

Ear anatomy

Overview: The ear converts sound vibrations into a neural signal that gets sent to the brain. Vibrations enter the ear and are amplified by the eardrum and tiny bones called ossicles (hammer, anvil, and stirrup). The stirrup passes these vibrations to the cochlea. The cochlea is filled with fluid and tiny hairs. Different vibration frequencies move different hairs. The movement of these hairs is converted to a nerve signal that travels to the brain.

pinna - (auricle) the visible part of the outer ear. It collects sound and directs it into the outer ear canal

outer ear canal - the tube through which sound travels to the eardrum.

eardrum - (tympanic membrane) a thin membrane that vibrates when sound waves reach it.

hammer - (malleus) a tiny bone that passes vibrations from the eardrum to the anvil.

anvil - (incus) a tiny bone that passes vibrations from the hammer to the stirrup.

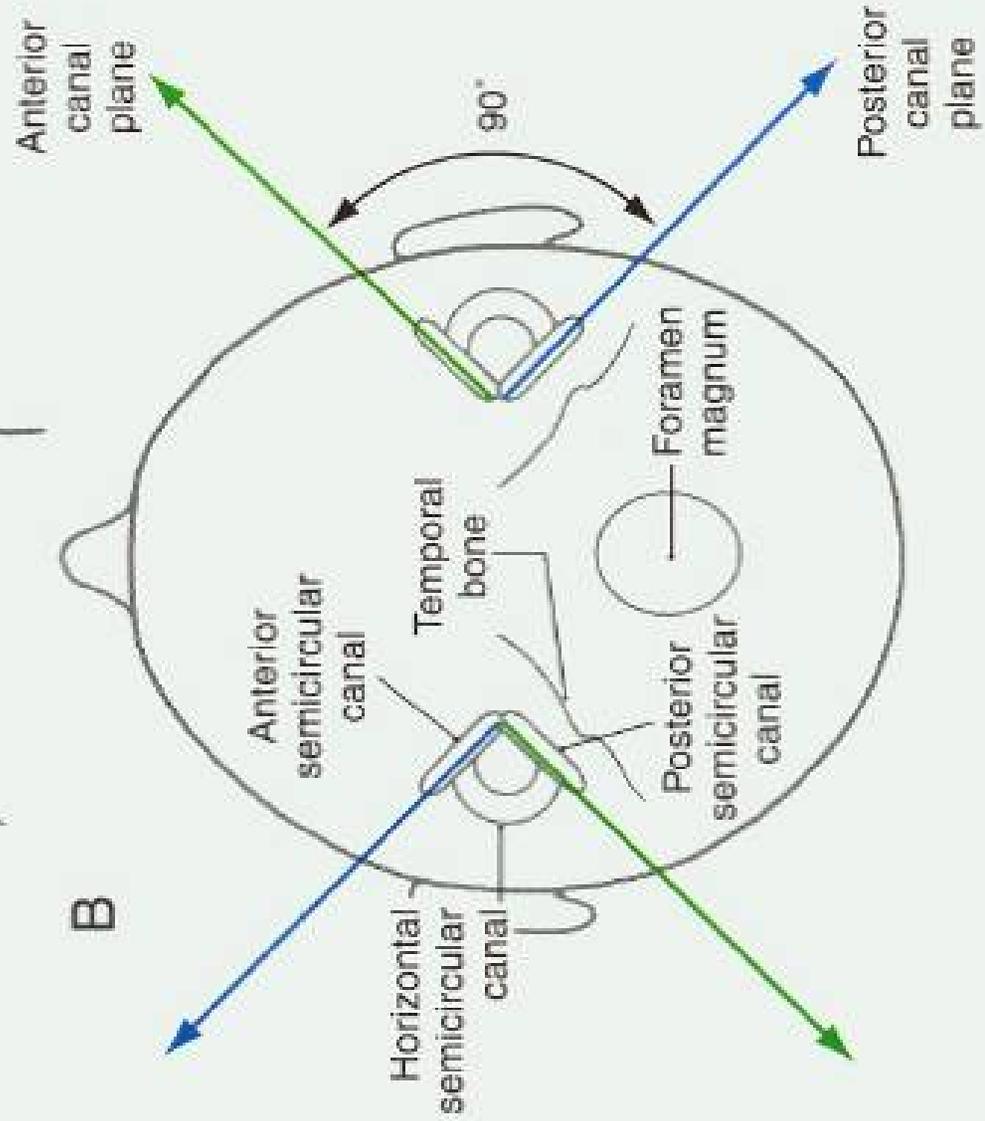
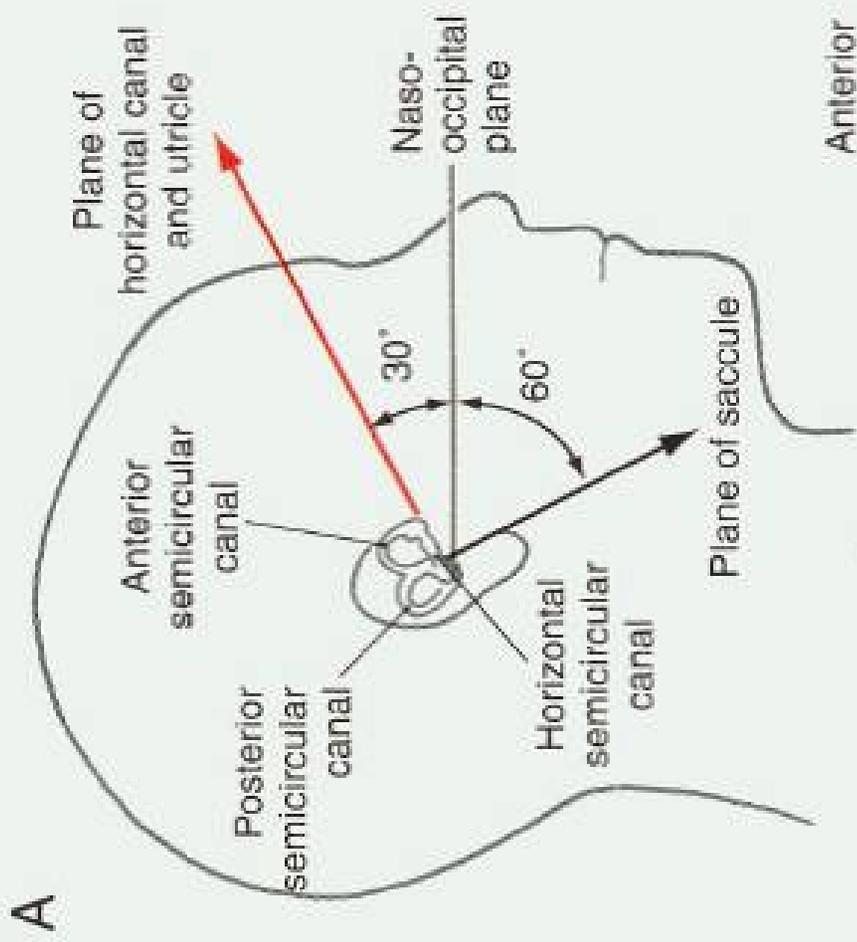
stirrup - (stapes) a tiny, U-shaped bone that passes vibrations from the stirrup to the cochlea. This is the smallest bone in the human body (it is 0.25 to 0.33 cm long).

