

11

Vision II

Image formation

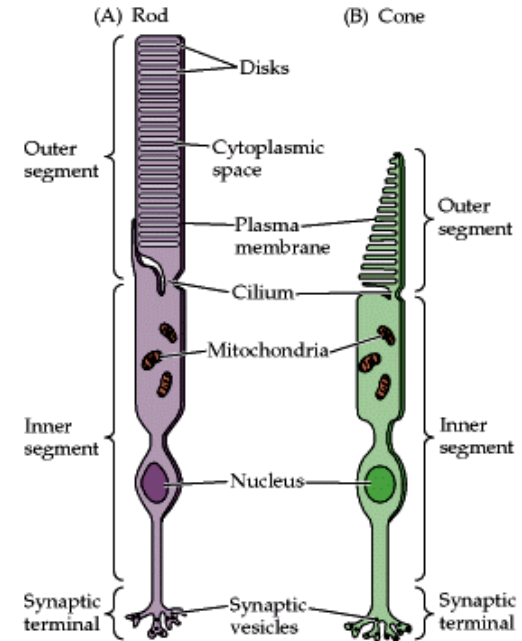
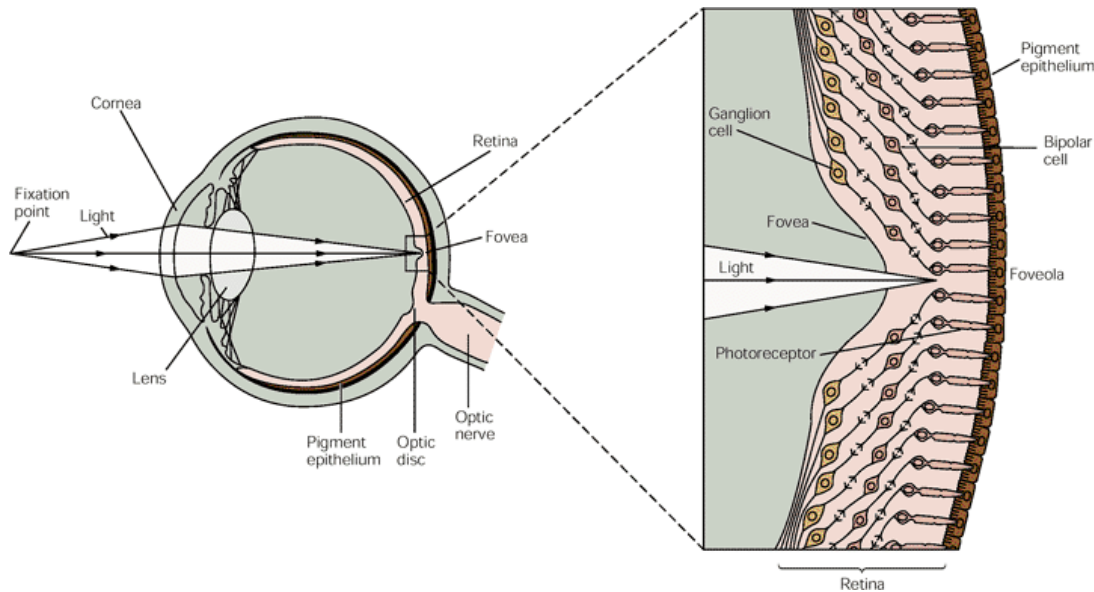


Table 26-1 Differences Between Rods and Cones and Their Neural Systems

Rods

High sensitivity to light, specialized for night vision
 More photopigment, capture more light
 High amplification, single photon detection
 Low temporal resolution: slow response, long integration time
 More sensitive to scattered light

Rod system

Low acuity: not present in central fovea, highly convergent retinal pathways
 Achromatic: one type of rod pigment

Cones

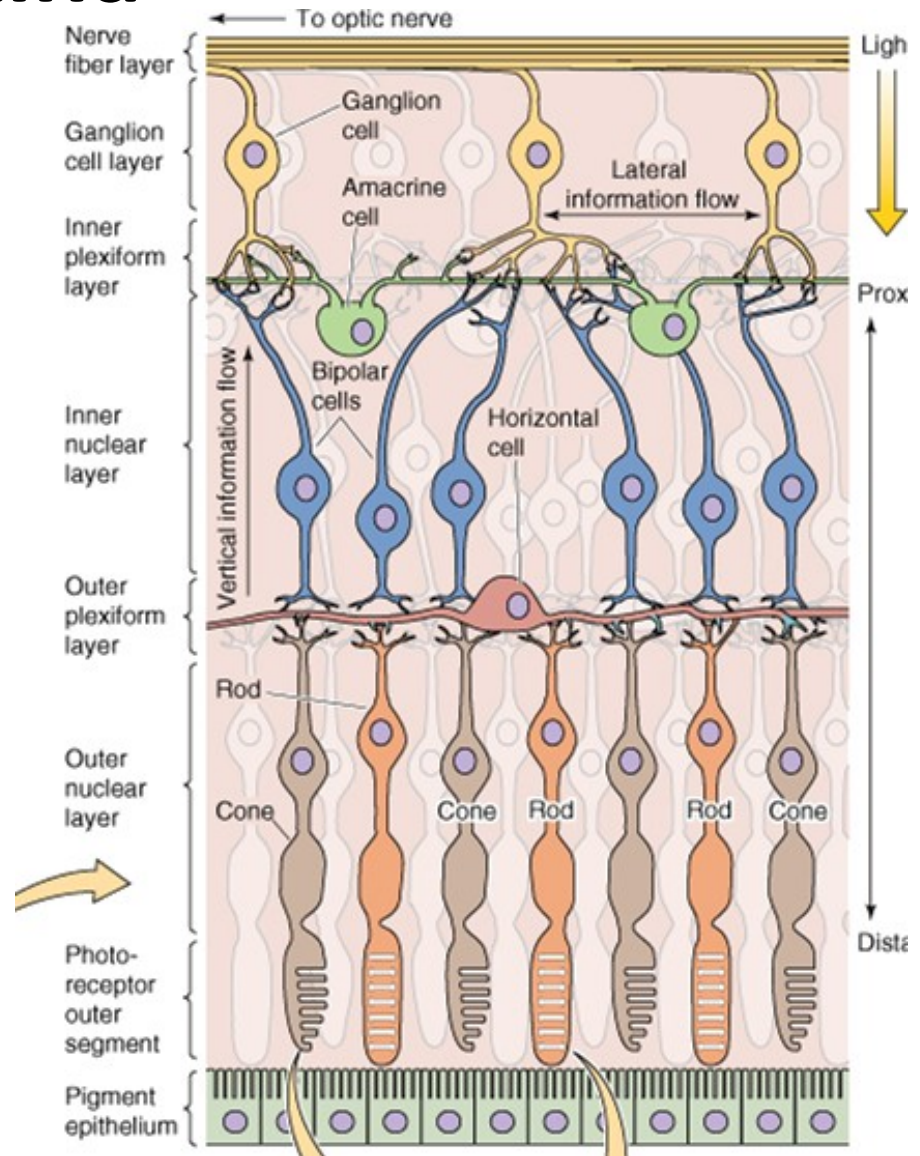
Lower sensitivity, specialized for day vision
 Less photopigment
 Lower amplification
 High temporal resolution: fast response, short integration time
 Most sensitive to direct axial rays

Cone system

High acuity: concentrated in fovea, dispersed retinal pathways
 Chromatic: three types of cones, each with a distinct pigment that is most sensitive to a different part of the visible light spectrum

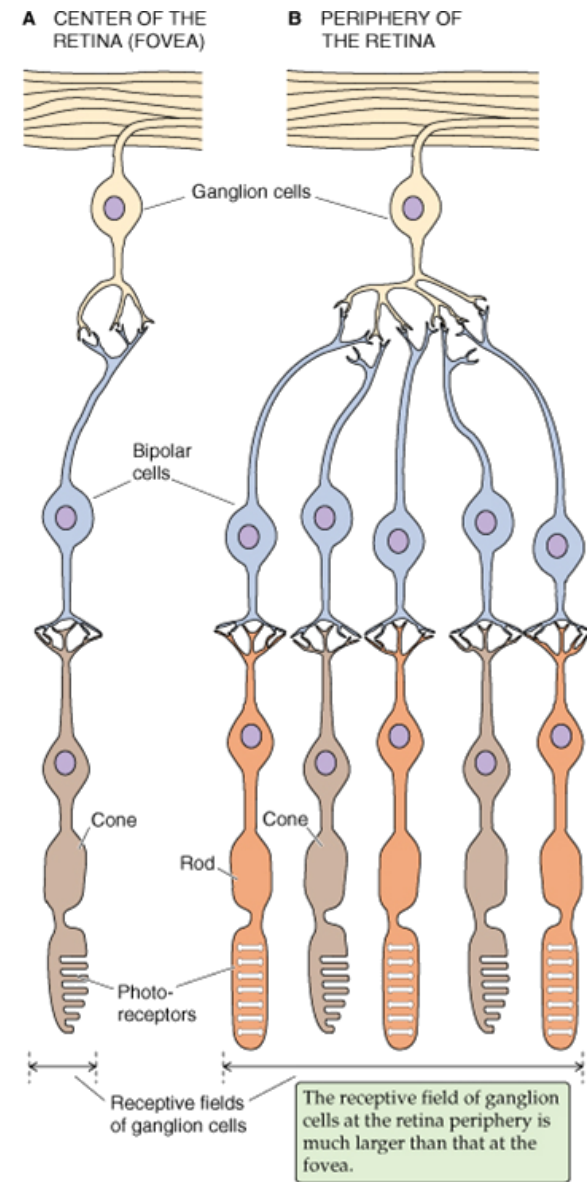
Retina

- Photoreceptors
- Interneurons
 - Horizontal cells
 - Horizontal interconnection
 - Bipolar cells
 - Vertical interconnection
 - Amacrine cells
 - Both horizontal and vertical interconnection
- Ganglion cells
 - AP generation
 - Transmission of AP to the brain

