



Vision Part 2

Vision Accommodation & Pupillary Light Reflex



Color index

- **Important**
- Further Explanation

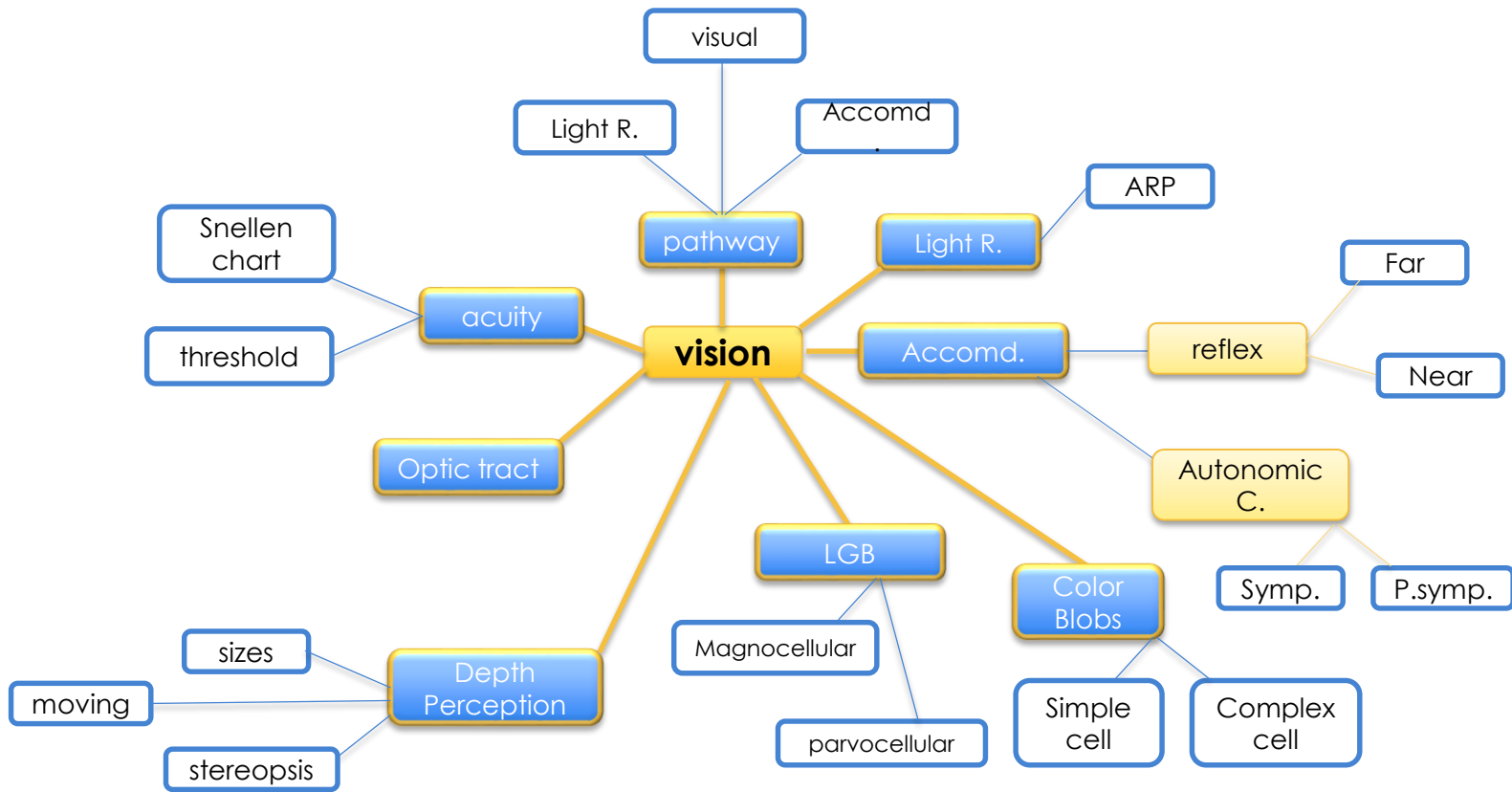
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- Identify the lateral geniculate body and visual cortex functions.....15,16,17,18

Recommended Videos!



Please check out this link before viewing the file to know if there are any additions/changes or corrections. The same link will be used for all of our work [Physiology Edit](#)



I believe this lecture is quite difficult because of many objects including of anatomy and histology also pathology, So please try to study it with clear mind, I tried my best to illustrate it by some pics and graphs, it's only 15 slides... I wish you the best luck doctor ;)

VISUAL ACUITY

- It is the degree to which the details and contours of objects are perceived.
- it is usually defined in terms of the shortest distance by which **two lines can be separated and still be seen as 2 lines.**
- (person can normally distinguish two separate points if their centers lie up to 2 micrometers apart on the retina, which is slightly greater than the width of a foveal cone).



VISUAL THRESHOLD

- **It is the minimal amount of light that elicit sensation of light .**

DUPLICITY THEORY OF VISION

(2 kinds of vision under difference conditions)

Q: Differentiate between cones & rods vision ?

PHOTOPIC VISION

(**bright light vision**):

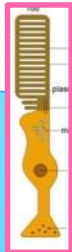
- **served by cones.**
- high visual acuity = **colors & details.**
- low sensitivity to light = needs high visual threshold to be stimulated .