cochlea - a spiral-shaped, fluid-filled inner ear structure; it is lined with cilia (tiny hairs) that move when vibrated and cause a nerve impulse to form.

nerves - these carry electro-chemical signals from the inner ear (the cochlea) to the brain.

semicircular canals - three loops of fluid-filled tubes that are attached to the cochlea in the inner ear. They help us maintain our sense of balance.

Eustachian tube - a tube that connects the middle ear to the back of the nose; it equalizes the pressure between the middle ear and the air outside. When you "pop" your ears as you change altitude (going up a mountain or in an airplane), you are equalizing the air pressure in your middle ear.



Vestibular system

Overview: Humans have the ability to control posture and bodily movements. Balance relies on signals coming from different places in the body, such as your eyes, cerebellum, muscles and joints, and the vestibular system in the ear.

The semicircular canals (horizontal, anterior, and posterior) are sensitive to head rotations. The otolith organs (utricle and saccule) are sensitive to forward movements and to the orientation of the head relative to gravity.

Each semicircular canal and otolith organ is spatially aligned to be most sensitive to movements in specific planes in three-dimensional space.

Most vestibular activity happens without your awareness. However, in situations that produce conflicting information, such as a bumpy airplane ride, unusual or novel vestibular stimulation may cause you to become aware of vestibular perception and experience dizziness, vertigo, or nausea. (In the plane, your eyes tell your brain that you are sitting still, but your vestibular system tells your brain that you are moving).

Activity:

Two Ears are Better Than One: Sound Localization

Materials: tape

Directions: To show the importance of two ears, try this out. Make an X on the floor with tape. Mark other places on the floor in a circle around this X, at distances that range between 5 and 15 feet.

Place a participant with their eyes closed on the X and have them plug one of their ears. Now, you stand on one of the other locations marked on the floor. Say the subject's name or clap once. Without opening their eyes, the subject must now point to where you are standing.

Try it when the subject uses one and both ears. Make it harder with shorter distances from the X. Are 2 ears better than one in judging distance? Why do we have 2 eyes and 2 nostrils?

For most people, it will be easier to judge distance using two ears. Our brains use the loudness of sounds and the differences in time for sounds to reach each ear to make accurate determinations of sound locations.