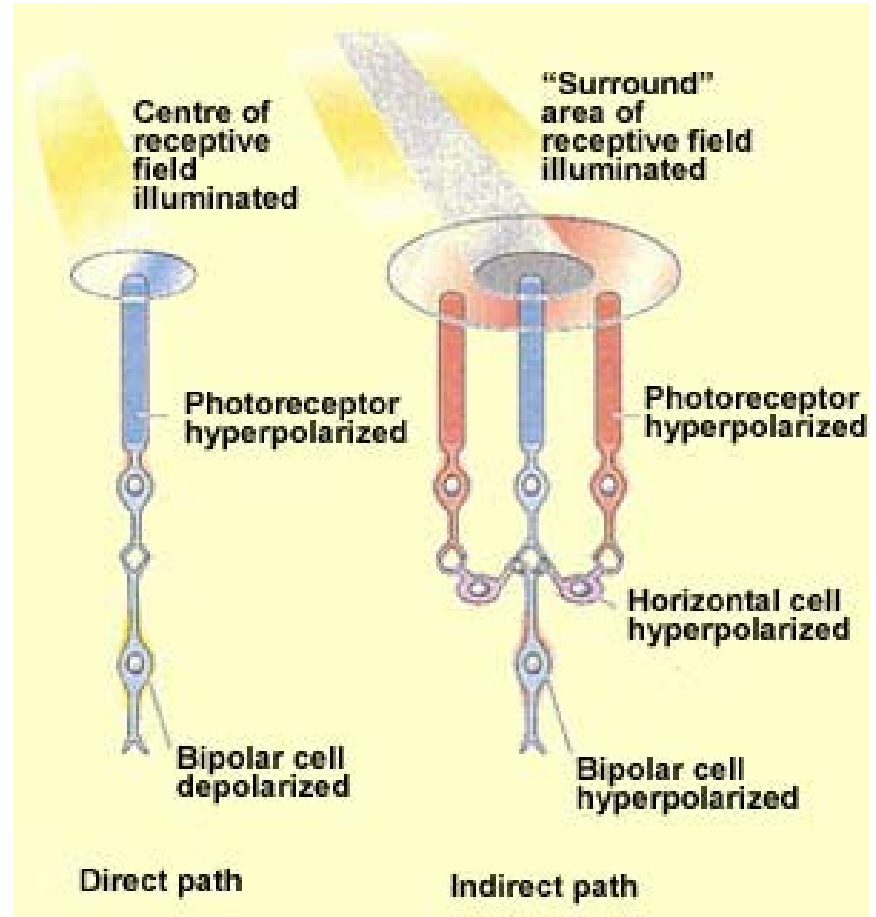
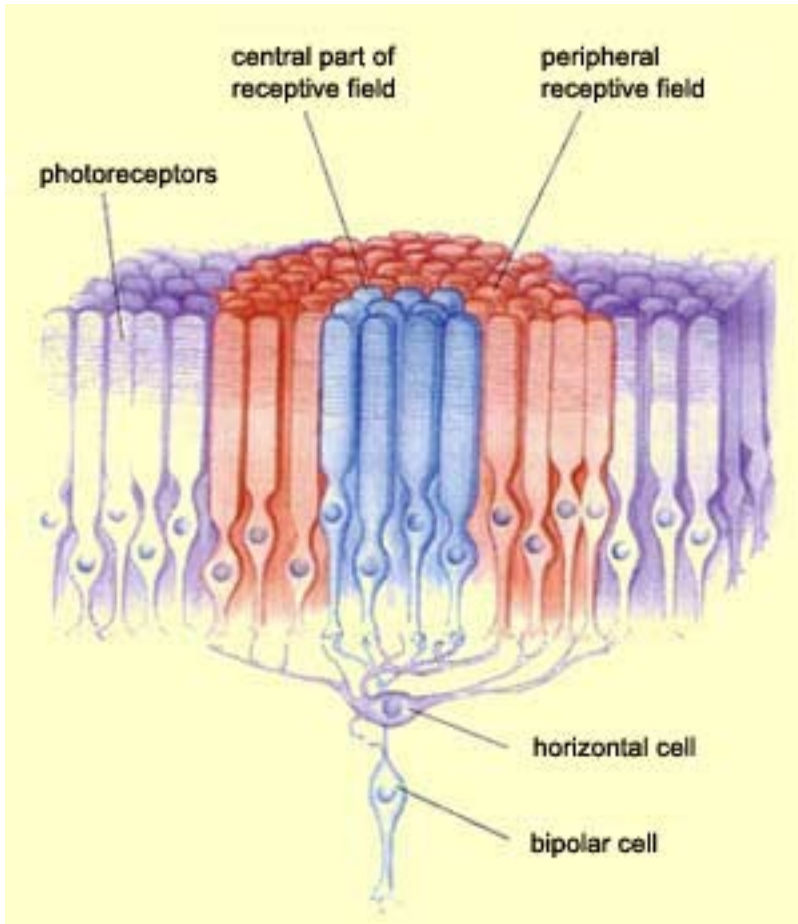


Retina

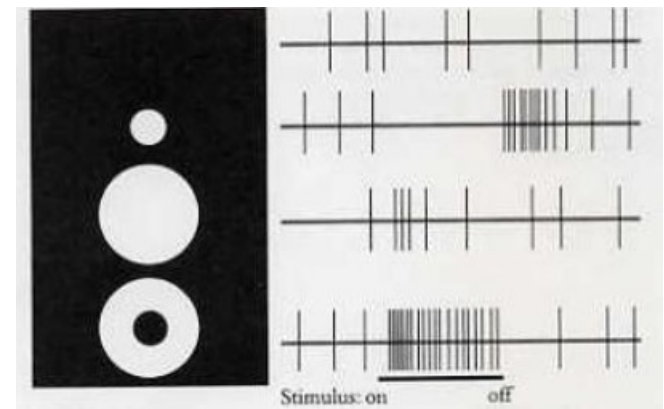
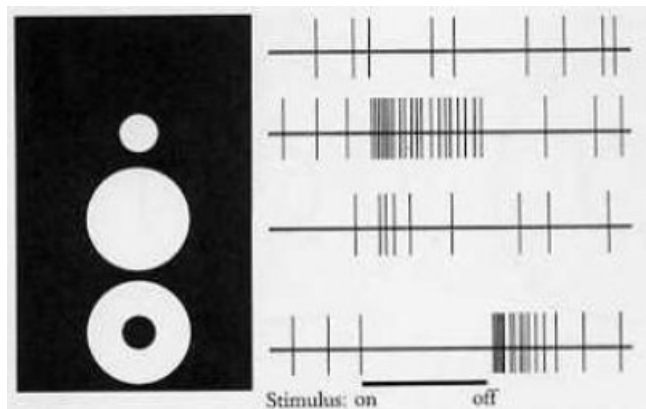
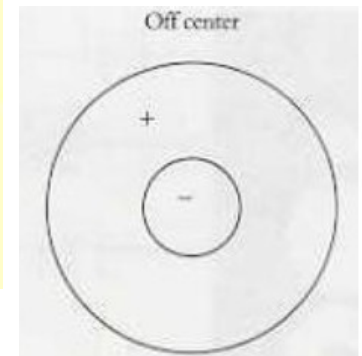
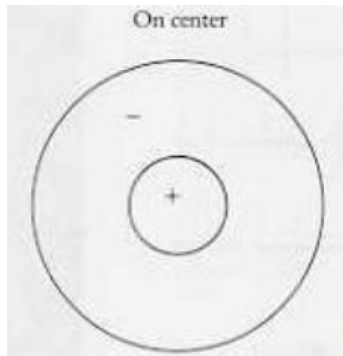
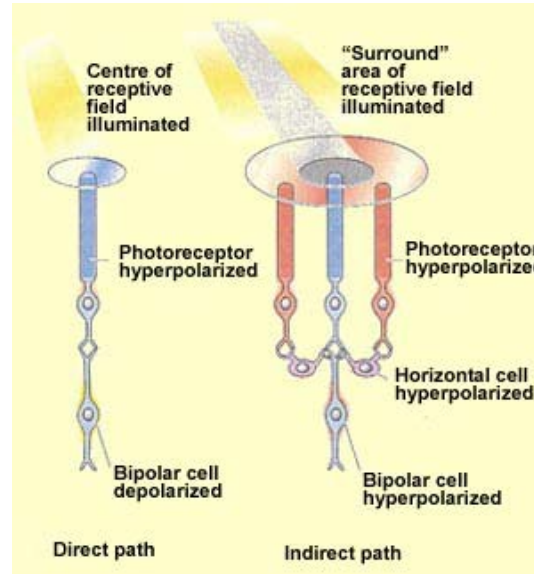
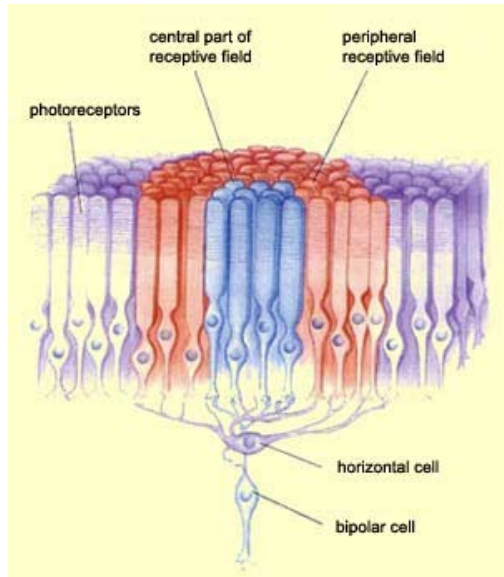
- Fovea
 - Low convergence
 - Small receptive field
 - High resolution
 - Lower sensitivity to light
- Periphery of retina
 - High degree of convergence
 - Large receptive field
 - Low resolution
 - High sensitivity to light



