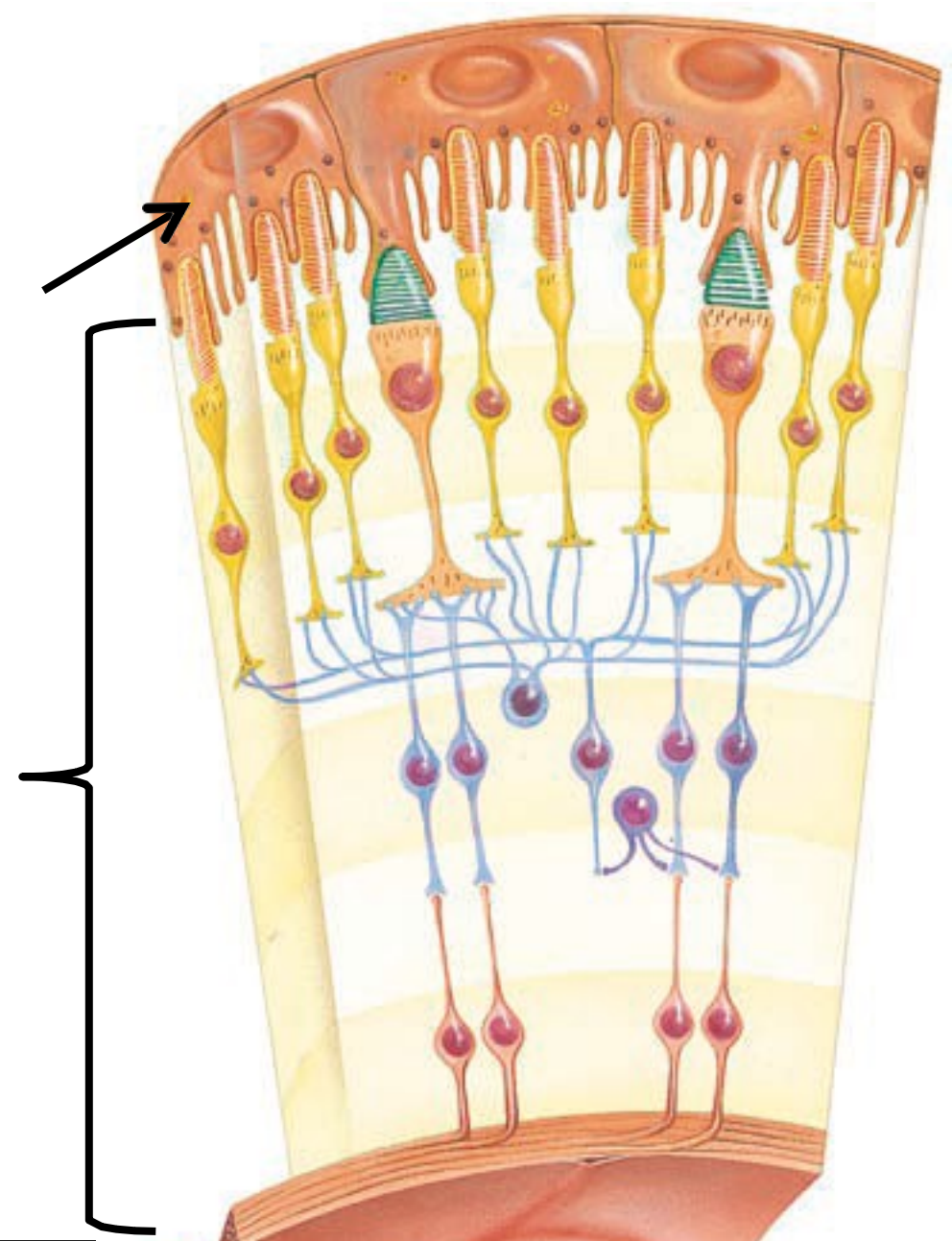


3. The Retina

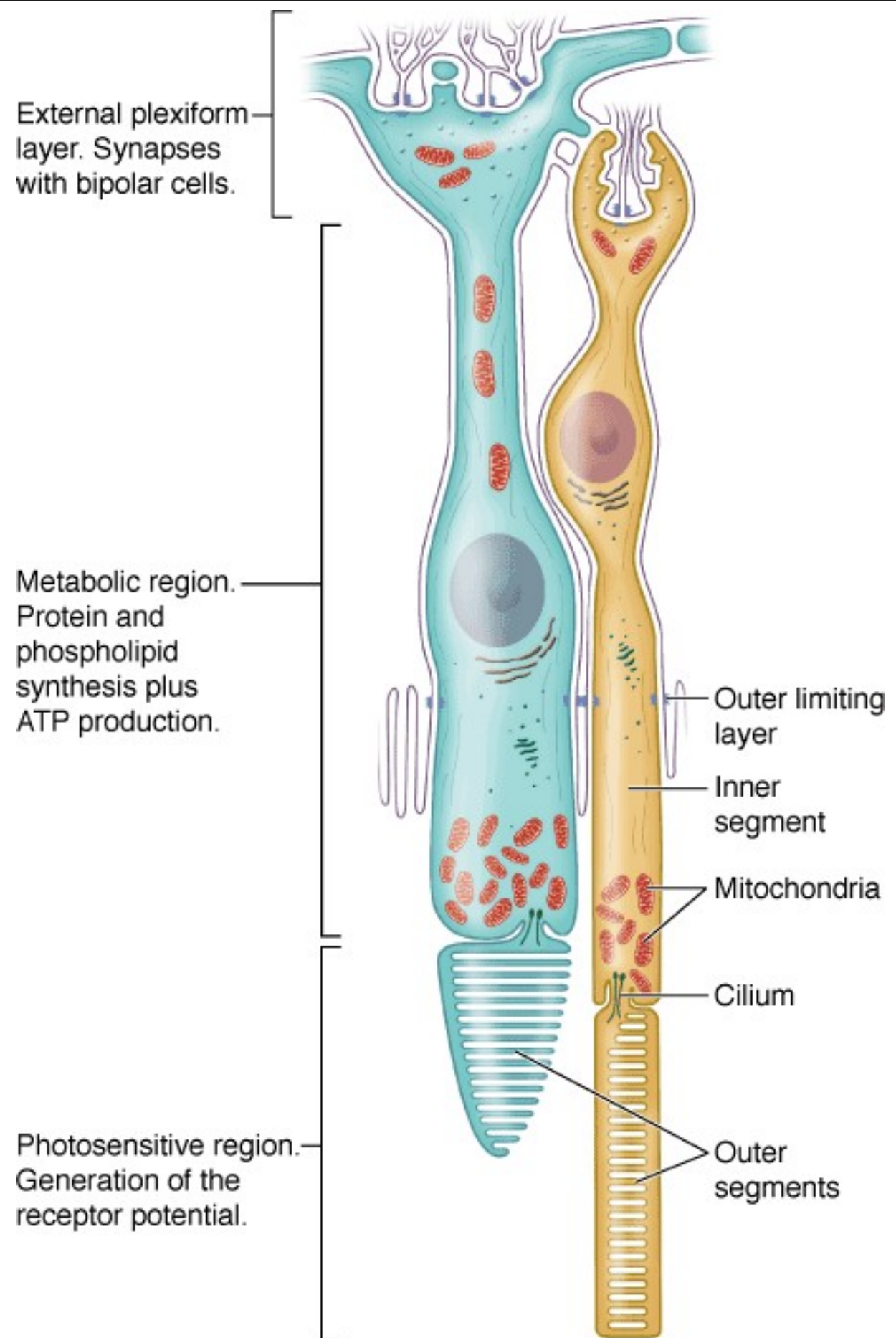
- Located in the posterior 2/3 of the eyeball
- Formed of two layers:
 - a) An outer **Pigmented layer** which contains melanin that absorbs any stray light
 - b) An inner **Neural layer** formed of several types of cells including the photoreceptors
- Axons from the neural layer will come together to form the Optic nerve (CN II)

Fig.32: The retina.

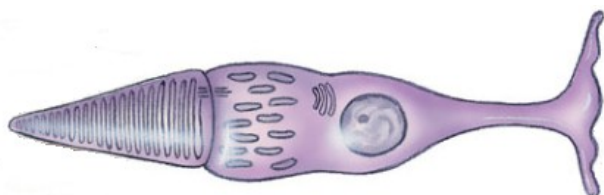


The Photoreceptors of the retina – Rods and Cones

Fig.33: The rods and cones.



Cones	Feature	Rods
Cone-shaped	Outer segment	Rod-shaped
Continuous with the cell membrane	Membranous discs	Stacked on each other and separated from the cell membrane
Contains the nucleus, mitochondria, Golgi and polyribosomes	Inner segment	Contains the nucleus, mitochondria, Golgi and polyribosomes
Modified cilium	2 segments connected by	Modified cilium
Less	Sensitivity to light	More
Color vision	Specialized in	Dark vision
Mostly in the center	Location in Retina	Mostly on the periphery



- **Optic disc** is the area in the retina at which the optic nerve exits the eyeball. This area has no cones or rods and, therefore, it's called the *blind spot*.

