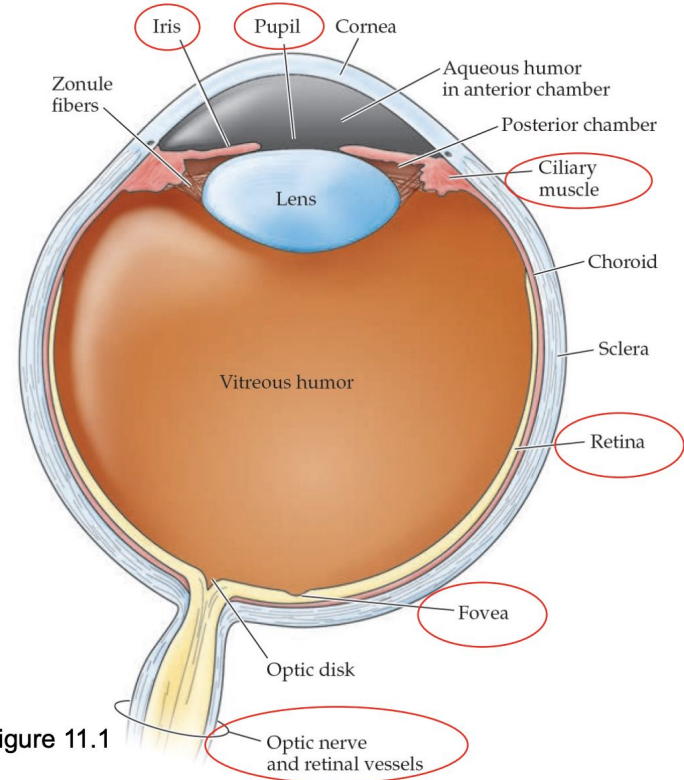


BIO-311 Neuroscience

Vision: the Retina

Anatomy of the eye

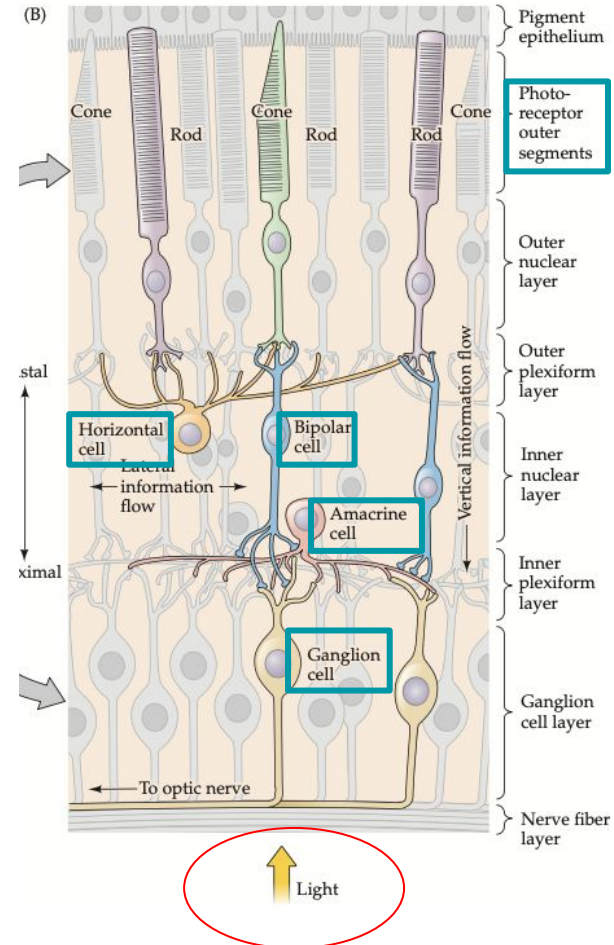
- Photoreceptor cells;
Primary sensory
transduction in vision
- Structure of the retina;
Five major neuron types
- Blind spot and fovea
- Scotopic (rod-based) and
photopic (cone-based)
vision; Rod and cones



