

INTRODUCTI ON

- **Sensory organs** have special receptors that allow us to **smell, taste, see, hear, and maintain equilibrium or balance.**
- Information conveyed from these receptors to the central nervous system is used to help maintain homeostasis.
- The organs used for these functions are eye, ear, tongue and skin.

EYE

- More than half the sensory receptors in the human body are located in the eyes, and a large part of the cerebral cortex is devoted to processing visual information.

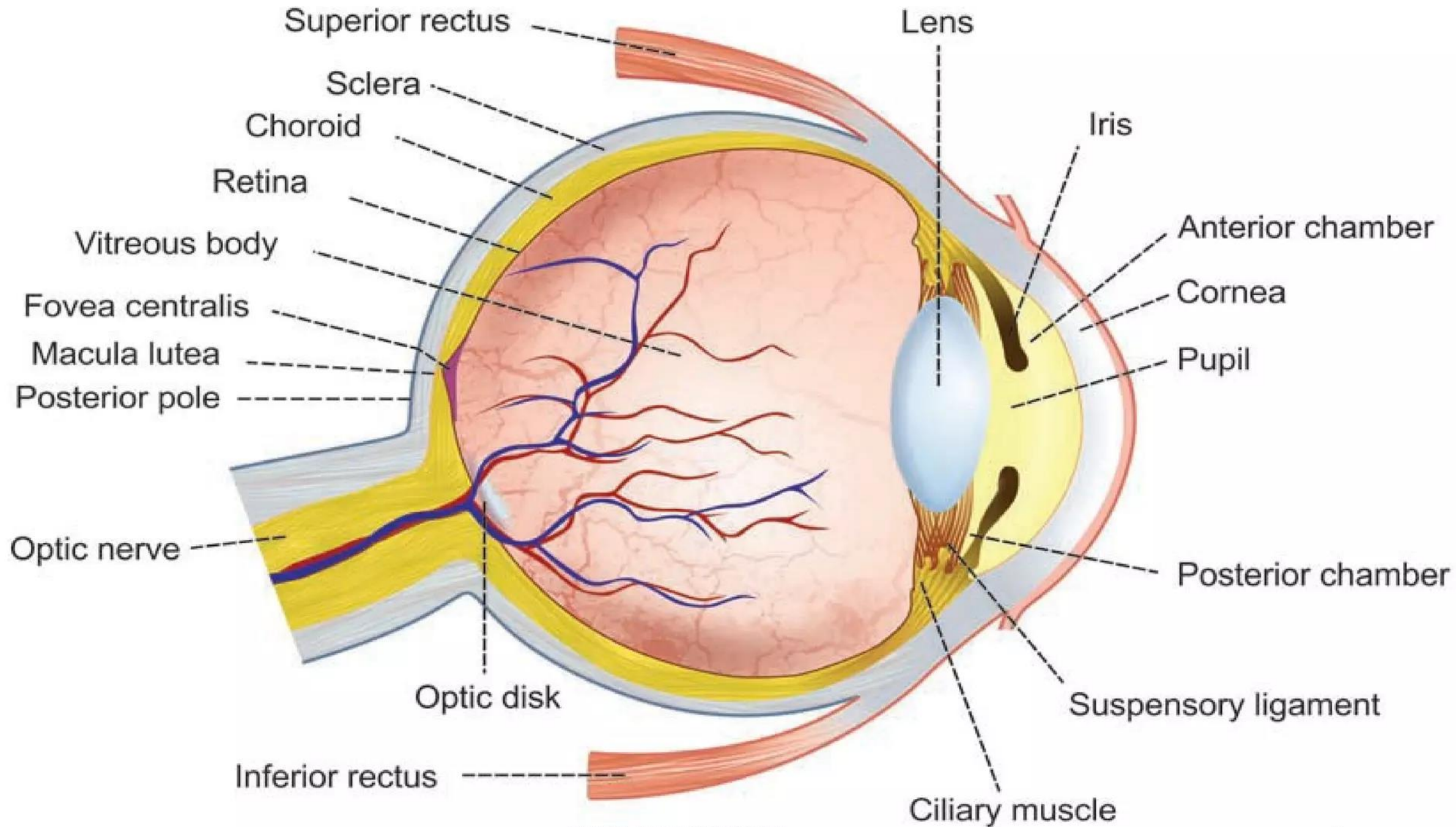
- **Accessory Structures of the Eye**

- The **accessory structures** of the eye include the eyelids, eyelashes, eyebrows, the lacrimal (tearing) apparatus, and extrinsic eye muscles.

- **Anatomical parts of eye are**

- cornea, iris, pupil, lens, retina, macula, optic nerve, choroid and vitreous.

- **Cornea:** clear front window of the eye that transmits and focuses light into the eye.
- **Iris:** colored part of the eye that helps regulate the amount of light that enters
- **Pupil:** dark aperture in the iris that determines how much light is let into the eye
- **Lens:** transparent structure inside the eye that focuses light rays onto the retina
- **Retina:** nerve layer that lines the back of the eye, senses light, and creates electrical impulses that travel through the optic nerve to the brain
- **Macula:** small central area in the retina that contains special light-sensitive cells and allows us to see fine details clearly
- **Optic nerve:** connects the eye to the brain and carries the electrical impulses formed by the retina to the visual cortex of the brain
- **Vitreous:** clear, jelly-like substance that fills the middle of the eye.



Physiology of Vision

- Light waves from an object (such as a tree) enter the eye first through the cornea, which is the clear dome at the front of the eye.
- It is like a window that allows light to enter the eye.
- The light then progresses through the pupil, the circular opening in the center of the colored iris.
- Fluctuations in the intensity of incoming light change the size of the eye's pupil.
- As the light entering the eye becomes brighter, the pupil will constrict (get smaller), due to the pupillary light response.
- As the entering light becomes dimmer, the pupil will dilate (get larger).