SCOTOPIC VISION

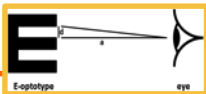
(night vision, **dim light vision**):

- **served by rods**
- low visual acuity = **no colors or details.**
- great sensitivity to light = low visual threshold .

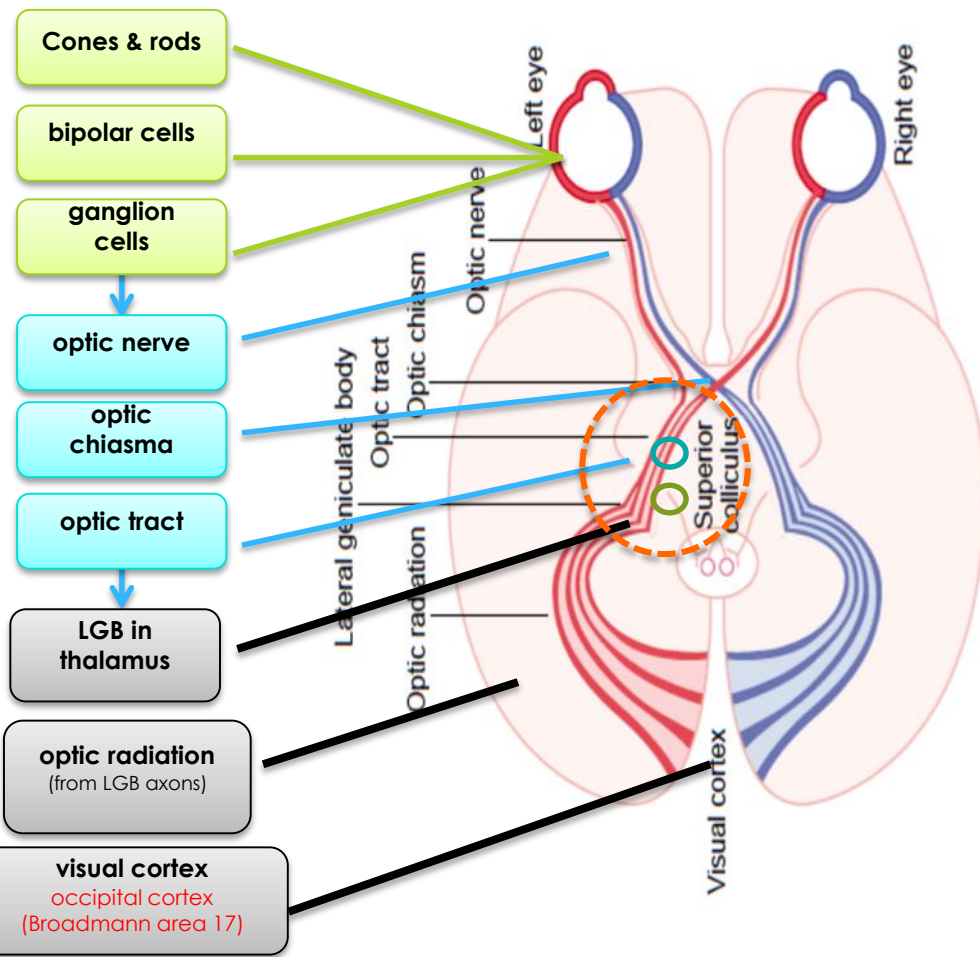


Snellen chart for measure visual acuity

- d: distance of Patient. **Normal acuity : ($d/D = 6/6=1$).**
 - D: distance of normal person .
- A person of $6/12=0.5$ has less vision than normal vision.



**** Quick video about snellen chart**



 **Important**

- some ganglion cells axons pass from optic tract to ¹**pretectal region of midbrain** for pupillary reflexes & eye movement.
- Some axons of ganglion cells from optic chiasma pass directly to ²**hypothalamus** for circadian rhythm (light-dark cycle) that synchronize various physiologic changes of the body with night and day.
- Some axons from ³**lateral geniculate body** in thalamus to **superior colliculus** in midbrain for (accomodation reflex) & its miosis* component & to control rapid directional movements of the two eyes.

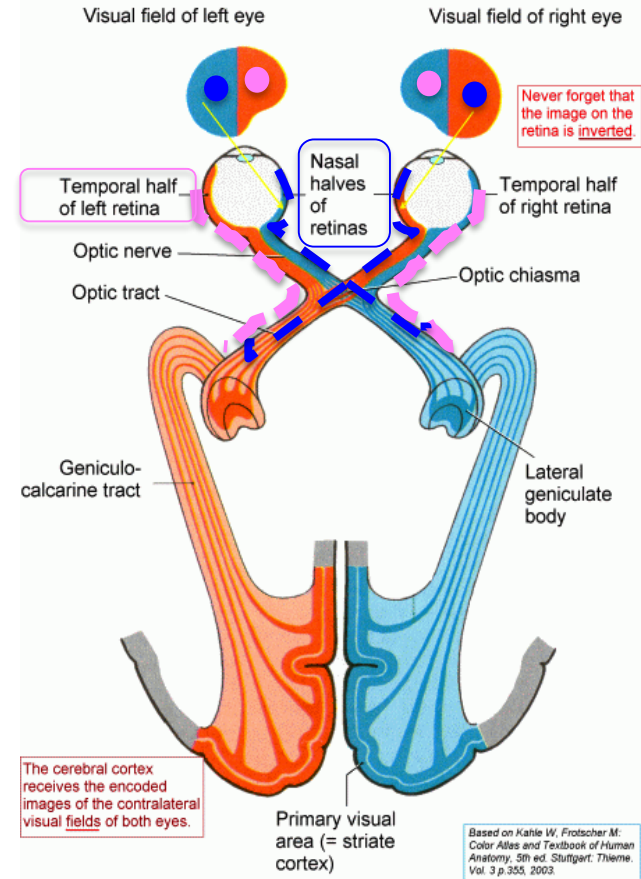
*Miosis: excessive constriction of the pupil of the eye.

