# Difference Between Rod and Cone Cells

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## Key Difference - Rod vs Cone Cells

The photoreceptors are cells in the retina of the eye which respond to the light. The distinguishing feature of these cells is the presence of tightly packed membrane that contains the photopigment known as **rhodopsin** or related molecules. The photopigments have a similar structure. All photopigments consist of a protein called **opsin** and a small attached molecule known as a **chromophore.** The chromophore absorbs the portion of light by a mechanism that involves the change in its configuration. The tight packing in the membranes of these photoreceptors is highly valuable in order to achieve high photopigment density. This allows the large portion of light photons which reach the photoreceptors to be absorbed. In vertebrates, the retina consists of two photoreceptors (rod and cone cells) which are bearing photopigment at their outer region. This particular region is composed of a large number of pancake-like disks. In rod cells, the disks are closed, but in the cone cells, the disks are partially open to the surrounding fluids. In invertebrates, the photoreceptors structure is very different. The photopigment was born in a regularly arranged structure called as microvilli, finger-like projections with about diameter of 0.1µm. This photoreceptor structure in invertebrates is known as **rhabdom.** The photopigments are less densely packed in the rhabdom than in vertebrates' disks. The **key difference** between rod and cone cells is that the **rod cells are responsible for vision at the low light levels (scotopic vision) while the cone cells are active at higher light levels (photopic vision).**

# What are Rod Cells?

Rod cells are the photoreceptors in the eye which can function at the low-intensity light than the other photoreceptor of the eye named as "cone cells." The rods are usually concentrated at the outer edges of the retina and are responsible for the peripheral vision. It is estimated that approximately 90 million rod cells are found in the human retina. The rod cells are found to be more sensitive than the cone cells and almost entirely responsible for the night vision. The rod cells have an only little part in the color vision. This is the reason why colors are less apparent in the darkness. The rod cells are little longer and leaner than the cone cells in structure. The opsin containing disks are seen at the end of the cell attached to the retinal pigment epithelium which in turn is attached to the sclera. The rod cells (100 million) are more common than cone cells (7 million).

The rods have three segments; outer segment, inner segment, and synaptic segment. The synaptic segment forms the synapses with another neuron (bipolar cell or horizontal cell). The inner and outer segments are connected by a cilium. The organelles like nucleus can be observed in the inner segment. The outer segment contains the light absorbing materials.