Purves, Figure 11.1

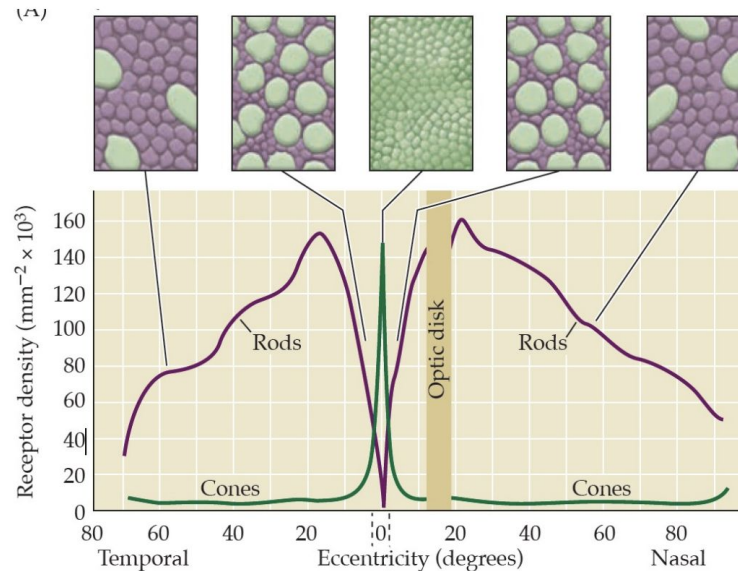
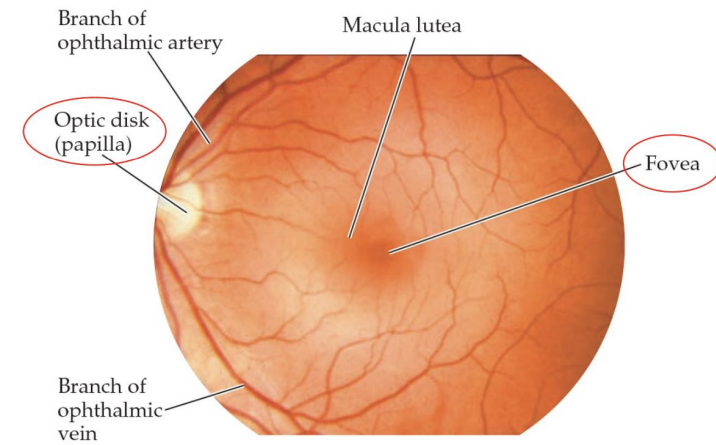
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Anatomy of the eye

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Rod system:

- Low spatial resolution
- High light sensitivity

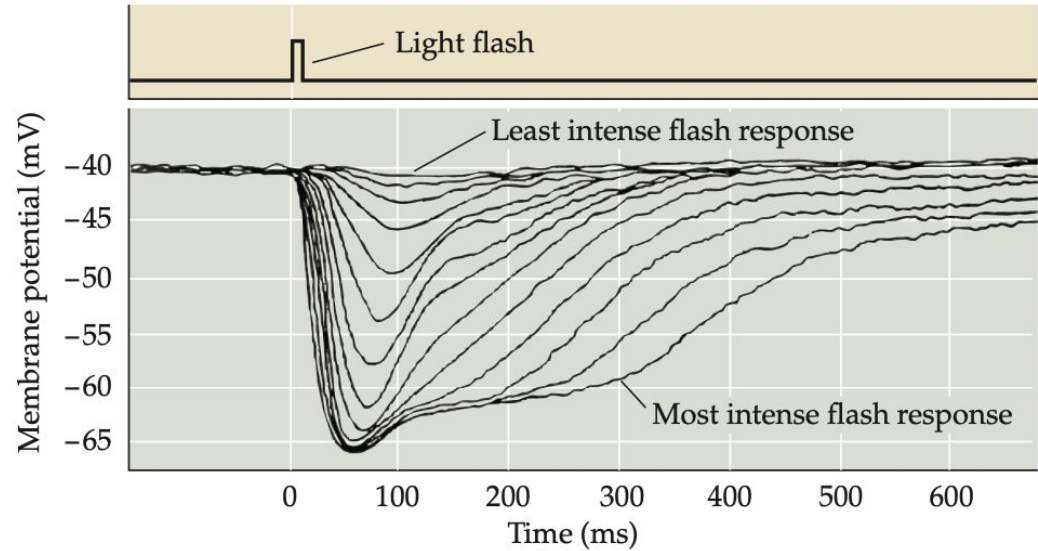
Cone system:

- High spatial resolution (high "acuity")
- Lower light sensitive

↑ ↑ In the fovea there is a high density of cones

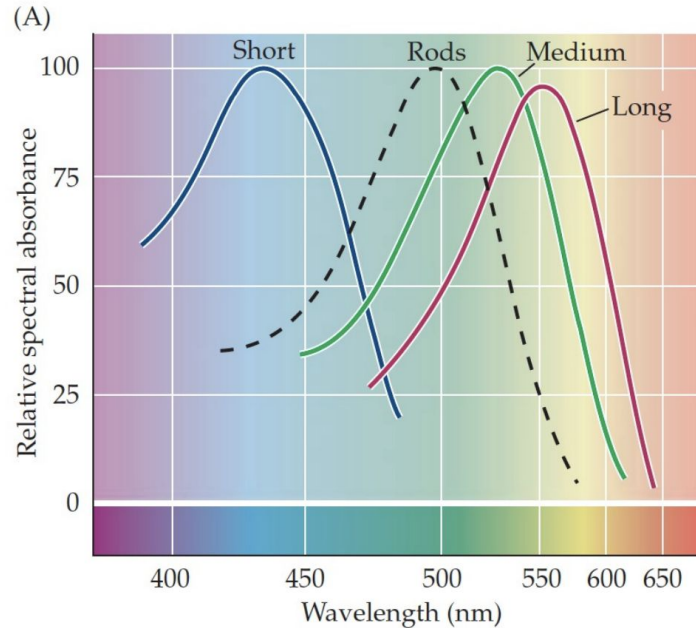
Hyperpolarisation of the photoreceptors

- graded voltage signal vs action potentials
- hyperpolarisation signal



Function of the retina

- Color vision: S-, M-, L- cones;
- Color blindness
- Concept of receptive field (in general) of a sensory neuron
- Light adaptation



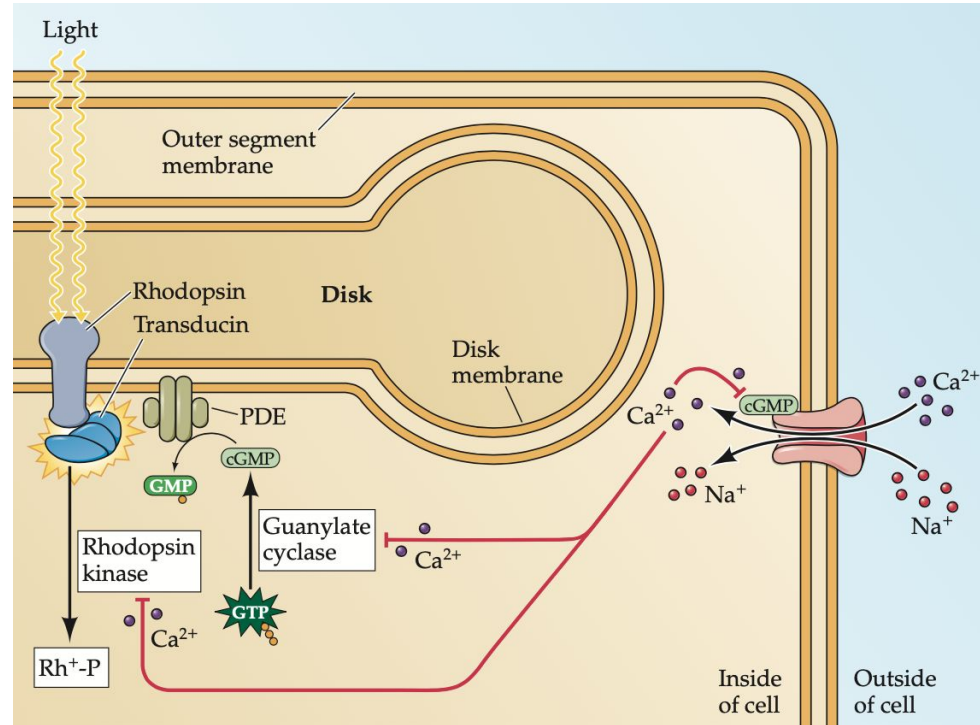
S-cones M-cones L-cones

Primates including humans:
Trichromatic color vision

Other mammals:
Dichromats (no M-cones)