Cont.

- ***The nasal fibers** (**medial**) cross to opposite side
- ***The temporal fibers** (**lateral**) do not cross
- Nasal fibers conveys temporal field (outer) of vision
- Temporal fibers conveys nasal field (inner) of vision

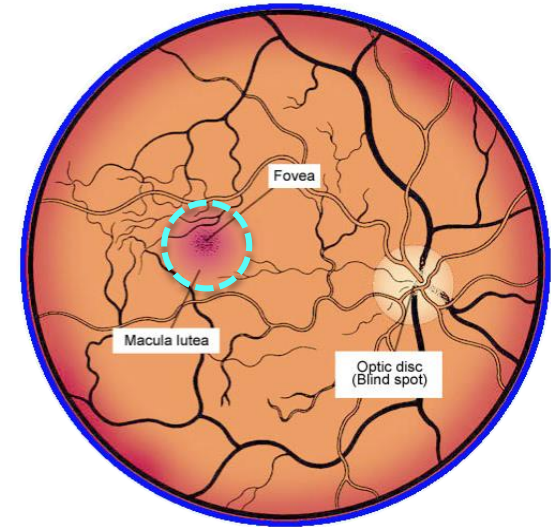
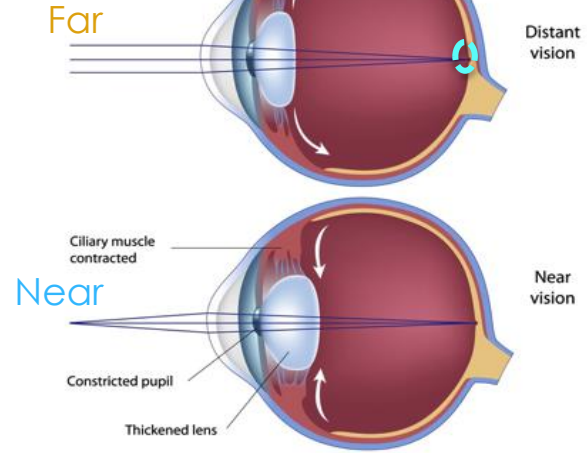
OPTIC TRACT

- Includes **LATERAL FIBERS** of the same side + **MEDIAL fibers** of the opposite side (i.e. temporal field of other eye(outer)).
- **Example: LEFT OPTIC TRACT:** Conveys **LATERAL** (temporal fibers) of the **left** eye + **MEDIAL** (nasal fibers) of the **right** eye = (RIGHT half of visual field of left eye + RIGHT half of visual field of right eye), both form right half of visual field of both eyes.
- **N.B:**
 - The **left optic tract** corresponds to the right 1/2 of the visual field.
 - The **right optic tract** corresponds to the left 1/2 of the visual field.



- When an object is 6 m (20 ft) or more away from the viewer the light rays reflected from the object **nearly parallel** to one another.
- The lens must bend these parallel rays just enough to be focused on the ***central fovea**, where vision is **sharpest**.
- Because light rays that are reflected from objects closer than 6 m (20 ft) **are divergent rather than parallel**, the **rays must be refracted more if they are to be focused on the retina**.
- This additional refraction is accomplished through a process called **accommodation**:
- So, it is an active process for modification of the refractive power of the eye to view a nearby object by increasing the curvature of lens
- Ciliary muscle has two separate sets of smooth muscle fibers longitudinal fibers and circular fibers.

The near response of the eye



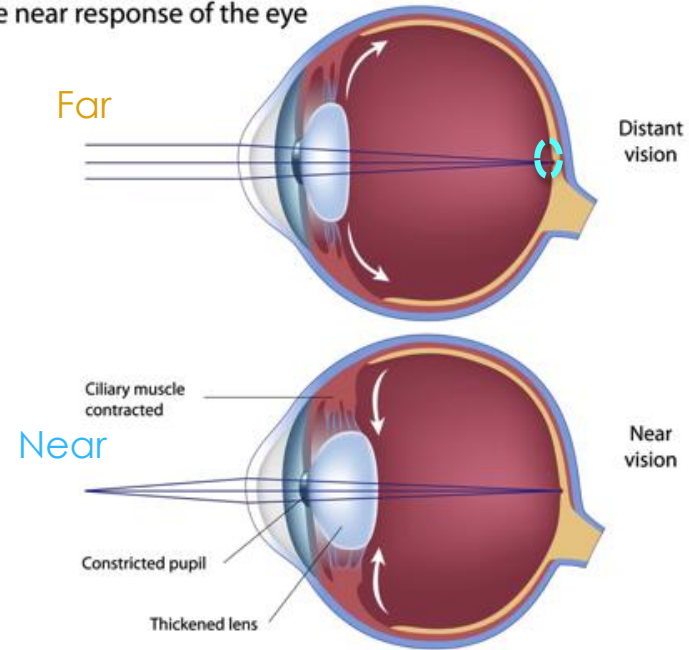
- **Contraction of either set in *the ciliary muscle relaxes *the ligaments** to the lens capsule, and the lens assumes a more spherical shape, because of the natural elasticity of the lens capsule & **and increase its refractive power.**
- The ciliary muscle of accommodation is controlled by parasympathetic nerves transmitted to the eye through the third cranial nerve III.

