

Sense organs

Somatic Sensory Receptors

Somatic sensation is the most widespread and diverse of the body's sensory systems (*soma* means “body” in Greek). Its receptors are distributed throughout the body instead of being condensed into small and specialized sensory surfaces, as most other sensory systems are arranged. Somatosensory receptors cover the skin, subcutaneous tissue, skeletal muscles, bones and joints, major internal organs, epithelia, and cardiovascular system. These receptors also vary widely in their specificity. The body has mechanoreceptors to transduce pressure, stretch, vibration, and tissue damage; thermoreceptors to gauge temperature; and chemoreceptors to sense a variety of substances. Somatic sensation (or somesthesia) is usually considered to be a combination of at least four sensory modalities: the senses of touch, temperature, body position (proprioception), and pain (nociception).

chemoreceptors

A **chemoreceptor**, also known as chemosensor, is a specialized sensory receptor cell which transduces a chemical substance (endogenous or induced) to generate a biological signal.

Central **chemoreceptors**, located in the respiratory center at the base of your brain, monitor the levels of carbon dioxide and oxygen by detecting changes in the

pH levels of the cerebral spinal fluid. **Examples** of direct **chemoreceptors** are taste buds, which are sensitive to chemicals in the mouth, and the carotid bodies and aortic bodies that detect changes in pH inside the body.

The eye

Layers of the eye

- The wall of the eye consists of 3 layers:
 1. An outer, fibrous **corneoscleral coat**, including the **sclera** and the **cornea**
 2. The **uvea**: a middle vascular layer including the **choroid**, the **ciliary body** and **iris**
 3. The inner **retina**, including the **outer pigment epithelium**, the **inner neural retina**, and the **epithelium** of the ciliary body and iris.
- The internal cavity of the eye is filled with the **vitreous body**, a transparent gel that supports the shape of the eye.

The corneoscleral coat

- The **cornea** covers the **anterior one sixth** of the eye, and is continuous with the fibrous sclera posteriorly.
- It consists of 5 layers:
 1. The outer layer of stratified squamous, non-keratinizing **corneal epithelium**
 2. **Bowman's membrane**, upon which the corneal epithelium sits
 3. The **corneal stroma** (substantia propria) forming most of the thickness of the cornea
 4. **Descemet's membrane**, the basal lamina of the corneal endothelium
 5. The inner layer of cuboidal cells called the **corneal endothelium**
- The **sclera** consists of dense, irregular connective tissue, making it opaque.
- Bowman's membrane ends at the junction of the cornea and the sclera, called the **limbus**, which contains the **canal of Schlemm** that drains aqueous humour from the eye into veins of the sclera, preventing the buildup of **intraocular pressure**.

The Uvea

- This consists mainly of the **choroid**, which has a dark brown colour due to many venous plexuses and capillaries, as well as melanin pigment, which helps to reduce glare within the eye.
- Just posterior to the corneoscleral junction, the **ciliary body** extends inwards to form a ring-like thickening, with ciliary processes on its anterior third, from which the **suspensory ligament of the lens** (zonular ligament) arises.
- The ciliary body continues posteriorly until it merges with the retina at the **ora serrata**.
- The layers of the ciliary body include a stroma and an epithelium, with the stroma divided into 2 layers:
 1. The outer **ciliary muscle**, which alters the shape of the lens in accommodation.
 2. An inner vascular region extending into the ciliary process
- The **epithelium** of the ciliary body is **double layered**, derived from the layers of the optic cup (the retinal epithelium), and thus the deeper layer is **pigmented** (like the retinal pigment epithelium)
- The superficial, **non-pigmented epithelial layer** secretes **aqueous humour**, which passes into the anterior chamber of the eye before draining laterally to the angle formed between the cornea and iris, finding its way to the canal of Schlemm.
- **The iris extends over the anterior surface of the lens from the anterior border of the ciliary body, and consists of 5 layers, from anterior to posterior:**
 1. A discontinuous layer of fibroblasts and melanocytes
 2. The avascular anterior stromal sheet (lamella)
 3. A vascular layer of loose connective tissue forming the bulk of the iris
 4. The **posterior membrane**, containing the circular **sphincter pupillae** and radial **dilator pupillae** muscles
 5. A **double layer of pigmented epithelium**.

The Retina

- The retina consists of:
 1. The inner, **neural retina**, containing photoreceptor cells, with a 10 layered structure.
 2. The outer **retinal pigment epithelium** (RPE) that sits on the choroid, consisting of cuboidal melanin-containing cells.

| Layers of the retina, from the outside inwards | |
|-------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------|
| Retinal Pigment Epithelium | <ul style="list-style-type: none"> • Melanin containing cells |
| Layer of rods and cones | <ul style="list-style-type: none"> • Inner and outer segments of photoreceptor cells |
| External (Outer) limiting membrane | <ul style="list-style-type: none"> • Apical boundary of Müller's cells |
| Outer nuclear layer | <ul style="list-style-type: none"> • Cell bodies of rods and cones |
| Outer plexiform layer | <ul style="list-style-type: none"> • 1st synaptic layer, between photoreceptors and horizontal, amacrine and bipolar cells |
| Inner nuclear layer | <ul style="list-style-type: none"> • Cell bodies of horizontal, amacrine, bipolar and Müller's cells |
| Inner plexiform layer | <ul style="list-style-type: none"> • 2nd synaptic layer, between horizontal, amacrine and bipolar cells and ganglion cells |
| Ganglion cell layer | <ul style="list-style-type: none"> • Cell bodies of ganglion cells |
| Layer of optic nerve fibres | <ul style="list-style-type: none"> • Processes of ganglion cells travelling to the brain |
| Internal (Inner) limiting membrane | <ul style="list-style-type: none"> • Composed of the basal lamina of Müller's cells |

- The neural retina meets the **optic nerve** at the **optic disc** (or optic papilla), which is devoid of photoreceptor cells, forming a **blind spot** in the visual field.
- The **fovea**, lateral to the optic disc, is the area of greatest **visual acuity**, and is surrounded by a yellow pigmented zone called the **fovea lutea**.

Chambers of the eye

- There are 3 chambers of the eye:
 1. The **anterior chamber**, between the cornea and the iris
 2. The **posterior chamber**, between the posterior surface of the iris and the anterior surface of the lens
 3. The **vitreous space**, between the posterior surface of the lens and the neural retina.

The conjunctiva

- This is a thin, transparent mucous membrane extending from the lateral margin of the cornea, across the sclera, and covering the internal surface of the eyelids.
- It is composed of a stratified squamous columnar epithelium, containing many goblet cells, that rests on a lamina propria of loose connective tissue.

The Lens

- The lens is a transparent, avascular, biconvex structure that is suspended by the suspensory ligament of the lens, and has 3 components:
 1. The **lens capsule**, produced by anterior lens cells
 2. A **subcapsular epithelium**, a cuboidal layer of cells that is only present on the anterior surface of the lens
 3. **Lens fibres**, derived from the subcapsular epithelial cells, which lose their nuclei and organelles to become filled with proteins called **crystallins**.