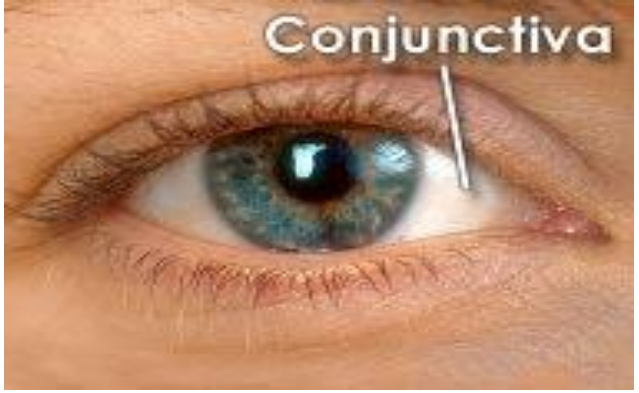

Vision

1-Physiology of the eye & Refraction

By
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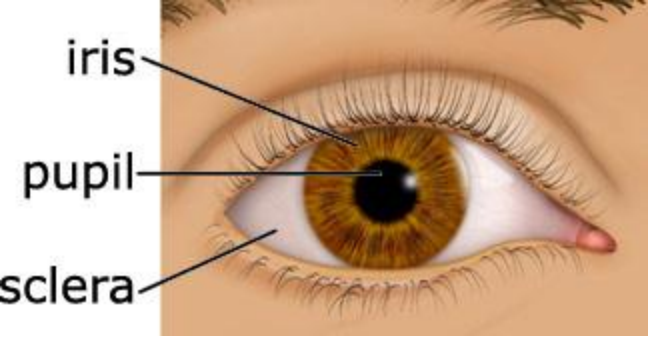
College of medicine-King Saud University
Physiology Dept

OBJECTIVES:-

At the end of this lecture, the student should be able to:-

-Describe different components of the eye and function of each and -understand the eye protection media
- Describe the refraction of light as it passes through the eye to the retina, identifying the refractive media of the eye
-Know glocuma and binocular vision
-Know layers of retina, blind spot, and fovea centralis
-explain the different light sensitivities of the fovea, peripheral retina and optic disk
- Know principles of optics and errors of refraction
-

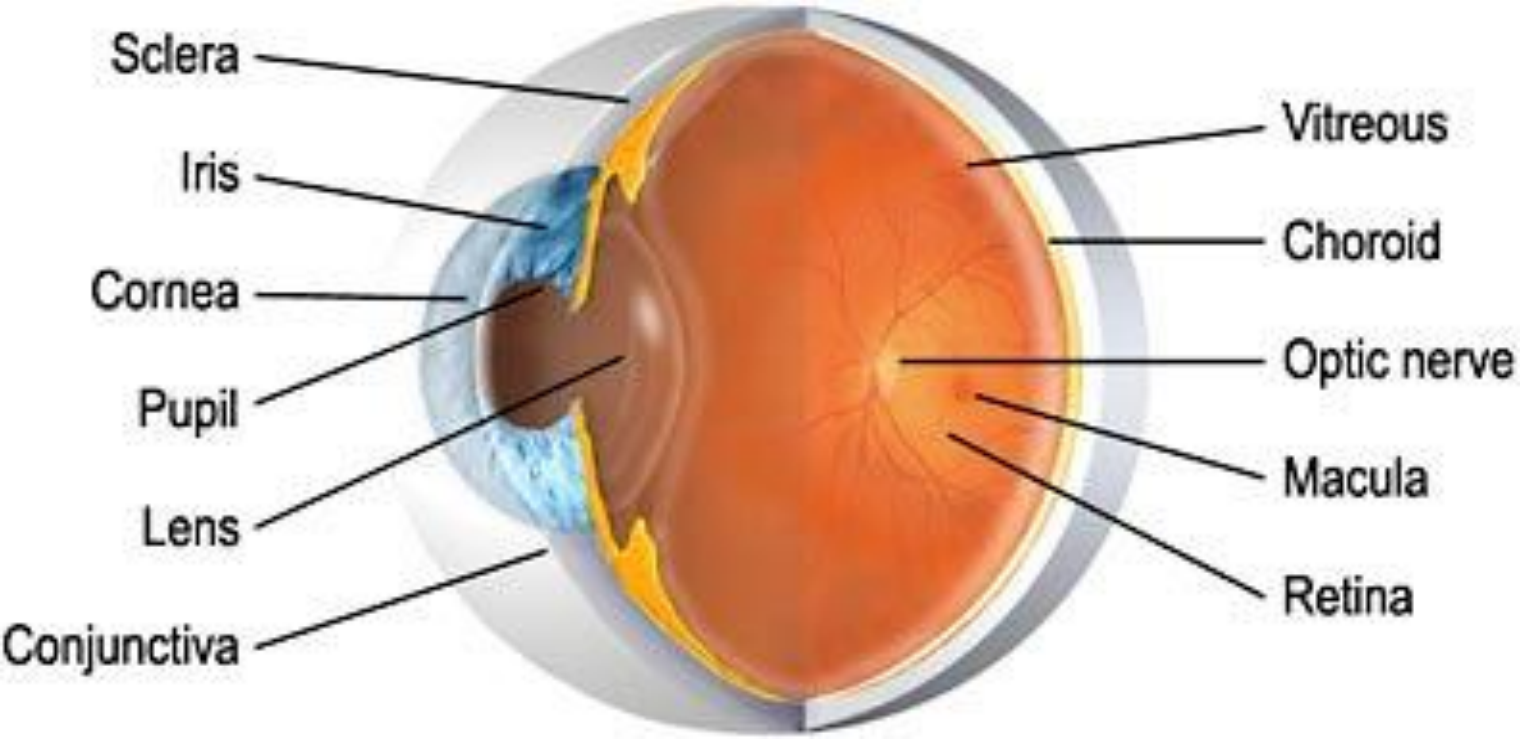


Anatomy of the eye:

1- Sclera (for protection- spherical appearance)-

-choroids inside sclera (BV to supply retina with blood)

- post 2/3 of choroid has **retina** innermost layer


Sclera
Iris
Cornea
Pupil
Lens
Conjunctiva
Vitreous
Choroid
Optic nerve
Macula
Retina

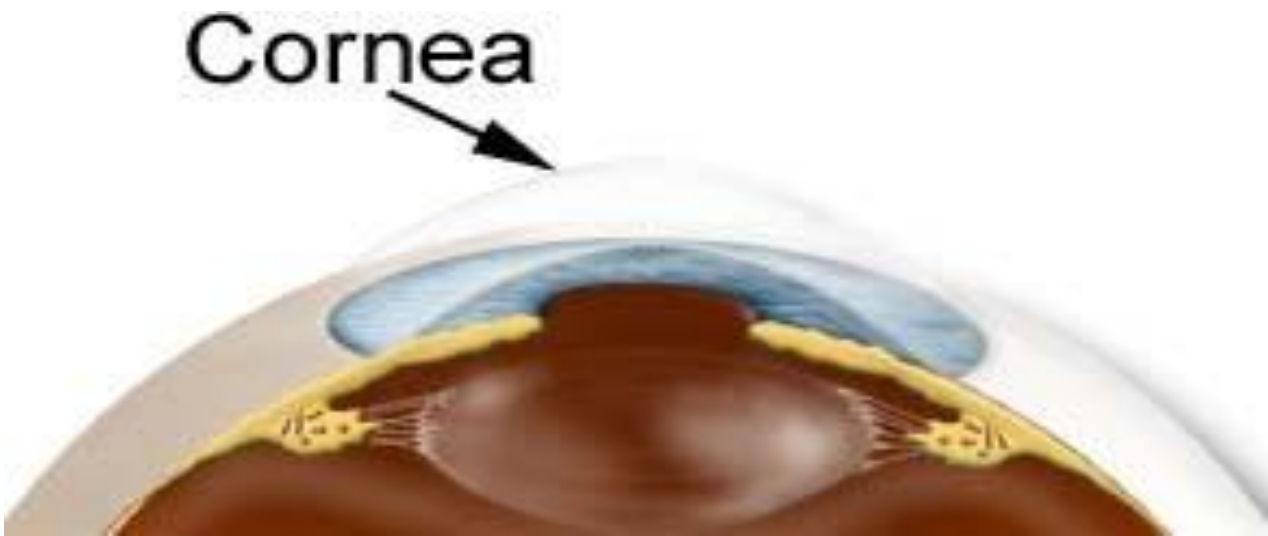
2- **cornea** (modified ant 1/6 of sclera) to allow light to enter the eyes, transparent , avascular.

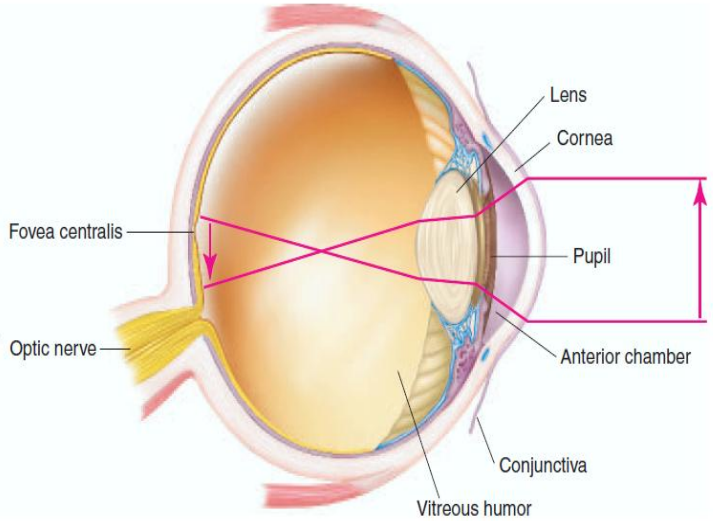
--Refractive or diopteric power **40-45 D at its anterior surface.**

EYE HAS:-
1-Refracting Media

2- Coats (Sclera, Choroid and Retina)