At rest (looking at far objects):

Ciliary muscles are **relaxed + taut** (tense) **ligaments + flat lens**

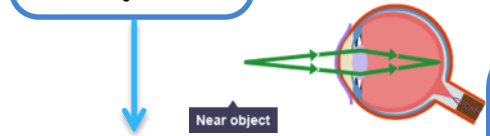
- **looking at near objects:** from near (close) objects parallel rays focus behind retina (if ciliary muscles remain relaxed) >> blurred vision
- **Solution is to increase curvature & refractive power** of lens by accommodation to bring focus on retina.

The near response of the eye



1) Focusing at near object

4) **slack = relaxed ligaments** why?



2) **Increased anterior surface curvature of lens**

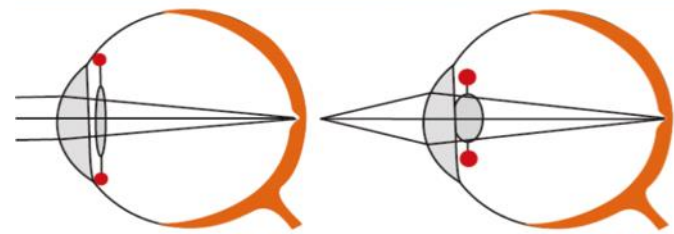
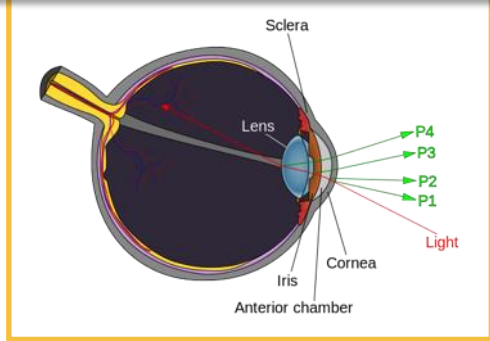
BY:

3) **ciliary muscles contraction** (THE CILIARY MUSCLE IS ONE OF THE MOST USED MUSCLES IN THE BODY)

- to add **12D** to **refractive power of lens**.
- both circular & longitudinal ciliary muscles contract to pull ciliary muscle forwards & inwards >> ciliary muscles edges come close to each other to **increase anterior surface curvature of lens**.

- Accommodation is the focusing of light in the retina. We focus by changing the shape of the lens.
- The lens is **flattened for distant objects**.
- The lens is **rounded for near objects**.

Purkinje images are reflections of objects from the structure of the eye.



When the ciliary muscles are relaxed the lens is flat and distant objects are focussed onto the retina

When the ciliary muscles are contracted, the lens becomes more round and a close object is focussed onto the retina

Looking at a close object (**near response**)

pupil constriction

convergence of both visual axis

Accommodation

why?

why?

why?

The pupil constricts in order to prevent diverging light rays from hitting the periphery of the retina and resulting in a blurred image.

In near objects the axis are in divergent pattern for that eye will converge the rays so they line at central fovea (focus on retina).

To converge the rays more, because they are divergent.

Near point and amplitude of accommodation

Age (yrs)	Near point (cm)	Amplitude of Accommodation
10	9.0	11.0
20	10.0	10.0
30	12.5	8.0
40	18	5.5
60	83	1.2
70	100	1.0

presbyopia

Triad:

- 1-loss of accommodation
- 2-loss of lens elasticity
- 3- near point recede

correction by **biconvex lens**

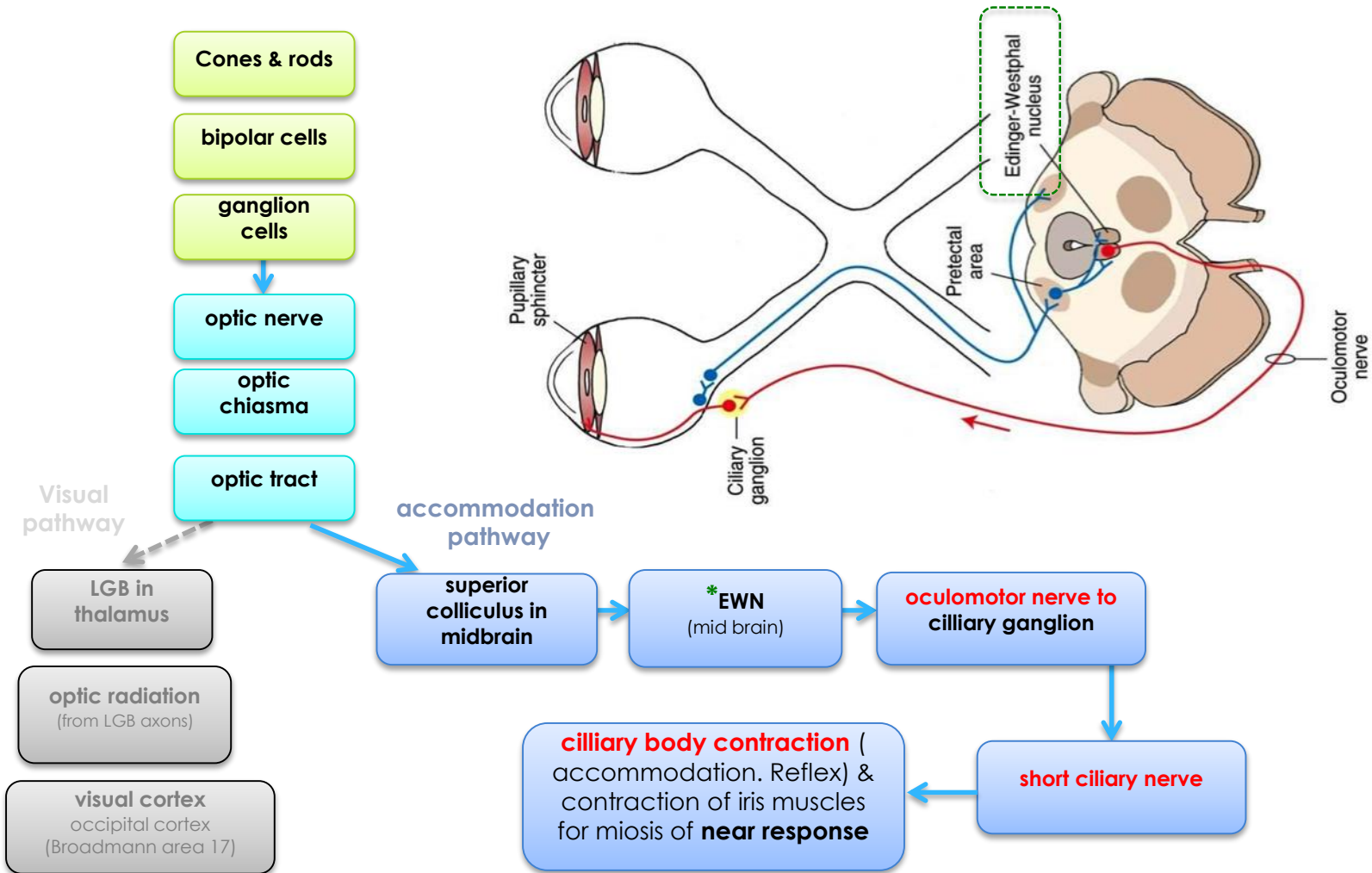


due to hardness of lens & loss of accommodation.

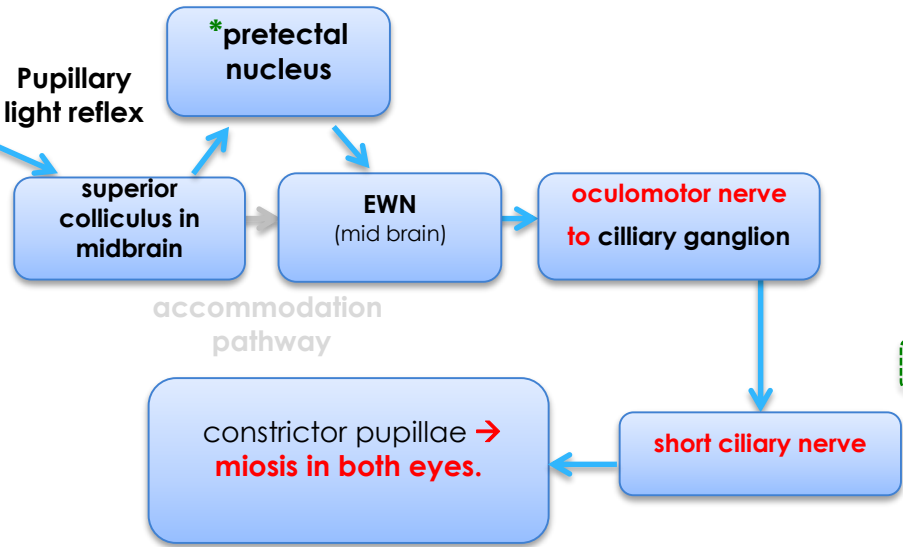
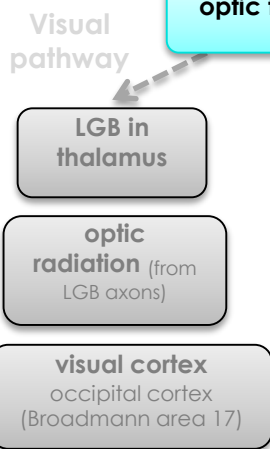
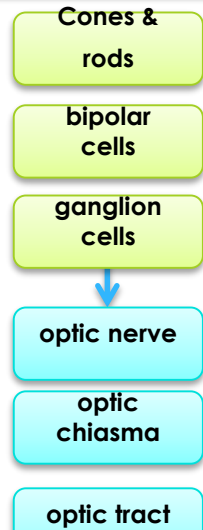


Near point:

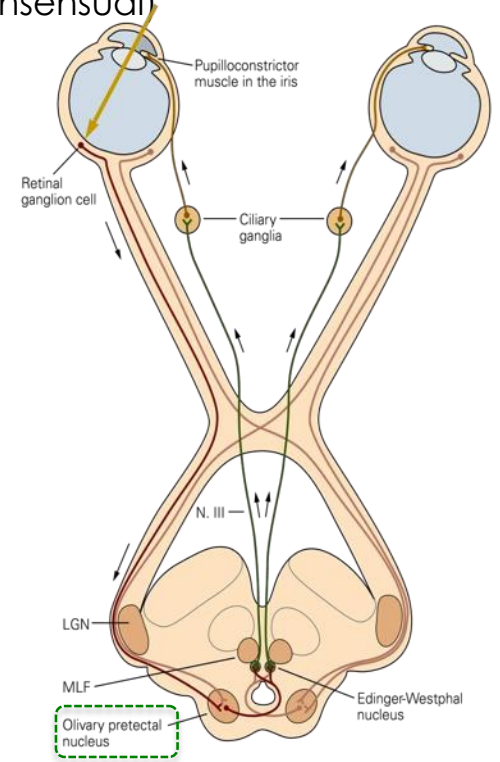
Nearest point to eye at which object can brought into focus on retina by ACCOMODATION