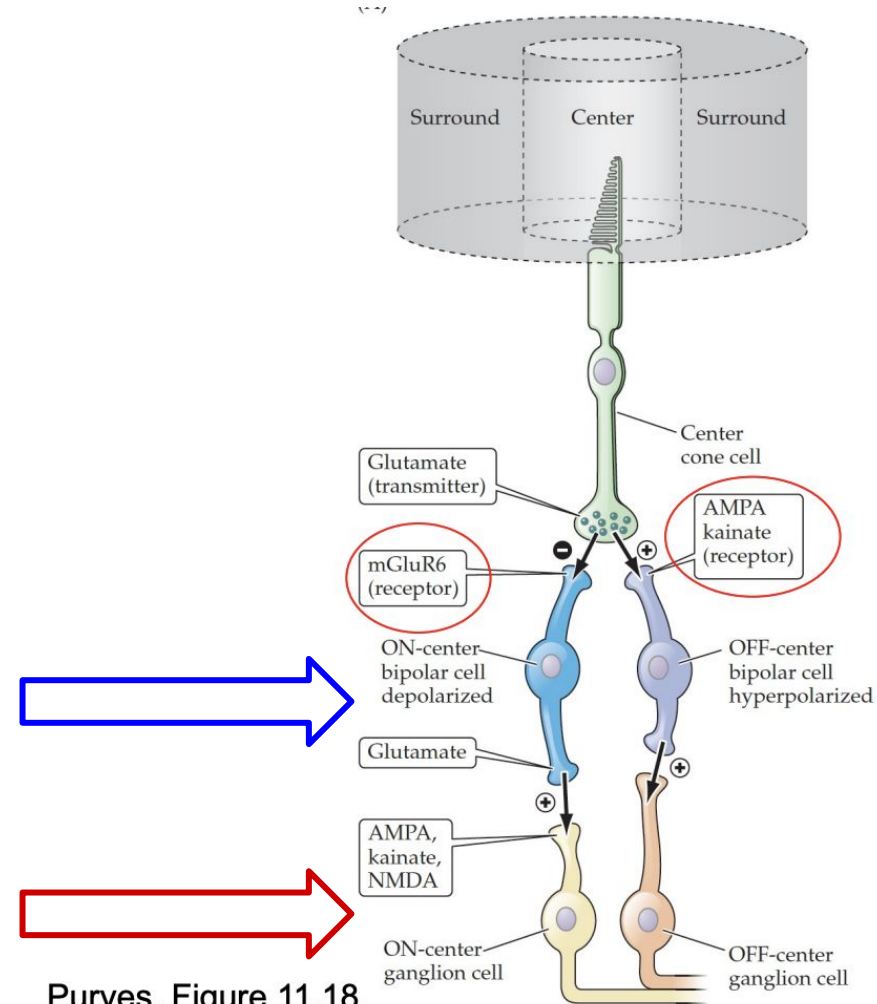
Mechanism of photoreceptor adaptation

- Mainly Ca^{2+} mediated
- The system does not encode absolute light intensity!



