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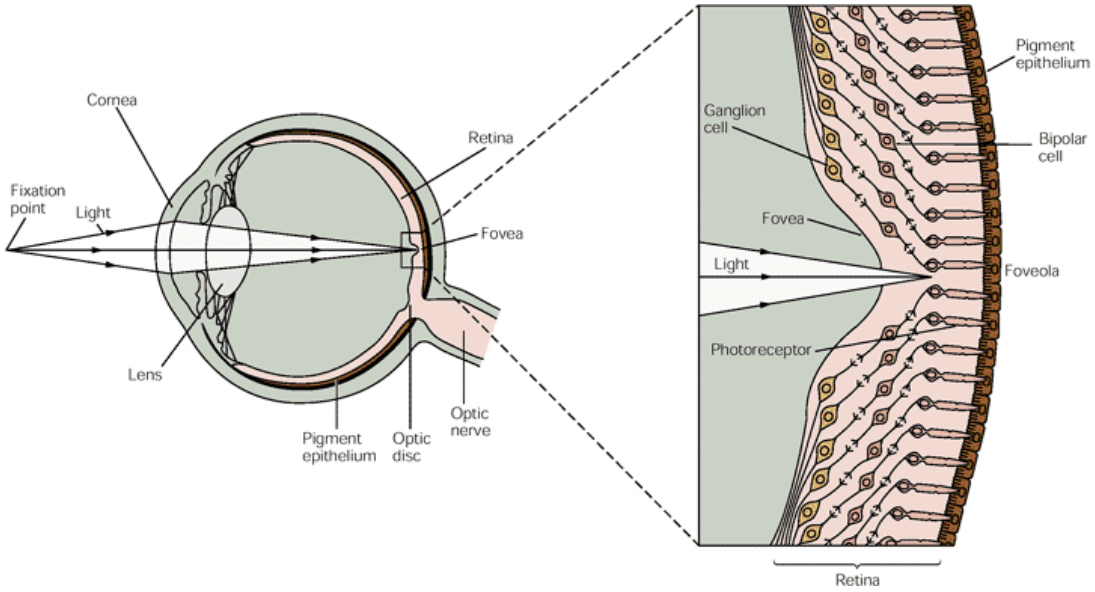
10

Vision II

Image formation



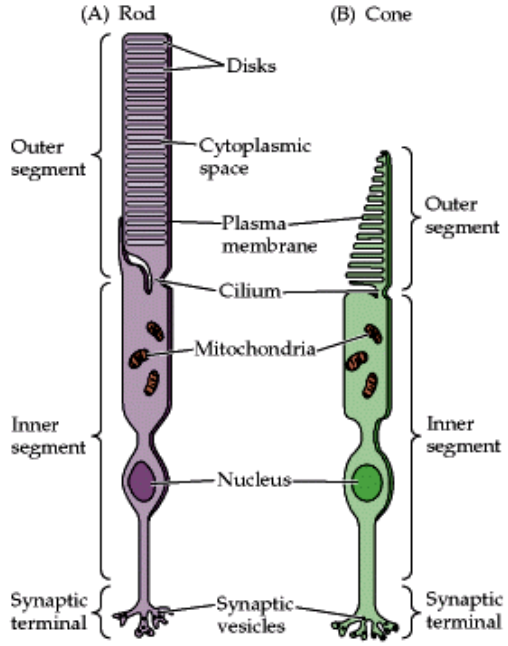


Table 26-1 Differences Between Rods and Cones and Their Neural Systems

Rods	Cones
High sensitivity to light, specialized for night vision	Lower sensitivity, specialized for day vision
More photopigment, capture more light	Less photopigment
High amplification, single photon detection	Lower amplification
Low temporal resolution: slow response, long integration time	High temporal resolution: fast response, short integration time
More sensitive to scattered light	Most sensitive to direct axial rays
Rod system	**Cone system**
Low acuity: not present in central fovea, highly convergent retinal pathways	High acuity: concentrated in fovea, dispersed retinal pathways
Achromatic: one type of rod pigment	Chromatic: three types of cones, each with a distinct pigment that is most sensitive to a different part of the visible light spectrum

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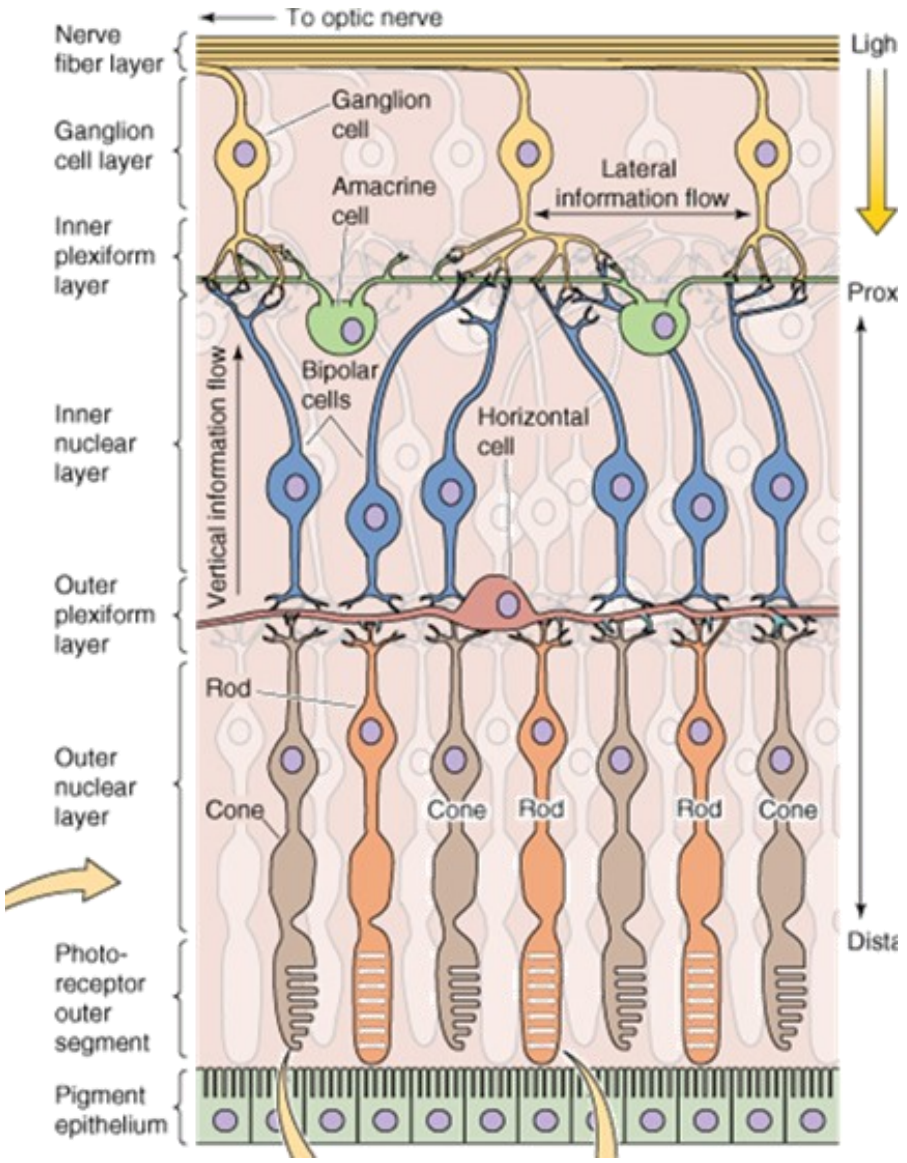
Retina

- 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



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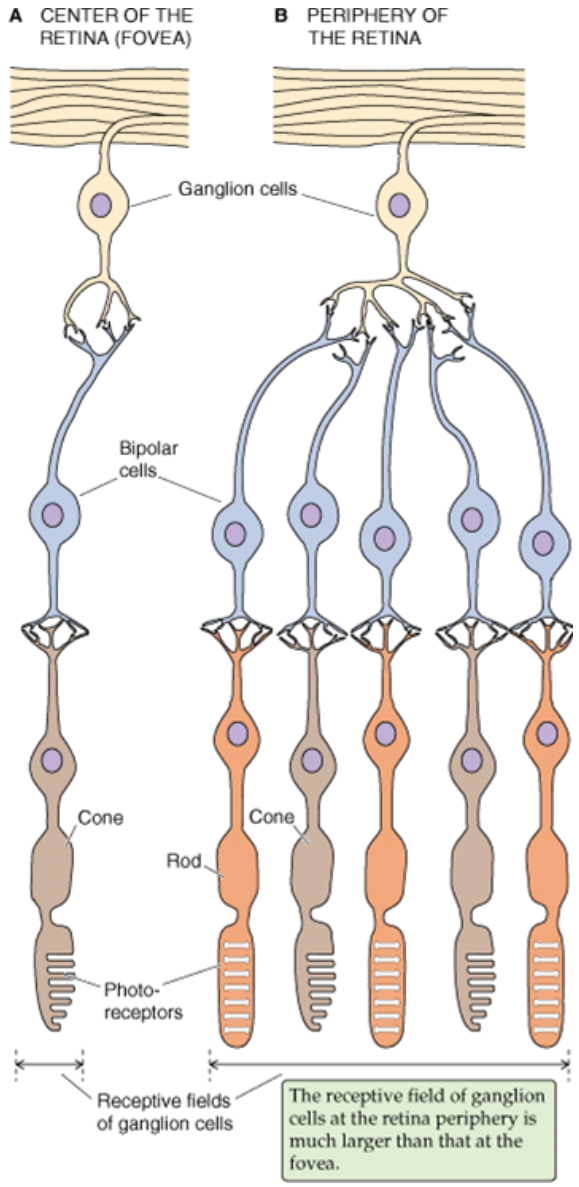
Retina

- 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



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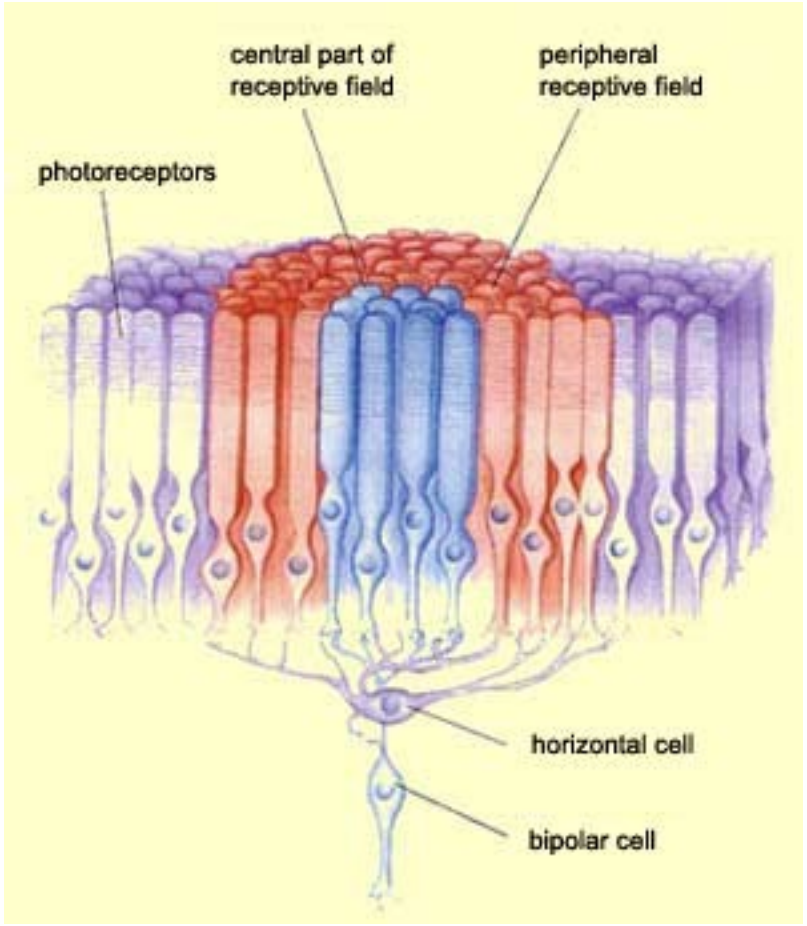
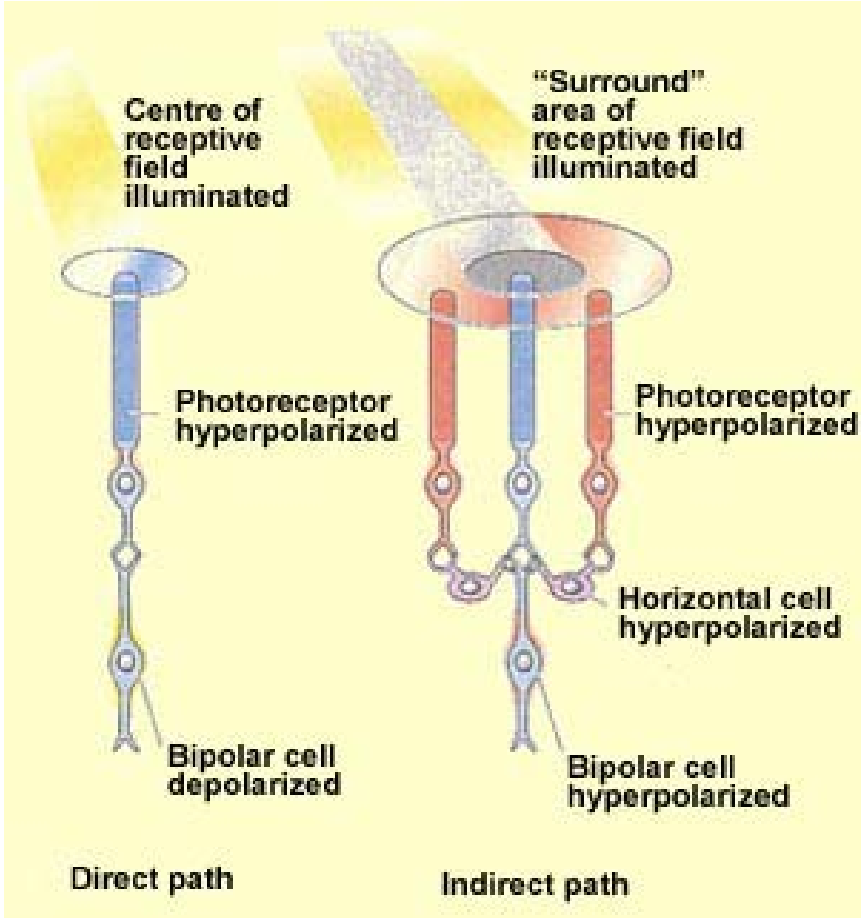
Receptive field