Pathway of consensual Pupillary light reflex (indirect):



➤ Light on one eye pupil will constrict of **this pupil (directly)** & the **other pupil (indirectly or consensual)**



Conversely, in darkness, **the reflex becomes inhibited**, which results in dilation of the pupil.

Argyll Robertson pupil

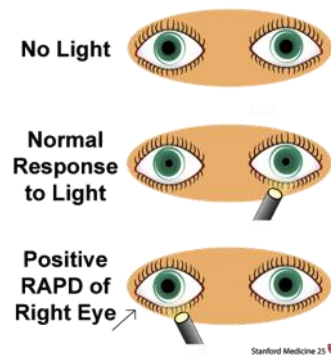
In syphilis tabes dorsalis which **destroy pretectal nucleus**.

tabes dorsalis is a late manifestation of untreated syphilis and is characterized by a triad of clinical symptoms namely gait unsteadiness, lightning pains and urinary incontinence. It occurs due to a slow and progressive degeneration of nerve cells and fibers in spinal cord. It is one of the forms of tertiary syphilis or neurosyphilis. Syphilis is a sexually transmitted disease caused by a bacteria named Treponema pallidum.

➤ **Light Reflex is lost**

➤ **Accommodation Reflex remains**

○ because lesion is in pretectal nucleus only, away from superior colliculus & fibers of accommodation.



Tabes Dorsalis morphology: **DORSALIS**

- D**orsal column degeneration
- O**rthopedic pain (Charcot joints)
- R**eflexes decreased (deep tendon)
- S**hooting pain
- A**rgyll-Robertson pupils

This image Not included in our subject

- Damage of transmission of visual signals from the retinas to the Edinger-Westphal Nucleus, blocking the pupillary reflexes as in alcoholism, encephalitis

Autonomic Control of Accommodation and Pupillary Aperture

PARAsympathetic

1. parasympathetic preganglionic fibers in the *Edinger- Westphal nucleus* to **third nerve** to the **ciliary ganglion**.
1. Then preganglionic fibers synapse with postganglionic parasympathetic neurons, which send in short *ciliary nerves* into the eyeball to:

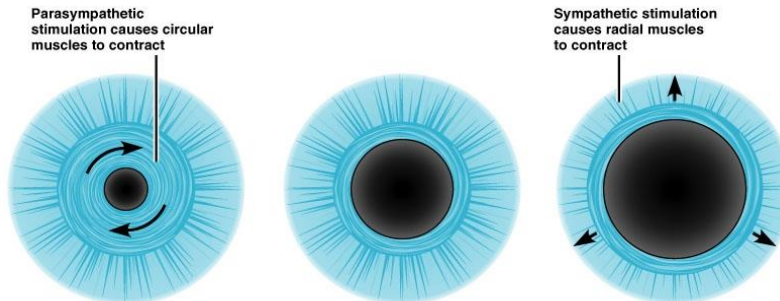
The **ciliary muscle** that controls focusing of the eye lens

The **sphincter of the iris** that constricts the pupil.

Sympathetic

1. The sympathetic innervation of the eye originates in lateral horn cells of the first thoracic segment of the spinal cord.
2. to sympathetic chain to the superior cervical ganglion.
3. synapse with postganglionic neurons. sympathetic fibers spread along the surfaces of the carotid artery ,to:

Innervate the **radial fibers** of the iris (which open the pupil)

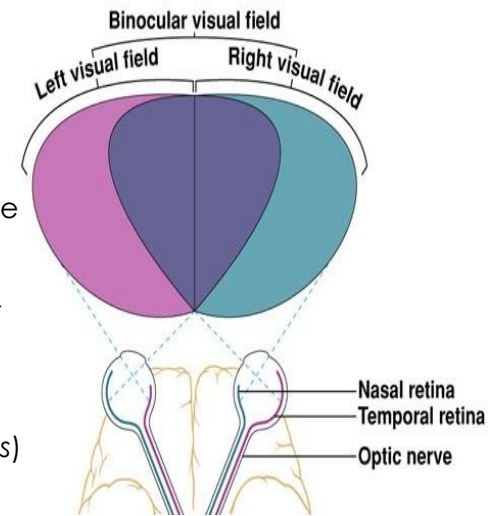


Determination of Distance of an Object from the Eye

“Depth Perception” :

A person normally perceives distance by three major means:

1. **The sizes** of the images of known objects on the retina, the brain calculate from image sizes the distances of objects.
1. **The phenomenon of moving parallax:** when the person moves his head to one side or the other, the images of close-by objects move rapidly across the retinas, while the images of distant objects remain almost completely stationary.
1. **The phenomenon of stereopsis or Binocular Vision:** **this binocular parallax** (or *stereopsis*) that gives a person with two eyes far greater ability to judge distances.