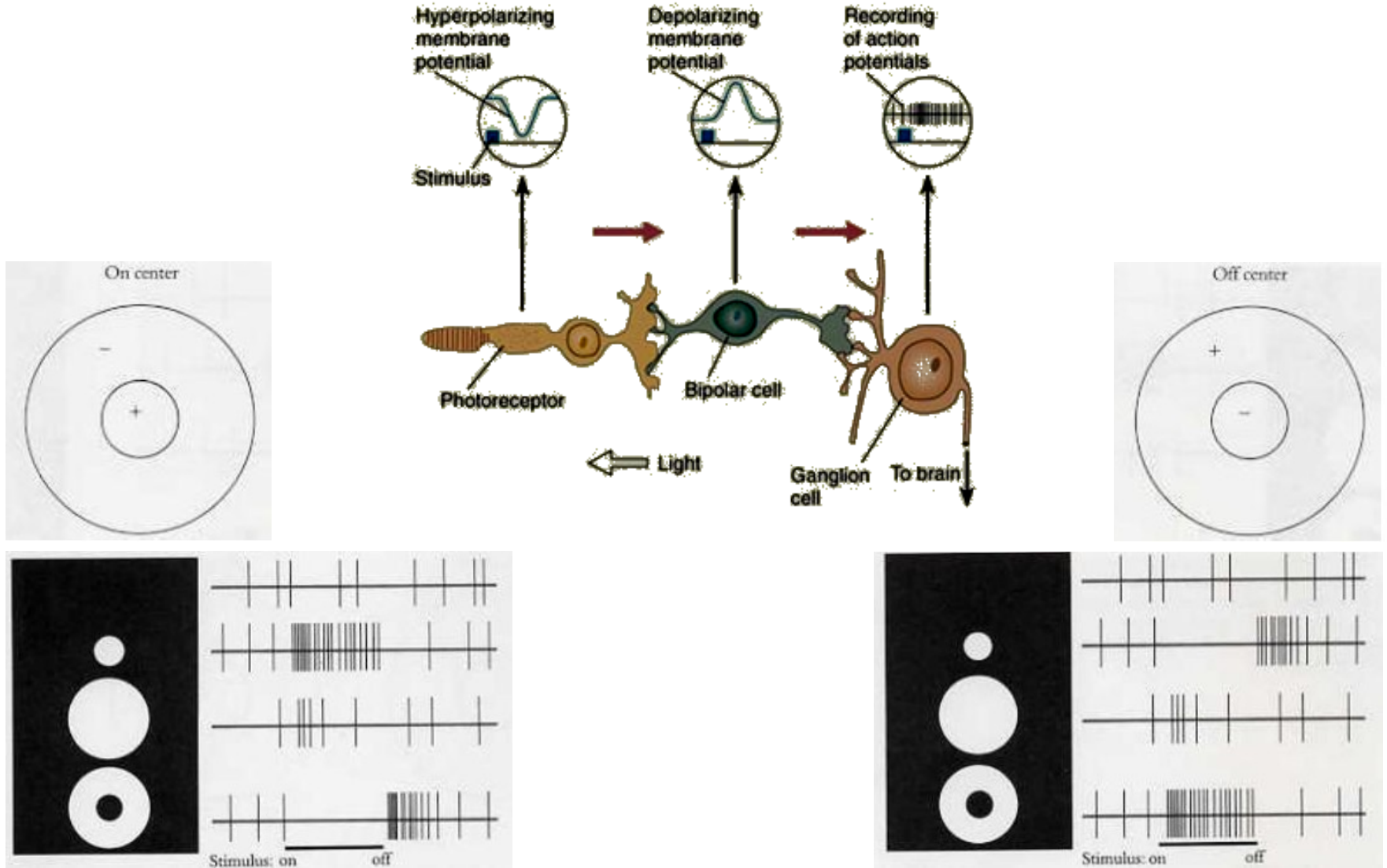
Receptive field



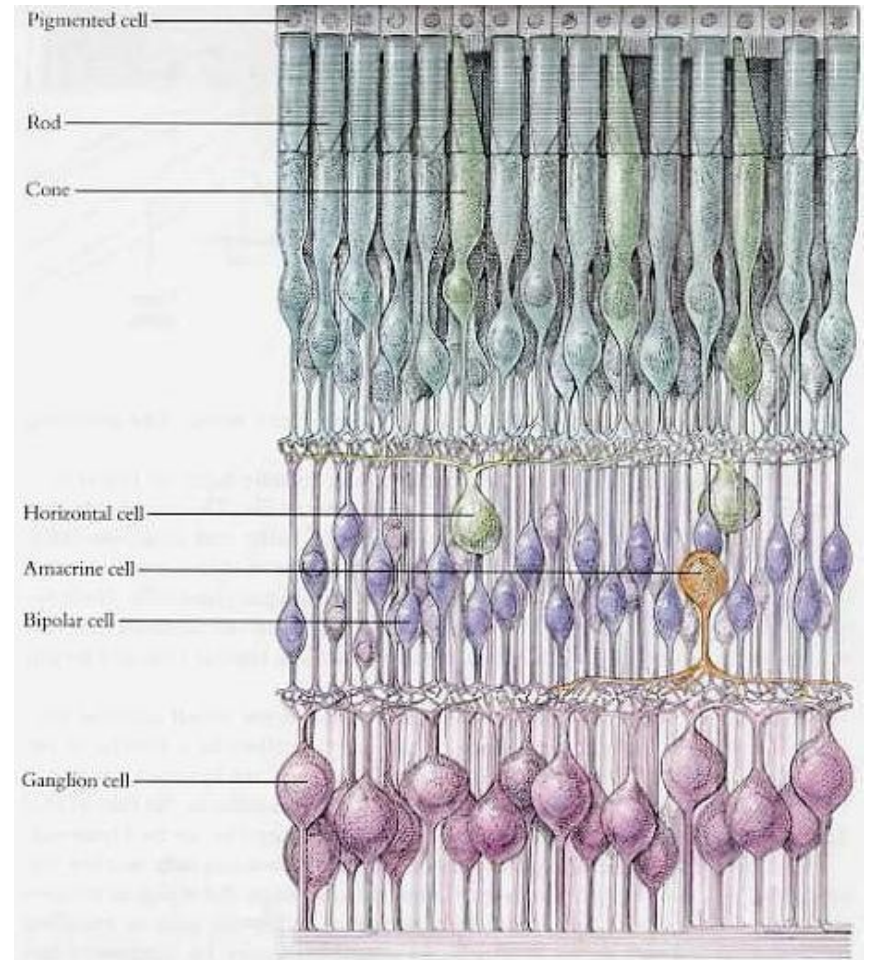
Receptive field



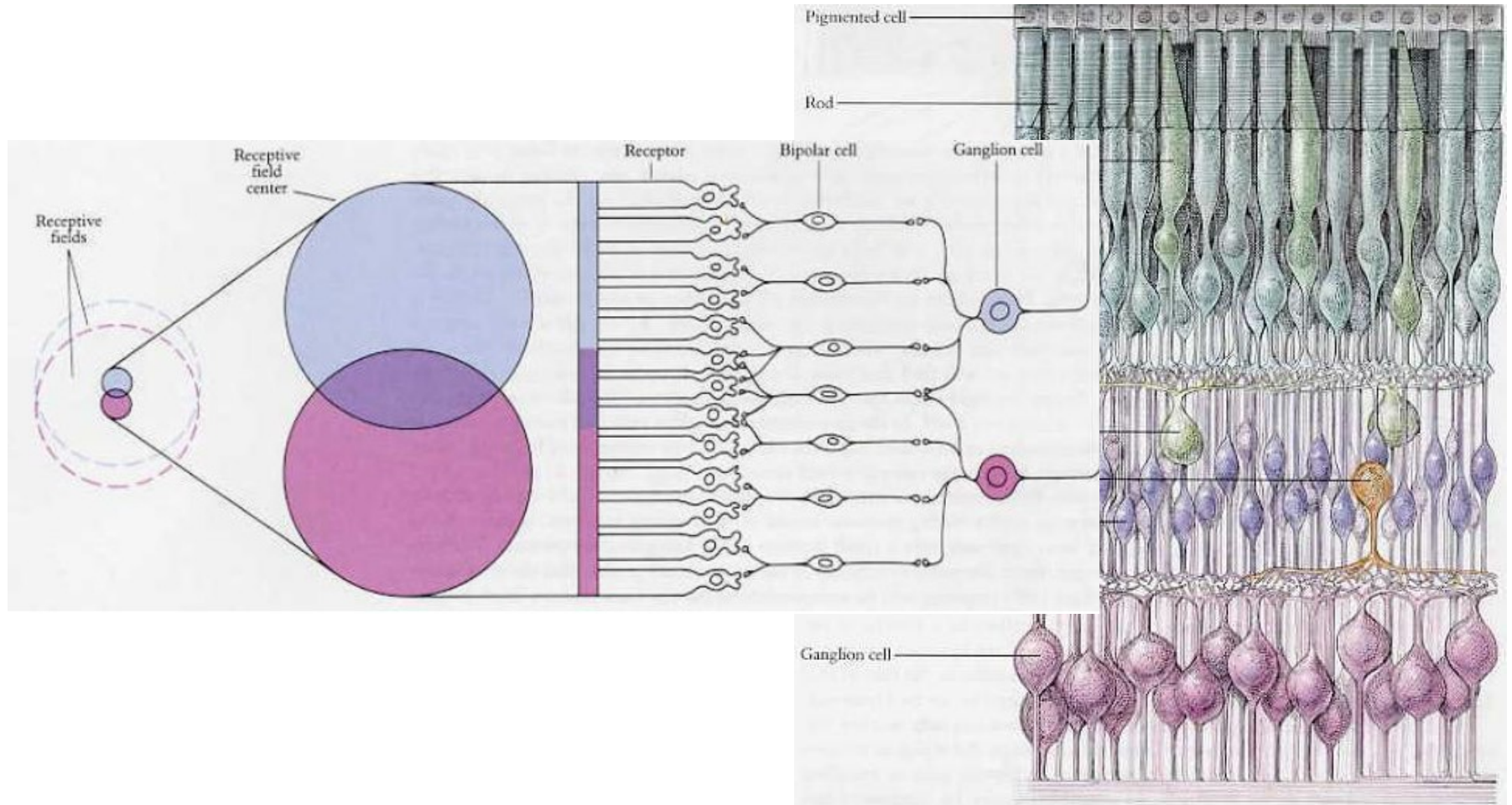
Receptive field



Receptive field

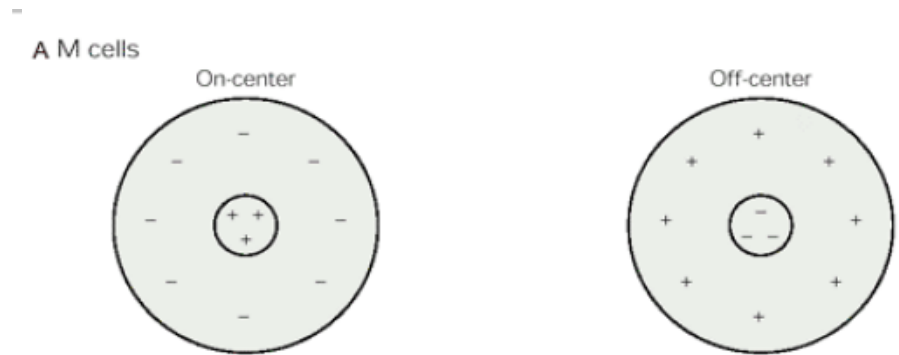


Receptive field



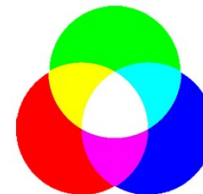
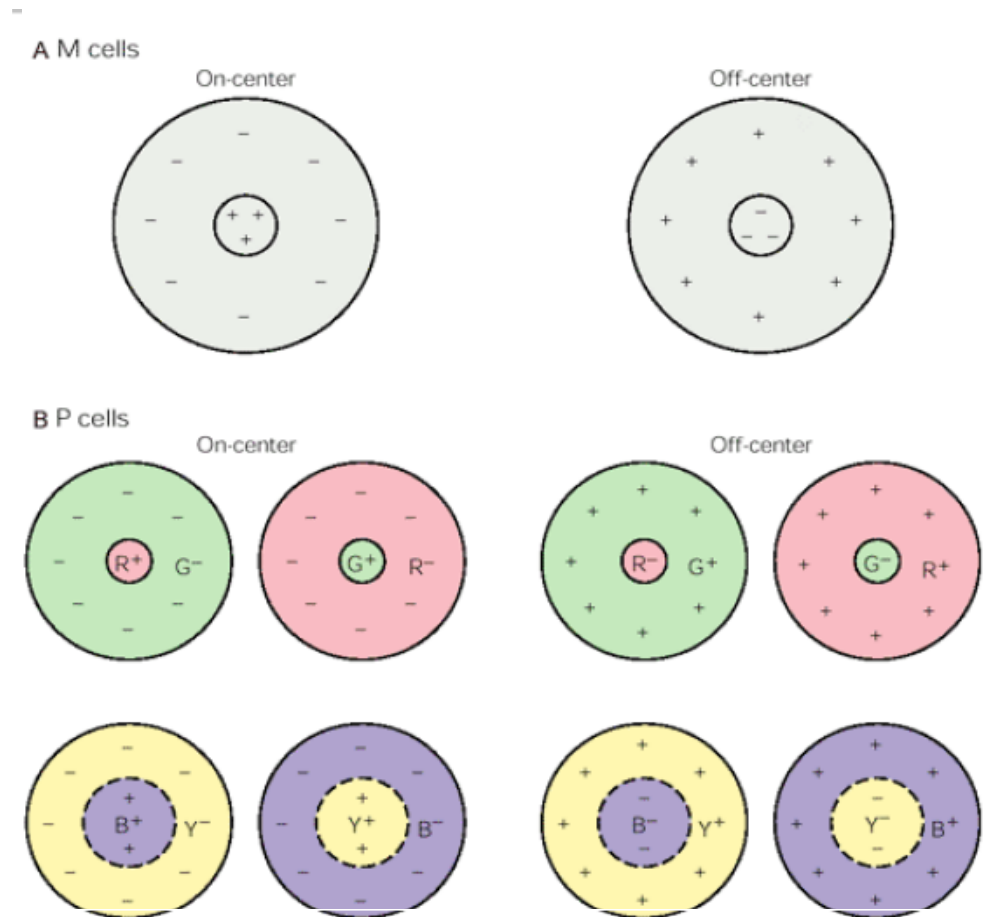
Receptive field

- Magnocellular system
 - Large receptive field
 - Rods and cones
 - **M ganglion cells (10%)**
 - High speed of velocity