3-Post2/3 Retina, Ant1/6Cornea

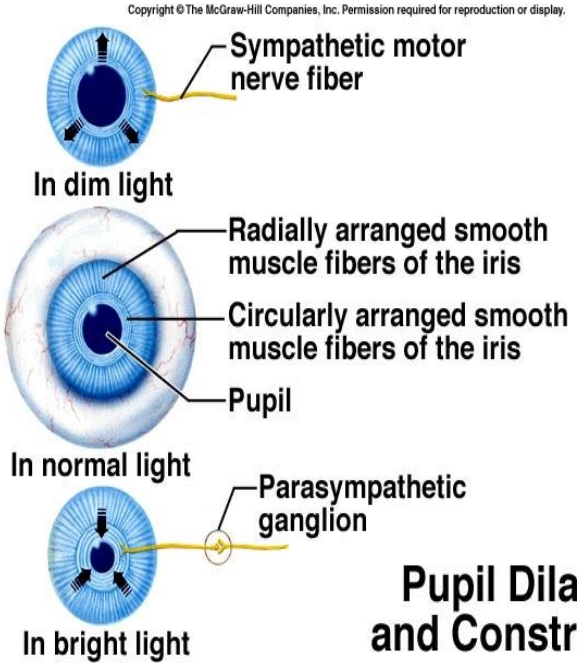


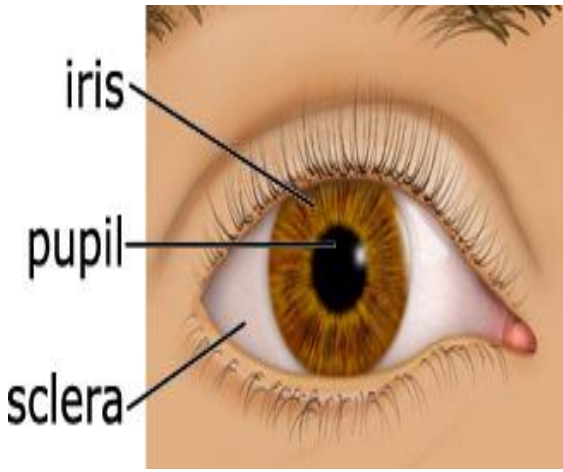


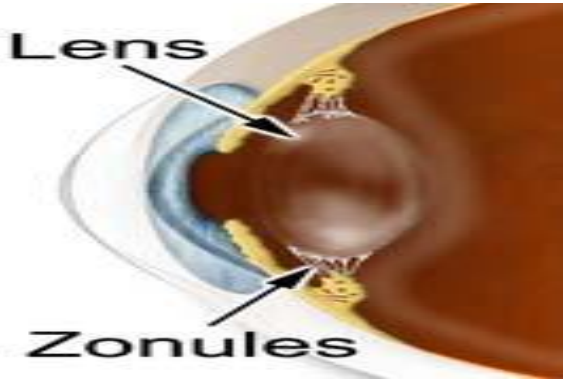
3- conjuctiva

- Transparent membrane cover anterior surface of eye,reflected on inner surface of eye lids
- Covered with thin film of tears for protection,wetness, cleaning

- **4- pupil / behind center of cornea, allow light to enter the eye**
- **5- Iris colored part (radial muscle dilates the pupil (supplied by sympathetic) + circular muscles constrict the pupil (by parasympathetic).**







6-cilliary muscles (body)

thick ant part of choroid to which attached suspensory ligaments (zonule)

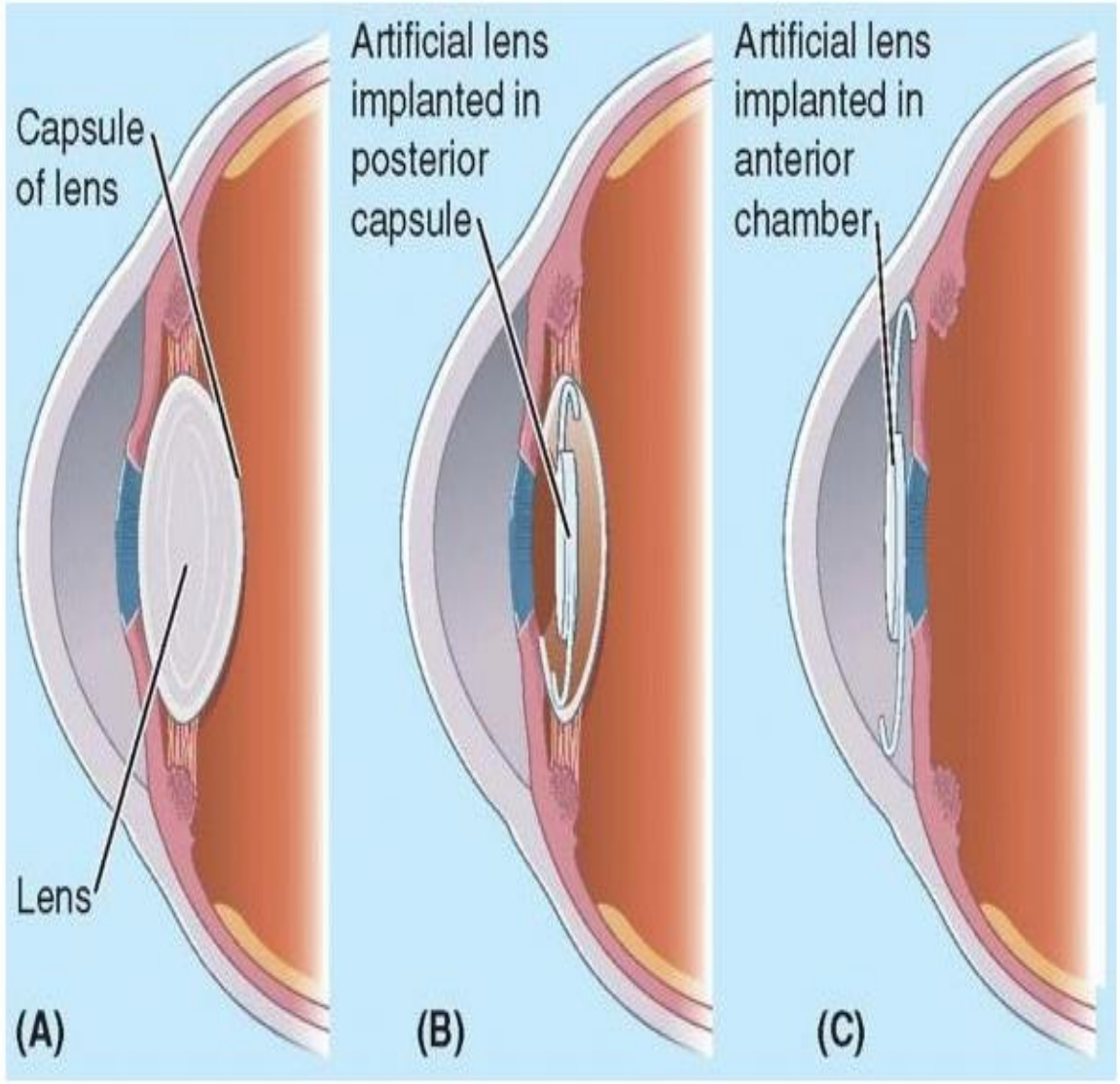
7- lens (transparent, biconvex, semisolid, diopteric power 15-20 D, held in place by zonule

(lens ligament= suspensory ligament)

attached to ant part of cilliary body (choroid)