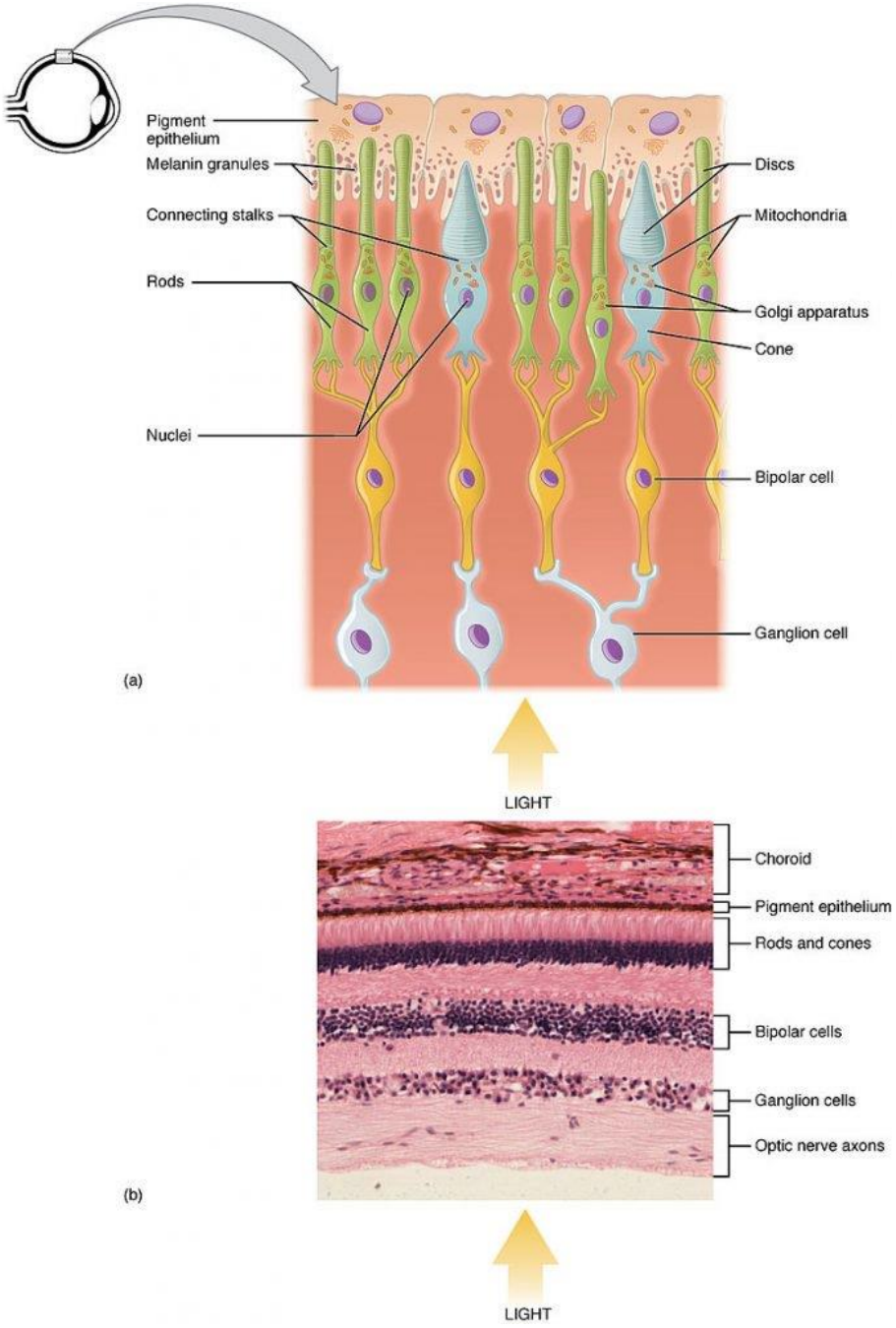


**Figure 01: Rod Cells and Cone Cells**

In vertebrates, the activation of the photoreceptor cell is known as hyperpolarization of the cell, which leads to the rod cell for not sending its neurotransmitter, that leads to the bipolar cells afterwards in the release of their neurotransmitter at the bipolar ganglion synapse to excite the synapse. So, it is a cascade reaction that takes place in that. Activation of a single unit of photosensitive pigment can give rise to the larger reaction in the cell. Thus, the rod cells can trigger a larger response to a smaller amount of light. Vitamin A deficiency causes a low amount of pigment that is needed by the rod cells. This is diagnosed as **night blindness.**

# What are Cone Cells?

The cone cell is one of the photoreceptors found in the human retina which functions best in the bright light condition and allows color vision. The color vision is based on the brain's ability to construct the colors upon receiving nerve signals from the three types of cones (L-long, S- short and M- medium), each sensitive to a different range of the visual spectrum of light. This is determined by the three types of photopsins present in the three different cone cells. Some vertebrates may have the four types of cone cells giving them the tetrachromatic vision. A partial or complete loss of cone system can cause color blindness. The cone cells are shorter than rod cells. But they are wider and tapered. They are 40-50µm in length and 0.5µm-4µm in diameter. They are tightly packed mostly, in the center of the eye (fovea). The S cones are randomly placed and have lesser frequency than the other cones (M and L) in the eye.

