that more of the brain is devoted to the sense of hearing than to any other sensory system.

Modified from "Metro London, 2010" by Prof W. Marcotti



What is hearing loss?

Hearing loss is when you are partially or completely unable to hear sound in one or both of your ears.

Facts about hearing

- In the UK there are 11 million people with hearing loss.
- 50,000 of those are children.
- 40% of people over the age of 50 have hearing loss.
- 71% of people over the age of 70 have hearing loss.
- It is estimated that by 2035 there will be around 15.6 million people with hearing loss across the UK – that is one in five.

Hearing loss in children:

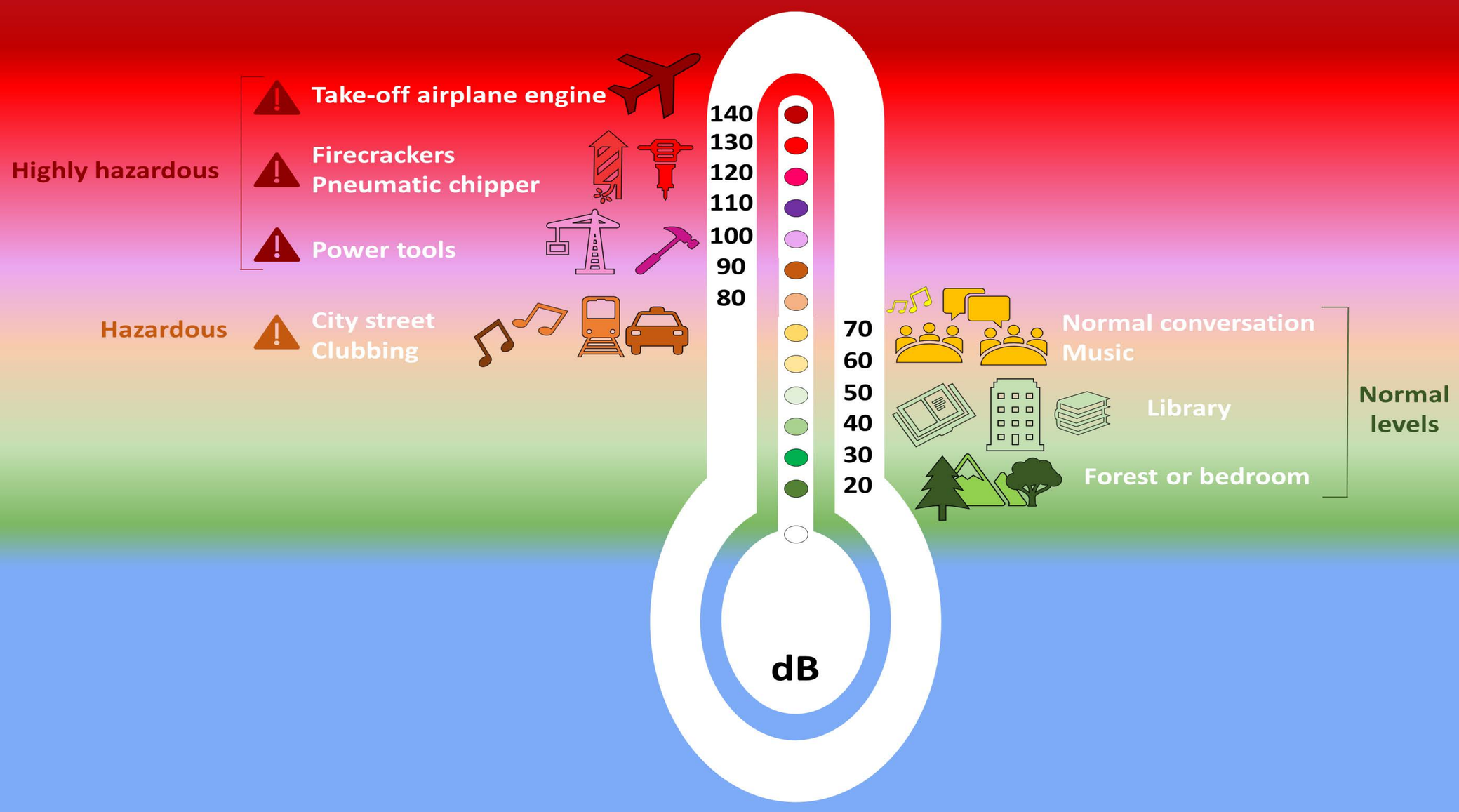
- Children experience difficulties in learning and talking.
- They will often ask you to repeat yourself.
- They do not answer when being called.
- They may often talk very loudly.