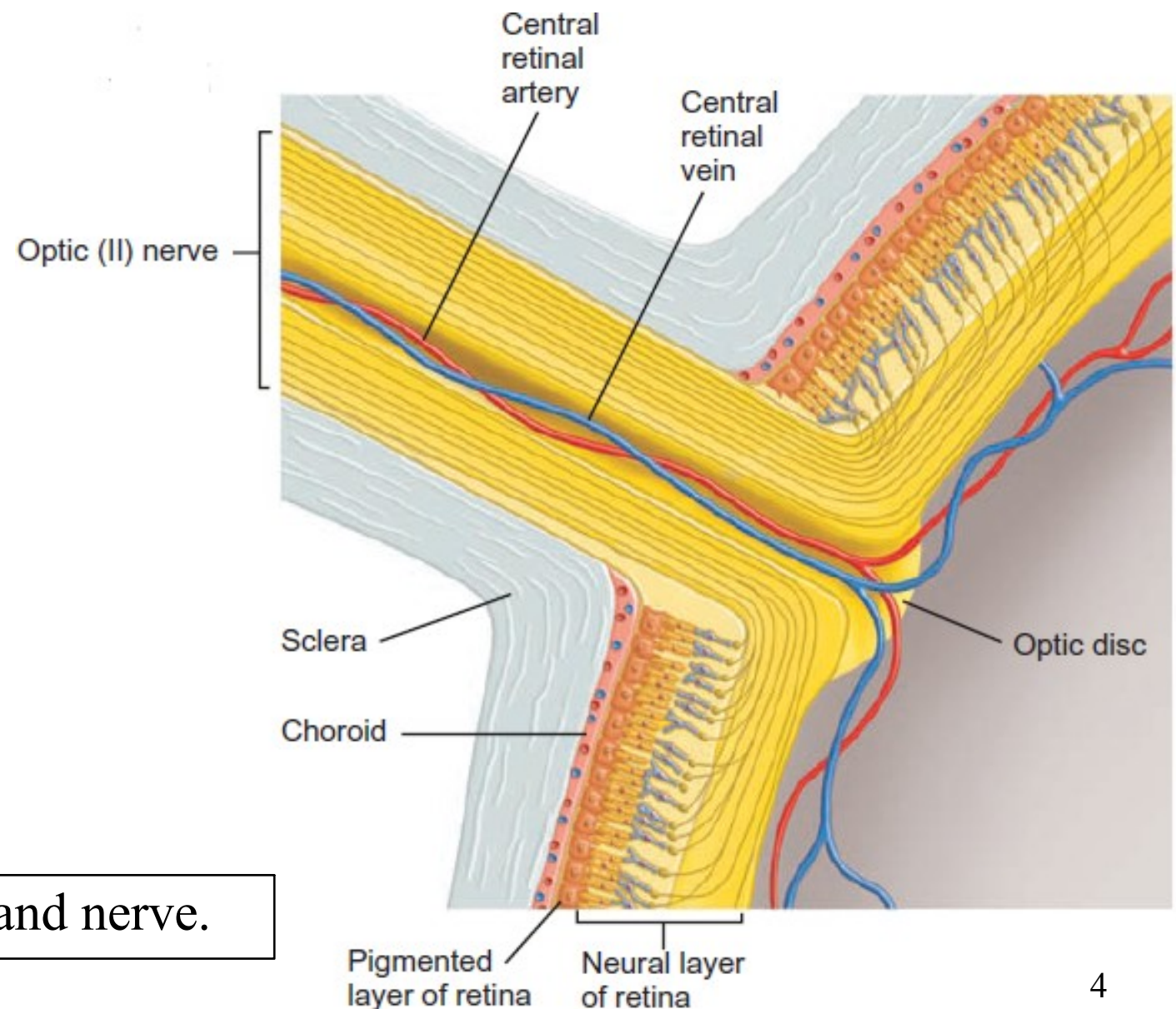


Fig.34: The optic disc and nerve.

The Interior of the eyeball

- **Lens**
 - Transparent structure.
 - Lacks blood vessels.
 - Divides the eyeball into two cavities: anterior and posterior.
- **Anterior cavity**
 - Between the cornea and the lens.
 - Contains *aqueous humor* which helps provide nutrients for the lens and cornea.
 - Further divided into:
 1. Anterior chamber: between cornea and iris
 2. Posterior chamber: between iris and lens
- **Posterior cavity**
 - Posterior to the lens.
 - Filled with the gelatinous *vitreous humor* which maintains the shape of the eye.