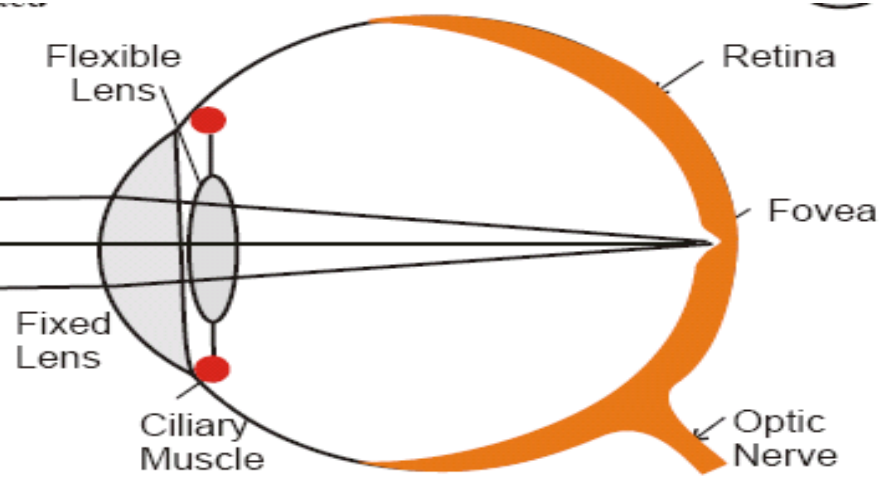
Q.what is cataract?

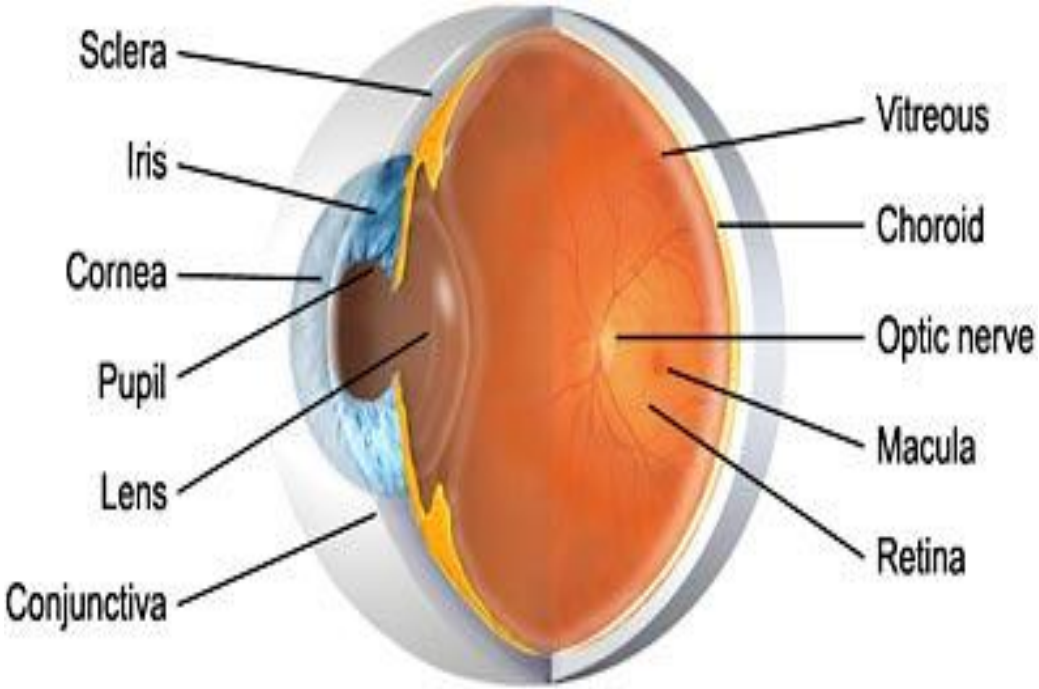
8- Uvea = choroid + iris + cilliary muscles



-An extracapsular cataract extraction involves removing the lens but leaving the capsule of the lens intact to receive a synthetic intraocular lens .

- Intracapsular lens extraction involves removing the lens and lens capsule, and implanting a synthetic intraocular lens in the anterior chamber (Fig. B7.26C).

