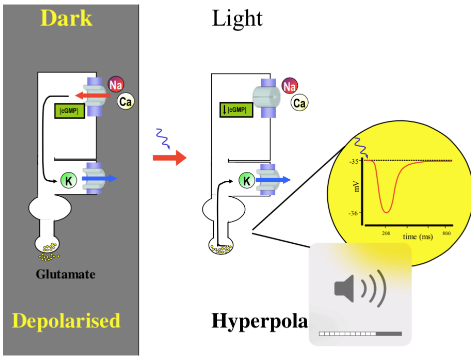
Lecture 11 Vision 2

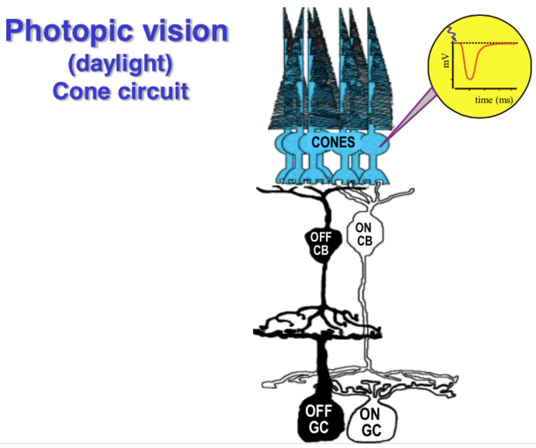
- Retina: Cone and Rod pathways
- Ganglion cell receptive fields
- Other GC functions: Direction selectivity and ipGC



In rods, when they are in the dark the cell is depolarized with active cGMP and releases glutamate.

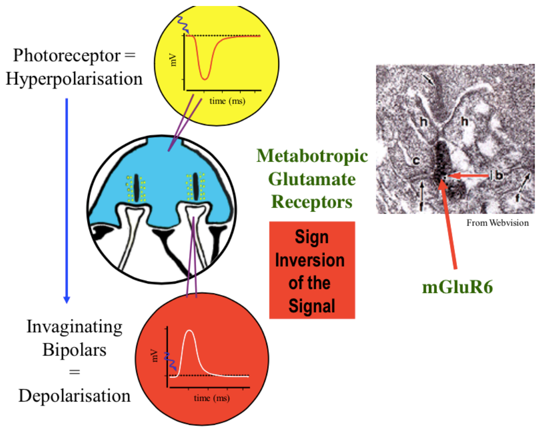
The cell inactivates in the light, reducing cGMP activity and becomes hyperpolarised

Bipolar cells



Bipolar cells are graded neurons, they do not produce action potentials. They are good at encoding light intensities

When cone cells are exposed to light, the ON bipolar cells are depolarized, and the OFF bipolar cells are hyperpolarized

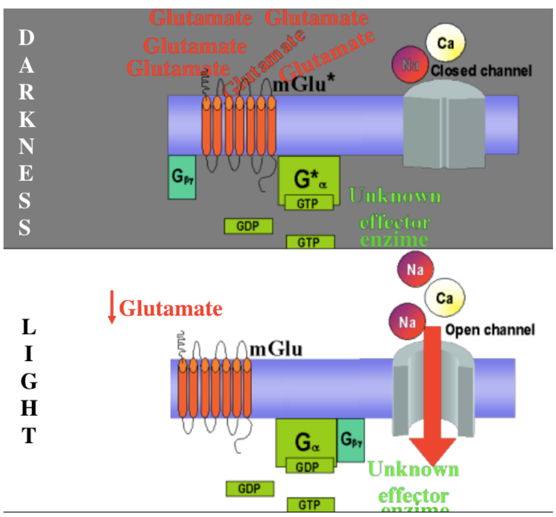


The ON cone bipolar cells

These cells are located in the **inner plexiform layer,** and stratify deeper in this layer (the ON-sublamina)

ON cone bipolar cell **dendrites** have specialized contacts (***invaginating contacts***), which express metabotropic glutamate receptors on their surface.
mGluR6

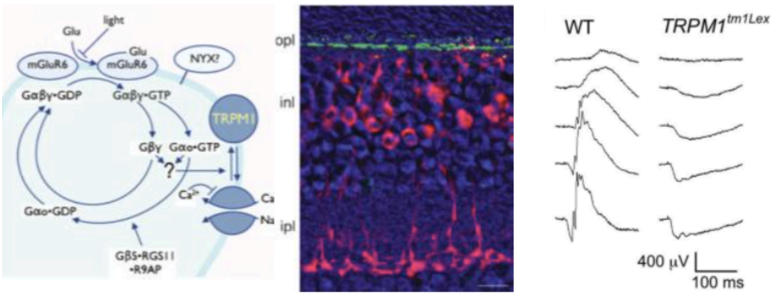
These receptors cause **sign inversion** of the signal, a hyperpolarization in the photoreceptor is turned into a depolarization in the ON bi-polar cells.