Processing of visual information

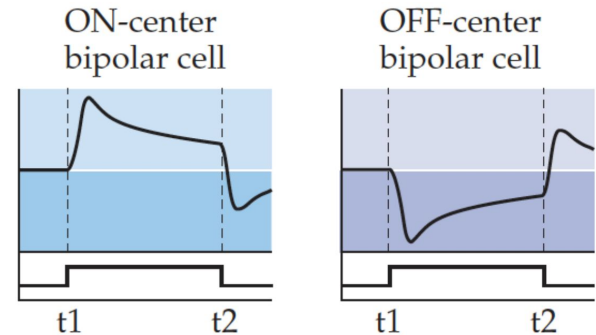
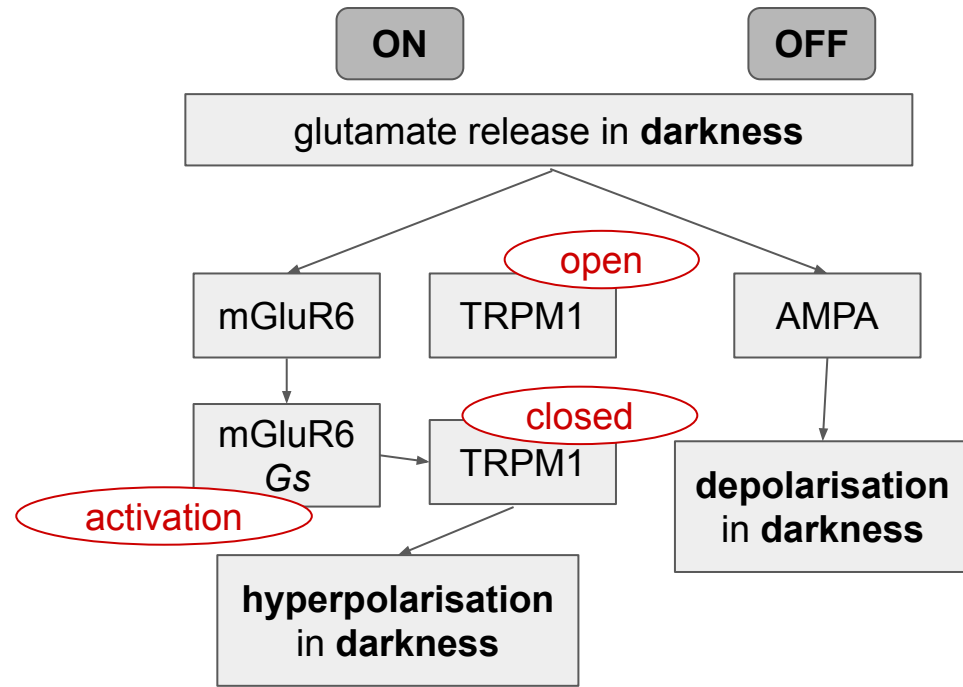
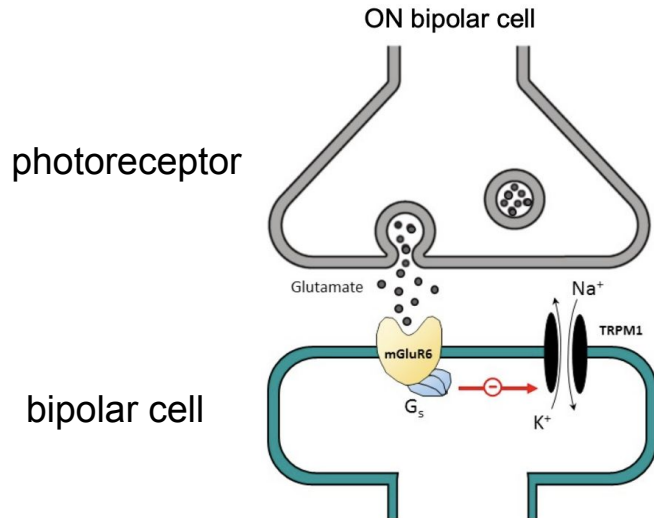
- ON and OFF bipolar cells and mechanisms
- Center-surround receptive field organization of ON-center and of OFF-center RGCs



Purves, Figure 11.18

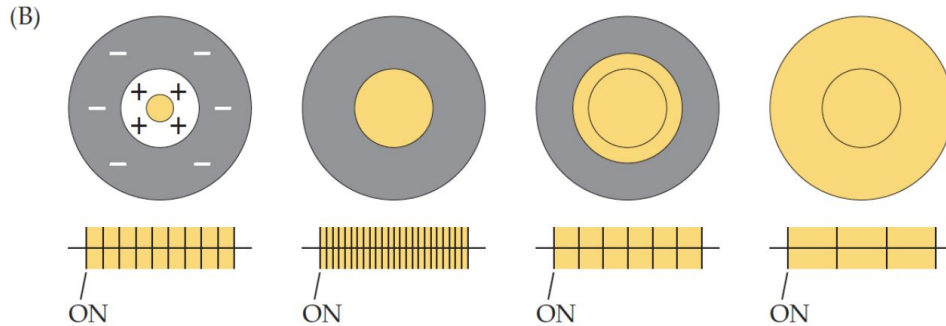
Processing of visual information

- ON and OFF bipolar cells and mechanisms
- Center-surround receptive field organization of ON-center and of OFF-center RGCs