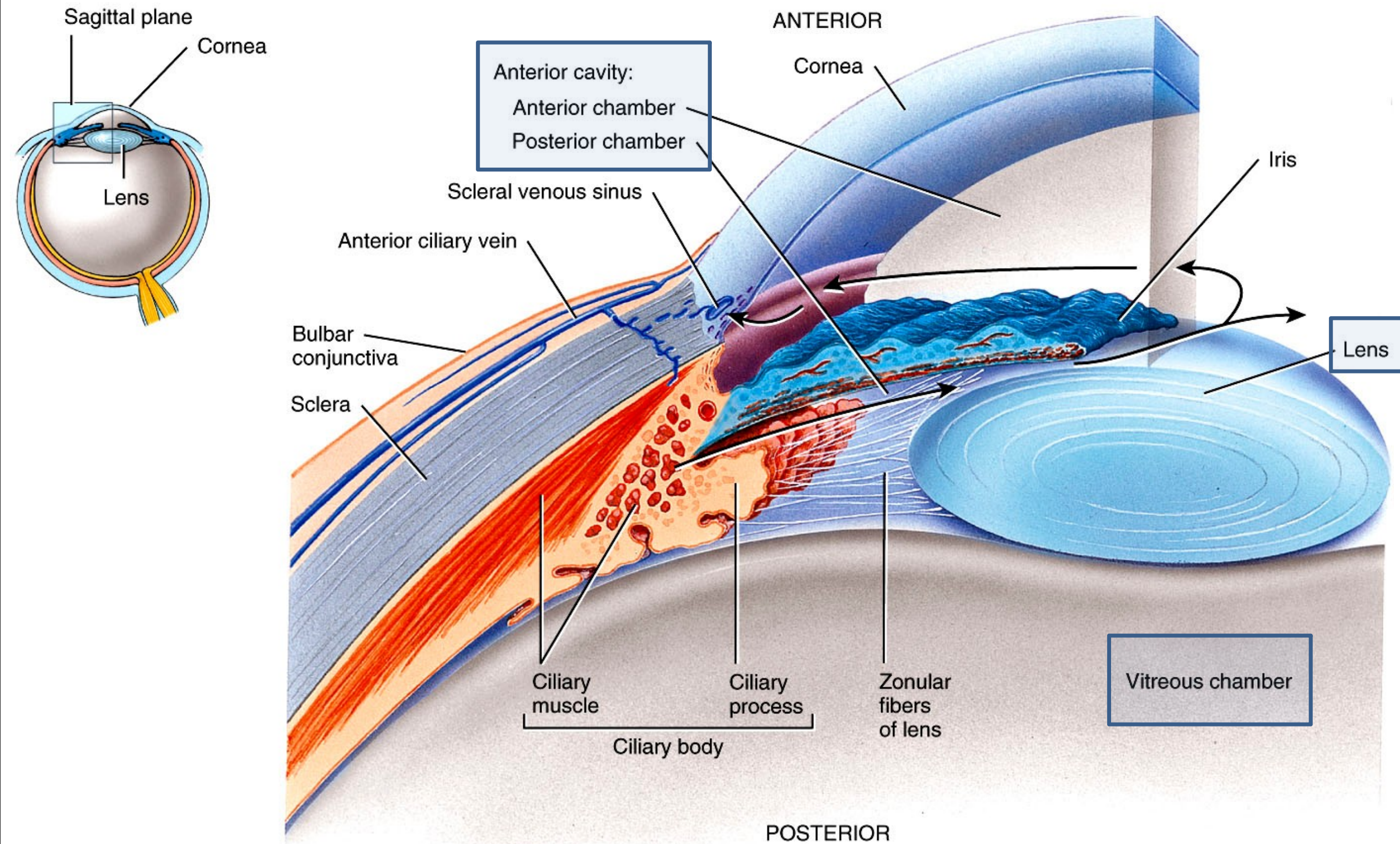


Fig.35: The cavities and chambers of the eye.

Glaucoma

- The aqueous humor is a fluid present inside a closed space (the anterior cavity); therefore, a pressure is formed in this space called '*the intraocular pressure*'.
- The aqueous humor is produced by the ciliary processes and circulates in the posterior chamber. After passing through the pupil, it enters and circulates in the anterior chamber. In the angle between the iris and the cornea, there are several channels through which this humor passes to enter the systemic venous circulation.
- There is a balance between the rate of production and removal of the aqueous humor. Any problem that leads to accumulation of this humor will lead to increased intraocular pressure; and this is a serious condition known as '*Glaucoma*'.

Special Senses – Hearing

- Hearing (and equilibrium) is the function of the ear.
- The ear is formed of 3 parts:
 1. The *external ear*, which collects sound waves and channels them inward.
 2. The *middle ear*, which conveys sound vibrations to the oval window.
 3. The *internal (inner) ear*, which houses the receptors for hearing and equilibrium.