- Initially, the light waves are bent or converged first by the **cornea**, and then further by the **crystalline lens** (located immediately behind the iris and the pupil), to a nodal point (N) located immediately behind the back surface of the lens.
- At that point, the image becomes reversed (turned backwards) and inverted (turned upside-down).
- The light continues through the **vitreous humor**, (the clear gel that makes up about 80% of the eye's volume), and then, ideally, back to a clear focus on the retina, behind the vitreous.
- The small central area of the retina is the **macula**, which provides the vision of any location in the **retina**.
- In the retina, **rods and cones** initiate visual signals and relay them to bipolar cells, which transmit the signals to ganglion cells.

- The retina registers the tiny photons of light interacting with it.
- Within the layers of the retina, light impulses are changed into electrical signals.
- Then they are sent through the optic nerve, along the visual pathway, to the occipital cortex at the posterior (back) of the brain.
- Here, the electrical signals are interpreted or “seen” by the brain as a visual image.

Disorders of eye

- **Myopia (Near Sighted ness)**

- Near-sightedness is a common eye condition in which faraway objects appear blurry.

- **Hyperopia (far sighted ness)**

- Farsightedness means it's easy to see things that are far away, but your close-up vision (near vision) is blurry.

- **Astigmatism**

- Astigmatism is a common vision problem caused by an error in the shape of the cornea. With astigmatism, the lens of the eye or the cornea, which is the front surface of the eye, has an irregular curve. This can change the way light passes, or refracts, to your retina. This causes blurry, fuzzy, or distorted vision.

- **Presbyopia:**
- Presbyopia is an eye condition in which your eye slowly loses the ability to focus quickly on objects that are close.
- **Cataract**
- A **cataract** is a clouding of the eye's natural lens, which lies behind the iris and the pupil.
- **Glaucoma**
- Glaucoma is an eye disease that can damage your optic nerve. The optic nerve supplies visual information to your brain from your eyes. Glaucoma is usually, the result of abnormally high pressure inside your eye.

