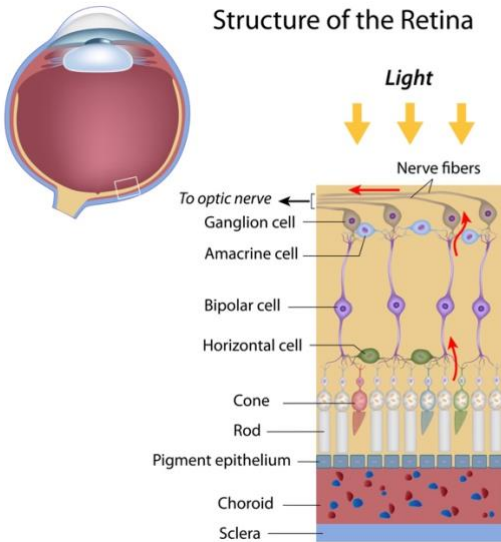
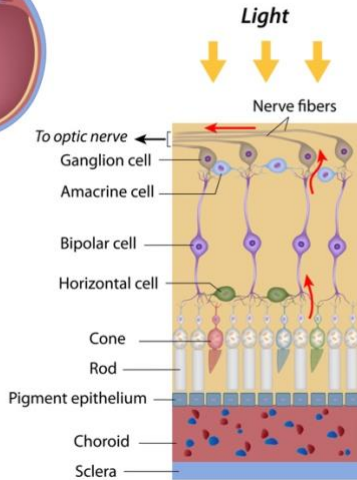


Layers of the Retina

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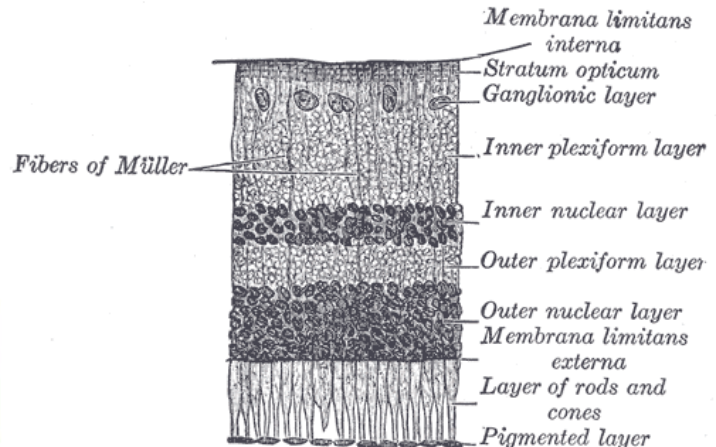