 - Brightness/low contrast sensitivity
 - Minimal sensitivity to color



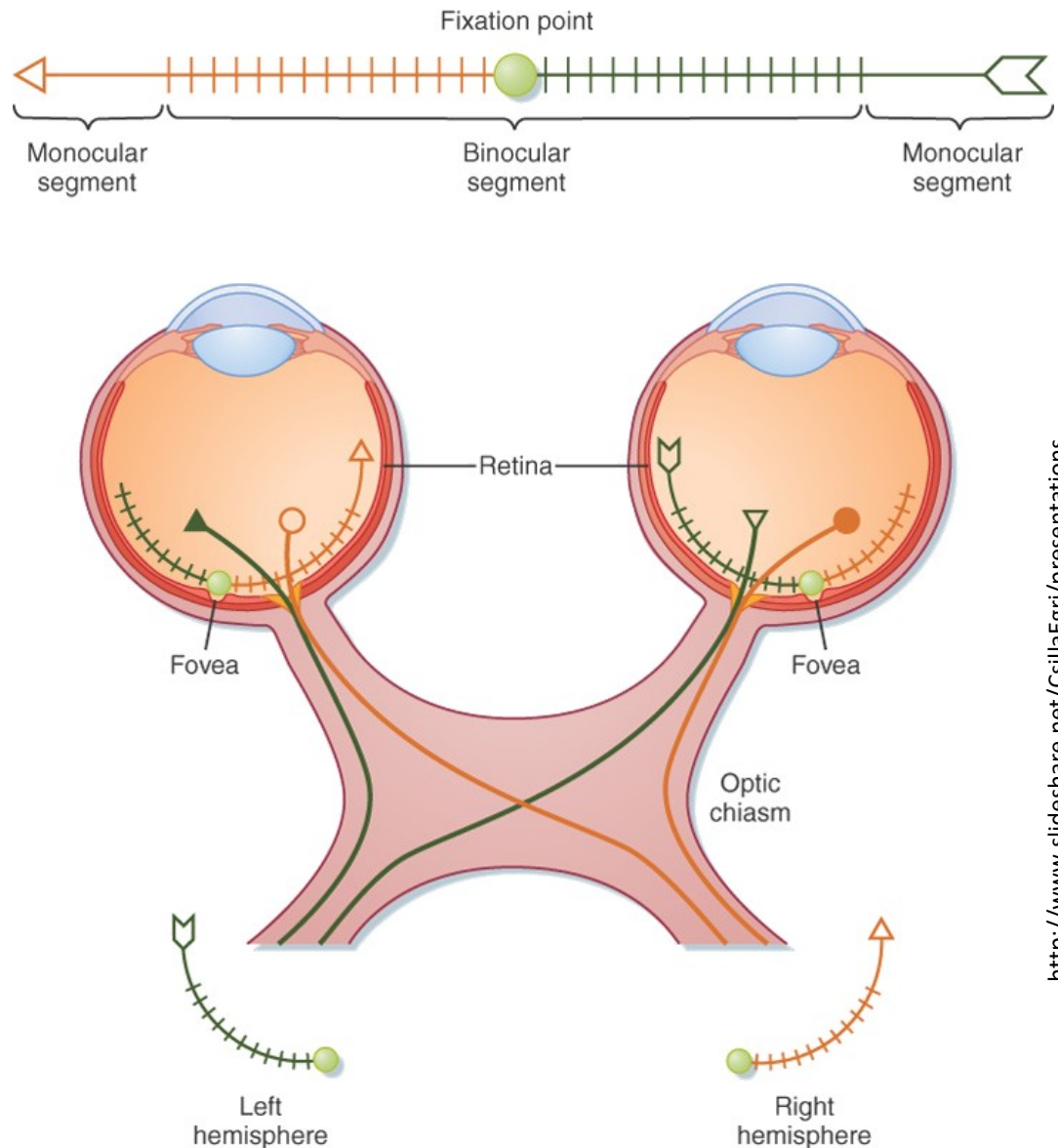
Receptive field

- Magnocellular system
 - Large receptive field
 - Rods and cones
 - **M ganglion cells (10%)**
 - High speed of velocity
 - Brightness/low contrast sensitivity
 - Minimal sensitivity to color
- Parvocellular system
 - Small receptive field
 - Cones and rods
 - **P ganglion cells (80%)**
 - Low speed of velocity
 - Low sensitivity in low contrast
 - Good sensitivity to color