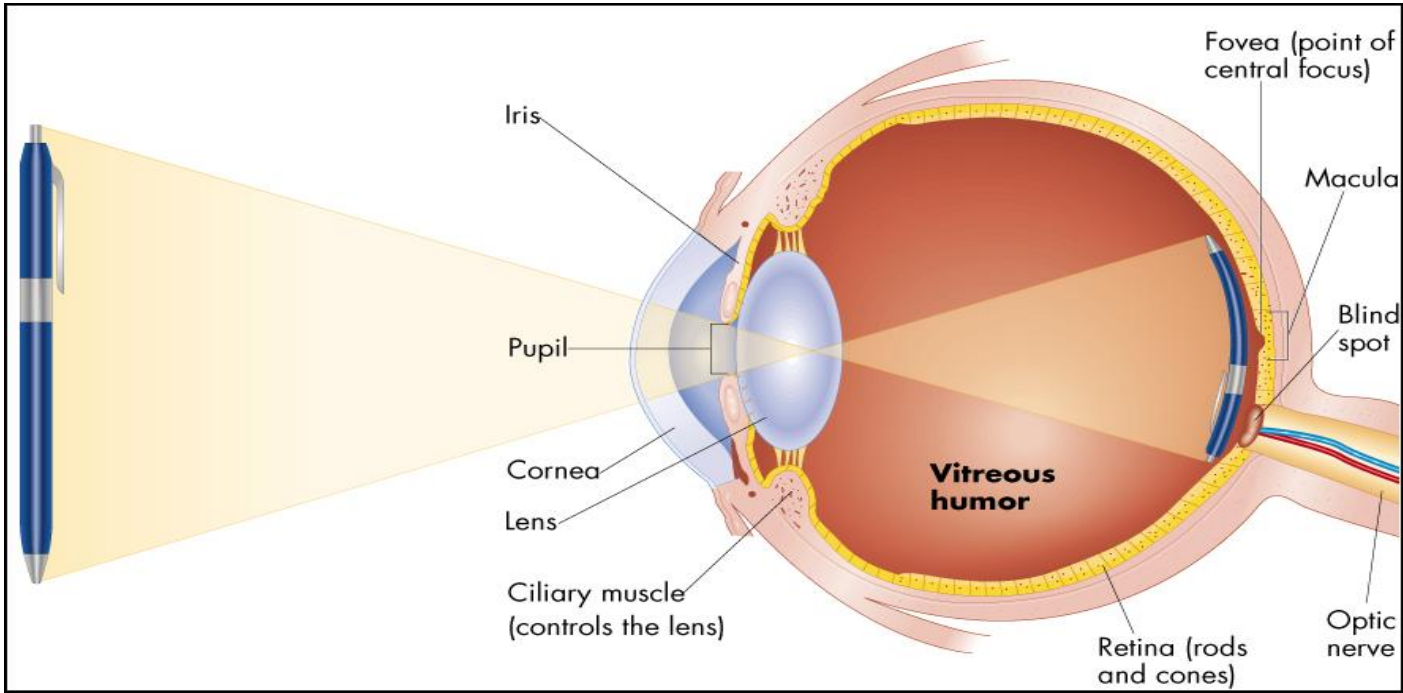

Flexible
Lens
Retina
Fovea
Fixed
Lens
Ciliary
Muscle
Optic
Nerve


Sclera
Iris
Cornea
Pupil
Lens
Conjunctiva
Vitreous
Choroid
Optic nerve
Macula
Retina


Choroid
Retina
Sclera

Anterior chamber of the eye ✹
/Between iris & cornea.

-**posterior chamber of the eye /**
Between iris & cilliary muscles
- Iris between both