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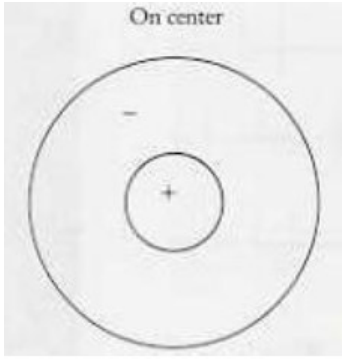
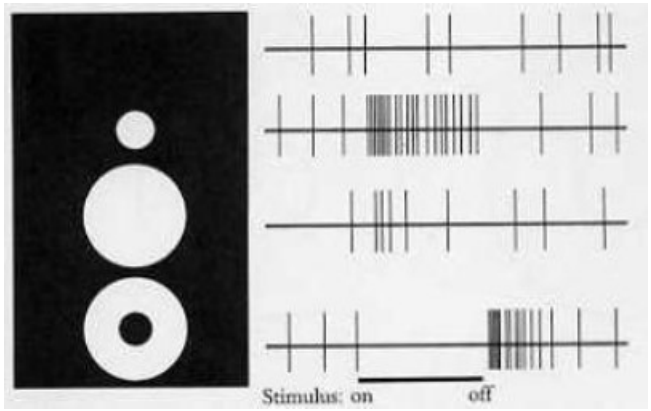
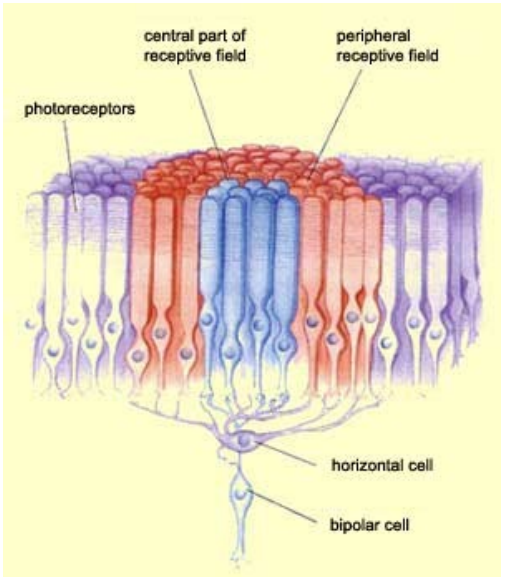
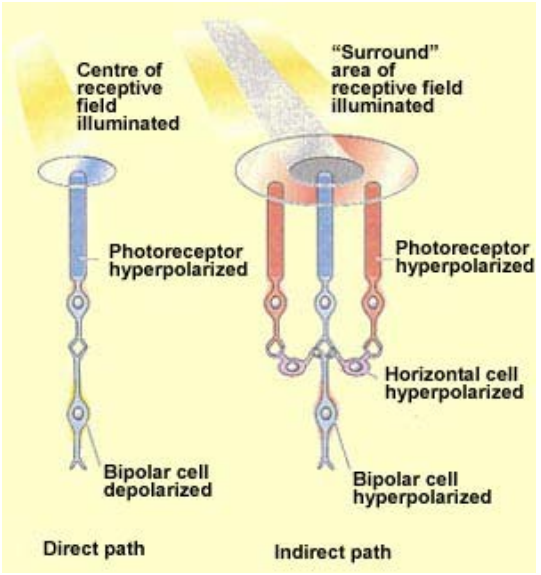
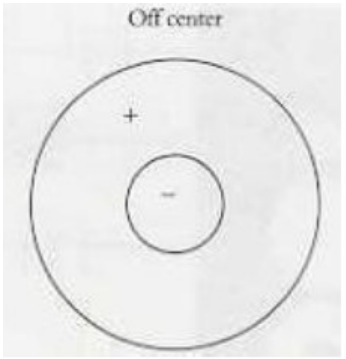
Receptive field

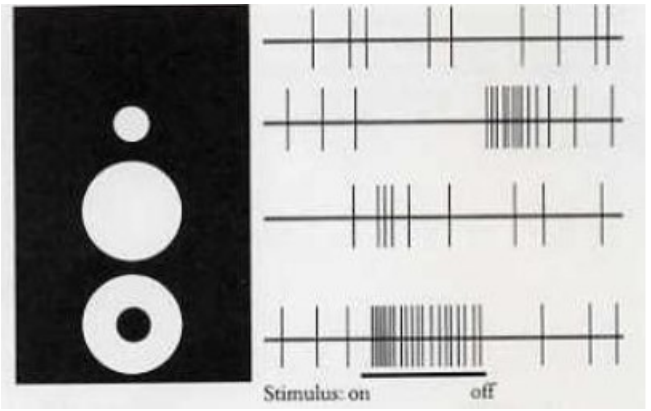












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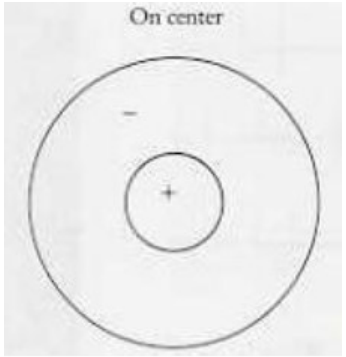
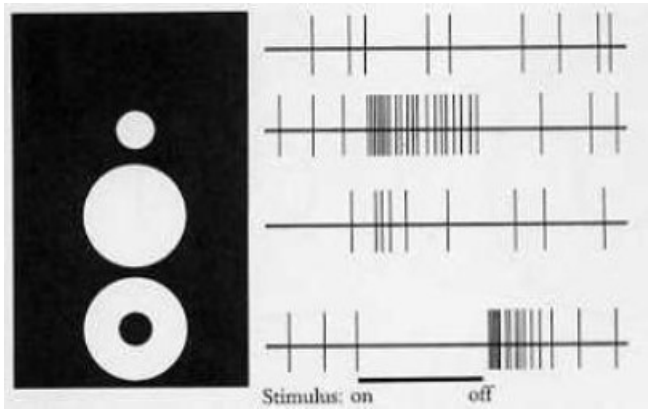
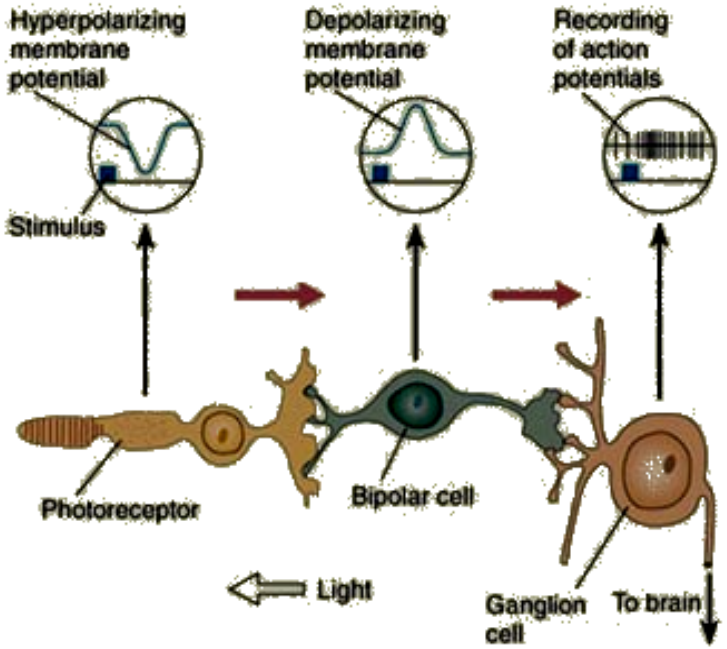
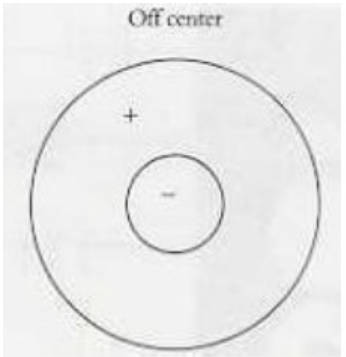
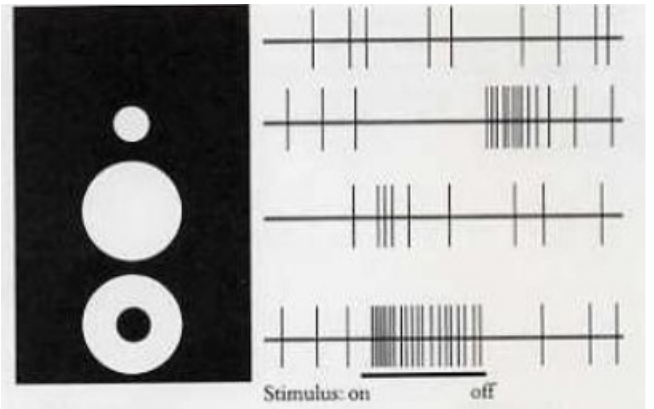
Receptive field