- **Night blindness**

- Night blindness is also called “nyctalopia.” It’s a type of vision impairment. People with night blindness experience poor vision at night or in dimly lit environments.

- **Strabismus**

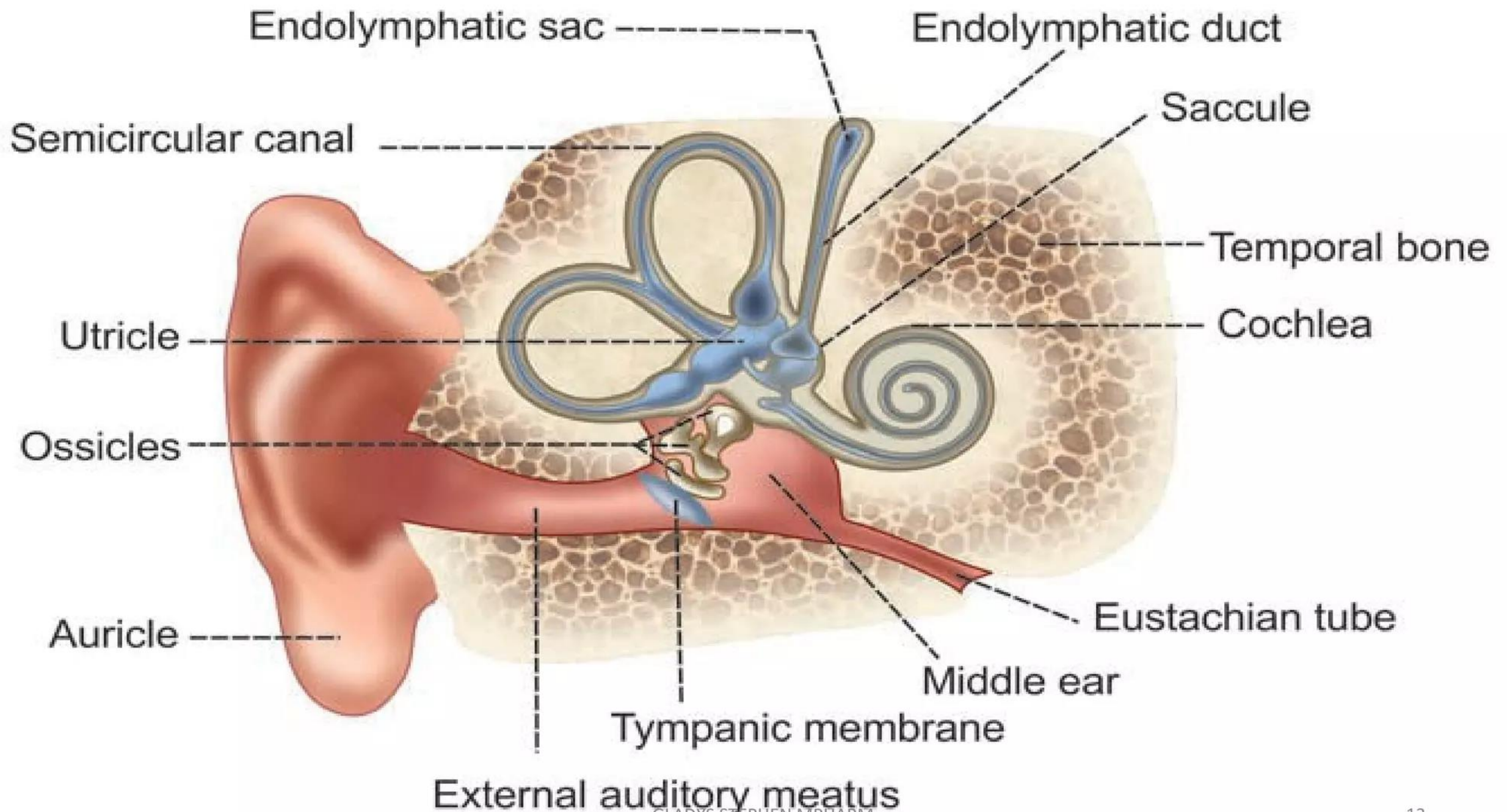
- Crossed eyes is also called strabismus, a condition in which your eyes don’t line up. If you have this condition, your eyes look in different directions. And each eye will focus on a different object.