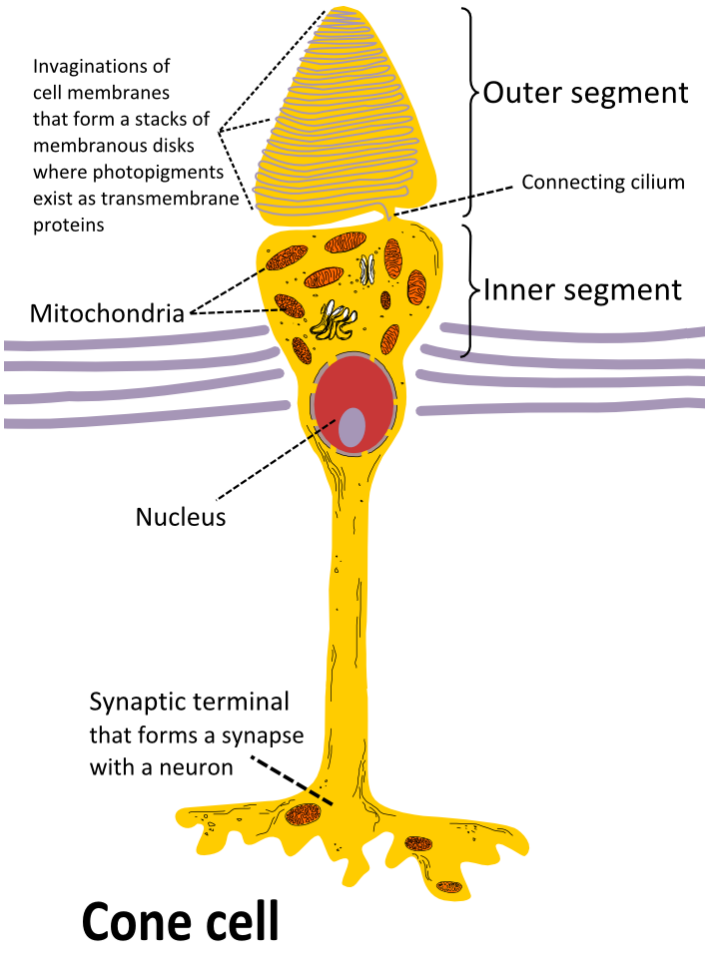


**Figure 02: Cone Cell**

The cones also consist of three segments (outer segments, inner segments, and synaptic segment). The inner segment consists of the nucleus and few mitochondria. The synaptic segment forms the synapse with a bipolar cell. Inner and outer segments are connected through a cilium. The cancer retinoblastoma is due to the defect of one gene called as RB1 in cone cells of the retina. This

situation arises in early childhood. This particular gene controls the signal transduction and normal cell cycle progression.

## What are the Similarities Between Rod and Cone Cells?

- Both are found in the retinal of the eye.
- Both are photoreceptors.
- Both contain visual pigments.
- Both are types of secondary exteroceptors.

## What is the Difference Between Rod and Cone Cells?

| Rod Cells vs Cone Cells | |
|---|---|
| Rod cells are the photoreceptors responsible for vision at the low light levels. | Cone cells are the photoreceptors responsible for vision at the high-intensity light levels. |
| **Number of Photopigments** | |
| Rod cells have more photopigments. | Cone cells have fewer photopigments. |
| **Amplification** | |
| Rod cells show more amplification. | Cone cells show less amplification. |
| **Directionally Selectiveness** | |
| Rod cells do not show directionally selectiveness. | Cone cells show directionally selectiveness. |
| **Sensitivity** | |
| Rod cells have a high sensitivity. | Cone cells have a low sensitivity. |
| **Convergent Retinal Pathway** | |
| Rod cells do have a high convergent retinal pathway. | Cone cells do have a less convergent retinal pathway. |
| **Response** | |
| Rod cells show a slow response. | Cone cells show a fast response. |
| **Acuity** | |
| Rod cells show low acuity. | Cone cells show high acuity. |
| **Pigment Types** | |

| | |
|---|---|
| Rod cells have only one type of pigments | Cone cells have three types of pigments. |
| **Visual Pigments** | |
| The visual pigment in the rod cells is Rhodopsin. | The visual pigment in the cone cells is Iodopsin. |

# Summary - Rod vs Cone Cells

The photoreceptors (rod and cone cells) are cells in the retina of the eye which respond to the light. The distinguishing feature of these cells, is the presence of tightly packed membrane that contains the photopigment; rhodopsin or related molecules. The tight packing in the membranes of these photoreceptors is highly valuable in order to achieve a high amount of photopigment density and number. This allows a large portion of light photons that reach the photoreceptors to be absorbed. In vertebrates, the retina consists of two photoreceptors (rod and cone cells) which bear photopigment constituted in the outer region. This particular region is composed of a large number of pancake-like disks. The rod cells can function at low-intensity light (Scotopic)**.** On the other hand, the cone cells are active at high-intensity light (Photopic). This is the difference between Rod and Cone Cells.

**Reference:**

1."Cone cell." Wikipedia, Wikimedia Foundation, 22 Oct. 2017. Available here

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