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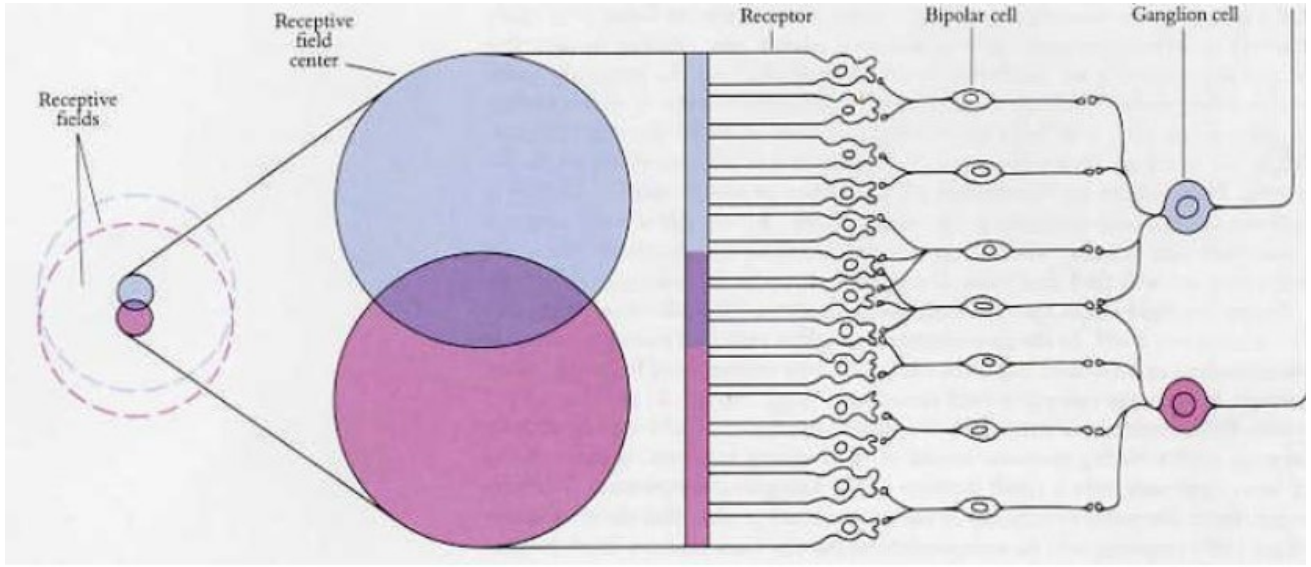
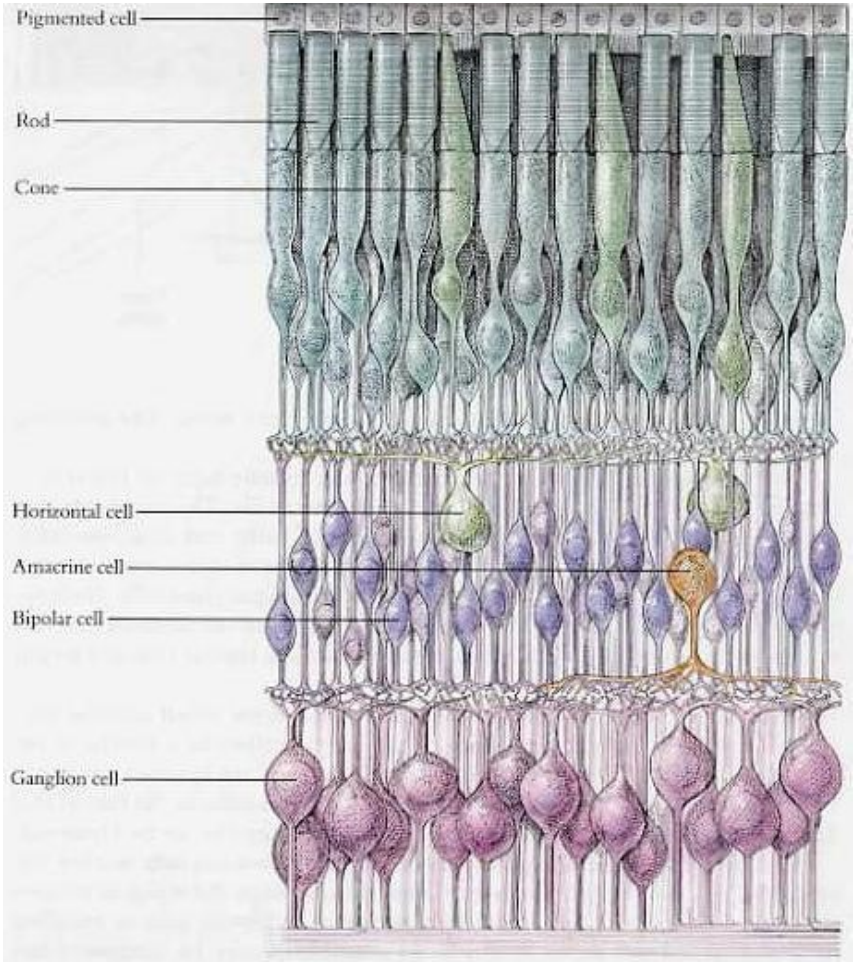
Receptive field





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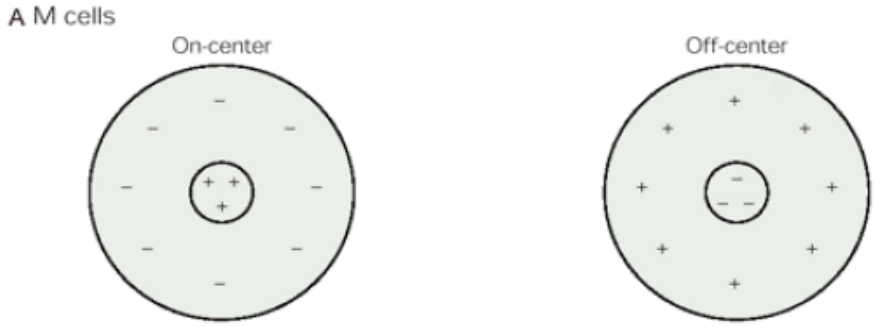
Receptive field

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



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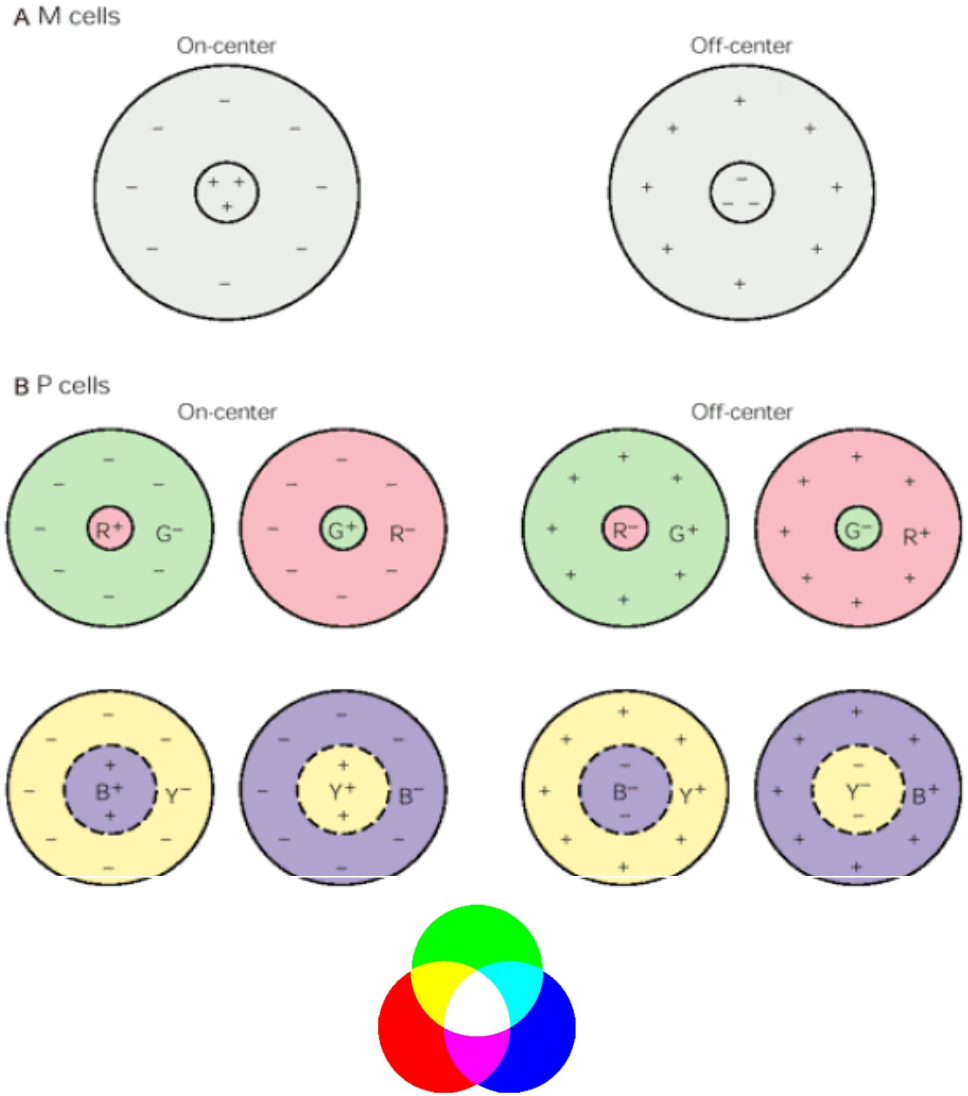
  - Rods and cones
  - **M ganglion cells (10%)**
  - High speed of velocity
  - Brightness/low contrast sensitivity
  - Minimal sensitivity to color
- Parvocellular system
  - Small receptive field
  - Cones and rods
  - **P ganglion cells (80%)**
  - Low speed of velocity
  - Low sensitivity in low contrast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



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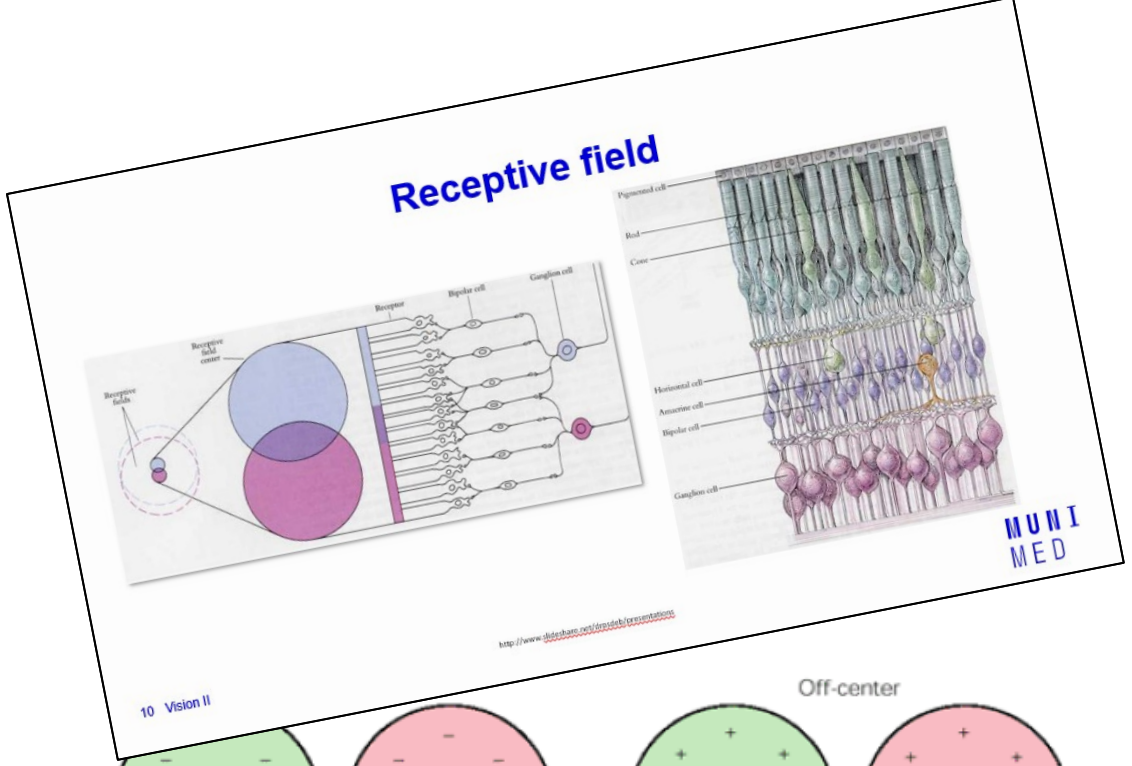