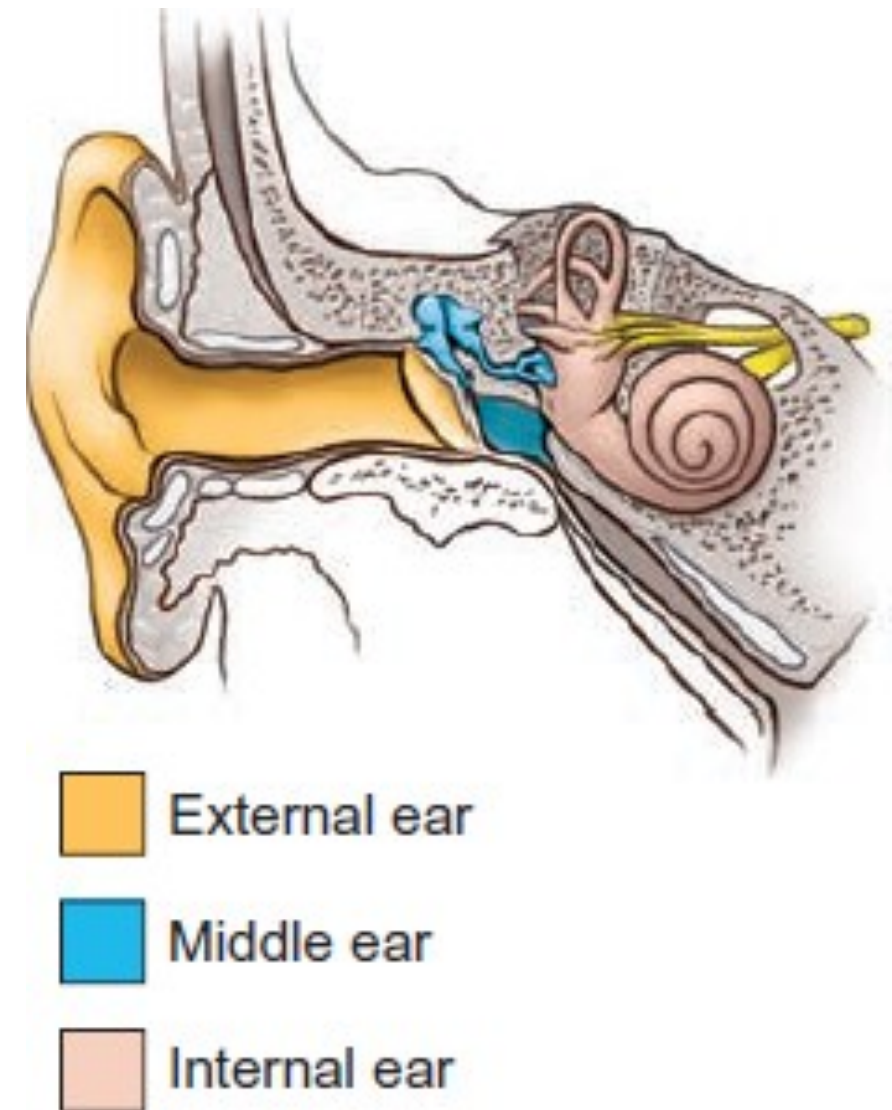


Fig.36: The three parts of the ear.

The External Ear

- Formed of the auricle, the external auditory canal and the tympanic membrane (eardrum).
- The **auricle** (pinna) of the ear is formed of elastic cartilage covered by skin. Its shape allows it to act as an antenna. The **external auditory canal** conveys sounds from the auricle to the eardrum.
- The **eardrum** is a thin semitransparent partition between the external and middle ears. It's ~~convex~~ towards the middle ear. To it is attached the malleus bone. It transmits sound to the middle ear.