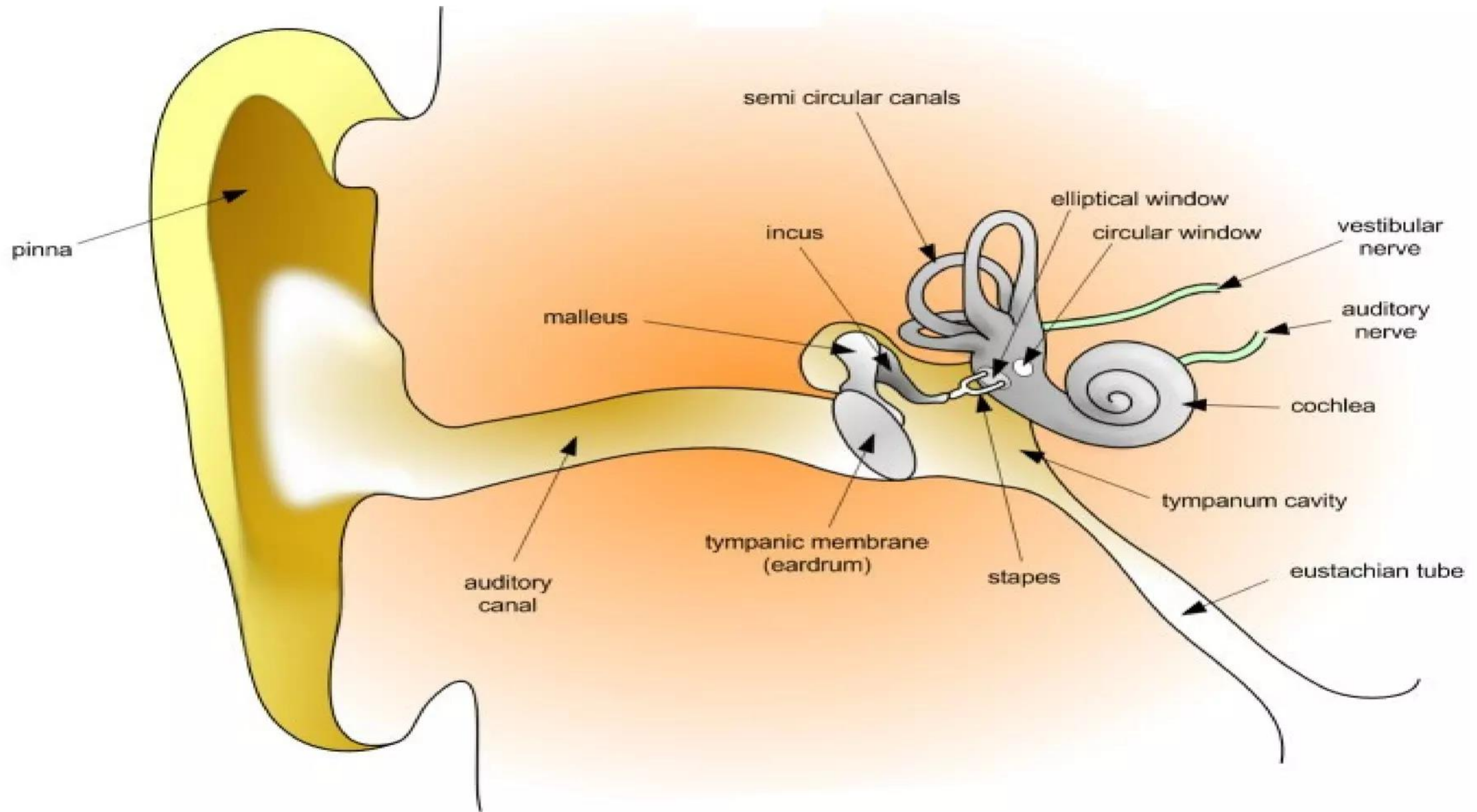
Ear

- The ear can transduce sound vibrations with small amplitudes into electrical signals 1000 times faster than photoreceptors can respond to light.
- Besides receptors for sound waves, the ear also contains receptors for equilibrium.