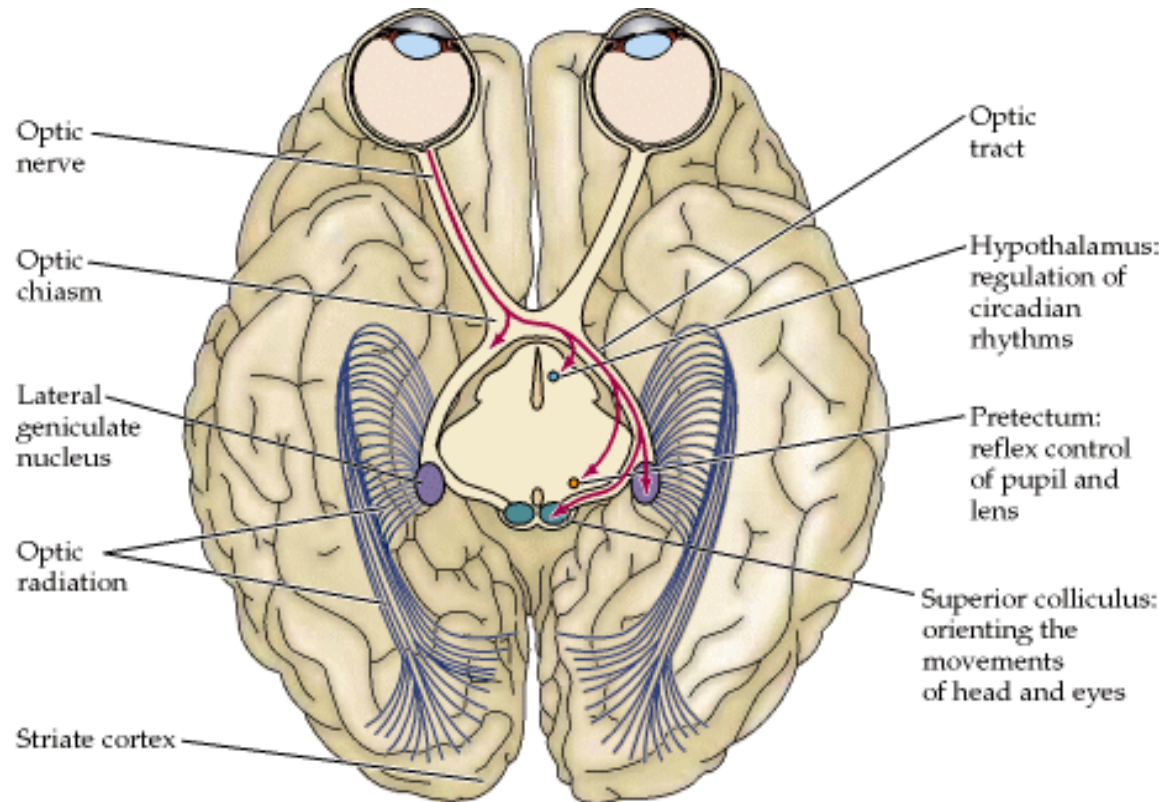
Optic nerve and optic tract

- Optic nerve
 - Signal from one eye
 - Signal from „whole“ visual field
- Optic tract
 - Signal from both eyes
 - Signal from half of visual field



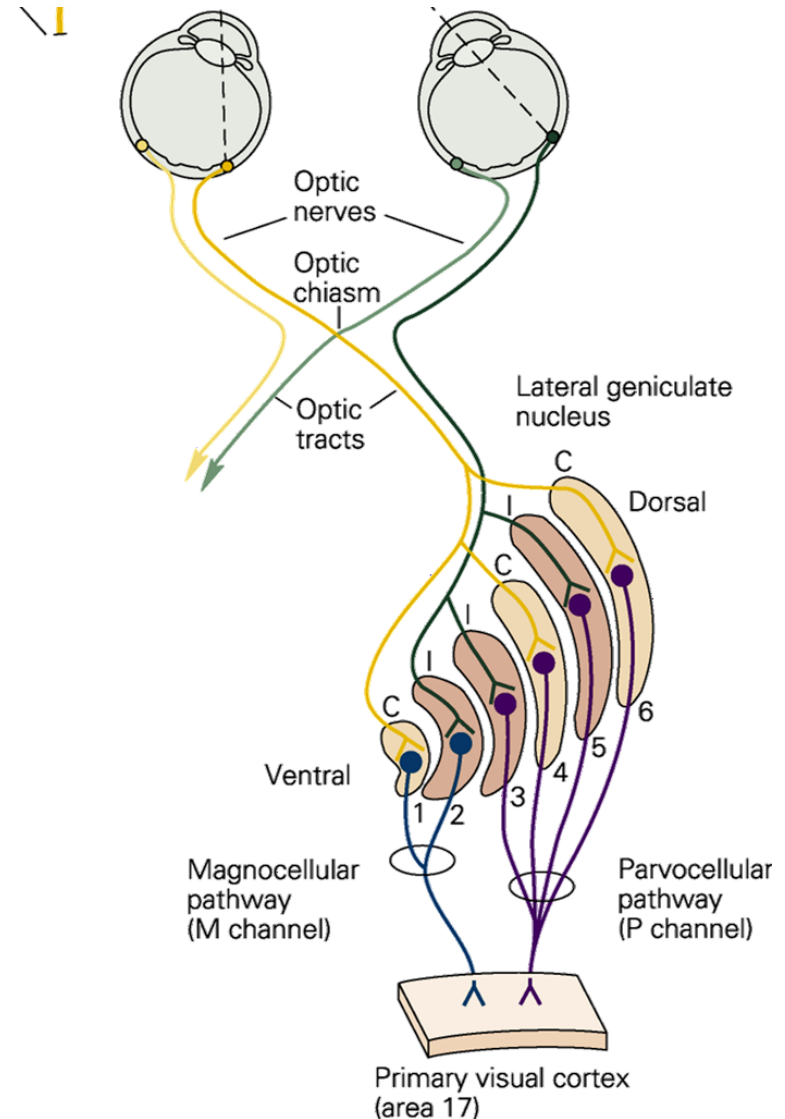
Visual pathways

- Nucleus corporis geniculati lateralis
 - Thalamus
 - Majority of projections
 - Via optic radiation to neocortex
- Hypothalamus
 - Regulation circadian activity
- Pretectum
 - Pupillary reflex
- Colliculi superiores
 - Reflex movement of eyes and head



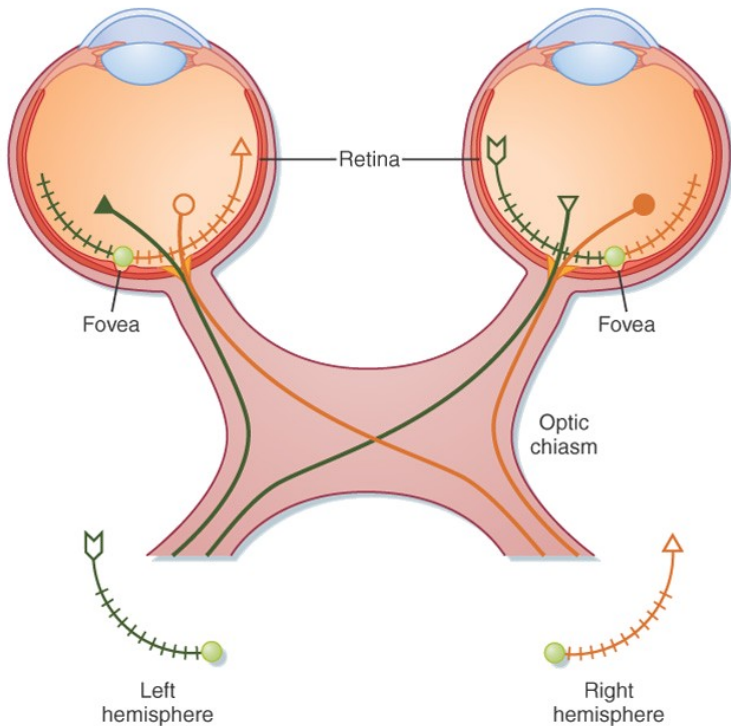
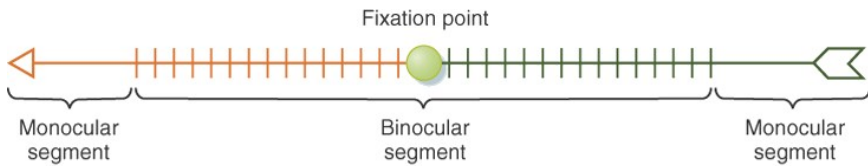
Nucleus corporis geniculati lateralis

- Six nuclear layers
- Retinotopic organization
- Each layer receives input from only c
- Layers 1-2
 - Magnocellular system
 - M ganglion cells
 - Large receptive field/brightness sen.
 - Information about localization ar
- Layers 3-6
 - Parvocellular system
 - P ganglion cells
 - Small receptive field / colour sensiti
 - Information about form and colo