Hearing loss in adults:

- Adults can find it hard to follow a conversation in noisy places or on the phone.
- They will also ask people to repeat themselves multiple times.

Types of hearing loss

- **Genetic-induced hearing loss:** caused by mutations or deletion of genes.
- **Noise-induced hearing loss - c**aused by repeated exposure to loud sound. This occurs because the sensitive hair cells inside the cochlea become damaged.
- **Ototoxic drug associated hearing loss -** caused by, for example, aminoglycoside antibiotics and some anti-cancer drugs.
- **Age-related hearing loss -** develops as a result of getting older.



Further information regarding support and care can be found at:

- **Action on Hearing Loss:** https://www.actiononhearingloss.org.uk
- **British Tinnitus Association:** https://www.tinnitus.org.uk/

How is hearing loss treated?

Currently, the only therapeutic options to ameliorate hearing loss are hearing aids and cochlear implants. While beneficial, they are unable to restore important features of hearing such as the ability to appreciate music and to understand speech in a noisy environment.

What can you do?

Hearing damage is irreversible, but you can help prevent the damage by:

- Avoiding repeated exposure to very loud noise
- Wearing headphones for short periods of time
- Don’t stay too close to speakers
- Wearing earplugs when exposed to loud noise
- Identifying the early signs and symptoms

What the research group at Sheffield does

Our perception of the outside world is regulated by our senses, which is the reason why human health and well-being are closely dependent on correct sensory function. At the University of Sheffield, the Hearing Research Group works together on several interrelated projects aimed at discovering how sound is processed by our ear and perceived by the brain. We also use this basic-discovery research to develop methods to create diagnostic tools and therapeutic interventions to prevent or cure the different forms of hearing loss and deafness.

The Hearing Research Group at the University of Sheffield

Prof. Walter Marcotti

In the Marcotti lab, we use mammalian and zebrafish models to elucidate how the auditory system develops and functions. Our research is also aimed at understanding the cause of deafness and age-related hearing loss in order to develop therapeutic approaches to restore hearing.

Prof. Tanya Whitfield

In the Whitfield lab, we use the zebrafish as a model system to understand how the inner ear develops in the embryo. Our current research focusses on the vestibular system, which acts as a motion sensor to help an organism maintain balance and posture.

Prof. Marcelo Rivolta

In the Rivolta lab, we are using stem cells to replace those that connect the ear with the brain. We are also exploring their potential use together with cochlear implants. This is because sensory cells in our ears are meant to last a lifetime; when they are lost we become permanently deaf.

Dr. Mirna Mustapha

In the Mustapha lab, we are investigating how loud noise and aging affect the survival of the nerve fibres that connect the ear with the brain. Understanding why these nerve fibres become vulnerable will help us to develop a strategy to prevent hearing loss.

Dr. Stuart Johnson

In the Johnson lab, we investigate how sound information in the ear is encoded and send to the brain in order to have an exact representation of the auditory world around us. We are also interested in understanding the regenerative potential of the mammalian auditory organ.

Dr. Marta Milo

In the Milo lab, we combine mathematics and basic biology to identify the mechanisms leading to deafness and different forms of hearing loss such as those occurring during ageing. The tools we develop help to define new lines of investigation in preventing and ameliorating deafness.

Dr. Anton Nikolaev

In the Nikolaev lab, we are interested in understanding how auditory and visual information from the outside world are combined and compared in the brain to allow animals to perform day-to-day tasks, such as localisation of moving objects and social interaction.

Dr. Laura Corns

In the Corns lab, we want to understand how nerves from the brain communicate with sensory cells within the ear and how this communication changes with age. Our overall aim is to determine whether this communication can be manipulated to protect our ears from age-related hearing loss.

Your ears pick up the sound, but the brain interprets it.

A new-born baby's hearing responds best to high pitch noises.

10-15% of adults hear a high pitched ringing all the time, which is a condition called tinnitus.

Your ears never stop growing.

The inner ear is able to detect movements the size of one atom.

Hearing loss has been linked to ear infections and tinnitus.

The faintest sound we can hear corresponds to a pressure of 20 μPa, which is around 10 million times less than the pressure produced by a penny coin resting on your finger tip.

The smallest bone in the entire human body is situated in the ear and it measures 2.6 millimetres.

Further information can be found at:

https://www.sheffield.ac.uk/hearing

For donations towards research aimed at curing Deafness, Age- related hearing loss and Balance disorders see:

https://www.sheffield.ac.uk/donate