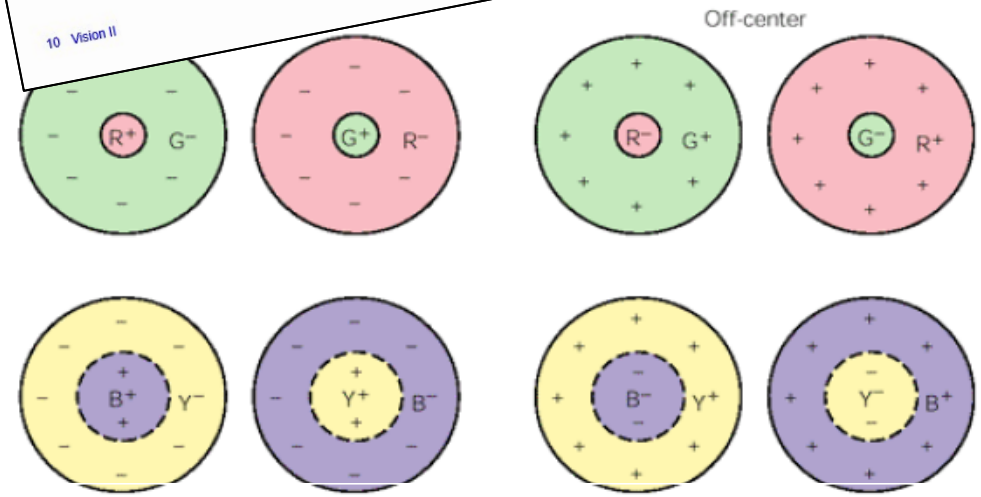

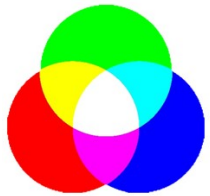

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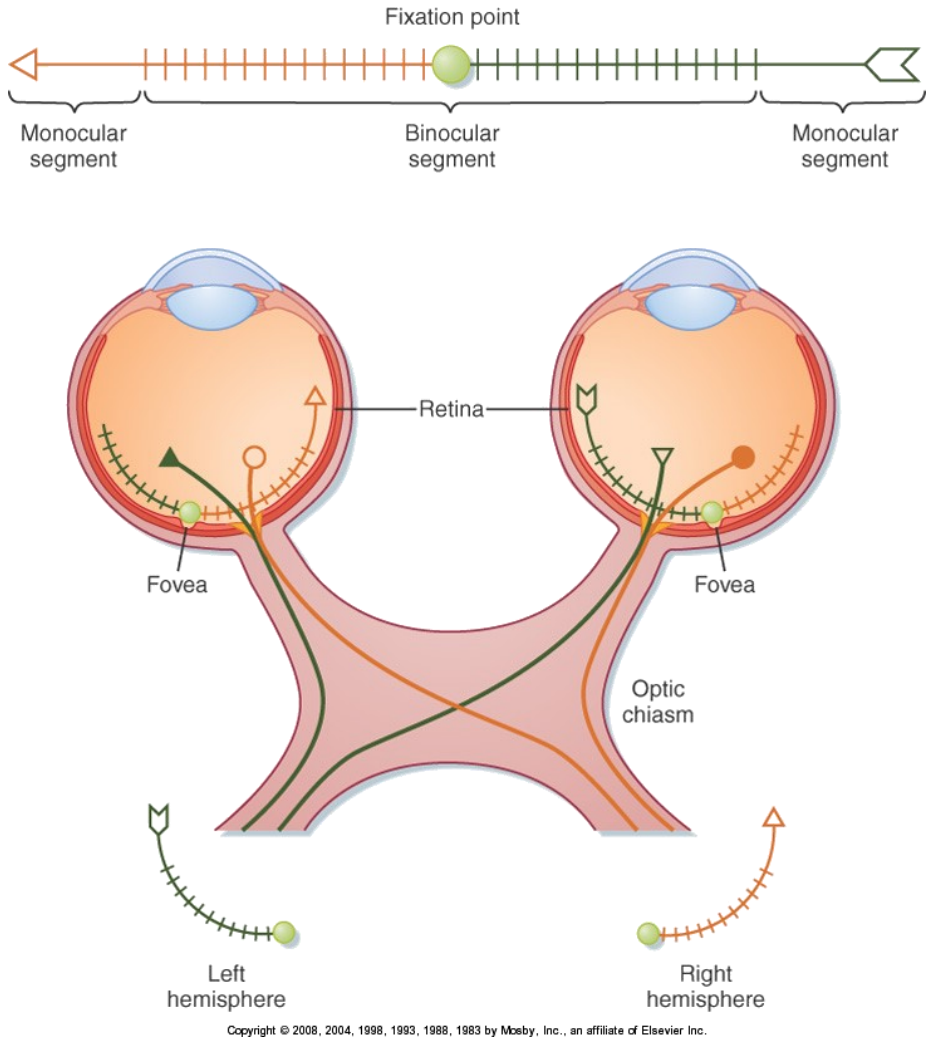
Optic nerve and optic tract

- Optic nerve
  - Signal from one eye
  - Signal from „whole“ visual field

- Optic tract
  - Signal from both eyes
  - Signal from half of visual field



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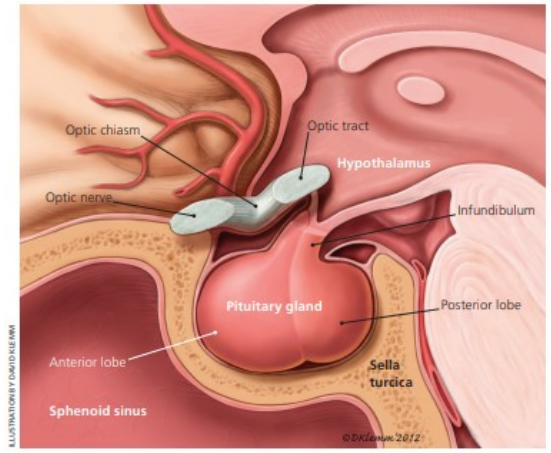

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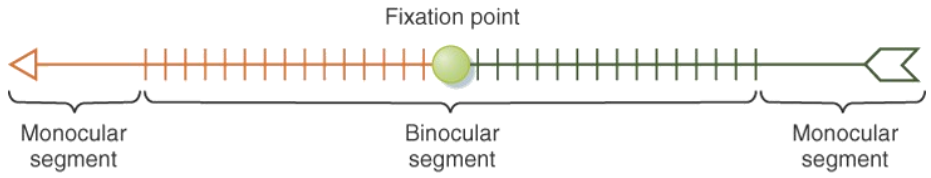

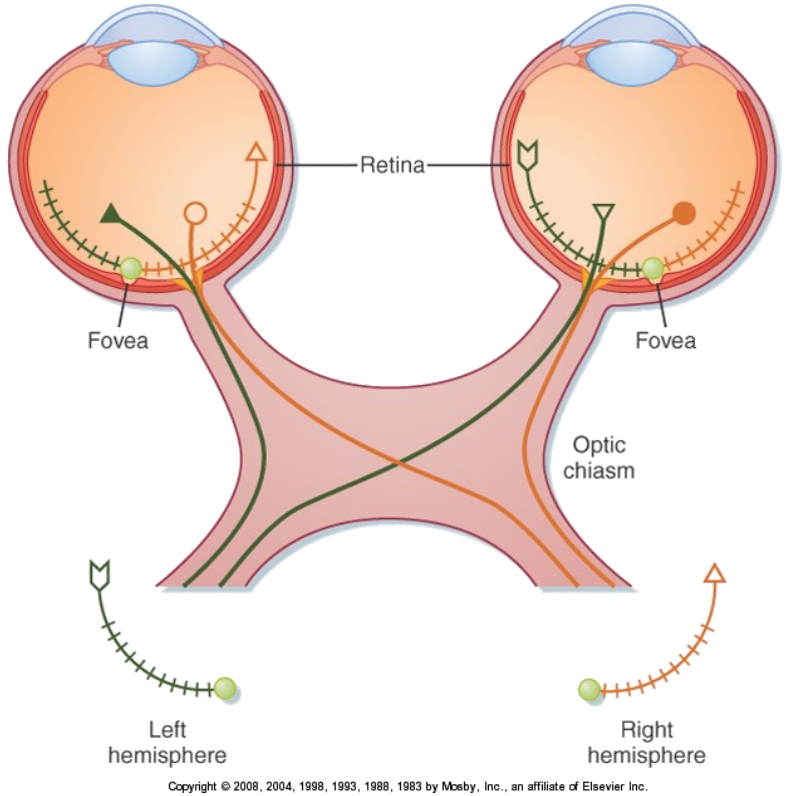

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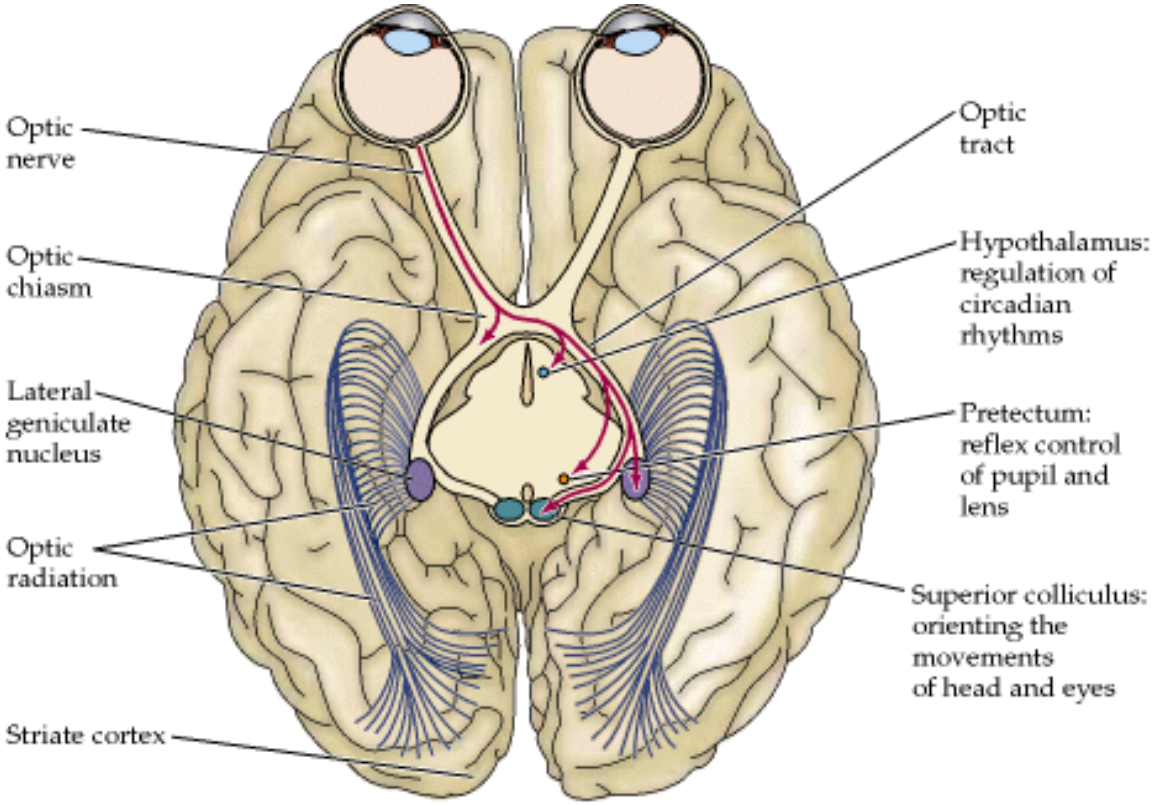
Visual pathways

- 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



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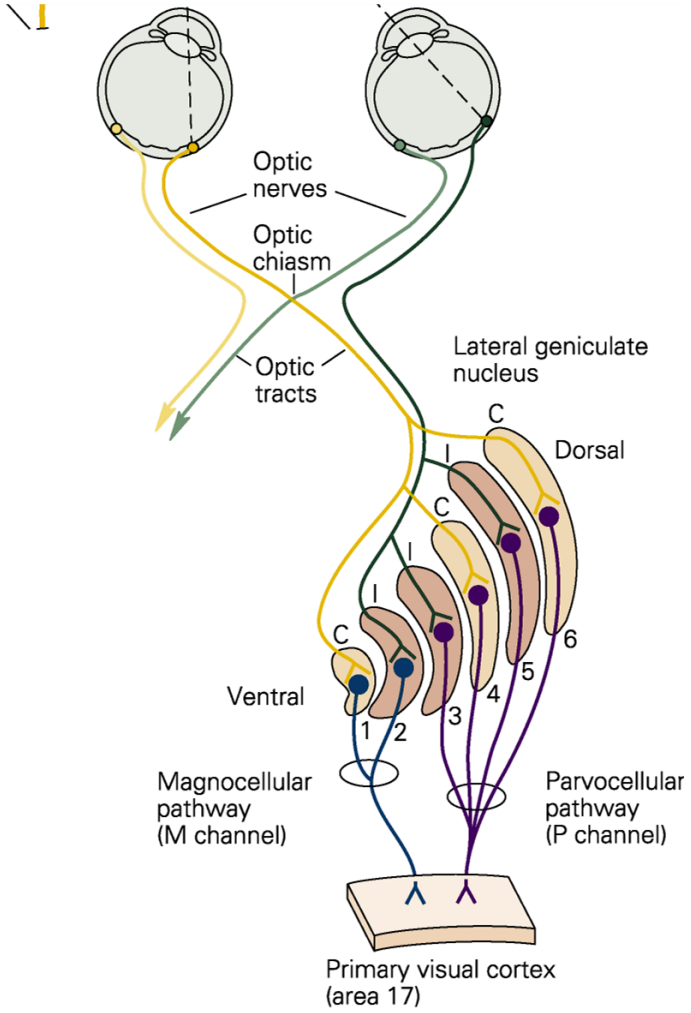
Nucleus corporis geniculati lateralis

- Six nuclear layers
- Retinotopic organization
- Each layer receives input from only one eye
- Layers 1-2
  - Magnocellular system
    - M ganglion cells
    - Large receptive field/brightness sensitivity
  - Information about localization and movement
- Layers 3-6
  - Parvocellular system
    - P ganglion cells
    - Small receptive field / color sensitivity
  - Information about form and color