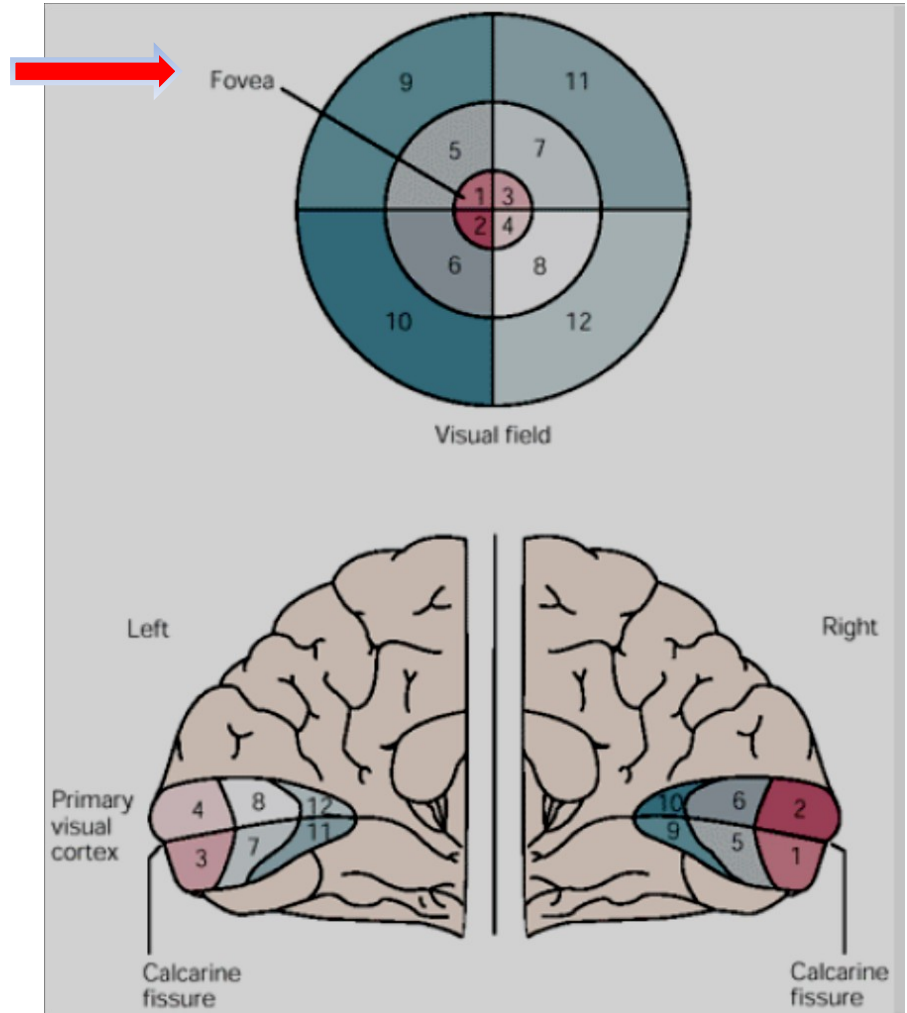


Primary visual cortex

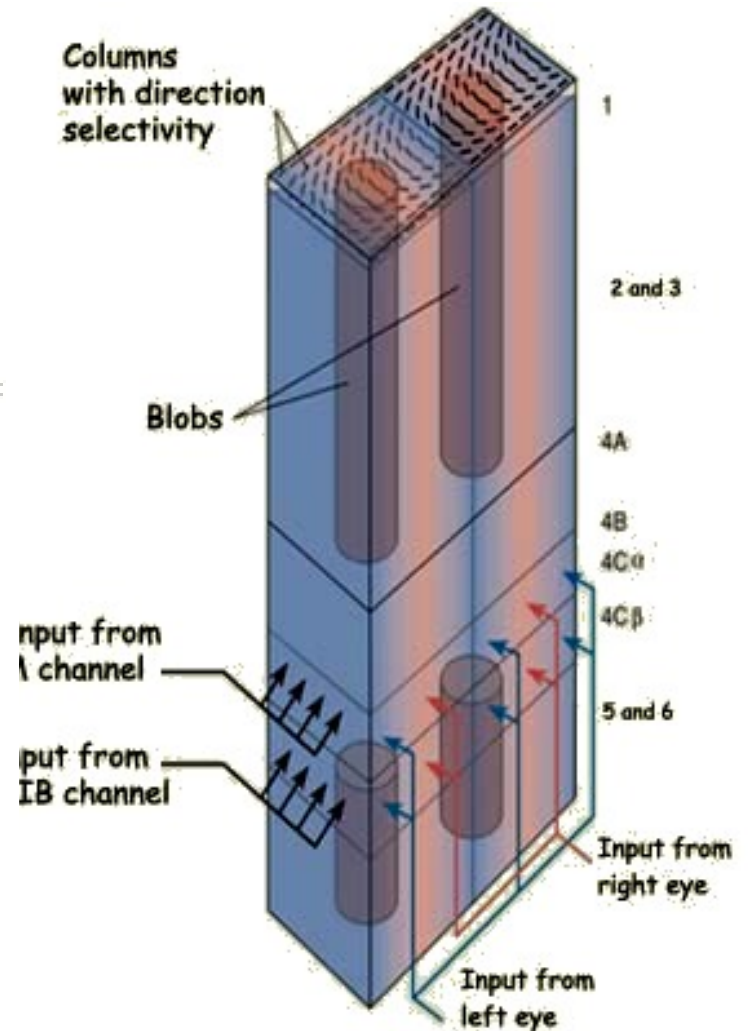
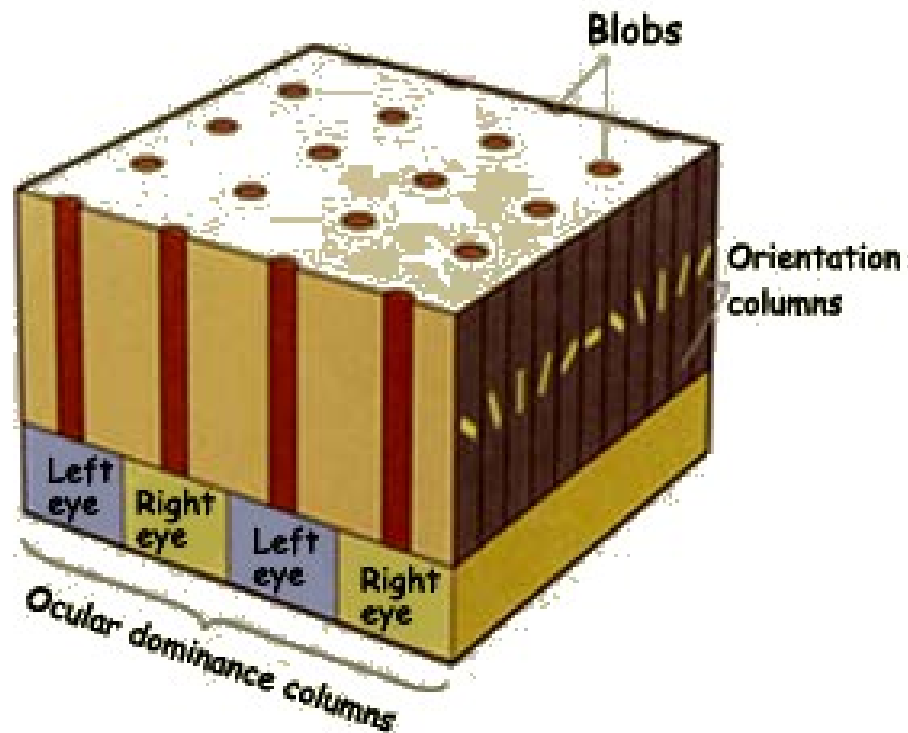
Retinotopic organization



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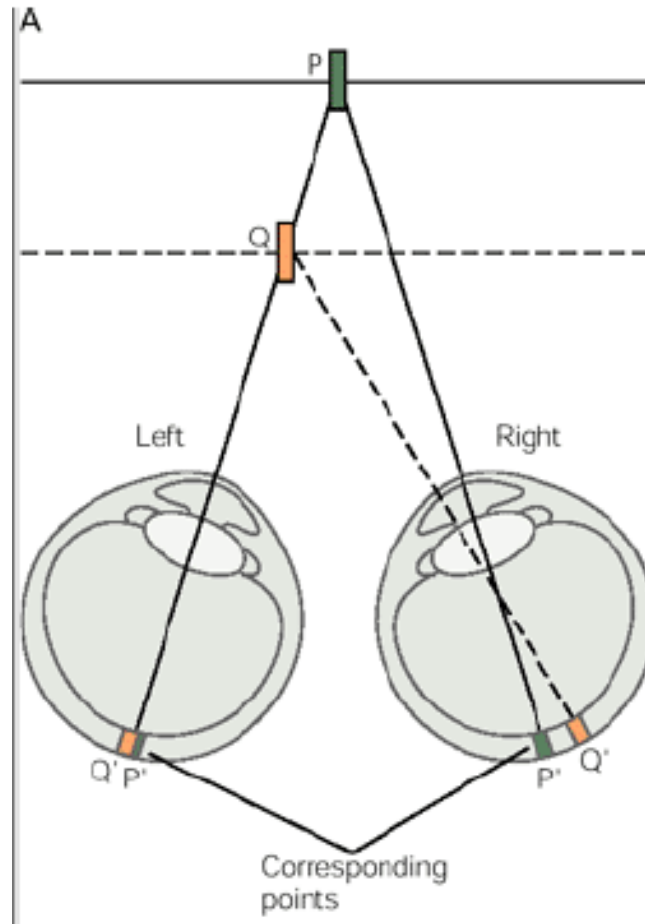