Lateral geniculate body LGB (6 layers):

- **Left LGB** (similar to **left optic tract**) has all layers receive from **RIGHT 1/2 of visual field.**
- **Right LGB** (similar to **right optic tract**) has all layers receive from **LEFT 1/2 of visual field.**

FUNCTION OF LGB:

1

Acts as a **relay station** for visual information from optic tract to cortex.

2

It has point to point transmission with high degree of (spatial fidelity) *

3

Acts as gate controls signal transmission to **visual cortex** i.e. control how much signals reach visual cortex

4

color vision & detect shapes & texture

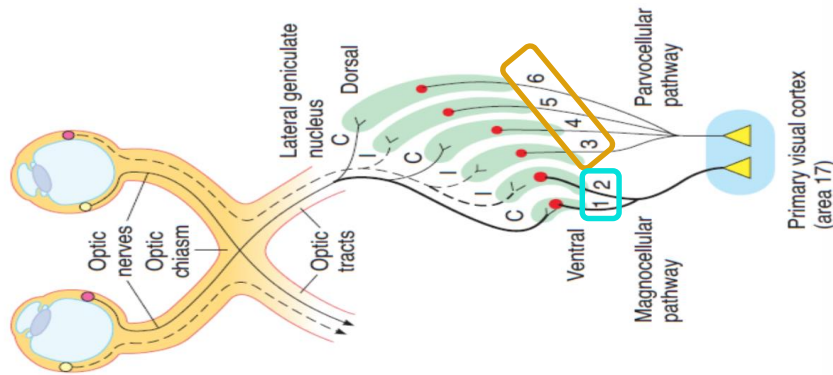
* From exact point of retina to exact point on cortex

LGB Cont. :

N.B:

It receives gating control signals from two major sources:

1. Corticofugal fibers returning in a backward direction from the primary visual cortex to the lateral geniculate nucleus.
2. Reticular areas of the mesencephalon. Both of these are inhibitory and, when stimulated, can turn off transmission through selected portions of the dorsal lateral geniculate nucleus.



LGB layers type :

The magnocellular pathway

From **layers 1 and 2** which have large cells and are called magnocellular.

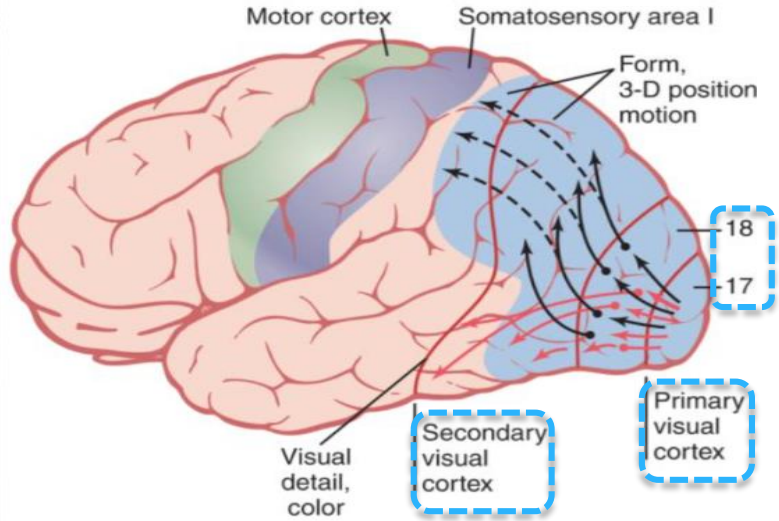
carries signals for **detection of movement, depth, and flicker.**

This magnocellular system provides a *rapidly conducting* pathway to the visual cortex. **However, this system is color blind, transmitting only black-and-white information**

The parvocellular pathway

From **layers 3,4,5,6** which have small cells and are called parvocellular.

carries signals for **color vision, texture, shape, and fine detail** moderate velocity of conduction.



- The fovea is responsible for the highest degree of visual acuity, so it has larger representation in the primary visual cortex than the most peripheral portions of the retina. “Repeated”
- The primary visual cortex is also called *visual area I*.
- Signals from the retinal fovea transmits its signals terminate near the occipital pole, whereas signals from the more peripheral retina terminate in concentric half circles anterior to the pole on the medial occipital lobe.
- The upper portion of the retina is represented superiorly and the lower portion inferiorly.

① Primary visual cortex (Brodmann area 17) :

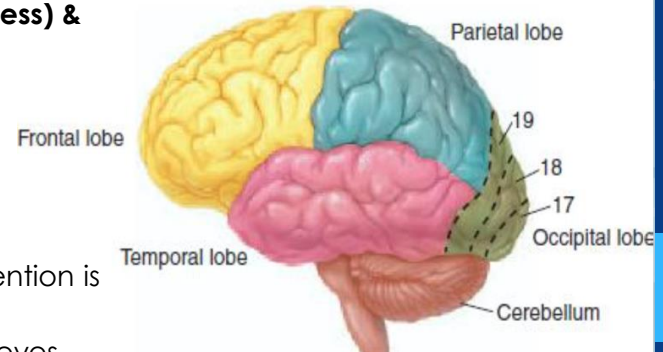
perceive sensation of vision (**movement + shapes+ stereoscopic vision + brightness**) & has blobs for color detection.

