The Eye, Central Vision, and Disorders of the Visual System
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The eye acts as far more than a sophisticated light sensor. As we shall see, information processing begins at the level of the retina. Scientists consider the retina to be part of the CNS.
Known collectively as photoreceptors, rods and cones serve complementary functions. **Rods** are most active in dim light and are not sensitive to color. They detect the presence or absence of photons. **Cones** are most active in bright light and are essential for color vision. Three subtypes of cones are sensitive to red, green, and blue wavelengths of light. Rods far outnumber cones except in a small patch of the retina called the fovea.
How do rods and cones convert light energy into a nerve signal?

**Vitamin A and Rhodopsin**

The photopigment 11-cis retinal is derived from Vitamin A. Humans obtain this vitamin strictly from dietary sources, esp. foods rich in carotene such as carrots and squash. A deficiency of Vitamin A leads to night blindness.
Bipolar cells transmit signal from the photoreceptors to retinal ganglion cells. A single bipolar cell may receive input from many rod cells. In contrast, a single cone cell may stimulate one bipolar cell, accounting for the high level of visual acuity produced by the fovea.
Retinal ganglion cells integrate signals from bipolar, amacrine, and horizontal cells. This signal processing ability manifests as the center/surround system that will be discussed in the next slide. The axons of RGCs form the optic nerve (CN II).
At the level of the retinal ganglion cells, information processing takes the form of center/surround fields. There are 2 basic set ups:

- ON Center/OFF Surround
- OFF Center/On Surround

Center /Surround fields function in processing not only black and white vision but color vision as well.
Once the optic nerve exits the retina, most of its fibers cross at the optic chiasm and form the optic tract. Each optic tract innervates the contralateral relay station of the thalamus known as the lateral geniculate nucleus, or LGN.

The optic radiation, including Meyer’s Loop, runs from the LGN to V1, the primary visual cortex, located in the occipital lobe of the brain.
A Closer look at the LGN

Layers 1 and 2 (green) are called magnocellular layers. Layers 3, 4, 5, and 6 (pink) are called parvocellular layers. Even though the LGN is thought of mainly as a relay nucleus, specific cell layers transmit information about an object’s shape and color (p-layers) as well as its motion (m-layers).
Signals travel from the LGN to V1. This area of the brain synthesizes a picture of the world based on colors, lines, object orientation, and the perception of motion. Much of the action in V1 involves cortical cells in Layer IV-C. The so-called **blobs** are responsible for color vision. **Interblob channels** detect edges and shapes. Finally, **M channels** are activated by the perception of motion.
Cells in V1 project to the brain’s temporal lobes along two pathways:

The middle temporal stream, MT, is concerned with analyzing motion and depth perception (the “where” aspects of vision) while IT, the inferior temporal stream, is devoted to object recognition (the “what” aspects).

The temporal lobes send information to the parietal and frontal lobes for further analysis. Ultimately, over 40% of the cerebral cortex is involved in processing visual information. This stands to reason, as vision accounts for 95% of our total sensory experience.
Visual field defects can arise from several causes including stroke, tumors, or other diseases affecting the CNS, e.g. multiple sclerosis, lupus, etc.