Primary visual cortex



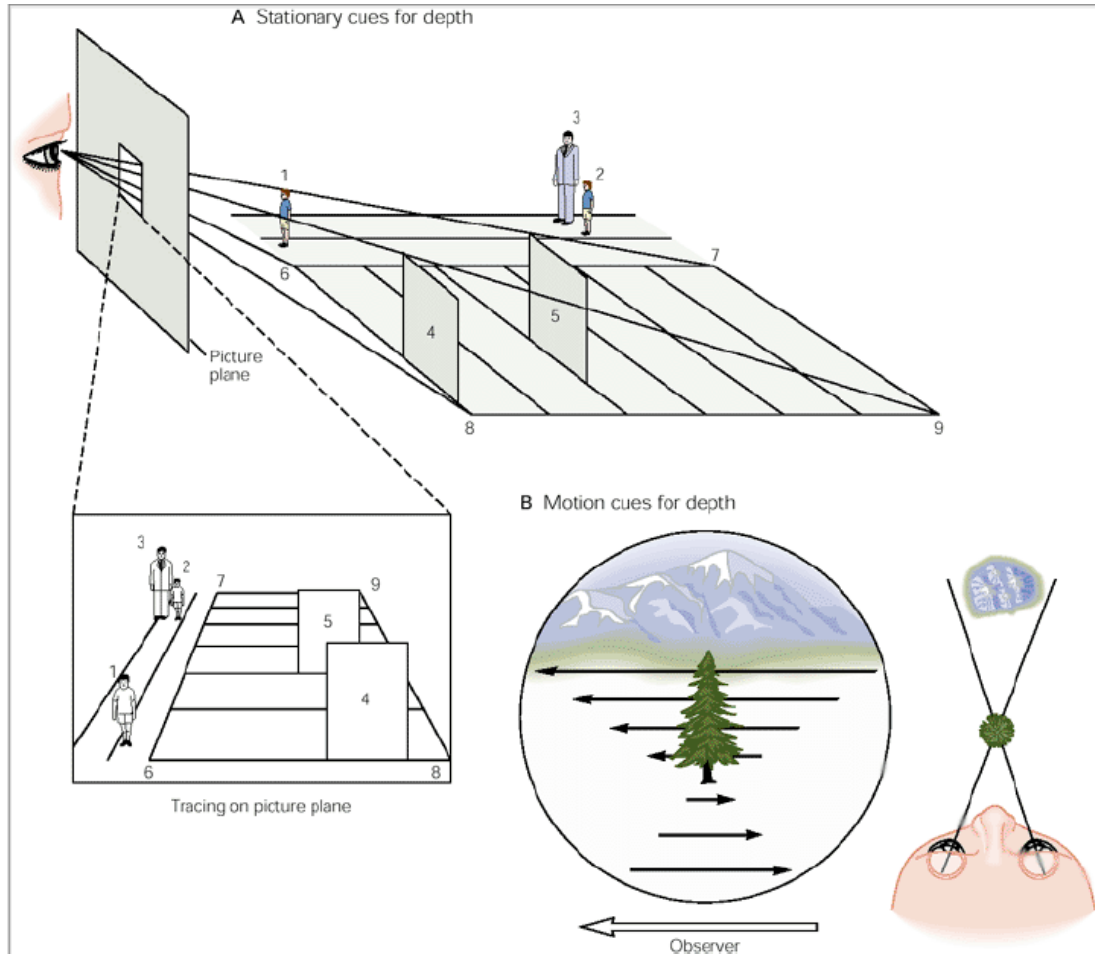
Spatial vision

Binocular

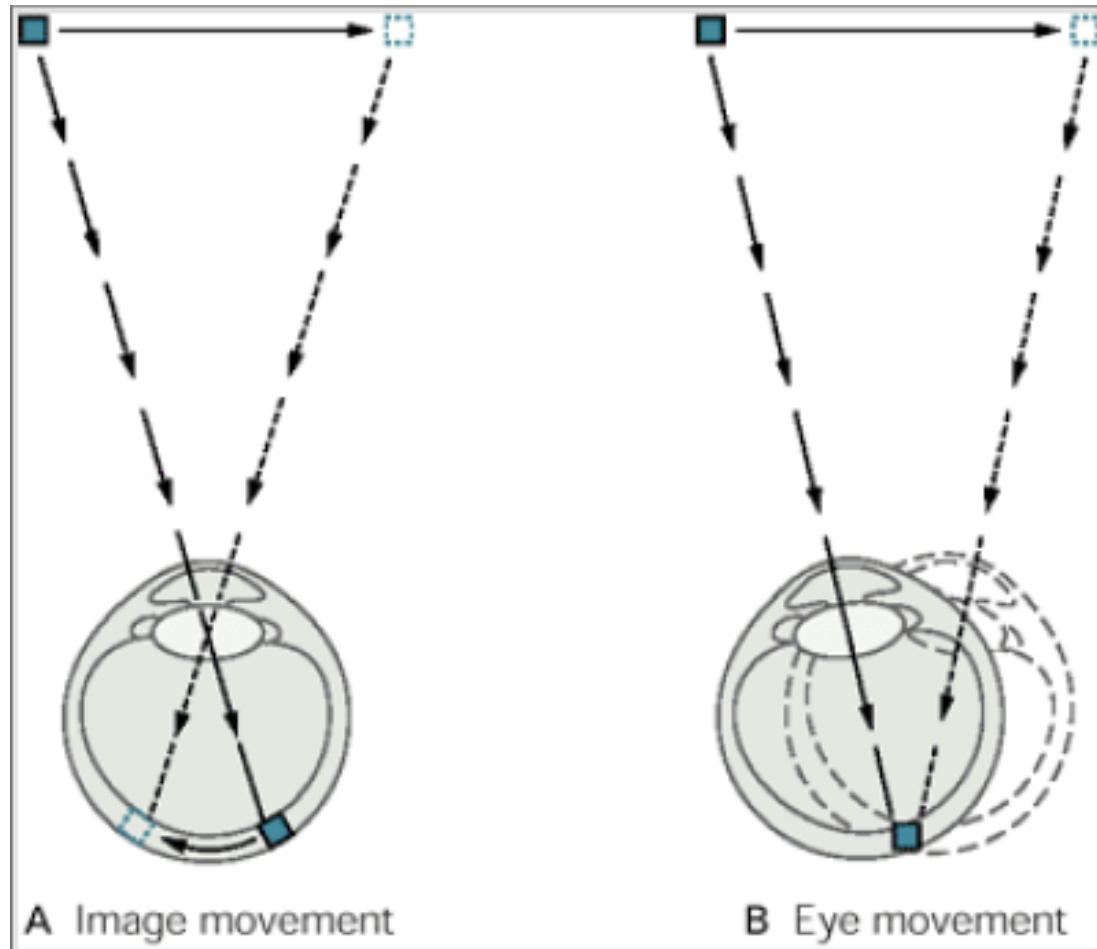


Spatial vision

Monocular – based on previous experience



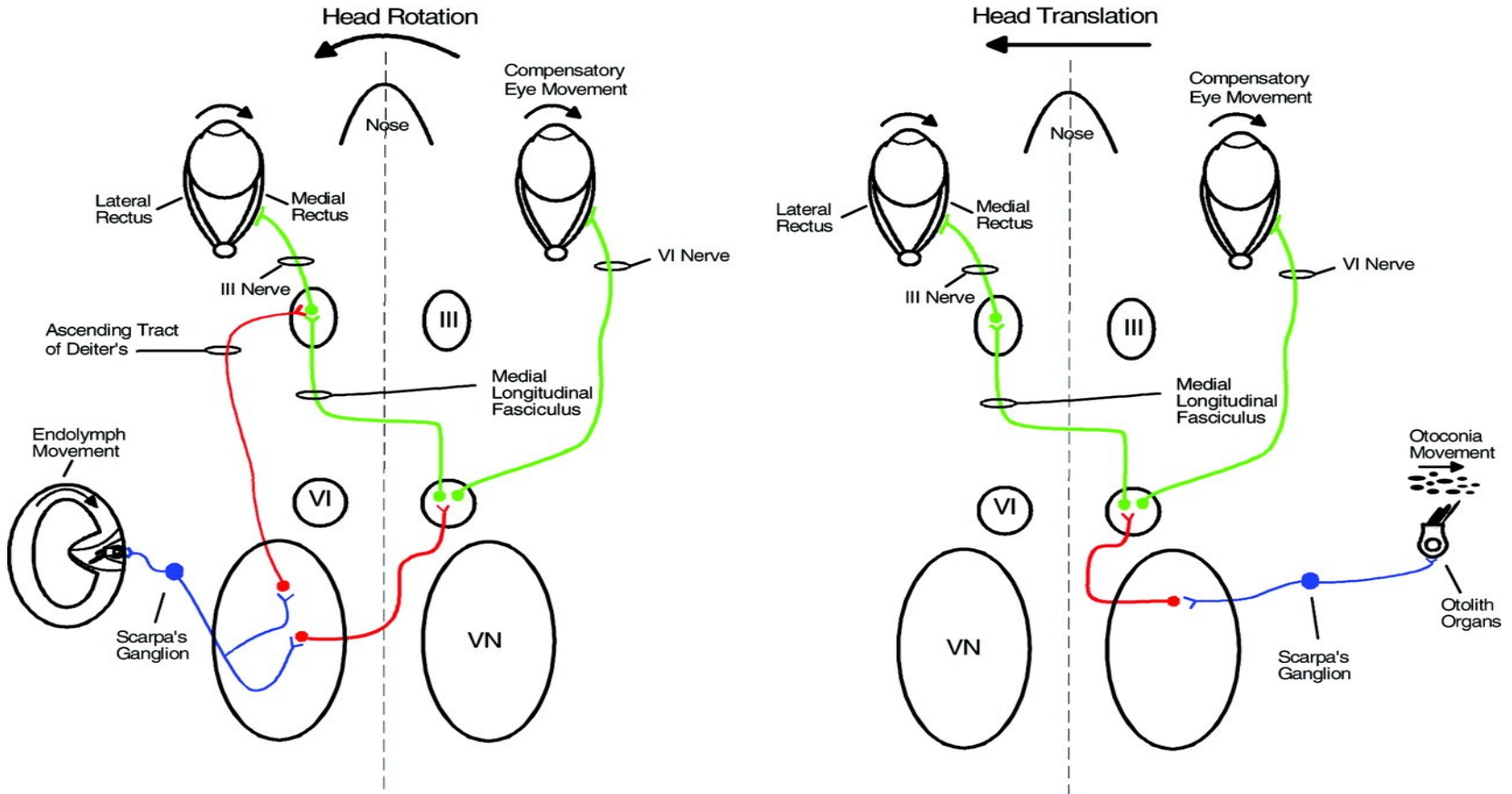
Motion perception



Vestibuloocular reflex

Rotational VOR

Translational VOR



Saccadic eye movements

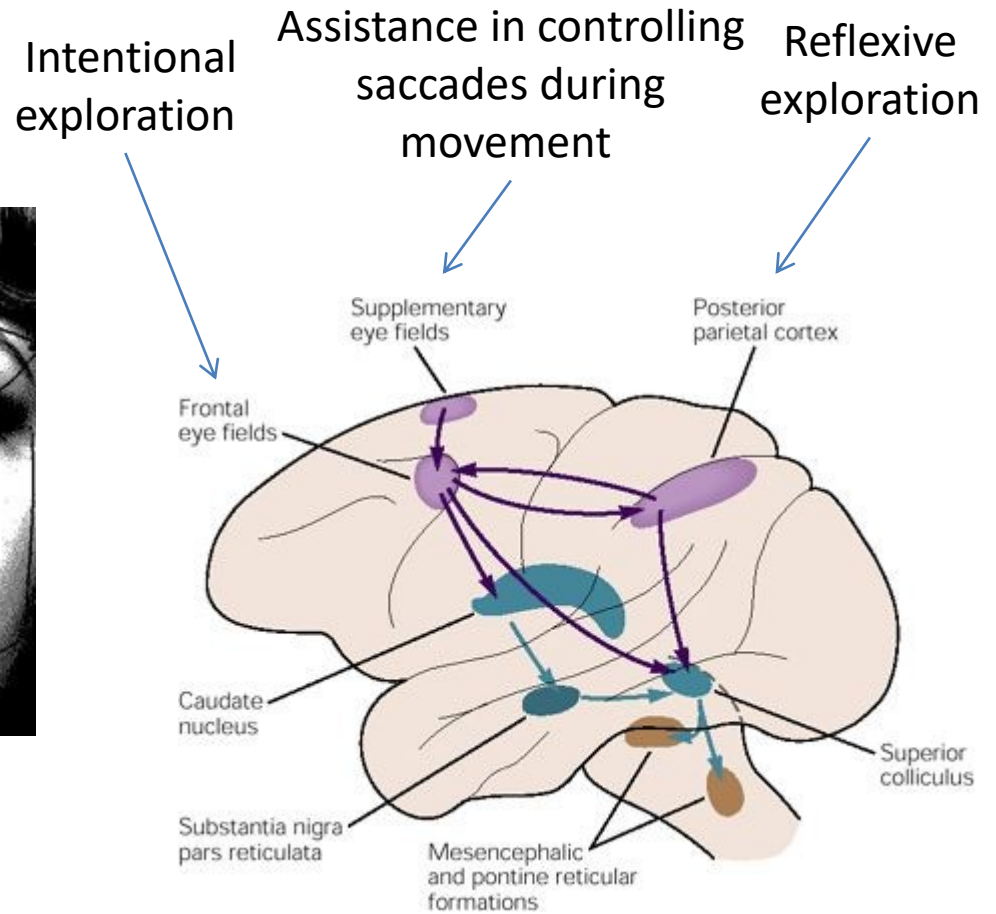


<https://en.wikipedia.org/wiki/Saccade#/media/File:Szakkad.jpg>

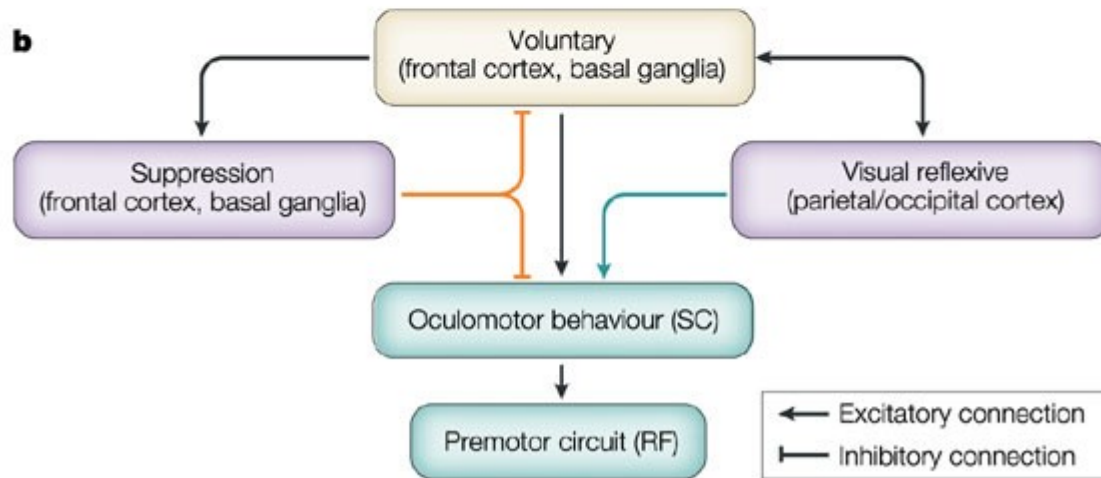
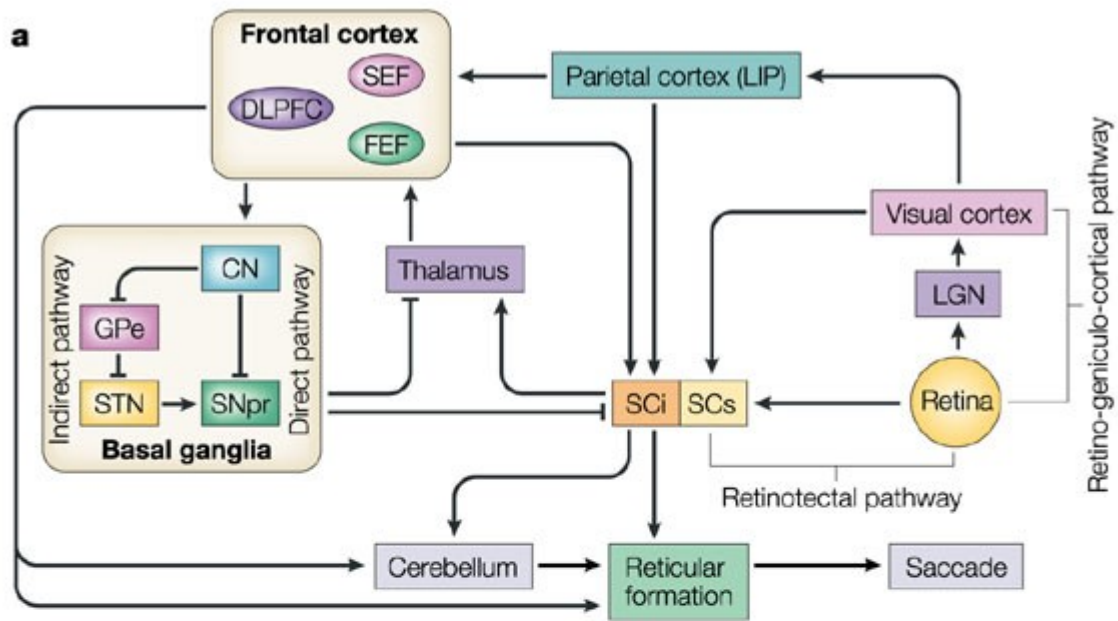
Saccadic eye movements



<https://en.wikipedia.org/wiki/Saccade#/media/File:Szakkad.jpg>



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Nystagmus

- Involuntary rhythmic eye movement
- Physiological
 - Postrotational
 - Optokinetic
- Pathologic
 - Vestibular system pathologies
 - Vestibulocerebellar damage
 - Other damage of CNS

Classifying nystagmus

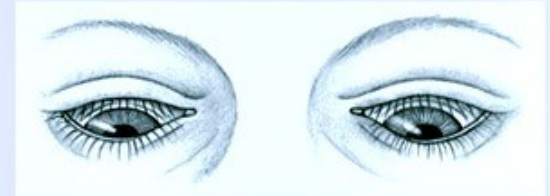
