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The Human Ear: Transduction of Sound waves into Nerve impulses

The mechanical process by which sound waves are received & perceived is a fascinating real-time look into how we are fundamentally and ceaselessly connected with our three-dimensional environment via the realm of the five senses, and how we interface this information to produce, enhance, or alter different states of consciousness. This process begins as sound waves move through the air and interact with the canal of the outer ear. The canal channels the sound waves, and due to its length of roughly two centimeters, it is capable of amplifying sounds approximating the frequency of 3000Hz. As sound travels through this canal, it is in the form of a wave with alternating patterns of high and low pressure regions, and then as it meets the eardrum, it is converted into the vibrations of the inner bone structure.

The middle ear is made up of the eardrum, and three bones known as the hammer, the anvil, and the stirrup. The eardrum is a tough and tightly-stretched membrane that vibrates at the same frequency of incoming pressure waves, and this vibration then affects the three bones the make up the rest of the middle ear and act as levers to amplify the sound. The physical displacements of the stirrup are greater than that of the hammer or anvil and as a result, the pressure waves are concentrated into the stirrup by the eardrum which increases our ability to hear very faint sounds. The middle ear is also connected to the mouth by the Eustachian tube which helps to equalize pressure in the head, when this pressure is offset, it can lead to earaches or headaches. Toning by association can be a useful tool to normalize the pressure, when used mindfully.

The inner ear consists of the cochlea, the semicircular canals, and the auditory nerve. The cochlea and the semicircular canals are filled with a water-like fluid, this fluid and the nerve cells of the canals serve as accelerometers to keep balance and detect accelerated movements. The stirrup of the middle ear is also connected to the inner ear, and through its vibrations creates a compression wave in the fluid of the semicircular canals and the cochlea. The cochlea is shaped in a golden-mean spiral that if uncurled, would stretch to approximately three centimeters. The inner surface of the cochlea is covered in 20,000 nerve cells resembling hairs that serve one of the most critical and intriguing aspects of our perception of sound. These "nerve-hairs" differ slightly in length and resilience to the fluid that passes over them. As a compression wave moves through the cochlea, the hair cells are set in motion. Each cell has a natural sensitivity to a specific frequency of vibration, when the frequency of a sound wave matches this, the nerve cell will resonate with higher amplitude. This increased amplitude causes the cell to release an electrical impulse across the auditory nerve to be interpreted by the brain, which then influences the physiological responses to the incoming stimuli. How this stimulus is interpreted by the brain in a material sense is still being studied. However, as an aspect of the human condition, we are inherently blessed with the opportunity to use our consciousness to work with this process of transduction. Through brainwave entrainment and meditation, we can begin to become more intimately connected with how we as individuals process and integrate sensory data, and by association interpret it into our own consciousness at large. This, by nature, then results in a cohesive higher awareness of self and relation to environment to the varying degrees of introspection and honesty.