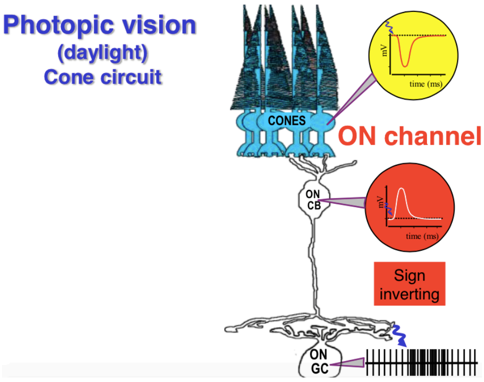


In the dark the mGluR6 is surrounded by glutamate and is activated, and activation keeps a membrane channel closed.

When light is present the concentration of glutamate decreases and the mGluR6 is less active causing the membrane cation channel to open

TRPM1 is the target of the mGluR6 signal transduction cascade

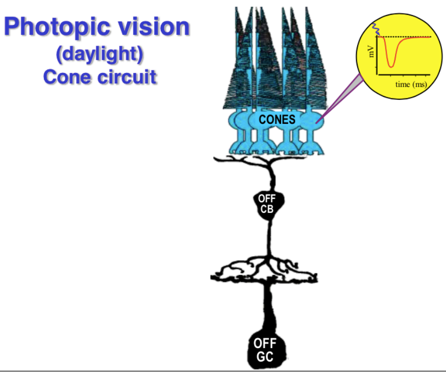


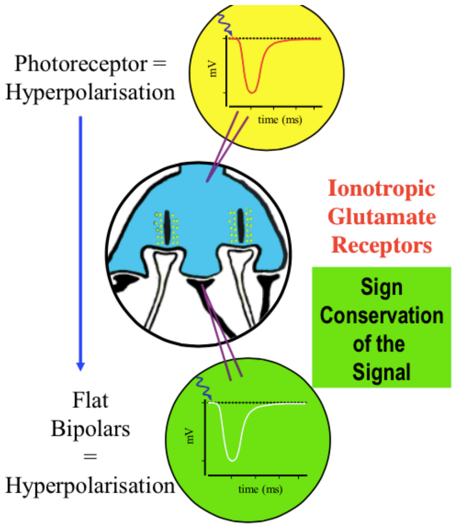


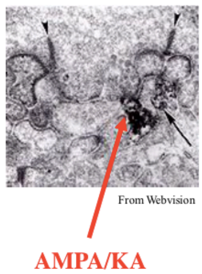
Sign inversion from the cone receptor to the ON bipolar cell.

Next an ON ganglion cell is stimulated

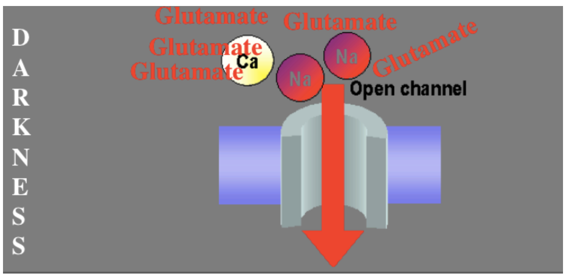
OFF Bipolar cells







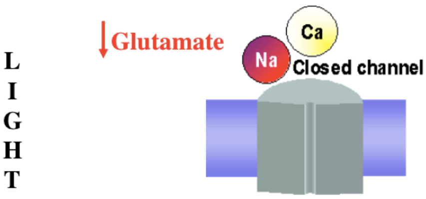
- OFF bipolar cells conserve the signal from the photoreceptor, and have non-specialised ***flat contacts*** with the base of the photoreceptor terminal
- These cells express **AMPA/KA** receptors which are ionotropic

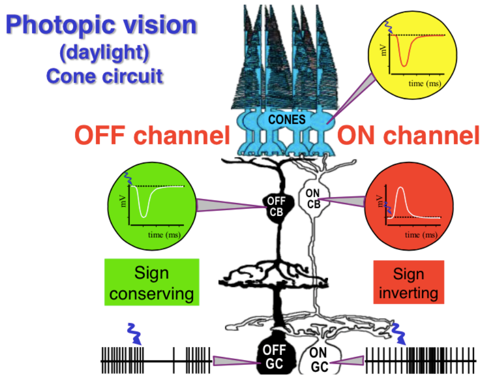


So in the dark when there is a constant photoreceptor release of glutamate, the ionotropic receptor in the OFF bi-polar cell is open and depolarized.

When light stimulates the photoreceptor, the concentration of glutamate decreases, and the ionotropic receptors close. Causing hyperpolarization.