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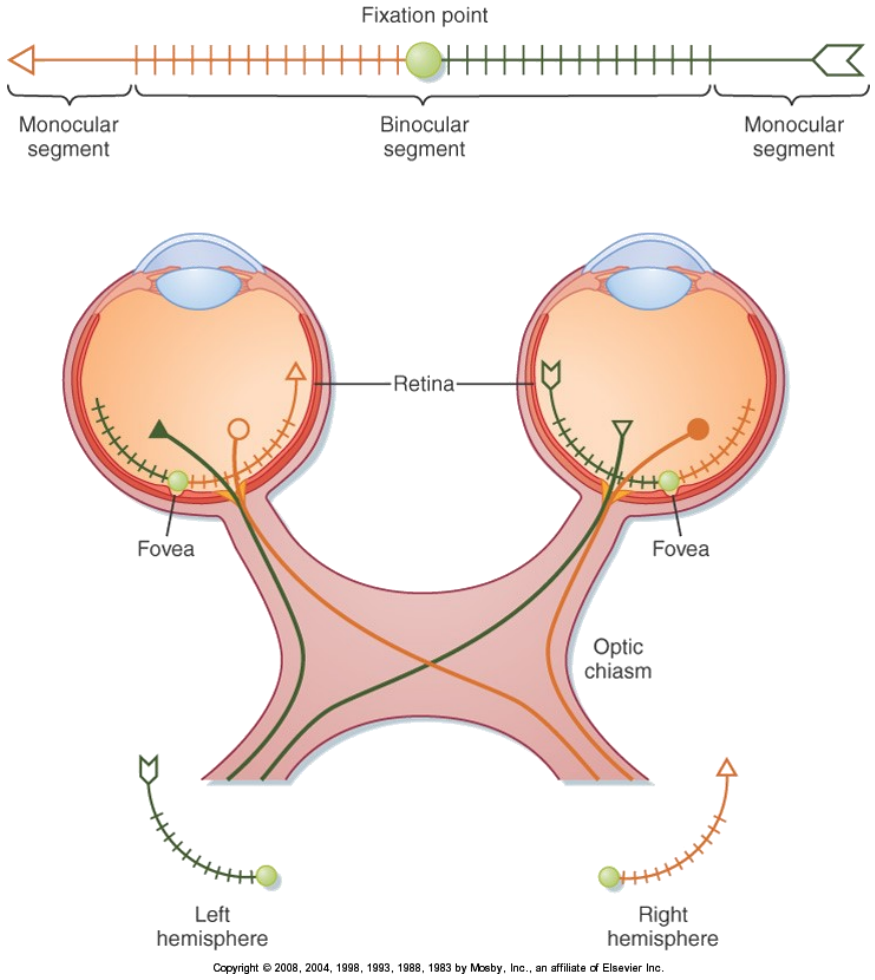
Primary visual cortex

Retinotopic organization



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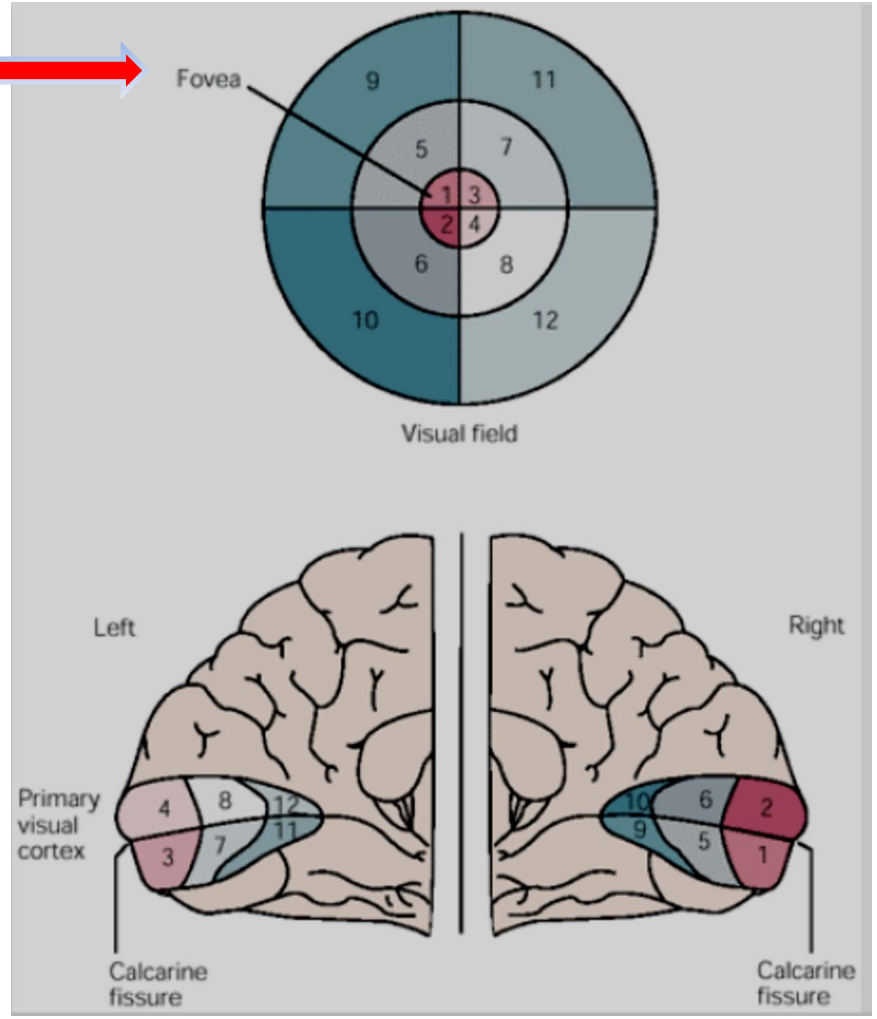

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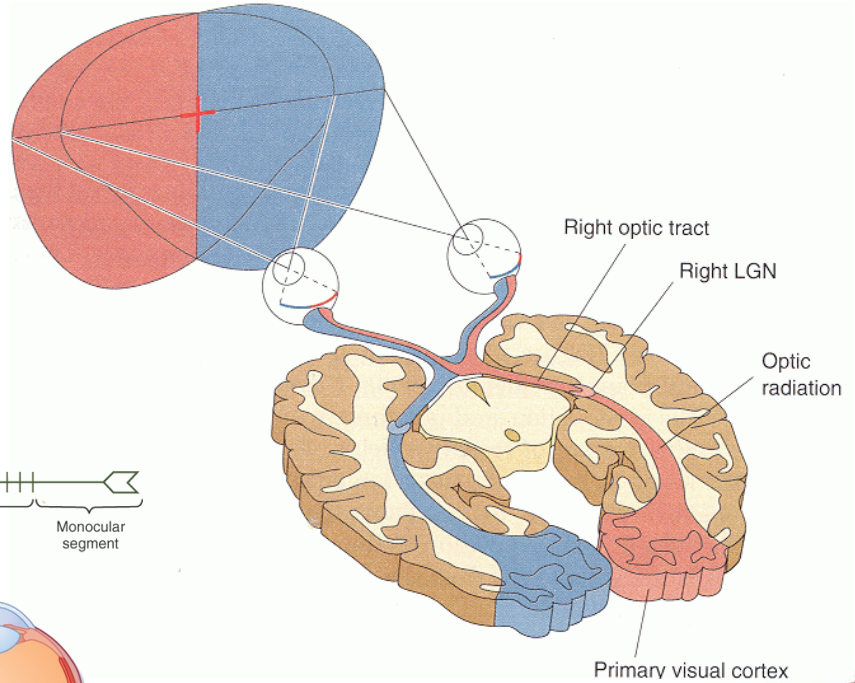

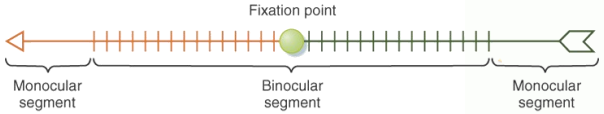

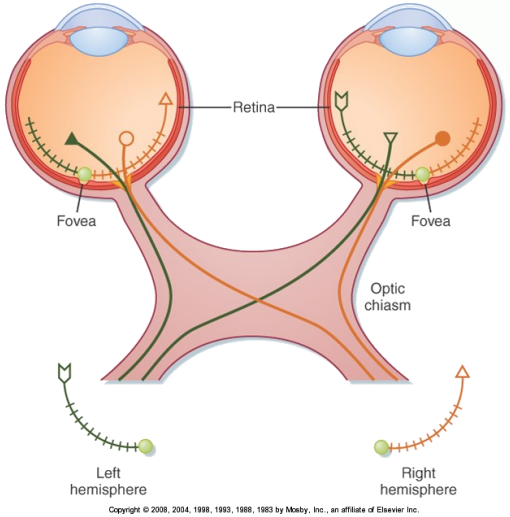

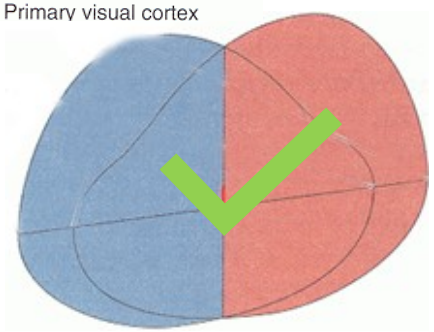

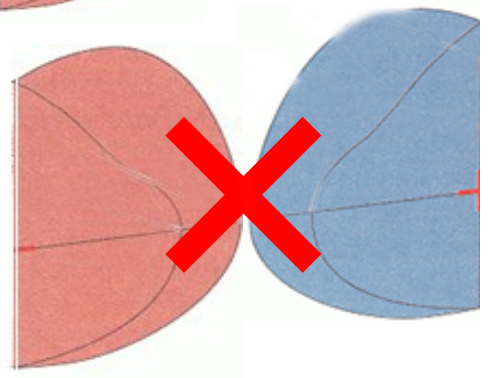

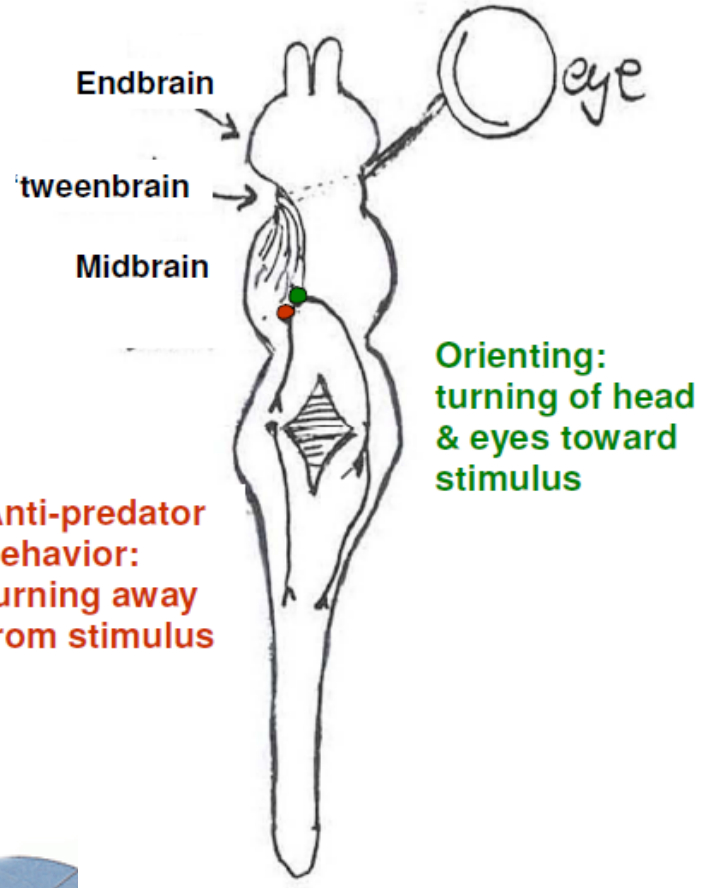

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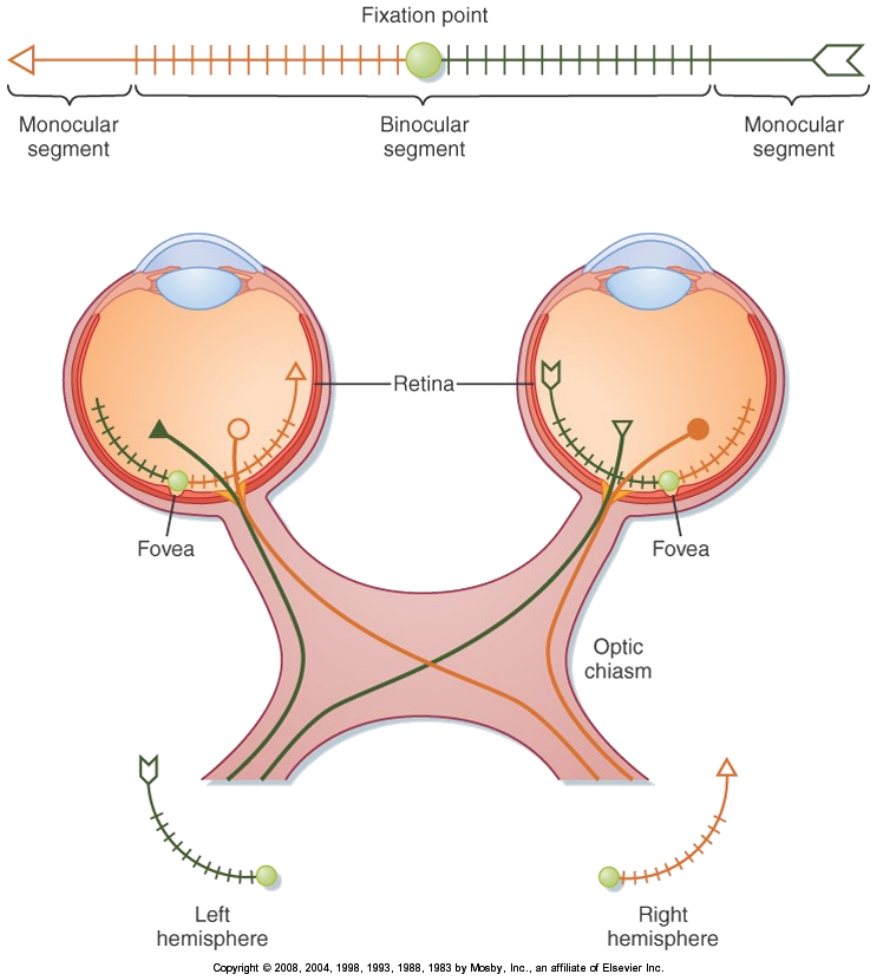
Primary visual cortex