•Anatomy of ear

- The ear is divided into three main regions:
- (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 ear, which houses the receptors for hearing and equilibrium.





EXTERNAL EAR

- Ear consists of three parts, namely
- external ear,
- middle ear and
- internal ear.
- External ear is formed by two parts:
 1. Auricle or pinna
 2. External auditory meatus.

MIDDLE EAR

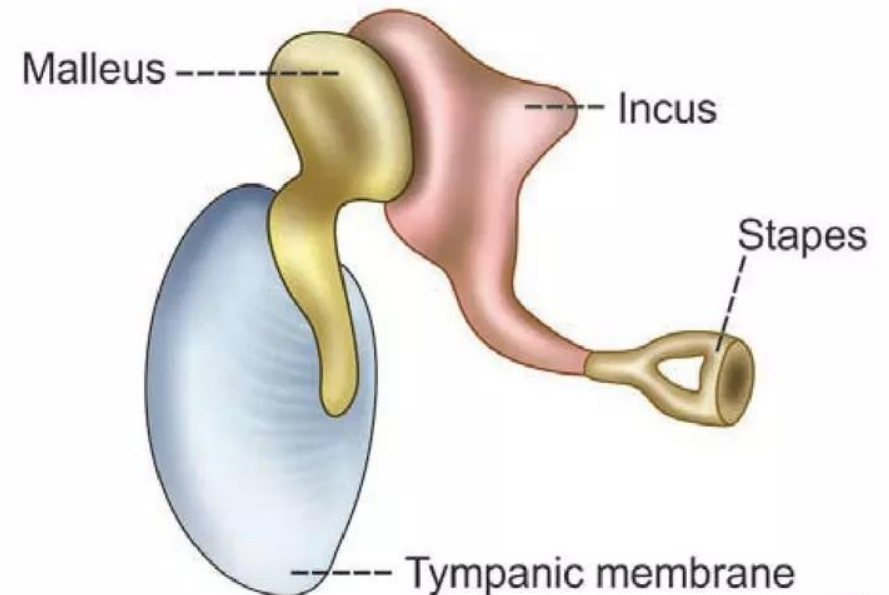
- Middle ear or tympanic cavity is a small, narrow, irregular, laterally compressed chamber, situated within the temporal bone.
- It is also known as **tympanum**. It is separated from external auditory meatus by **tympanic membrane**.
- Middle ear consists of the following structures:

- **1. Auditory ossicles**

- i. Malleus
- ii. Incus
- iii. Stapes.

- **2. Auditory muscles**

- **3. Eustachian tube.**



INTERNAL EAR

- Internal ear or labyrinth is a membranous structure, enclosed by a bony labyrinth in petrous part of temporal bone.
- It consists the sense organs of hearing and equilibrium. Sense organ for hearing is the **cochlea** and the sense organ for equilibrium is the **vestibular apparatus**.

Sense of Equilibrium

- The sense of equilibrium consists of two parts: static and dynamic equilibrium.
- 1. The organs of static equilibrium help to maintain the position of the head when the head and body are still.
 2. The organs of dynamic equilibrium help to maintain balance when the head and body suddenly move and rotate.