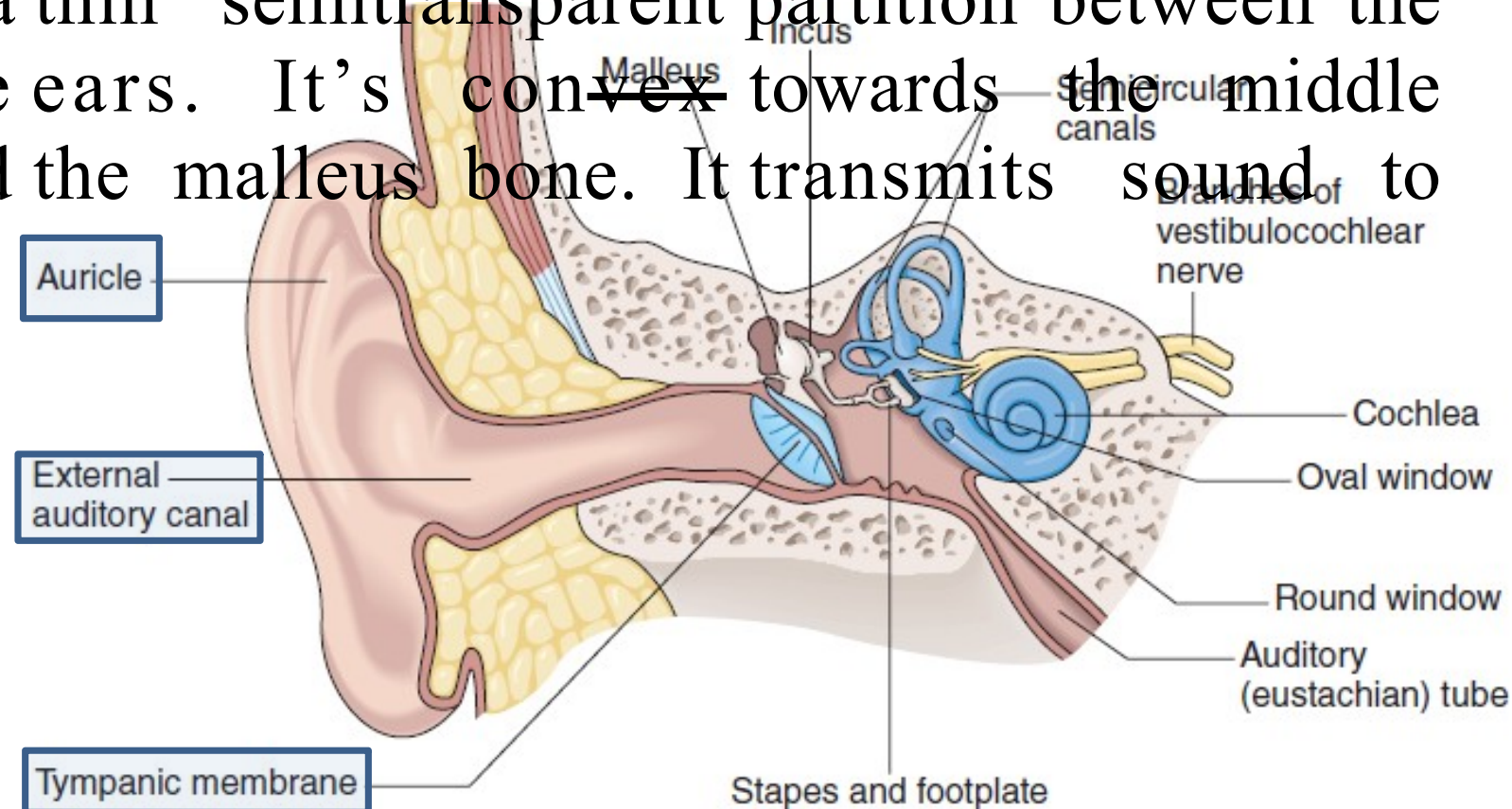


Fig.37: The external ear.

The Middle Ear

- A small, air-filled, epithelium-lined cavity in the petrous part of the temporal bone.
- It contains 3 very small bones (ear ossicles): the *malleus*, *incus*, and *stapes*. These bones articulate with each other by synovial joints.
- The stapes fits into an opening called the *oval windows*. Below this is another opening called the *round window* which is closed by a membrane called the *secondary tympanic membrane*.
- *Tensor tympani* muscle increases tension in the eardrum. The *stapedius* muscle (the smallest skeletal muscle in the body) dampens vibrations of the stapes. These skeletal muscles protect the inner ear from loud noises.
- The *auditory tube* connects the middle ear with the pharynx. This helps equalize air-pressure around the eardrum.