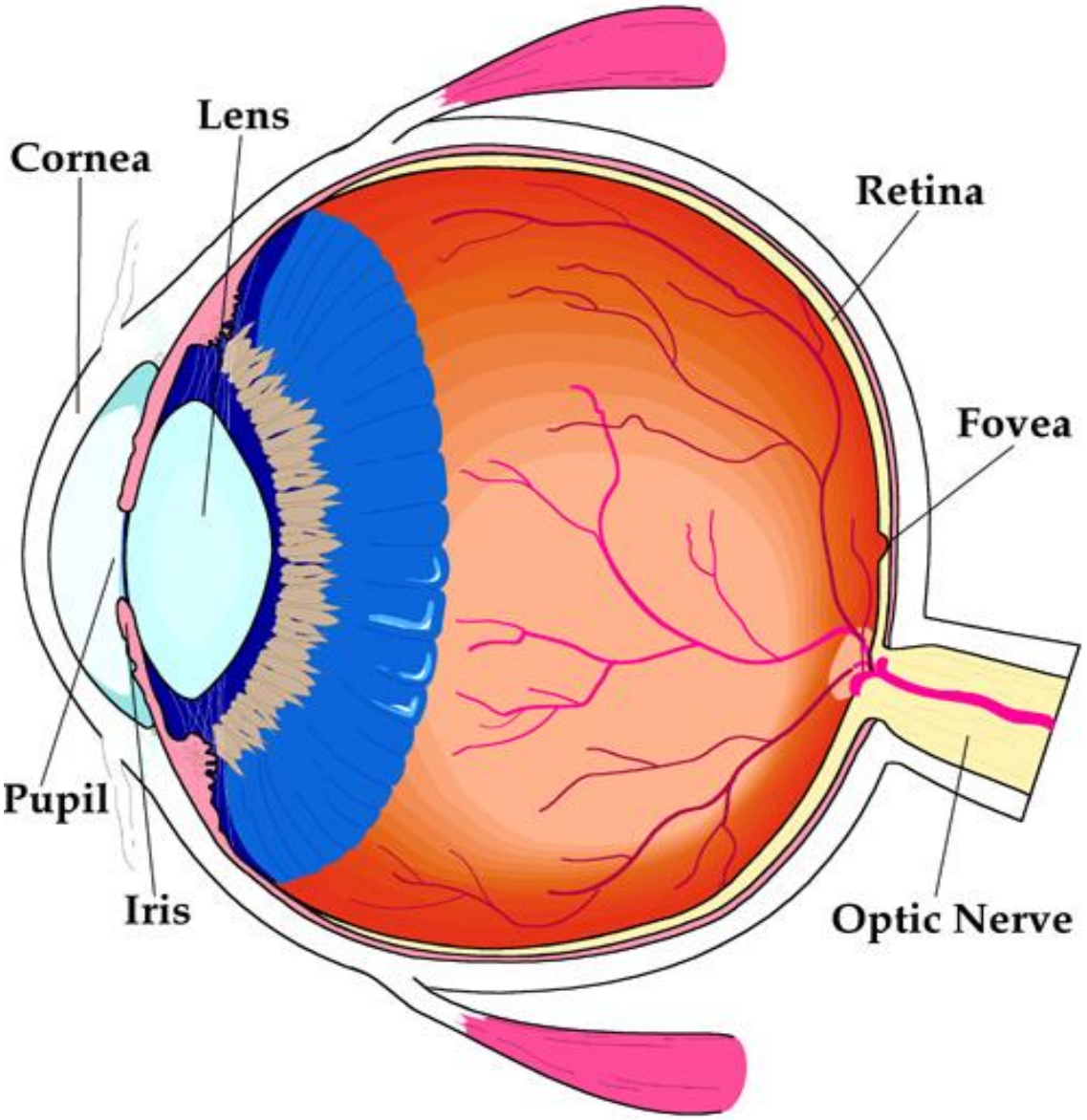


Refractive media of the eye:-

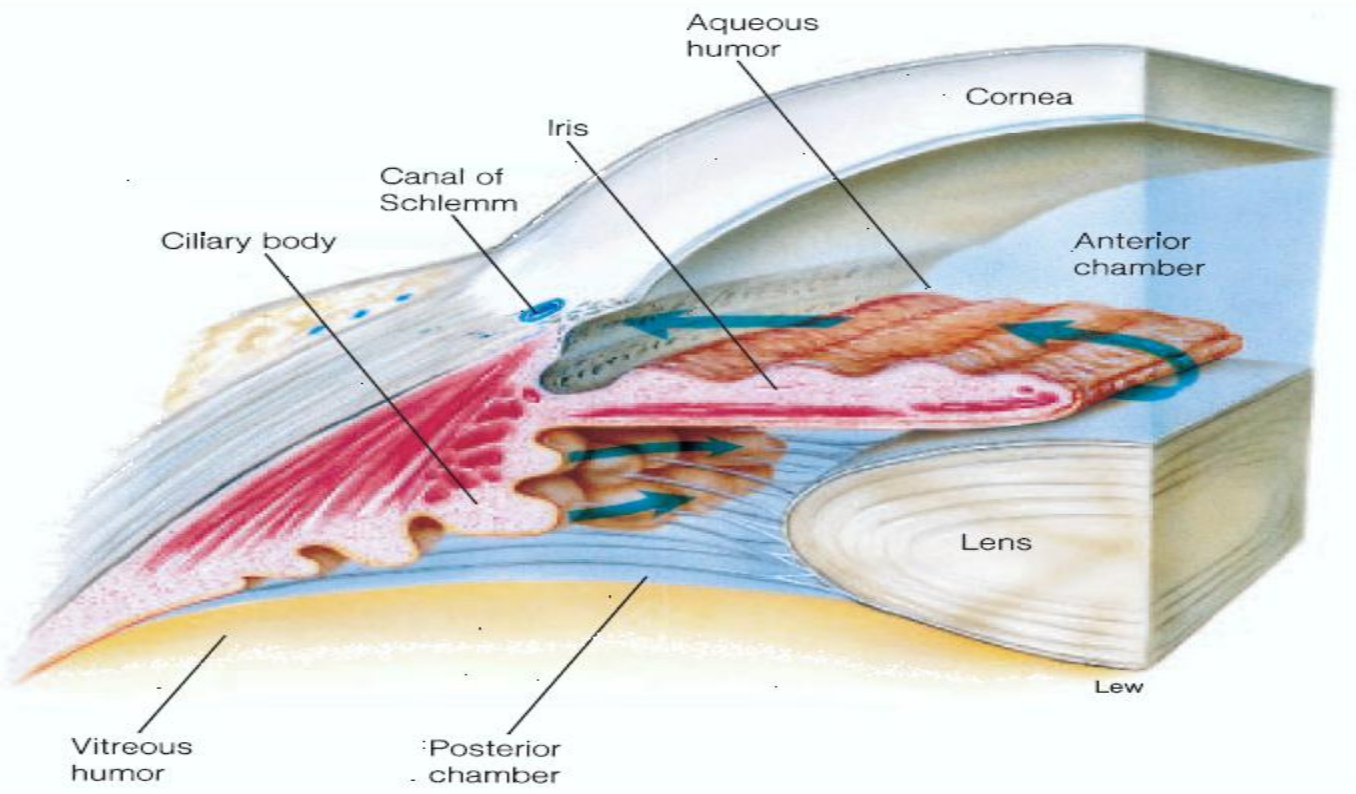
1-Cornea (has 2/3 of the refractive power)

Its diopteric power is 40-45 diopter at its anterior surface

Lens--retina distance =15mm



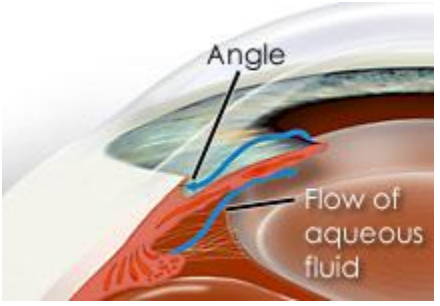
2-The aqueous humor➔ nourishes the cornea and iris ➔ it is produced in the ciliary body ➔ posterior chamber>>> to pupil >>>> ant chamber>>>>drained into canal of Schlemm in anterior chamber angle,which is a venous channel at the junction between
the iris and the cornea (**anterior chamber angle).**
It causes intra-ocular pressure 10-20 mmhg
Obstruction of this outlet leads to increased **intraocular pressure , a critical** risk factor for glaucoma



What is glucoma ?

(intraocular pressure more than 20mm Hg)

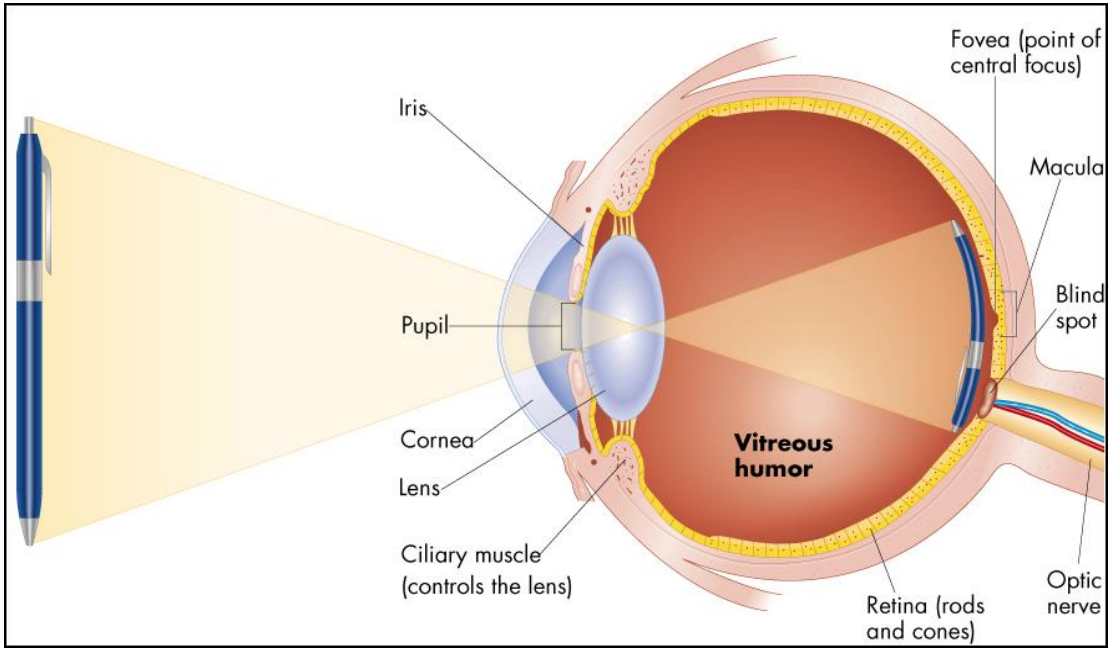
-Why it causes damage of optic nerve?



