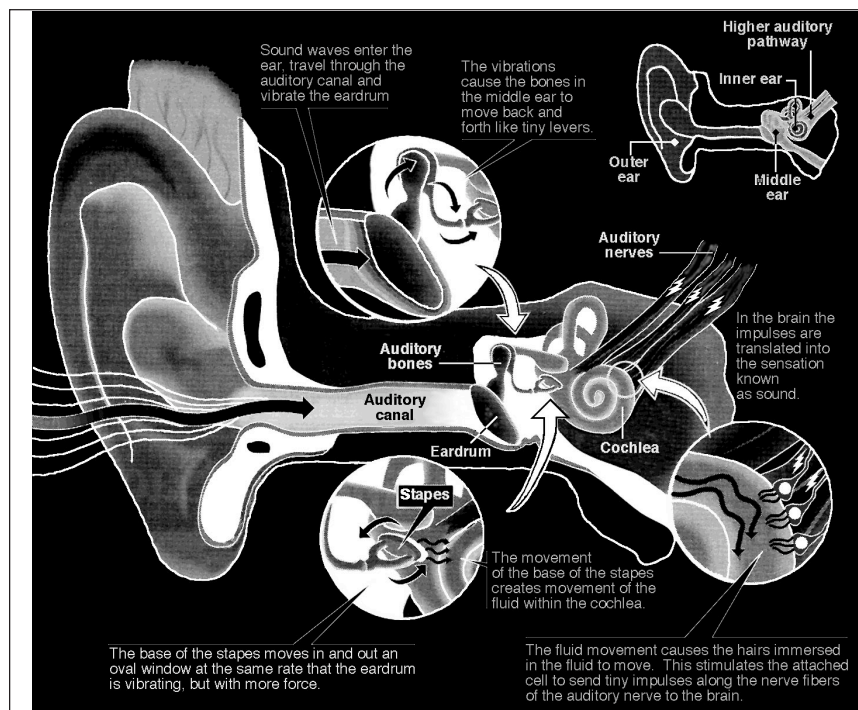


### 3 HOW YOU HEAR

The system by which the ear converts the energy in a sound wave into electrical signals to the brain is enormously complex. With the possible exception of the brain, the ear may be the most complicated, least understood organ in the body.

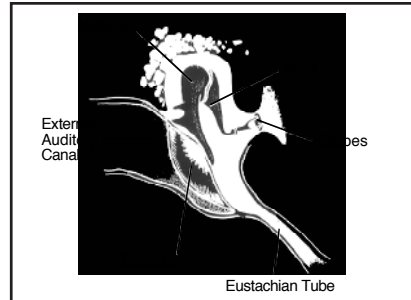


The hearing system can be considered to consist of at least four functional areas: the outer ear, the middle ear, the inner ear, and the higher auditory pathways.

The **outer ear** collects and channels sound waves from the air through the **external auditory canal**. It ends at the tightly stretched **eardrum** (tympanic membrane) where the signal is changed from a sound wave into a mechanical vibration.

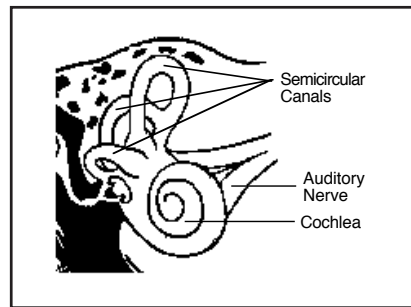


The vibrations of the eardrum are transferred through the **middle ear** by three tiny, connected bones (ossicles) called the **malleus**, **incus**, and **stapes**. The vibrations from the relatively large eardrum surface are directed to a much smaller opening into the inner ear, with these bones acting as levers to provide the necessary energy to move the fluid in the next stage.

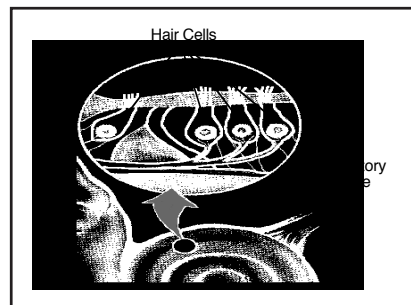


3

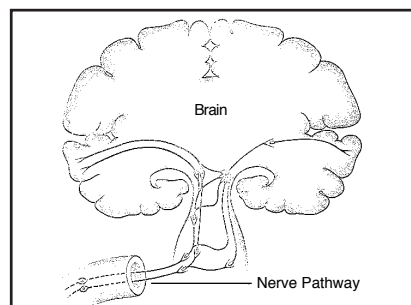
The **inner ear** consists of two parts; the *hearing mechanism* and the *balance mechanism*. The **cochlea** (snail-shaped structure) is involved with hearing and the **semicircular canals** are involved with balance and motion.



The **cochlea** of the hearing mechanism contains thousands of tiny specialized cells, each of which holds many microscopic hairs. These hairs are immersed in fluid which fills the cochlea. Movement of the fluid within the cochlea causes the hairs immersed in the fluid to move, which in turn, stimulates the attached cell to send a tiny electrical impulse along with fibers of the auditory nerve to the brain.

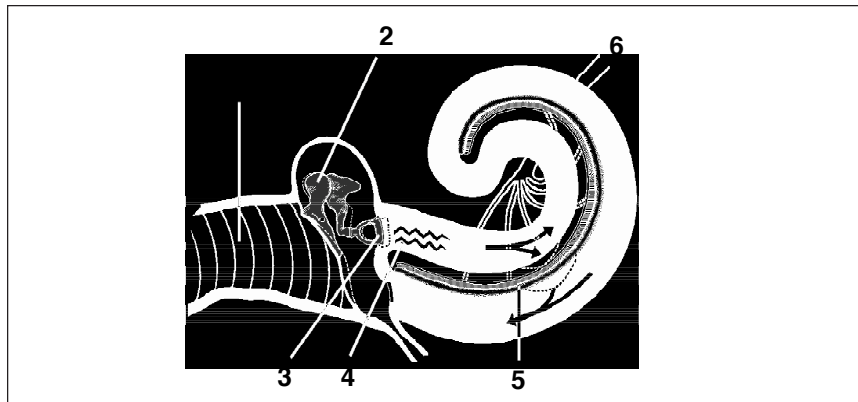


**Beyond the inner ear the system becomes more complex.** The nerve pathways lead from the hearing and balance mechanism to the lower area of the brain.



From there some of the nerve tracks cross from one side of the head to the other several times; others follow a more direct route to the higher brain centers. Signals from the auditory nerve are transmitted to nerve fibers within the central auditory system. Here the signals are compared, correlated, and further analyzed to provide a complex flow of neural information to the hearing centers of the brain.

**When it reaches the brain the impulse is translated into the sensation known as sound.** In each auditory area of the brain we receive impulses from both right and left ears. These auditory centers further extract information and stimulate other brain centers to give rise to the perception and recognition of the signal we call speech.



## How You Hear

1. Sound waves enter the ear, travel through the auditory canal, and vibrate the eardrum.
2. The vibrations of the eardrum cause the bones in the middle ear to move back and forth like tiny levers. This action changes the comparatively large vibrations of the eardrum into smaller, but more forceful stapes movement.
3. The base of the stapes moves in and out of an opening (oval window) at the same rate that the eardrum is vibrating, but with more force.
4. The movement of the base of the stapes creates movement of the fluid within the cochlea.
5. The fluid movement causes the hairs immersed in the fluid to move. This, in turn, stimulates the attached cell to send tiny impulses along the nerve fibers of the auditory nerve to the brain.
6. In the brain the impulses are translated into the sensation known as **sound**.