Retinotopic organization



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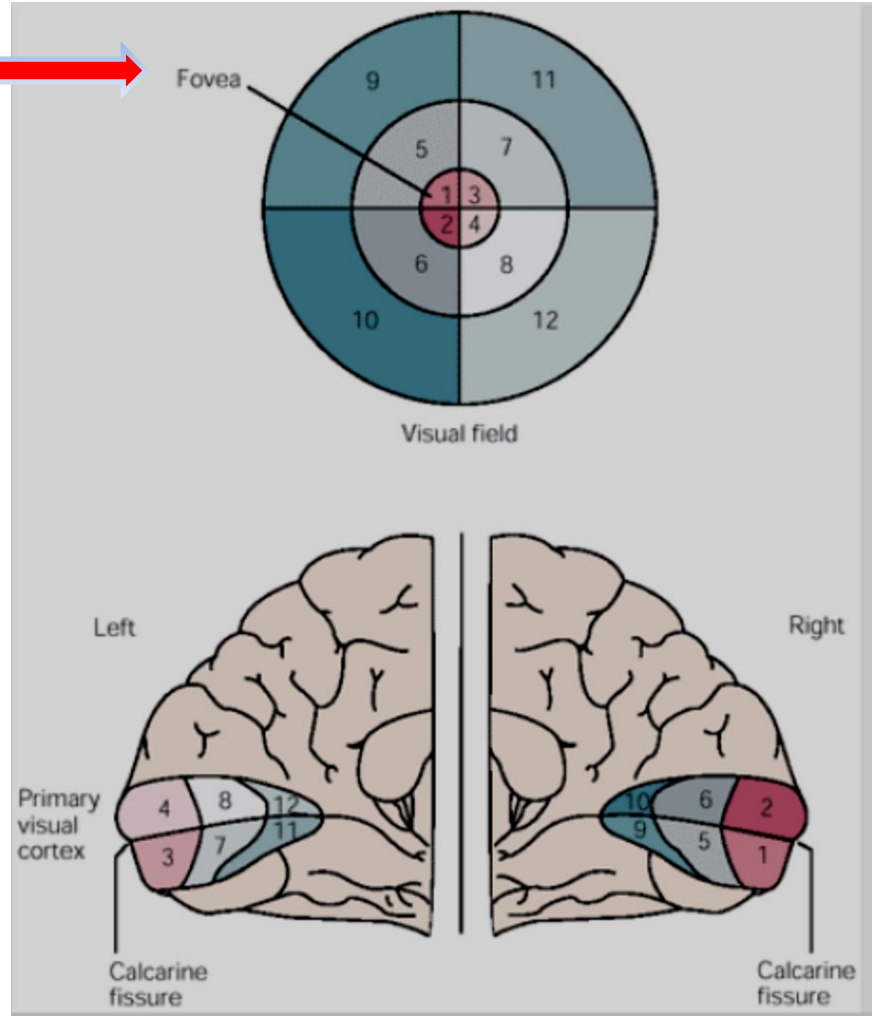

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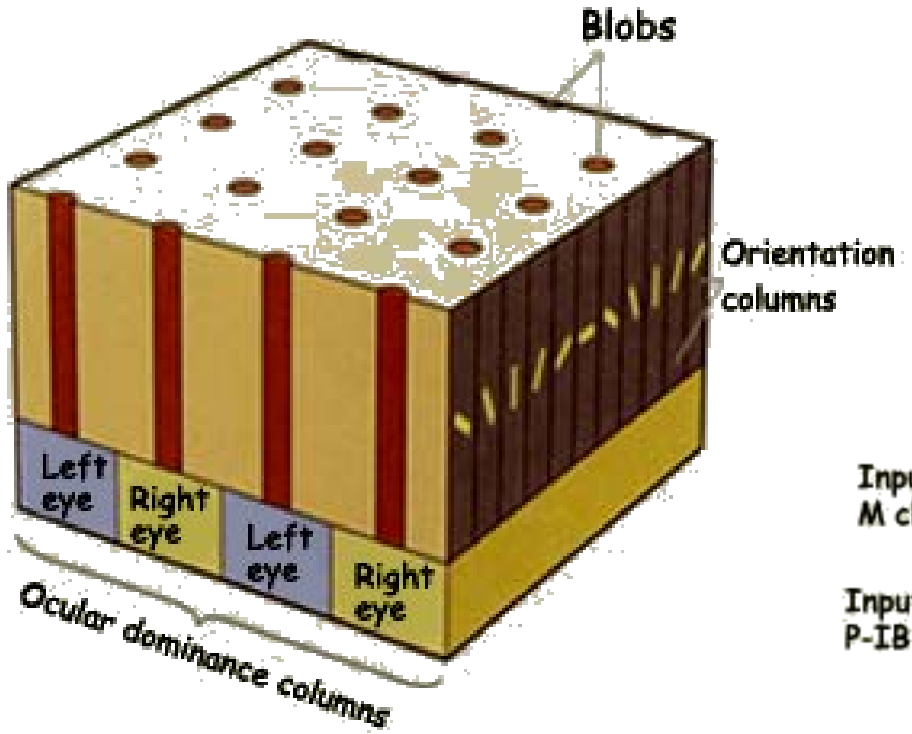
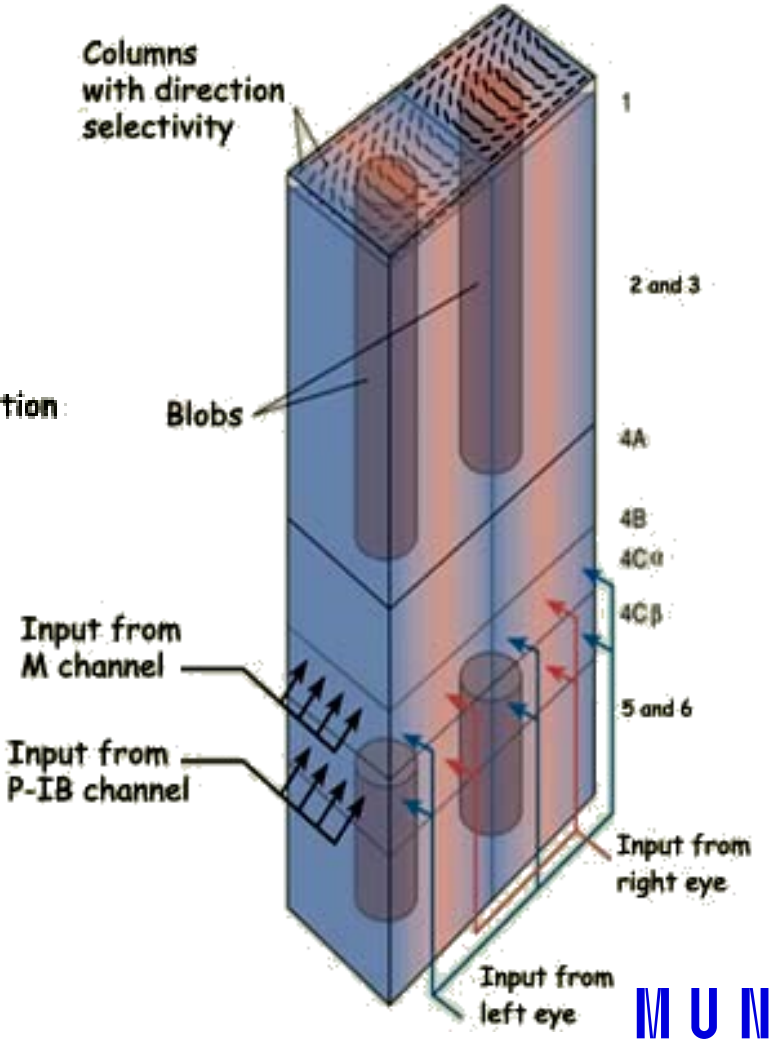
Primary visual cortex

- ✓ Retinotopic organization
- ✓ Columnar organization
  - Orientation columns
    - ➢ Respond to specific orientation
  - Blobs
    - ➢ Respond to color
  - Occular dominance column
    - ➢ Information from left or right eye
- ✓ Horizontal connections





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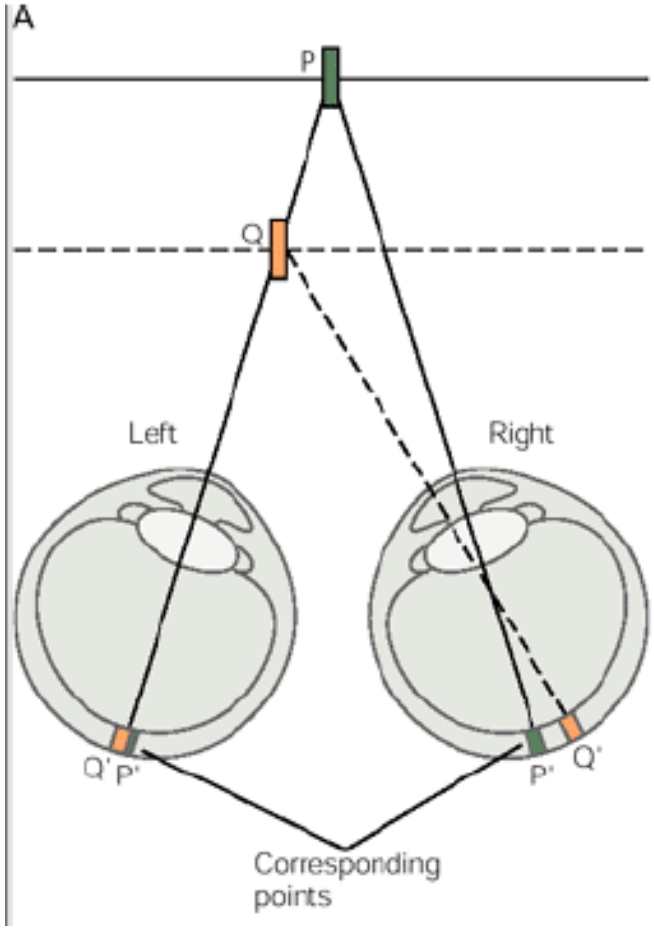
Spatial vision