3-lens:- diopteric power 15-20 D

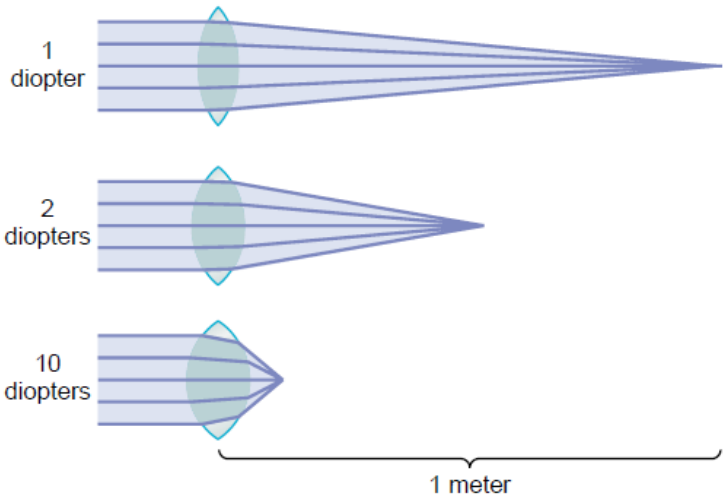
-(1/3 refractive power of eye) , more important than cornea. why?

4-Vitrous humour (between retina & lens for nourishing retina & keep spheroid shape of the eye)



Dioptre (s) = 1 / Focal length (m)

<u>Diopteric power of the eye:</u>
Cornea ……40-45 D (max refraction)
Lens ……. 15-20 D
Accomodation by lens …. +12 D



External protection of the eye

1- bony orbit

2- lids blinking keep cornea moist

3 -conjuctiva

4-tears from lacrimal gland has antibacterial, lubricating effect ,keep cornea moist & clear.)

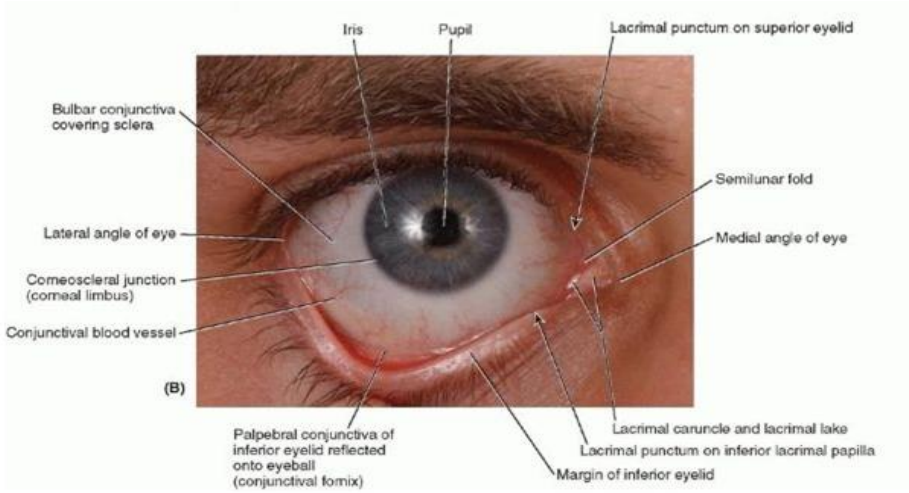
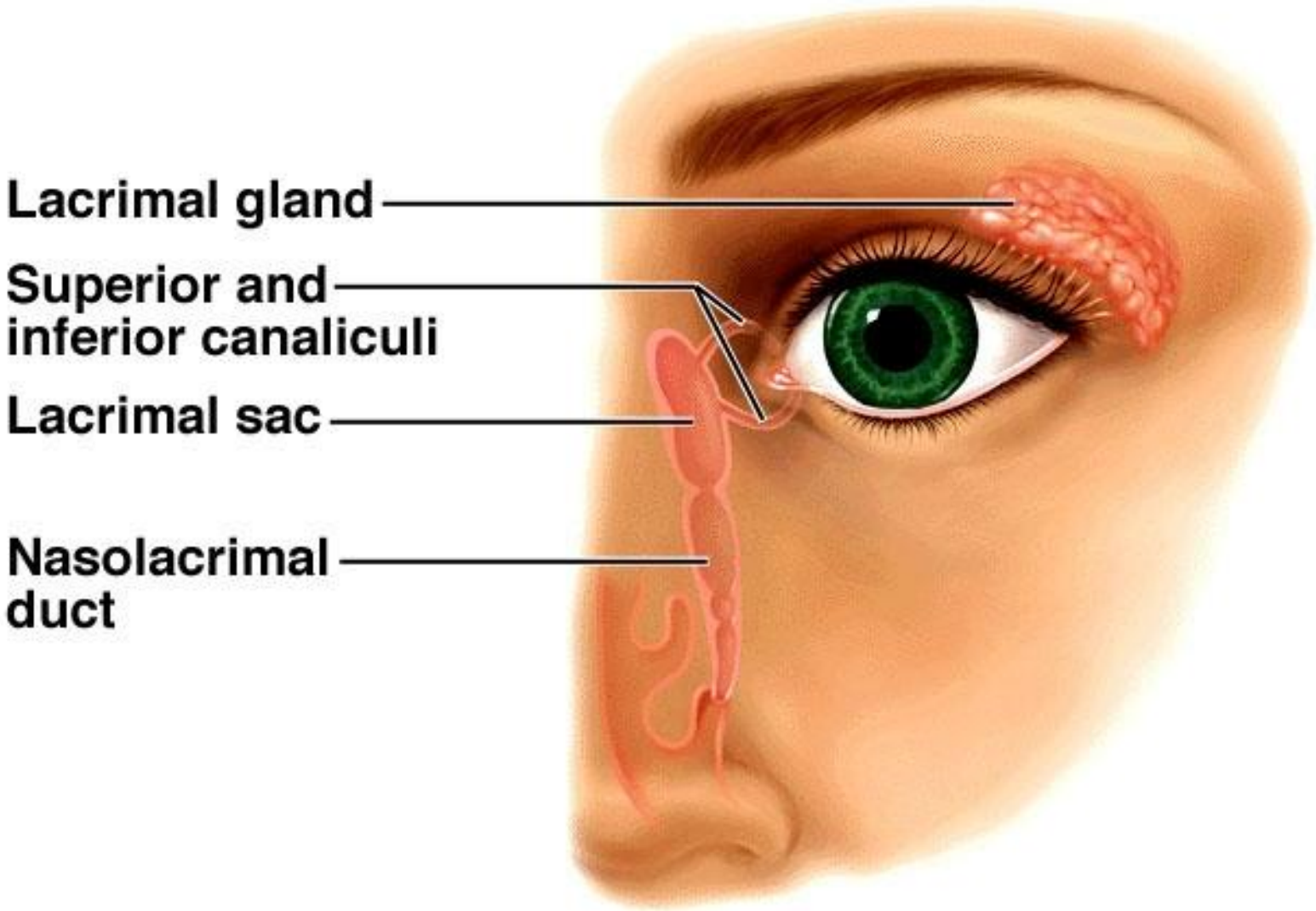