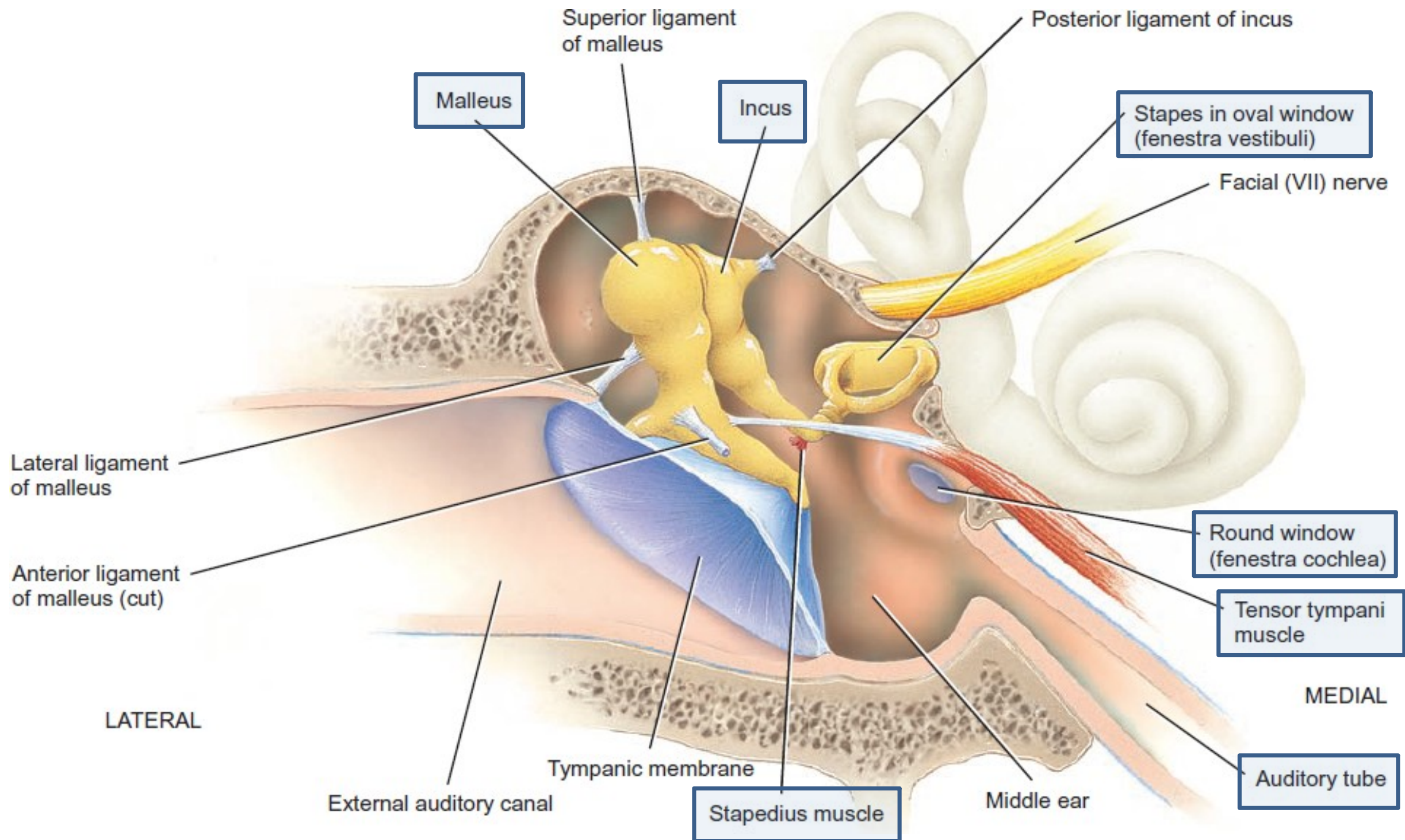


Fig.38: The middle ear.

The Inner Ear (The Labyrinth)

- Formed of the vestibule, cochlea and semicircular canals.
- These structures are bony cavities that lie within the petrous part of the temporal bone. Inside them is another set of membranous structures that have the same shape (the membranous labyrinth).
- Between the bony and membranous labyrinths, we have a fluid called *perilymph*. Inside the membranous labyrinth, we have another fluid called *endolymph*.
- The *vestibule* is the central portion of the bony labyrinth.
- There are three *semicircular canals*. The membranous *semicircular ducts* are present inside the canals.