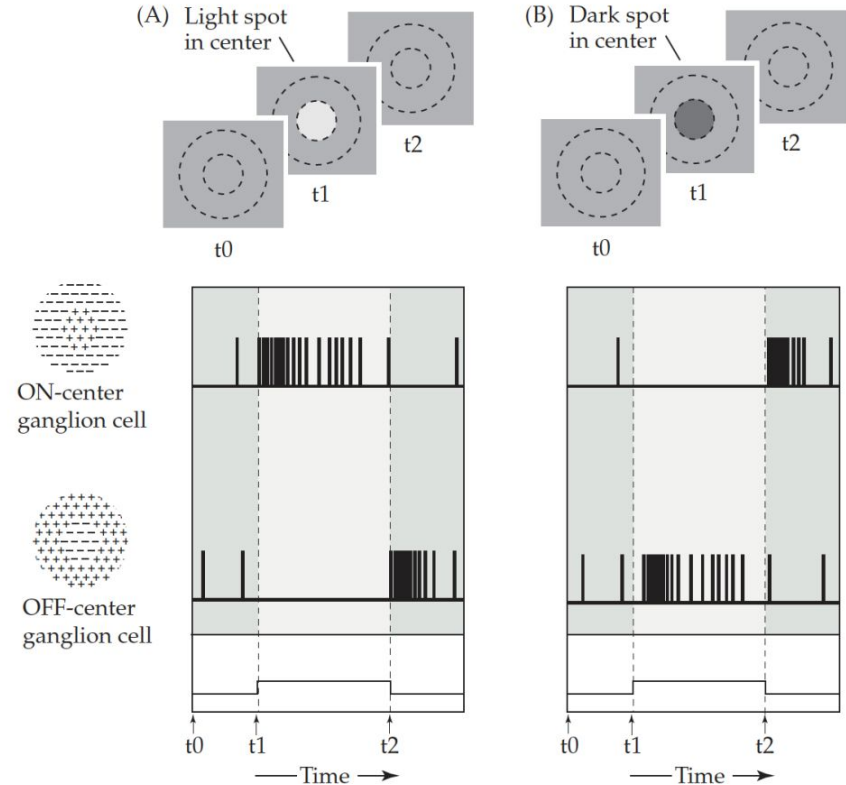


Processing of visual information

- ON and OFF bipolar cells and mechanisms
- Center-surround receptive field organization of ON-center and of OFF-center RGCs



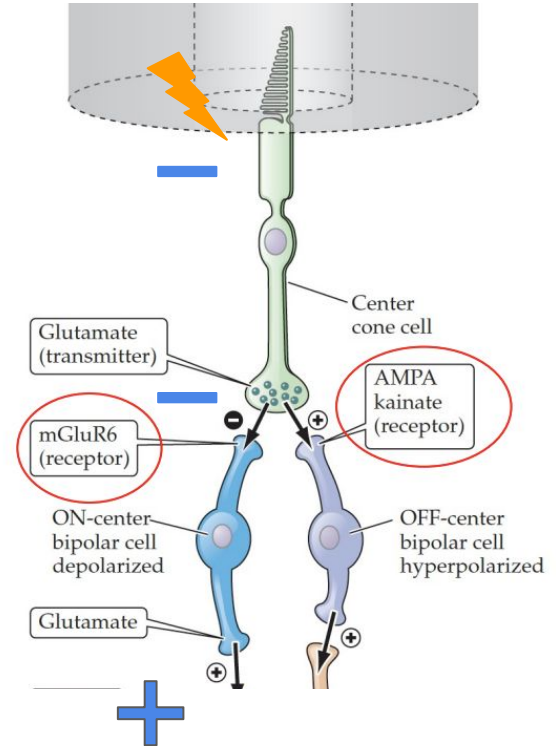
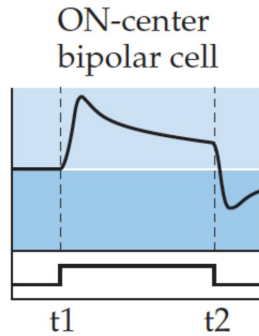
Luminance **contrast** is important



ON-center and OFF-center **Retinal Ganglion Cells**

“sign inversion” leading to the ON bipolar cell pathway

- Double negative response = positive response
 - **Hyperpolarisation** of the photoreceptors in **light**
 - **Blocking** of the mGluR6 pathway in **light**
 - = constitutively open TRPM1 cation channel
 - = **depolarisation** in **light**



Mechanism of surround inhibition

- Horizontal cells:
 - GABAergic -> hyperpolarisation
 - Since photoreceptors react through hyperpolarisation, horizontal cells **amplify** the signals normally
- When there is a large spot:
 - hyperpolarisation of photoreceptors
 - hyperpolarisation of horizontal cells
 - reduced GABA release
 - **reduced** sensitivity