Static Equilibrium

- 1. The organs of static equilibrium are located within the bony vestibule of the inner ear, inside the utricle and saccule (expansions of the membranous labyrinth).
- 2. A macula, consisting of hair cells and supporting cells, lies inside the utricle and saccule.
- 3. The hair cells contact gelatinous material holding otoliths.
- 4. Gravity causes the gelatin and otoliths to shift, bending hair cells and generating a nervous impulse.
- 5. Impulses travel to the brain via the vestibular branch of the vestibulocochlear nerve, indicating the position of the head

Dynamic Equilibrium

- 1. The three semicircular canals detect motion of the head, and they aid in balancing the head and body during sudden movement.
- 2. The organs of dynamic equilibrium are called cristae ampullaris, and are located in the ampulla of each semicircular canal of the inner ear.
- 3. Hair cells extend into a dome-shaped gelatinous cupula.
- Rapid turning of the head or body generates impulses as the cupula and hair cells bend.
- Mechanoreceptors associated with the joints, and the changes detected by the eyes also help maintain equilibrium.

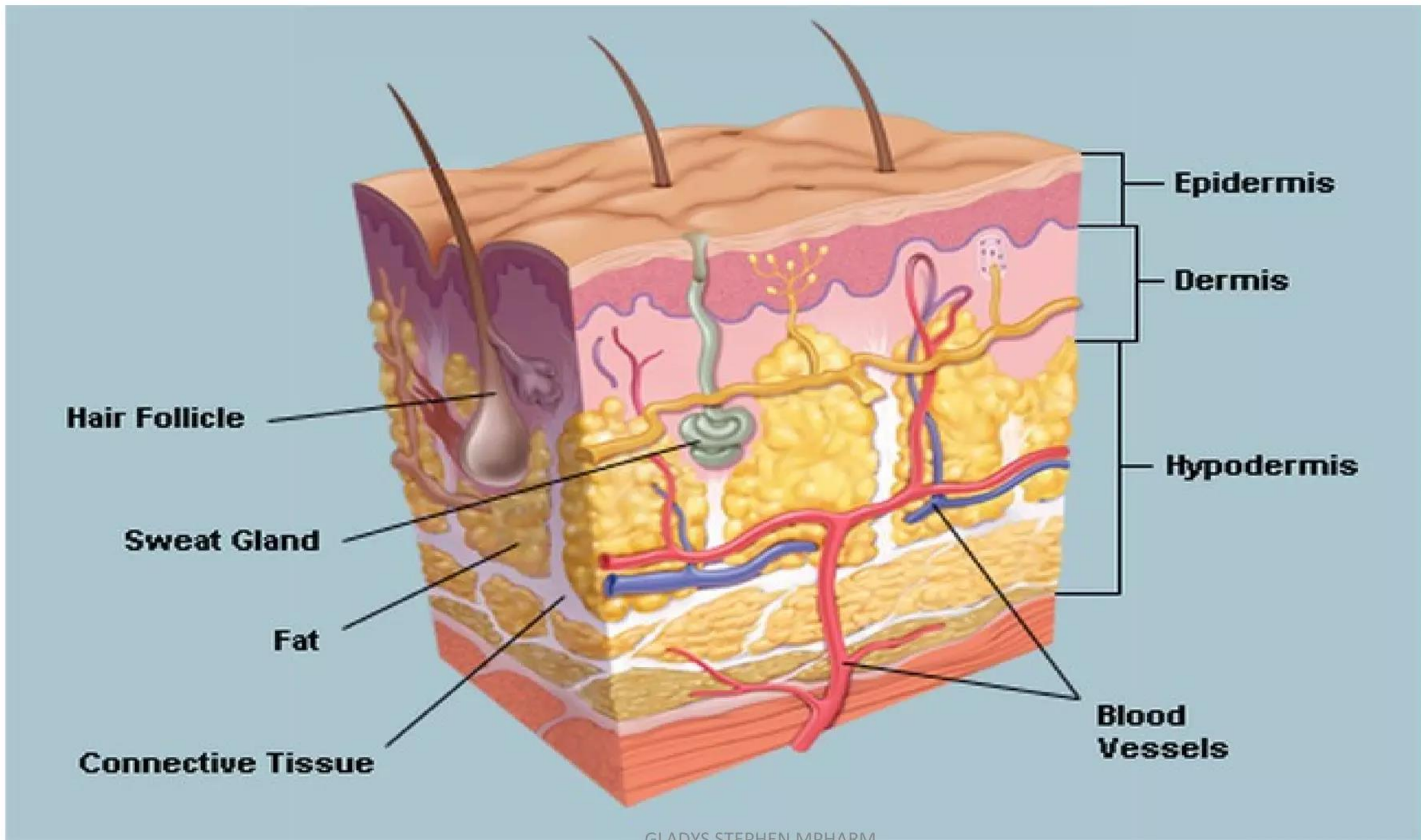
- **Conclusion**
- The human sense of hearing is attributed to the **auditory system**, which uses the **ear** to collect, amplify, and transduce sound waves into electrical impulses that allow the **brain** to perceive and localize sounds.
- The ear can be divided into the outer ear, middle ear, and inner ear, each of which has a specific function in the process of hearing.
- The outer ear is responsible for the collection and amplification of sound. The air-filled middle ear transforms sound waves into vibrations, protecting the inner ear from damage. The fluid-filled inner ear transduces sound vibrations into neural signals that are sent to the brain for processing.
- The cochlea is the major sensory organ of hearing within the inner ear. Hair cells within the cochlea perform the transduction of sound waves.
- Humans are capable of estimating a sound's origin through a process called sound localization, which relies on timing and intensity differences in sound waves collected by each of our two ears.