Therefore conservation of the hyperpolarization signal.

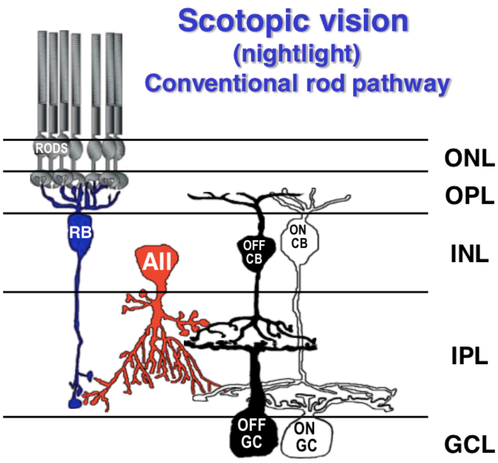




This is part of the **parallel processing**. In this case a single signal is noticed by two different cells. One of these cells will increase its activity but the other will decrease its activity

This system allows better **discrimination,** with changes in light intensities

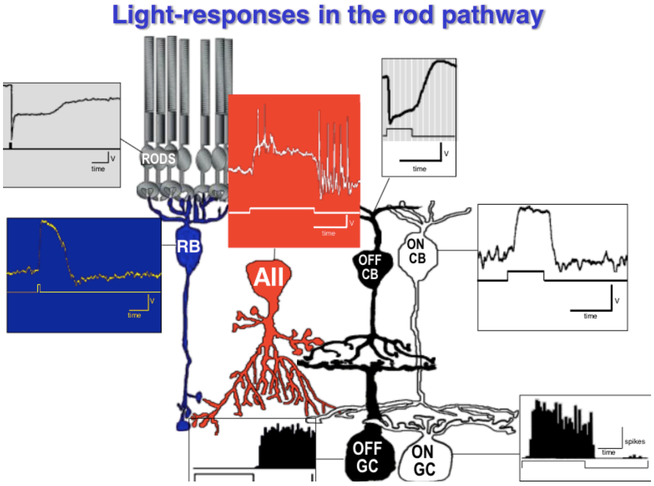
Scotopic vision (nightlight)



The rod bipolar cells to connect directly to the ganglion cells.

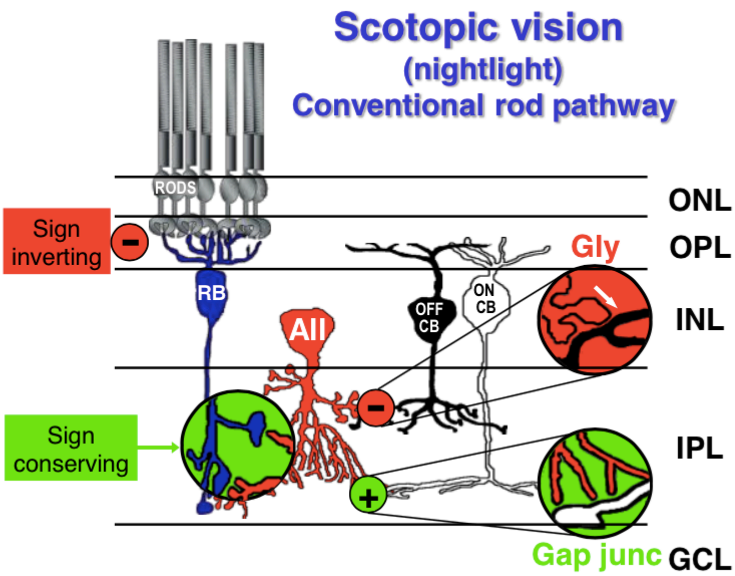
In daytime signal we saw there was a separation of the signal in the **outter plexiform layer.**

In this case there is only one type of bipolar cell and the splitting of the signal takes place in the **inner plexiform layer**



The bipolar cell of the rod is an ON bipolar cell so it depolarizes in response to light, and this cell also expresses **mGluR6**

But then it passes the signal to the **A2 amacrine cell.** This is the cell that will split the signal into the ON or OFF channel



From the rods to the ON bipolar cell there is sign inversion in the **outer plexiform layer**

Between the ON bipolar cell of the rod and the A2 amacrine cell there is a conservation of the signal so this synapse uses **ionotropic GluR,** causing the A2 cell to depolarize in response to light.

The amacrine cell has lobular appendages with varicosities, and in the inner most part of the inner plexiform layer the A2 cell has arboreal (thin) dendrites.

Lobular Appendages = Contact OFF cone bipolar cells ***(Releases glycine inhibiting OFF CB)***

Arboreal = Contact ON cone bipolar cells, at this synapse there are **gap junctions. (*conservation of signal)***