Structure of the Retina



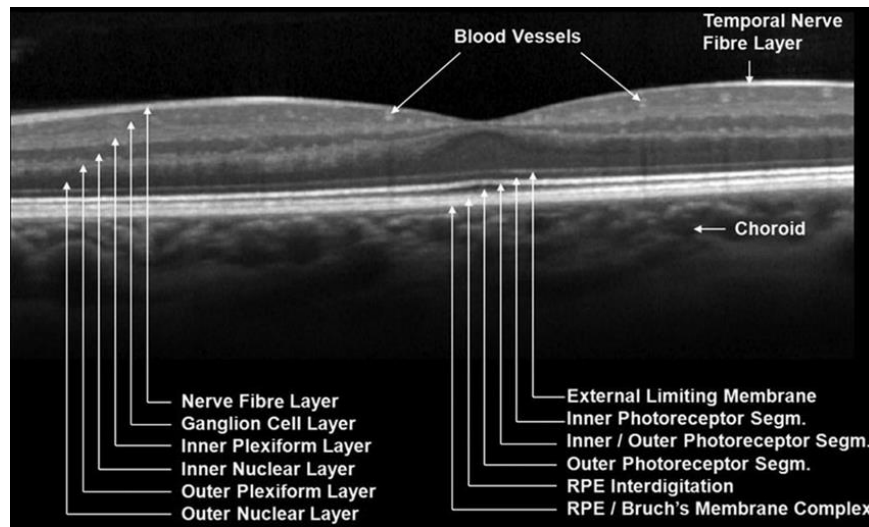
Cells of the Retina

Image courtesy of Discovery Eye Foundation¹



Histological Layers of the Retina

Image courtesy of Wikipedia / Public Domain



Optical Coherence Tomography (OCT) of the Retina

Image courtesy of Christopher M. Putnam²

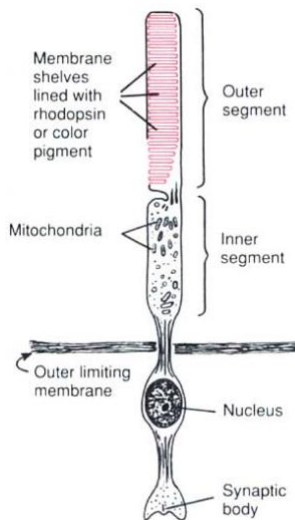
The retina is a multilaminar structure comprised of separate layers of neurons and glial cells which forms the inner surface of the eye's posterior segment. It is responsible for sensory transduction of light stimulus from the outside world, encoding it into neural signals which are transmitted to the central nervous system via the optic nerve.³ Many cell types comprise the

retina and allow it to perform its complex function; these include rods, cones, retinal ganglion cells, bipolar cells, Müller glial cells, horizontal cells, and amacrine cells.⁴

The ten layers of the retina from interior (bordering vitreous humor) to exterior (bordering choroid and sclera) are listed and described below.^{4,5}

1. **Inner Limiting Membrane** – forms a barrier between the vitreous humor and the neurosensory retina. It is composed of the laterally branching foot plates of the Müller cells and is responsible for maintaining the structural integrity of the inner retina.
 - **Clinical Correlation** – *The internal limiting membrane can be surgically removed for the treatment of several conditions, such as macular hole.*
2. **Nerve Fiber Layer** – composed of ganglion cell axons that eventually converge to form the optic nerve.
 - **Clinical Correlation** – *The nerve fiber layer and ganglion cell layers represent the part of the retina affected by glaucoma. The progression of glaucoma can be monitored by measuring the thickness of the nerve fiber layer using optical coherence tomography (OCT).*
3. **Ganglion Cell Layer** – contains ganglion cell bodies, whose main purpose is the summation of graded potential signals from other neurons which are converted into action potentials that can be transmitted through the optic nerve to the central nervous system. They also display some photosensitive activity, which is responsible for pupillary light reflexes and regulation of circadian rhythm.
4. **Inner Plexiform Layer** – contains bipolar cell axons and amacrine cell dendrites. Bipolar cell axons travel from the inner nuclear layer (described below) to synapse with the ganglion cell layer and to project photoreceptor input from the rods and cones to the ganglion cells. The amacrine cells serve a wide variety of functions, but their primary purpose seems to be modulating lateral transmission of neural microcircuits.
5. **Inner nuclear layer** – comprised of bipolar cell bodies, horizontal cell bodies, and amacrine cell bodies. Horizontal cells help to regulate and transmit information between photoreceptors and bipolar cells.
6. **Outer plexiform layer** – contains projections of horizontal cells, bipolar cells, and photoreceptor cells. This is the layer where rods and cones synapse with the cells of the inner nuclear layer.
 - **Clinical Correlation** – *The inner nuclear layer and outer plexiform layer are where fluid accumulates in various forms of macular edema, most commonly diabetic macular edema (DME) and exudative age-related macular degeneration (AMD).*

7. **Outer Nuclear Layer** – contains the nuclei of the rod and cone photoreceptors.
8. **External Limiting Membrane** – contains gap junctions and adherens junctions of the Müller glial cells that form a barrier between the rod and cone nuclei and their inner segments, where mitochondria and other organelles are located.
9. **Outer Segment layer** – contains the cellular machinery responsible for phototransduction. Membrane phospholipids form a complex network of multiple disc-like structures which maximize the surface area for photon interaction to take place. Here, transmembrane proteins called rhodopsin initiate a series of intracellular signaling cascades after a single photon induces a conformation change. Rod cells are known to be more sensitive to dim light, while cone cells are more sensitive to bright, colored light.
 - **Clinical Correlation** – *The outer retina is affected in retinitis pigmentosa and cone dystrophies where a genetic mutation results in photoreceptor cell death.*



Anatomy of a Rod Cell

Image courtesy of Wikipedia / Public Domain

10. **Retinal Pigment Epithelium** – a single layer of epithelial cells that serve a wide variety of functions, including Vitamin A metabolism, contributing to the blood-retina barrier, maintaining and supporting photoreceptor cells, and actively transporting ions, phospholipids, water, and other cellular materials. The RPE is responsible for phagocytosing and recycling 10-15% of the outer segment volume each day.

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