Binocular



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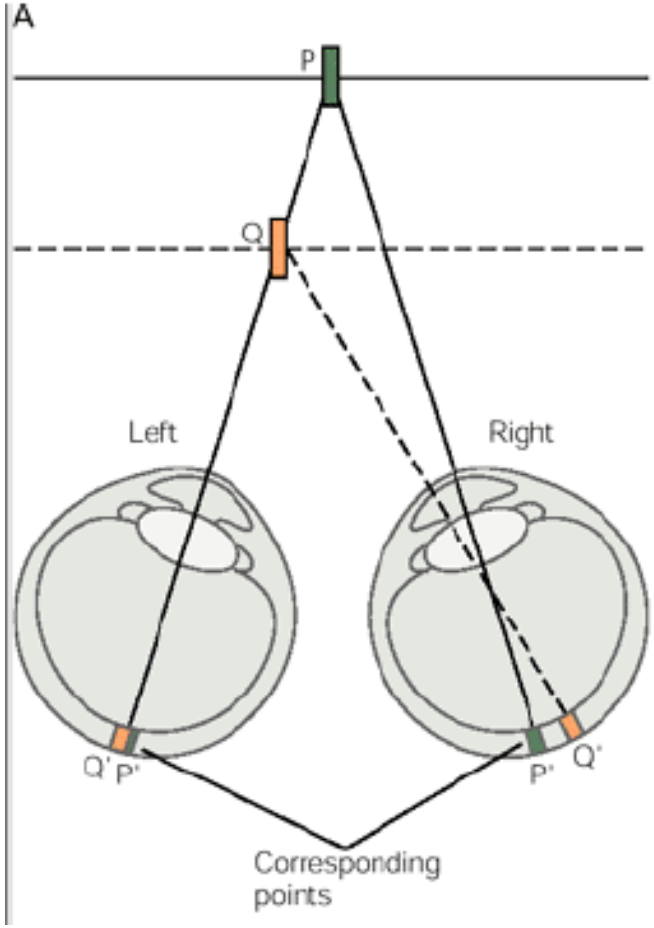
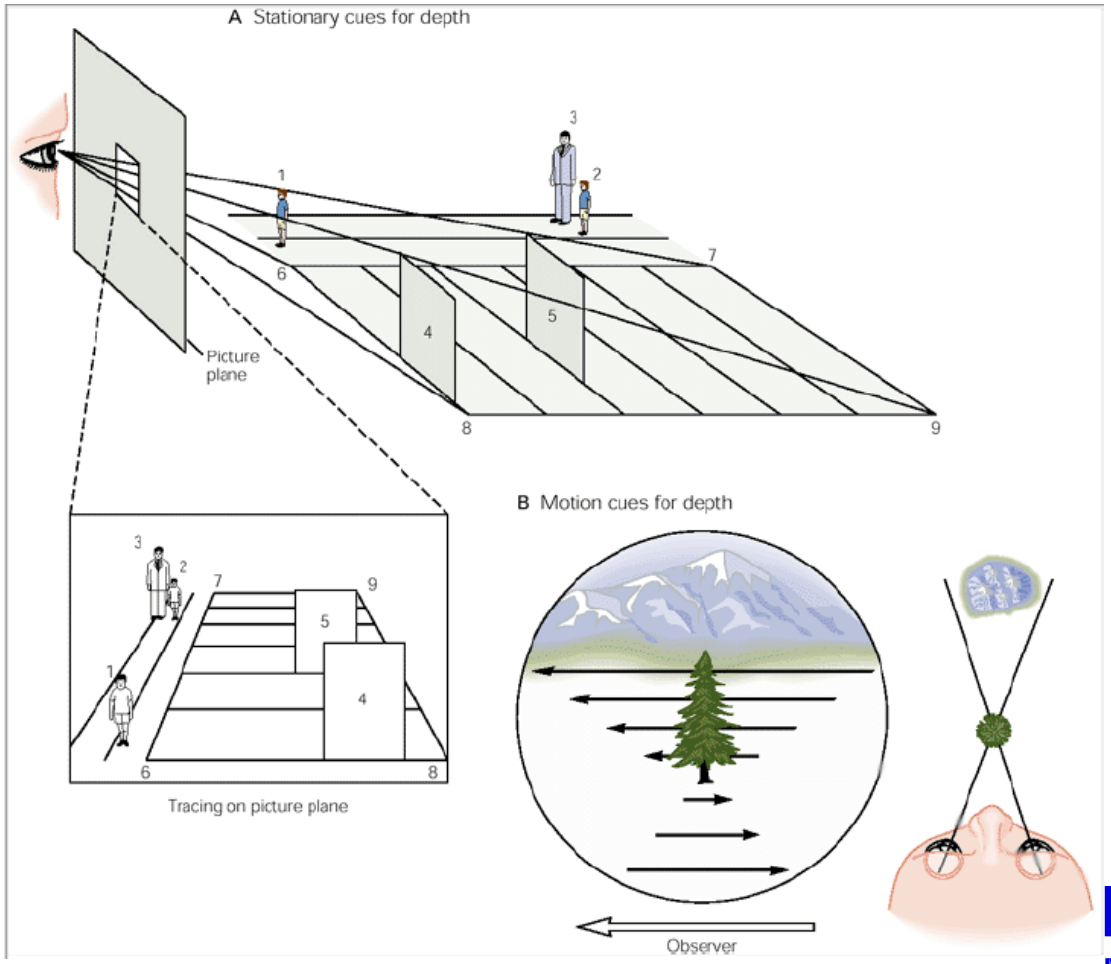
Spatial vision

Binocular



Monocular – based on previous experience



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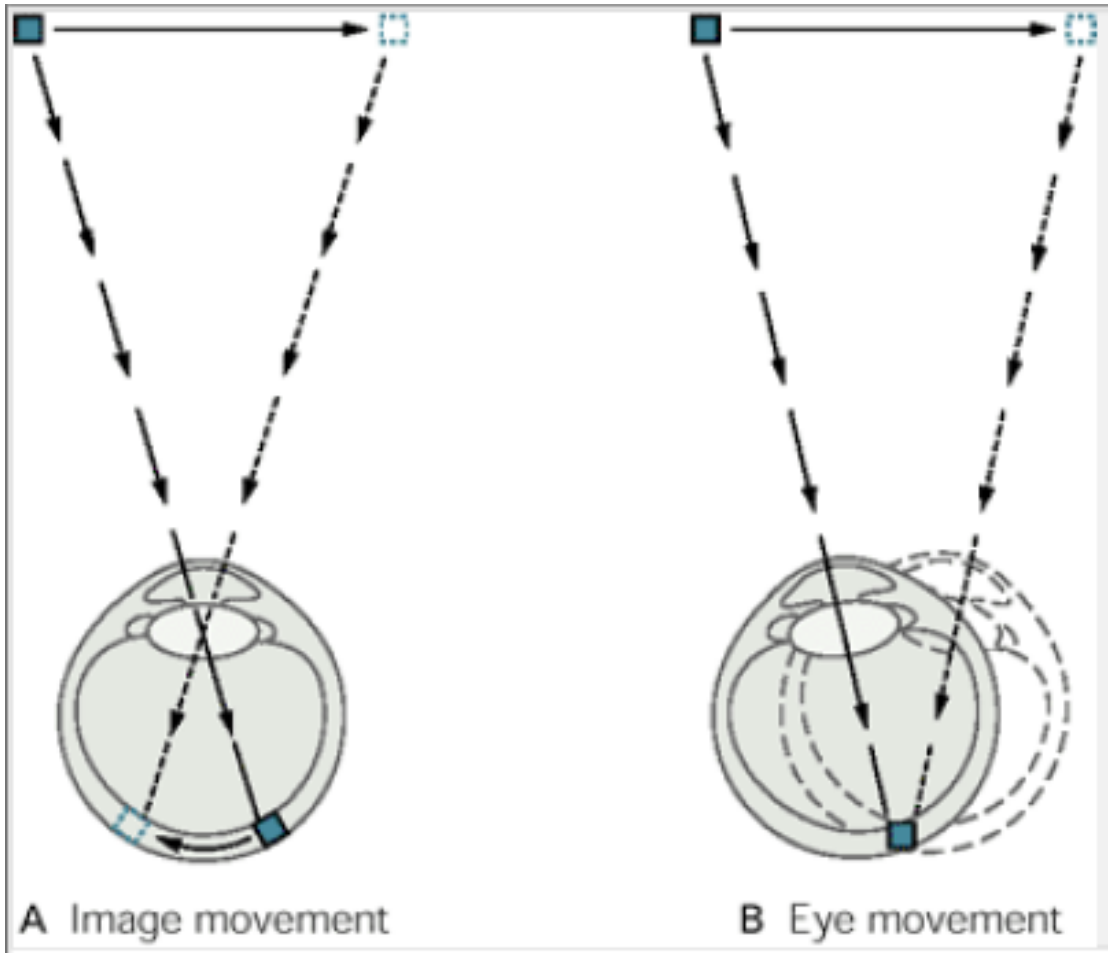
Motion perception



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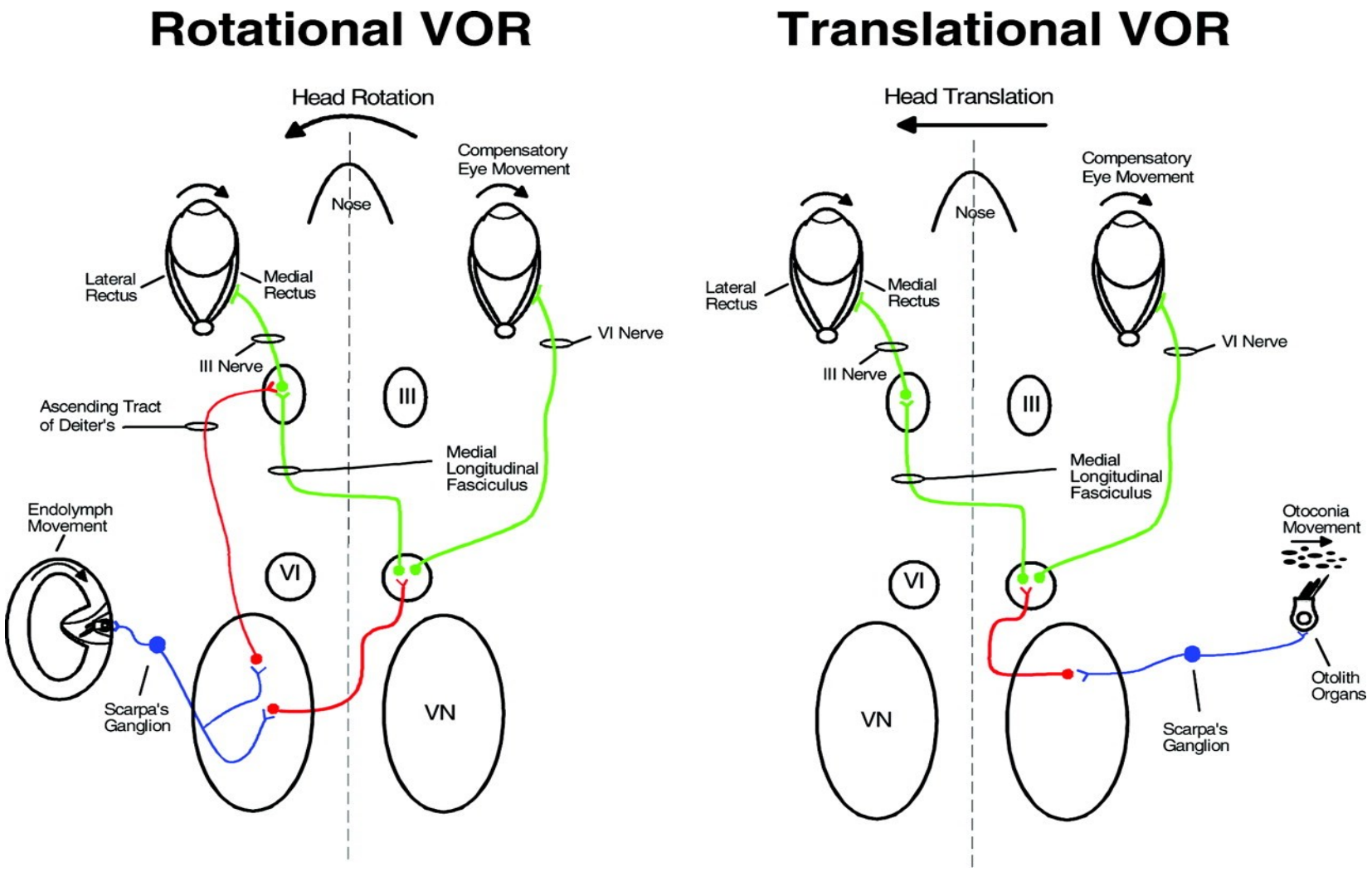
Vestibuloocular reflex