The various types of jerk and pendular nystagmus are illustrated below.

JERK NYSTAGMUS

Convergence-retraction nystagmus refers to the irregular jerking of the eyes back into the orbit during upward gaze. It can indicate midbrain tegmental damage.



Downbeat nystagmus refers to the irregular downward jerking of the eyes during downward gaze. It can signal lower medullary damage.

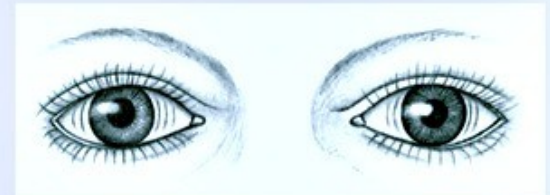


Vestibular nystagmus, the horizontal or rotary movement of the eyes, suggests vestibular disease or cochlear dysfunction.

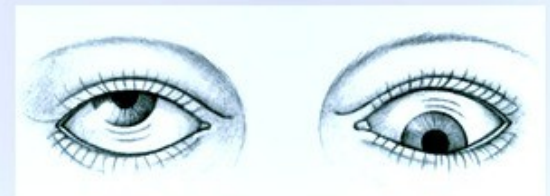


PENDULAR NYSTAGMUS

Horizontal, or pendular, nystagmus refers to oscillations of equal velocity around a center point. It can indicate congenital loss of visual acuity or multiple sclerosis.



Vertical, or seesaw, nystagmus is the rapid, seesaw movement of the eyes: One eye appears to rise while the other appears to fall. It suggests an optic chiasm lesion.



Pupillary reflex