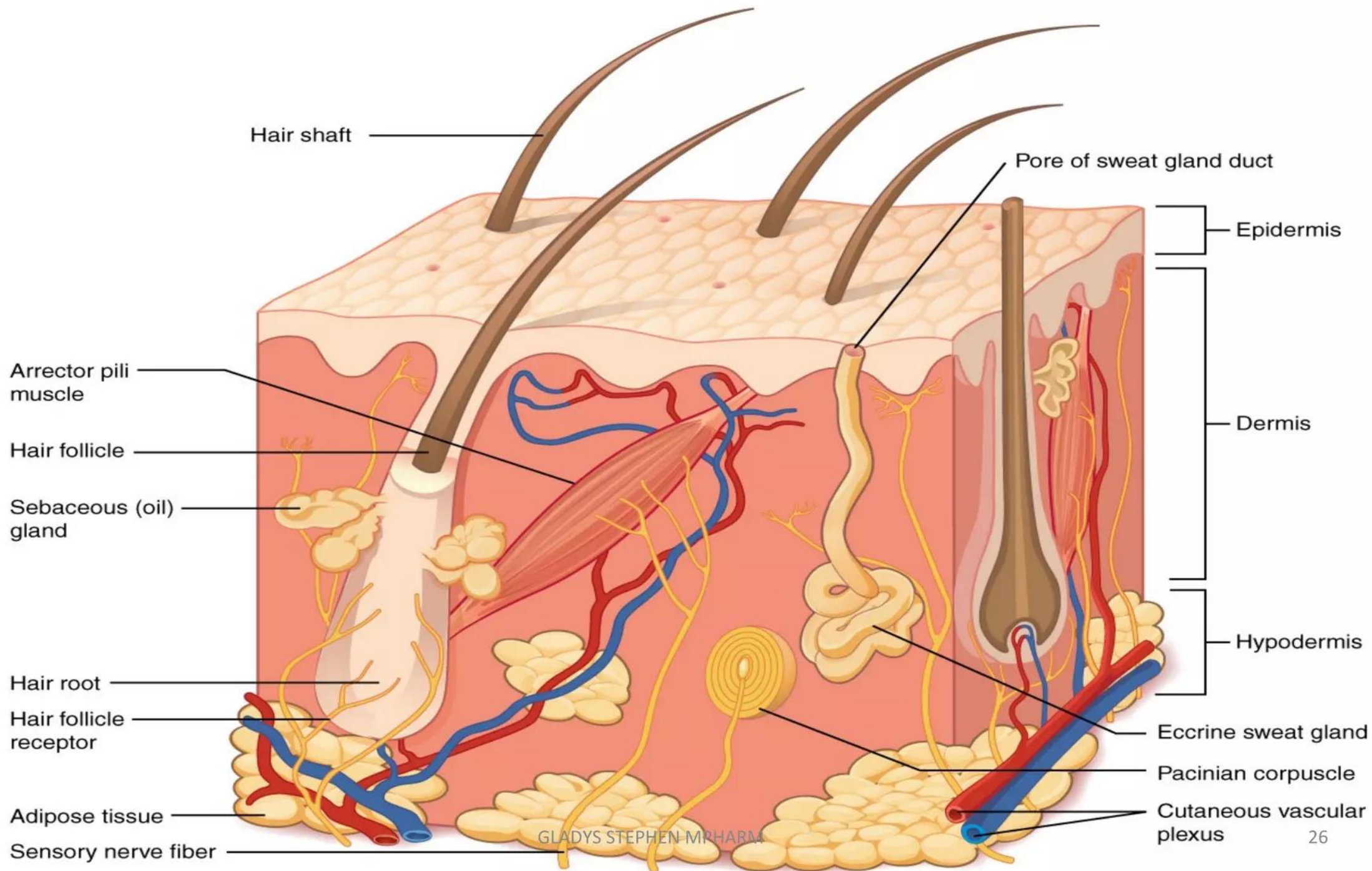
Skin

- The integumentary system contributes to homeostasis by protecting the body and helping regulate body temperature.
- It also allows you to sense pleasurable, painful, and other stimuli in your external environment.
- The **integumentary system** is composed of the skin, hair, oil and sweat glands, nails, and sensory receptors.

- The integumentary system helps maintain a constant body temperature, protects the body, and provides sensory information about the surrounding environment.
- Of all the body's organs, none is more easily inspected or more exposed to infection, disease, and injury than the skin.
- Because of its visibility, skin reflects our emotions (frowning, blushing) and some aspects of normal physiology (such as sweating).
- Changes in skin color may also indicate homeostatic imbalances in the body. For example, the bluish skin color associated with hypoxia (oxygen deficiency at the tissue level) is one sign of heart failure as well as other disorders.
- Abnormal skin eruptions or rashes such as chickenpox, cold sores, or measles may reveal systemic infections or diseases of internal organs.

- **Components of the integumentary system.** The skin consists of a superficial, thin epidermis and a deep, thicker dermis.
- Deep to the skin is the subcutaneous layer, which attaches the dermis to underlying fascia.
- The integumentary system includes the skin, hair, oil and sweat glands, nails, and sensory receptors.