② Association visual cortex (area 18&19) (secondary visual areas) :

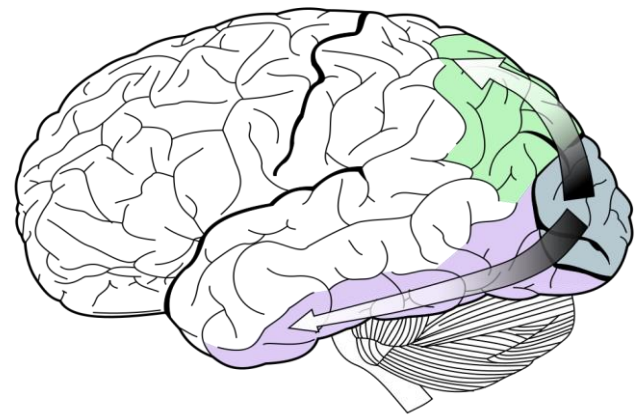
located mainly anterior to the primary visual cortex

-interpretation of visual stimuli,

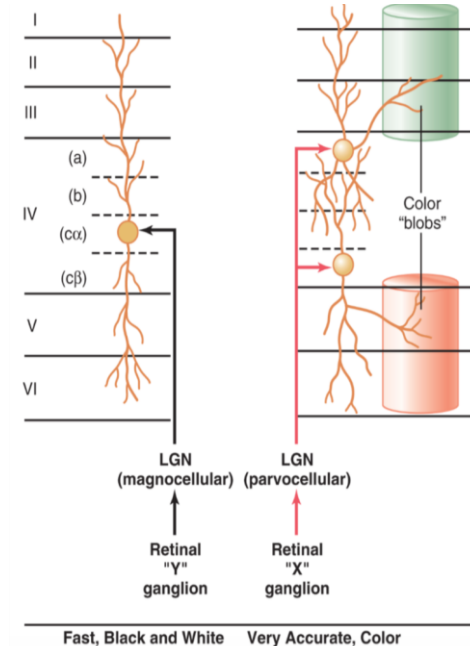
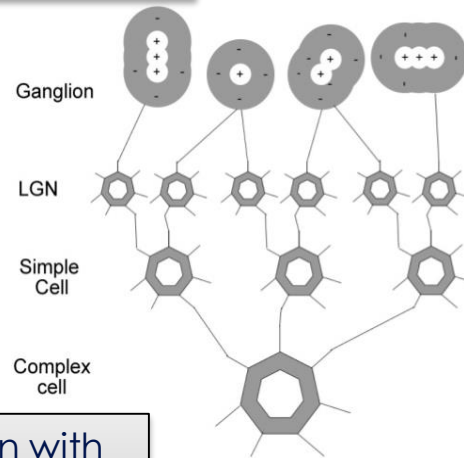
- The fixation mechanism that causes the eyes to “lock” on the object of attention is controlled by *secondary visual*.
- When this fixation area is destroyed bilaterally, causes difficulty keeping its eyes directed toward a given fixation point.



- Removal of the primary visual cortex causes loss of conscious vision, blindness, but **patient react subconsciously to changes in light intensity**, to movement in the visual scene..
- These reactions include turning the eyes, turning the head, and avoidance. This vision is believed to be subserved by neuronal pathways that pass from the optic tracts mainly into **the superior colliculi**.



- Color Blobs "Within the visual cortex" are clusters of cells responsible for color detection.
- **Simple cells** detect **color contrast details, bars of light, lines**, borders and edges.
- **Complex cells** detect **Line Orientation** When a Line Is Displaced Laterally or Vertically in the Visual Field (**linear movements of a stimulus**)



Macular sparing= loss of peripheral vision with intact macular vision.

because the macular representation is separate from that of the peripheral fields and very large relative to that of the peripheral fields.

1- Which type of cell in the visual cortex responds best to a moving bar of light?

- A. Simple
- B. Complex
- C. Hypercomplex
- D. Bipolar

2- Cutting which structure on the right side causes blindness in the temporal field of the left eye and the nasal field of the right eye?

- A. Optic nerve
- B. Optic chiasma
- C. Optic tract
- D. Fovea ganglion cells

3- Lesions of which type of cells in the lateral geniculate body will result in only black and white vision

- A. Parvocellular
- B. Complex
- C. Magnocellular
- D. Bipolar

4- Lesion of the pretectal nuclues, result in ..

- A. Loss of accommodation
- B. Loss of pupillary reflex
- C. Loss of both pathways
- D. Loss EWN action

5-The amplitude of accommodation as the person gets older will

- A. Increase
- B. Decrease
- C. Constant through out the life

6- IN Macular sparing, the damaged nerve normally terminate in the

- A. Frontal Lobe
- B. Temporal lobe
- C. Occipital pole
- D. Anterior to the pole on the medial occipital lobe

7- From which part of the brain stem there is fibers that inhibit Lateral geniculate nuclues

- A. Midbrain
- B. Pons
- C. Medulla
- D. Red nucleus

1- Contraction of the ciliary muscles lead to

. Relaxed ligaments → increase the curvature of lens → more refraction power

2- The effect of using atropine as muscarinic inhibitor to the pupil

. Mydriasis (dilation of the pupil)

3- Triad of of presbyopia?

loss of accommodation

Loss of lens elasticity

near point recede

4- Removal of the primary visual cortex lead

.loss of conscious vision, blindness, but patient react subconsciously to changes in light intensity

THANK YOU FOR CHECKING OUR WORK!

BEST OF LUCK

Done By:

- ✧ HAITHAM ALASIM
- ✧ Moath AlEisa
{MCQs}

