How does the ear process sound?

The outer ear and the ear canal constitute the outer ear which funnels sound to the ear drum. The middle ear begins at the ear drum (tympanic membrane). In the middle ear, three small bones called the hammer, the anvil, and the stirrup help to transmit and amplify the vibrations generated by the sound, such that it travels through the middle ear to the inner ear. The inner ear, besides having the functions that relate to the perception of sound, is also responsible for the perception of balance/orientation and acceleration.

Our greater concern in this article is specifically that unwanted sound that we call “noise.” The inner ear has a snail-like object called the cochlea, that is filled with fluid and lined by cells with very fine hairs. This sequence of sensitive cells is somewhat like the keys of a piano. In the inner ear, one end of the sensitive cells in the cochlea discerns high frequency sounds and the other end discerns low frequency sounds, with a continuous spectrum in between the two.

How do you measure noise?

Sound can be measured scientifically in terms of intensity, but also specifically related to particular frequency bands. Pitch or frequency is measured in cycles per second, or Hertz (Hz). The higher the pitch of sound, the higher the frequency. It is reported that in young children, even frequencies as low as 20Hz and up to 1000 times greater, as in a dog whistle, can be detected.

Sound intensity is measured in decibels (dB). By definition, the faintest level of hearing detected by the human ear is set at zero decibels (though some people can hear levels lower than this).

Potential for industrial hearing loss

Workers at special risk of hearing damage (industrial deafness) are usually those in heavy productive industry, such as metal work, drilling and quarrying, stone cutting, or the use of noisy machinery, as in textiles, printing, wood cutting, transportation, and agriculture. Noises above 90 dB, as measured with special instruments that are electronically weighted to mimic loudness functions of the human ear, are likely to cause damage to a proportion of the exposed population with continued exposure. Very high levels may cause damage after relatively short periods, even when the noise is intermittent. This may be illustrated by the frequent finding of hearing loss in people who have fired guns as an occasional hobby, as well as in people who are exposed to noise of lower levels but more constantly, such as those working on construction sites or in other industrial locations such as mines.

The harmful effects of noise are cumulative and not, of course, confined to the workplace. The use of personal iPods and frequenting of clubs has resulted in young people having some early damage to hearing before they even start work.

How does noise damage the ear? What is NIHL?

The answer to this is not completely known. However, we do know that the damage is caused to the sensitive cells in the cochlea. For reasons which are not entirely clear, some of the cells part of the way along the sensory organ in the cochlea are more sensitive than others. Hence, noise-induced hearing loss (NIHL) will begin to affect hearing of certain frequencies. This results in a ‘dip’ in an audiogram predominately in the high frequencies.
The effects of hearing loss

The first symptom of noise-induced hearing loss is usually difficulty hearing a conversation against a noisy background. The sufferer comes to avoid parties where everyone is apparently chattering away happily, yet he or she hears just a jumble of noise. Consonants seem to be lost first. Often he or she will mention intermittent high-pitched ringing in the ears, though this is rarely sufficient to be more than an irritant. By the time these symptoms have become sufficient to prompt a medical consultation, the damage as measured by audiometry will be severe, and even with cessation of noise exposure, progressive hearing loss can continue.

How can NIHL be prevented?

The following measures can and should be taken: Assessment of exposure, using tools and equipment which generate a lower level of noise, segregation and insulation, appropriate work practices and personal protection, such as ear muffs and ear plugs. Additionally, steps should be taken to protect workers from noise.

The most reasonable way to protect the ears is to generate less noise in the first place, by better design of machinery and equipment.

Secondly, steps should be taken to insulate the machinery to reduce the noise that it emits and to segregate people from it.

People should work in areas where they are not exposed to high levels of noise. The same goes for leisure activities.

At a personal level, it is possible to protect the ears with ear muffs and/or ear plugs. If you must work in an excessively noisy environment, you should wear protectors.

Hearing protection may attenuate noise by between 15 and 30 dBA. As with all personal protection, this is the last line in protection. Appropriate low noise machinery/processes must be in place, then followed by insulation and segregation to attenuate the workers’ exposure to noise.

Research:

Raymond Agius 2006
“Noise-Induced Hearing Loss; Scientific Advances”:
Colleen G. Le Prell (Editor), Donald Henderson (Editor)
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“Medical-Legal Evaluation of Hearing Loss”:
Robert A Dobie (author)

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This article was written by one of GENEX’s CHOICE Network Providers.