- **Skin Glands**
- Glands are epithelial cells that secrete a substance. Several kinds of exocrine glands are associated with the skin: sebaceous (oil) glands, sudoriferous (sweat) glands, and ceruminous glands.





- **Functions of skin**

- **Thermoregulation**

- The skin contributes to thermoregulation in two ways: by liberating sweat at its surface and by adjusting the flow of blood in the dermis.

- **Blood Reservoir**

- The dermis houses an extensive network of blood vessels that carry 8–10% of the total blood flow in a resting adult. For this reason, the skin acts as a **blood reservoir**.

- **Protection**

- The skin provides **protection** to the body in various ways. Keratin protects underlying tissues from microbes, abrasion, heat, and chemicals and the tightly interlocked keratinocytes resist invasion by microbes.

- **Cutaneous Sensations**

- Cutaneous sensations are sensations that arise in the skin, including tactile sensations—touch, pressure, vibration, and tickling—as well as thermal sensations such as warmth and coolness.

- **Excretion and Absorption**

- The skin normally has a small role in **excretion**, the elimination of substances from the body, and **absorption**, the passage of materials from the external environment into body cells.

- **Synthesis of Vitamin D**

- Synthesis of vitamin D requires activation of a precursor molecule in the skin by ultraviolet (UV) rays in sunlight.