Auditory Transduction Script

00:00 [Sounds of orchestra tuning.]
00:25 [Conducting tapping baton.]

00:29
The sense of hearing is accomplished by a process known as auditory transduction. The ear converts sound waves in the air into electrical impulses, which can be interpreted by the brain.
00:41
As sound enters the ear, it passes through the external auditory canal, where it meets the tympanic membrane.
00:51
The tympanic membrane then vibrates in response to the sound.
00:56 [Music.]
01:00
Sounds of a lower pitch, or *frequency*, produce a slower rate of vibration,
01:06 [low frequency sound]
and sound of lower volume, or *amplitude*, produce a less dramatic vibration.
01:11 [quieter sound]
Higher frequency sounds produce faster vibrations.
01:16 [high-frequency sound]

01:18
The tympanic membrane is cone shaped, and articulates with a chain of three bones, called the *auditory ossicles*. They consist of the *malleus*, the *incus*, and the *stapes*.
01:35 [background music]
The movements of the tympanic membrane vibrate the ossicles, passing on the information of frequency and amplitude.

01:44
The three bones pivot together on an axis shown here in red.
01:55
The pivotal axis is due to a series of ligaments which hold the bones in place within the middle ear cavity.
02:02
The *anterior malleal ligament*, and the *posterior incudal ligament*, are of particular importance for the pivotal axis. Two structures which normally obscure this view of the middle ear have been removed.
02:17
They are the *chordae tympani nerve*,
02:22
and the tendon of the *tensor tympani muscle*. Through the ossicles, the vibrations of the tympanic membrane are transferred to the footplate of the stapes.
02:31 [music]
[02:39] The stapes moves with a piston-like action, which sends vibrations into a structure called the *bony labyrinth*. [02:51] The labyrinth is filled with a fluid called

perilymph. If it were a completely closed and inflexible system, the movement of the stapes would be unable to displace the perilymph, and therefore unable to send vibrations into the bony structure.

[03:08] Due to the flexibility of a membrane called the *round window*, [03:11] the stapes movement can displace the perilymph, allowing vibrations to enter the labyrinth.
[03:18 music]
[03:25] The corridor leading to the round window is found within the spiral portion of the bony labyrinth known as the *cochlea*. Vibrations produced by the stapes are drawn into the spiral system [03:36], and return to meet the round window [03:41].
[03:46] The portion of the spiral passage in which vibrations ascend to the apex of the cochlea is called the *scala vestibuli*. [03:55] The descending portion of the passage is called the *scala tympani*.
[04:00] A third structure, called the *cochlear duct*, is situated between the scala vestibuli and the scala tympani. [04:09] The cochlear duct is filled with a fluid called *endolymph*, and when viewed in cross-section, the membranes separating the two fluid filled systems are visible. They are [04:20] *Reissner's membrane*, and the [04:22] *basilar membrane*.
[04:24] The membranes are flexible, and move in response to the vibrations traveling up the scala vestibuli [04:30]. The movements of the membranes then send vibrations back down to the scala tympani [04:38].
[04:42] A specialized structure, called the organ of Corti, is situated on the basilar membrane. As the basilar membrane vibrates, the organ of Corti is stimulated [04:51], which sends nerve impulses to the brain via the *cochlear nerve*.
[04:56] The actual nerve impulses are generated by specialized cells within the organ of Corti called *hair cells* [05:03]. The hair cells are closely covered by a structure called the *tectorial membrane* [05:10]. As the basilar membrane vibrates, the tiny clusters of hairs are bent against the tectorial membrane [05:18], triggering the hair cells to fire.
[05:28] The entire basilar membrane does not vibrate simultaneously. Instead, specific areas along the basilar membrane move variably in response to different frequencies of sound. [05:40] Lower frequencies vibrate the basilar membrane closer to the apex of the cochlea, [05:45] whereas higher frequencies produce vibrations closer to the base.
[05:51] This arrangement is known as *tonotopic organization*. [05:53 music with high and low frequency segments alternating]
[06:02] Together, this sequence of events is responsible for our acoustic perception of the world around us. [06:09 to END, music]