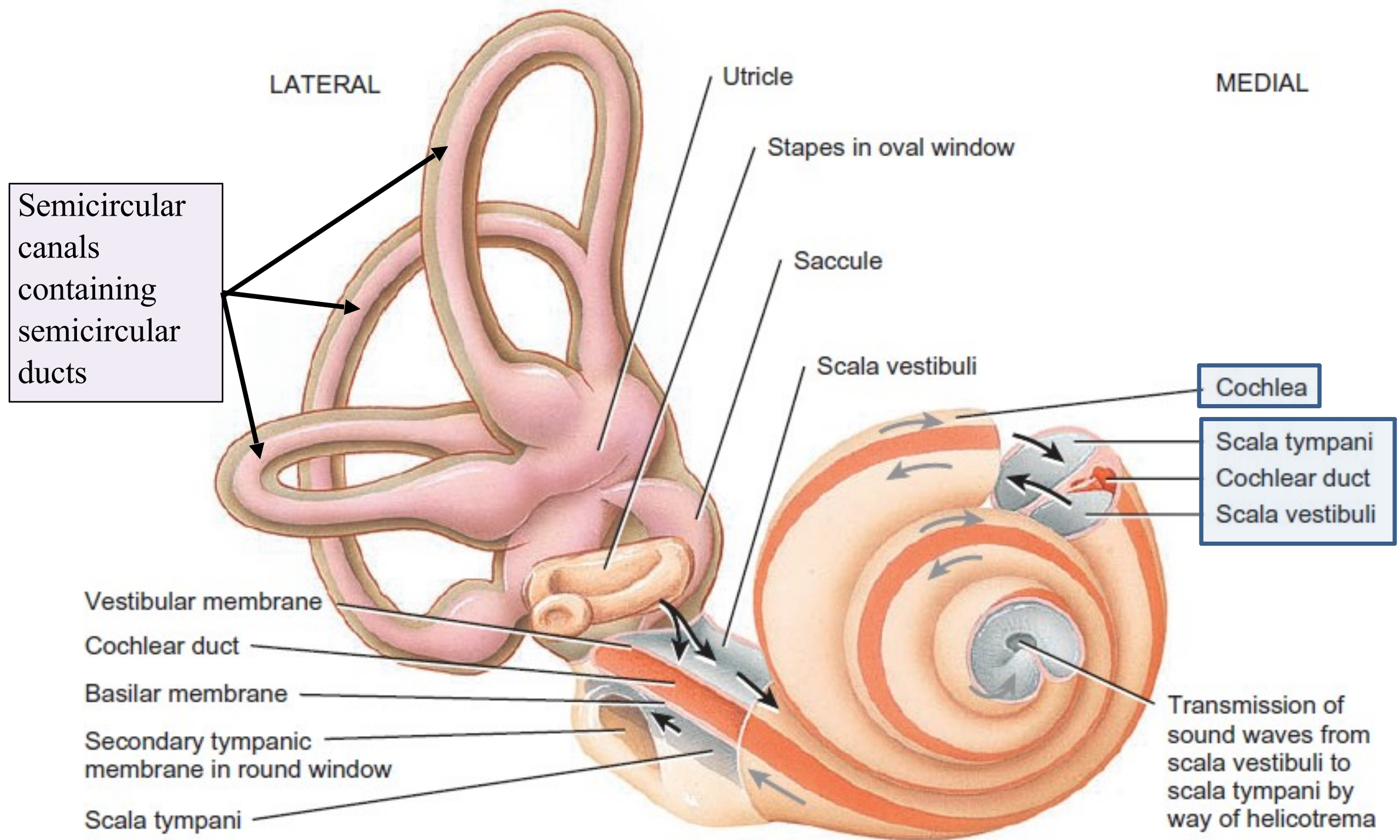


Fig.39: Parts of the inner ear.

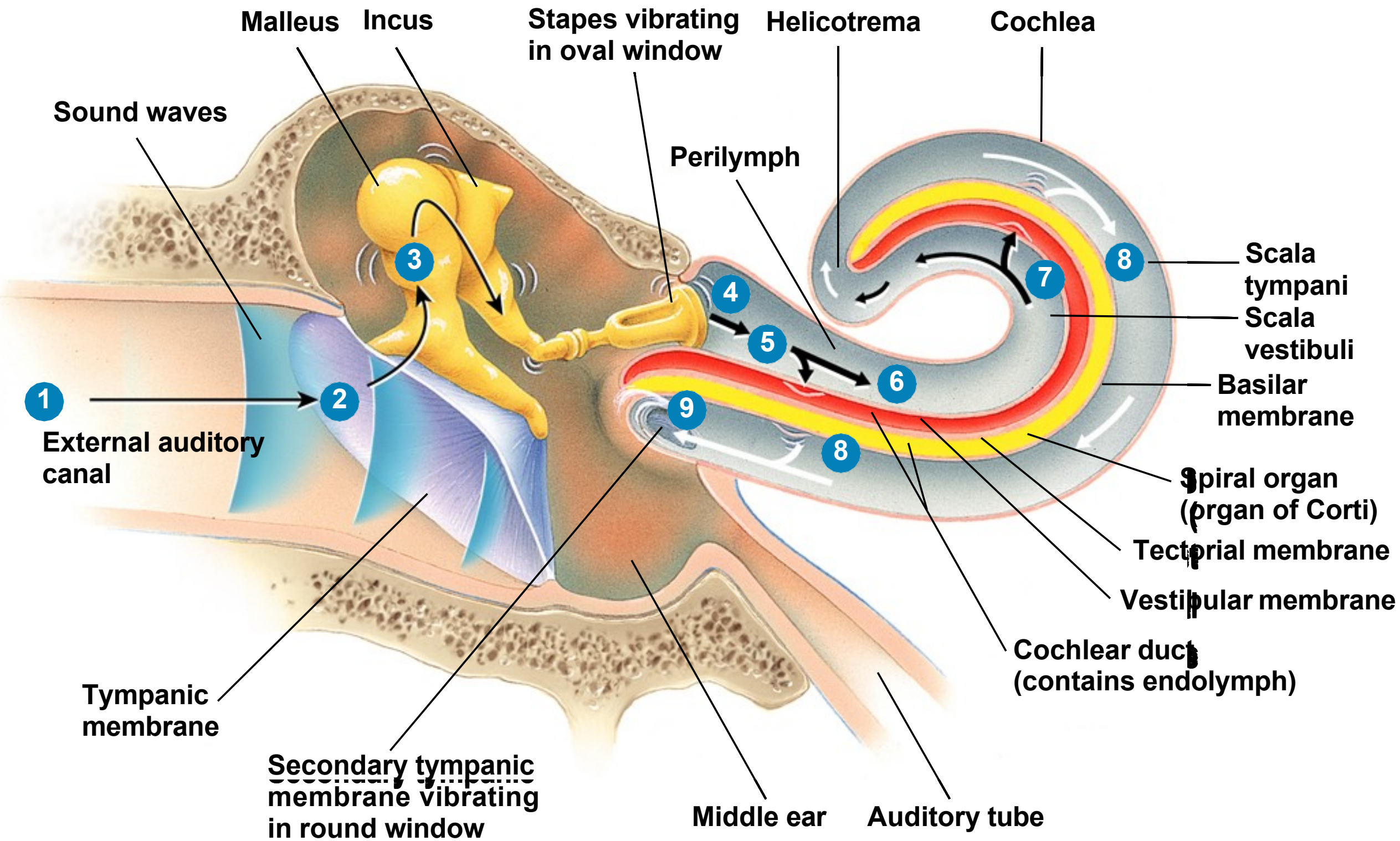


Fig.40: How sound is transmitted in the ear.