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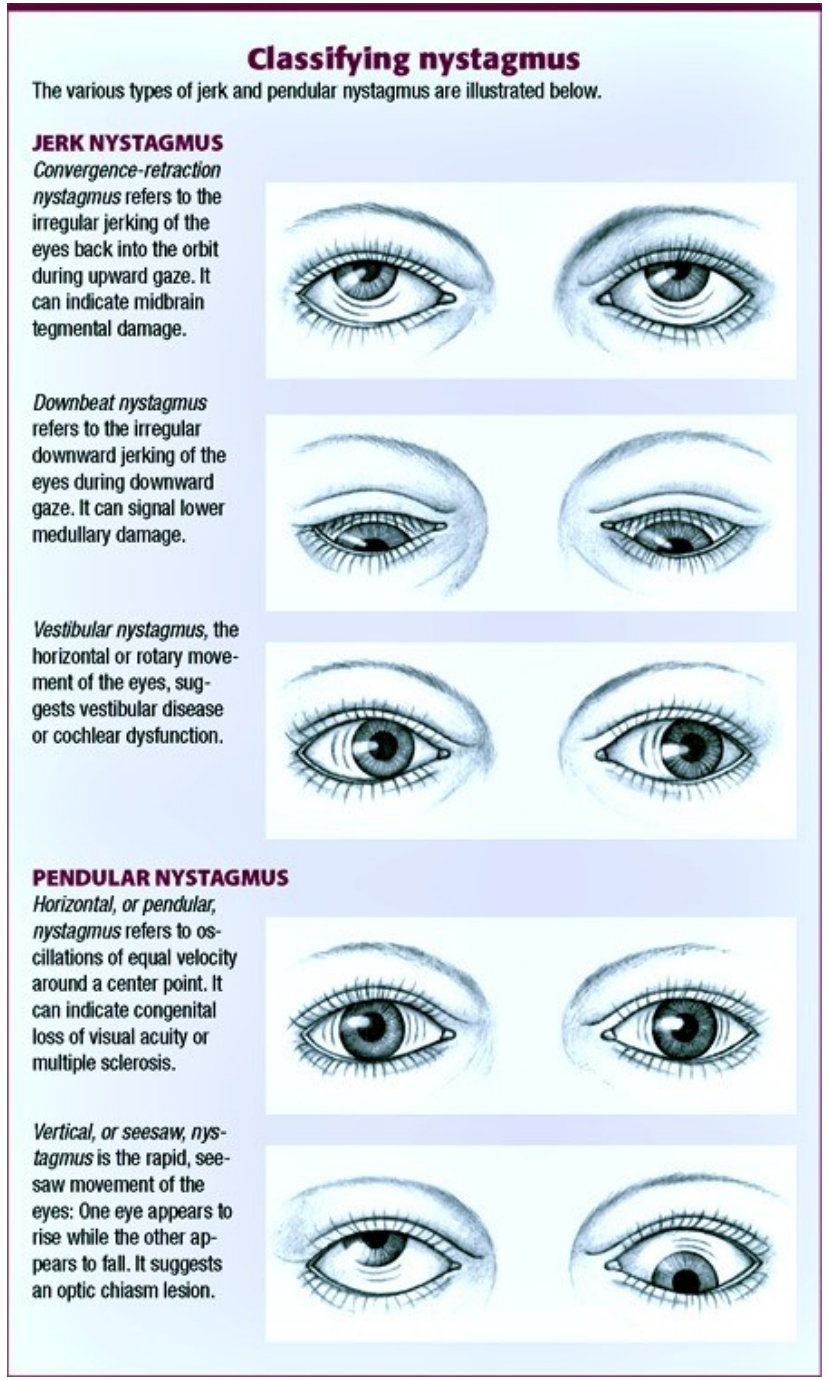
Nystagmus

- Involuntary rhythmic eye movement

- Physiological
  - Postrotatinal
  - Optokinetic

- Pathologic
  - ✓ Peripheral
    - Vestibular system pathologies
  - ✓ Central
    - CNS damage (cerebellum, midbrain…)



http://dxline.info/img/new_ail/nystagmus.jpg

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Saccadic eye movements

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

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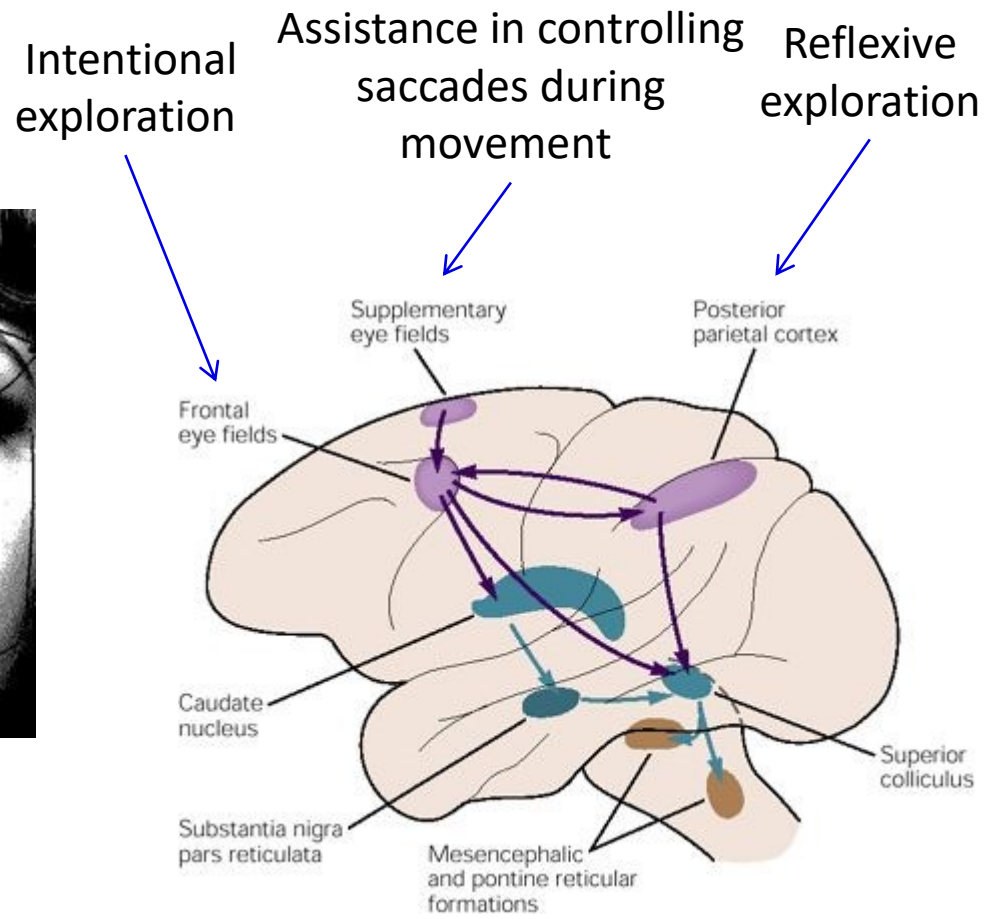

https://s-media-cache-ak0.pinimg.com/564x/51/f7/26/51f7267e7c8a59caa90f904cd4f965eb.jpg

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https://nasregion.cz/praha/praha-5-i-letos-podpori-filmovy-festival-febiofest

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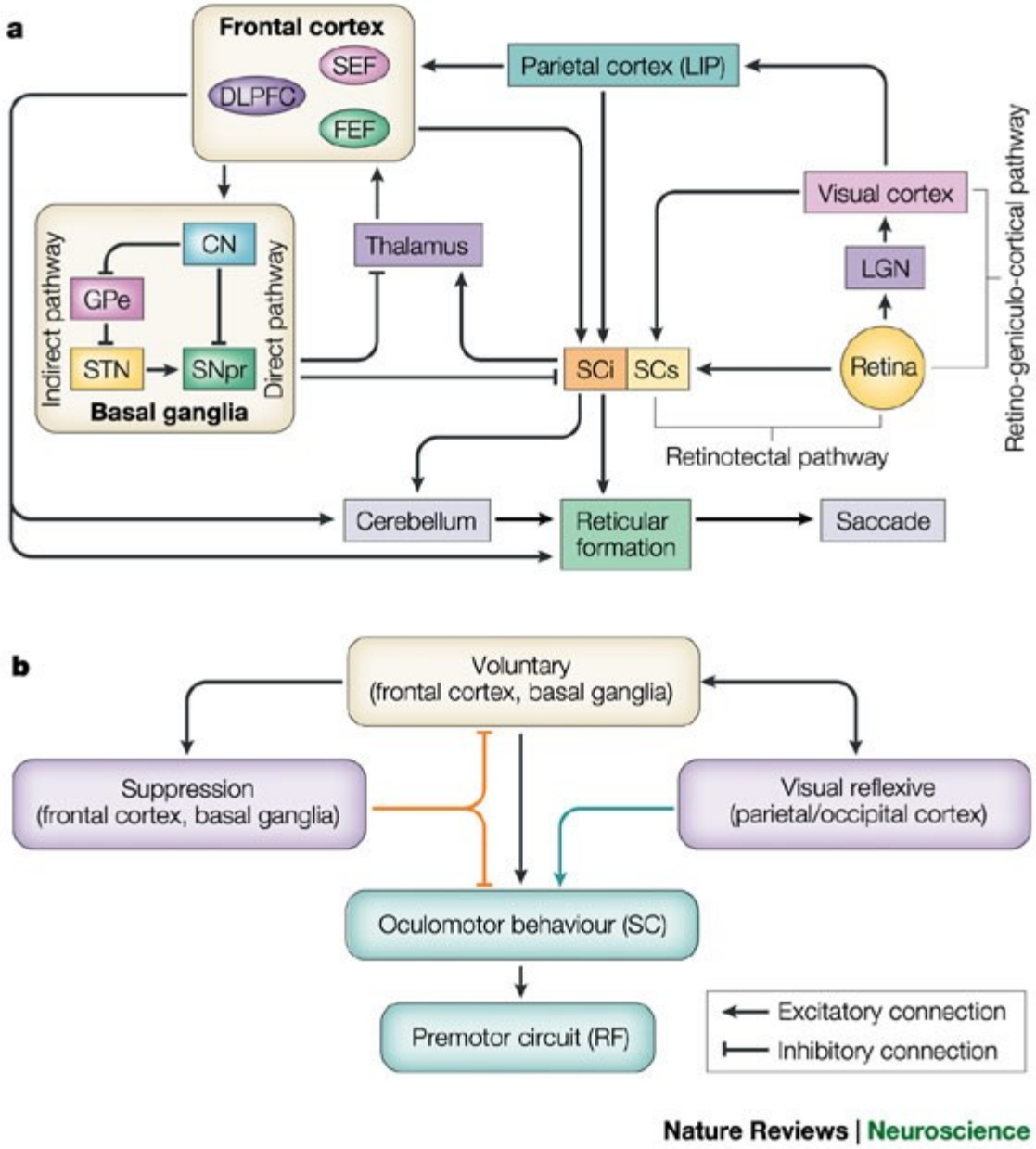

http://www.nature.com/nrn/journal/v5/n3/box/nrn1345_BX1.html

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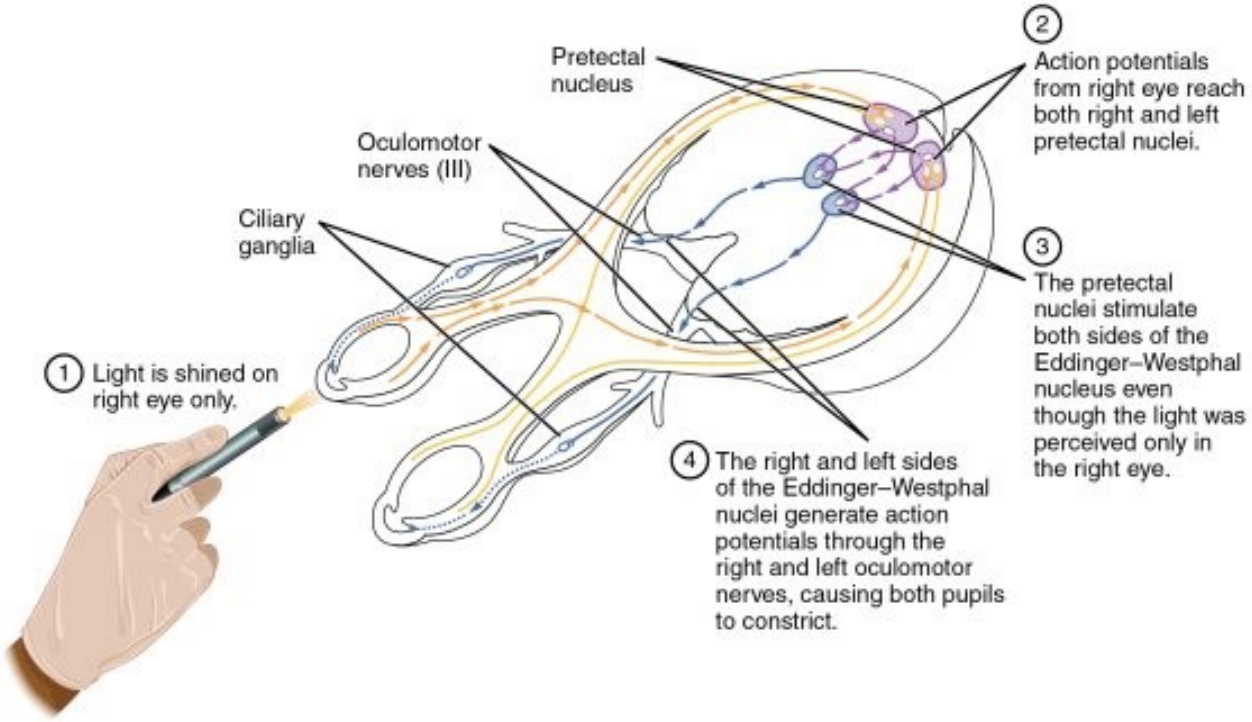
Pupillary reflex



http://www.ubooks.pub/Books/B0/E27R7642/MAIN/images/1509_Pupillary_Reflex_Pathways.jpg

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78. The basic physiology of visual system – rods and cones function, on/off receptive field, nervus opticus vs. tractus opticus

- Rods and cons function
  - Characterization and comparison
  - Phototransduction mechanism and adaptation
- Brief overview of retina organization (retina process receptor potential – analog, AP is generated in ganglion cells)
- Receptive field organization
  - On/off receptive fields
  - Magnocellular system (BW)
  - Parvocellular system (Color)
- Nervus opticus vs. tractus opticus
- Projections from tractus opticus (Main centers in the brain involved in visual signals processing)

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