FIGURE 7.64. Surface anatomy of the eye (A) and lacrimal apparatus (B).

Lacrimal Apparatus

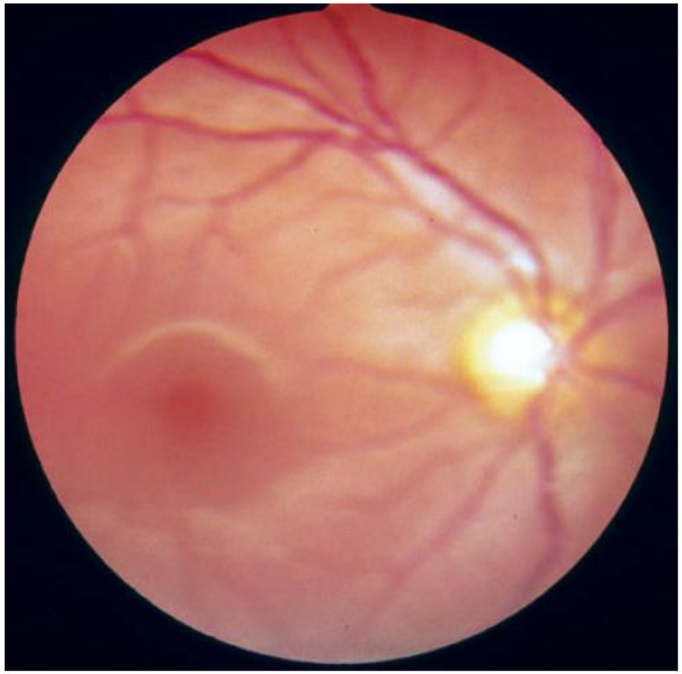


- **RETINA**

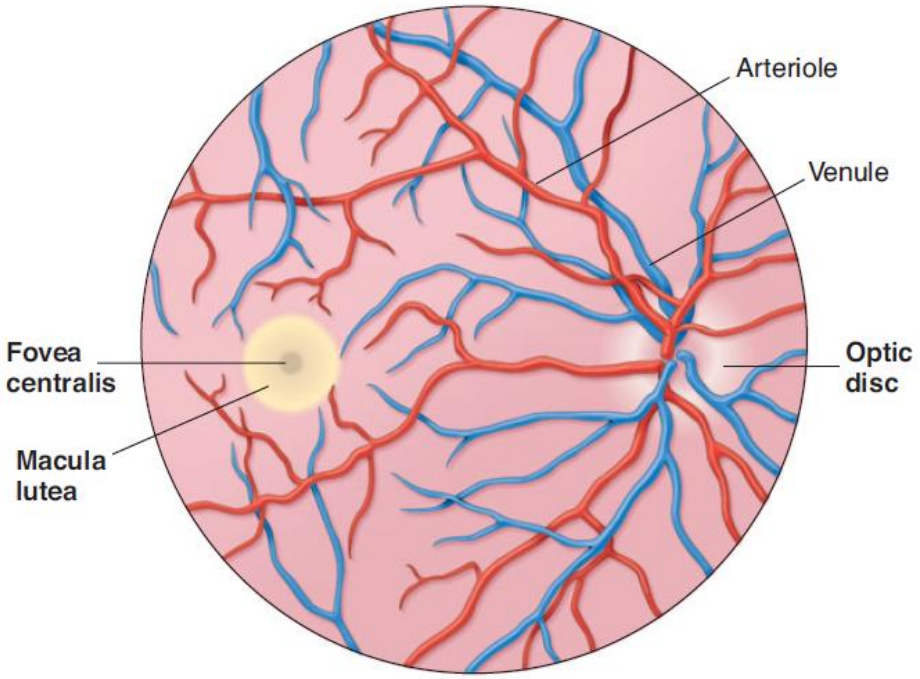
  1-Photoreceptors (RODS + CONES)

- **2-OPTIC DISC (blind spot. Why?)**
  - 3mm medial & above post pole of eye
  - optic nerve leave & retinal bld vessles enter + no photoreceptors so it is blind)

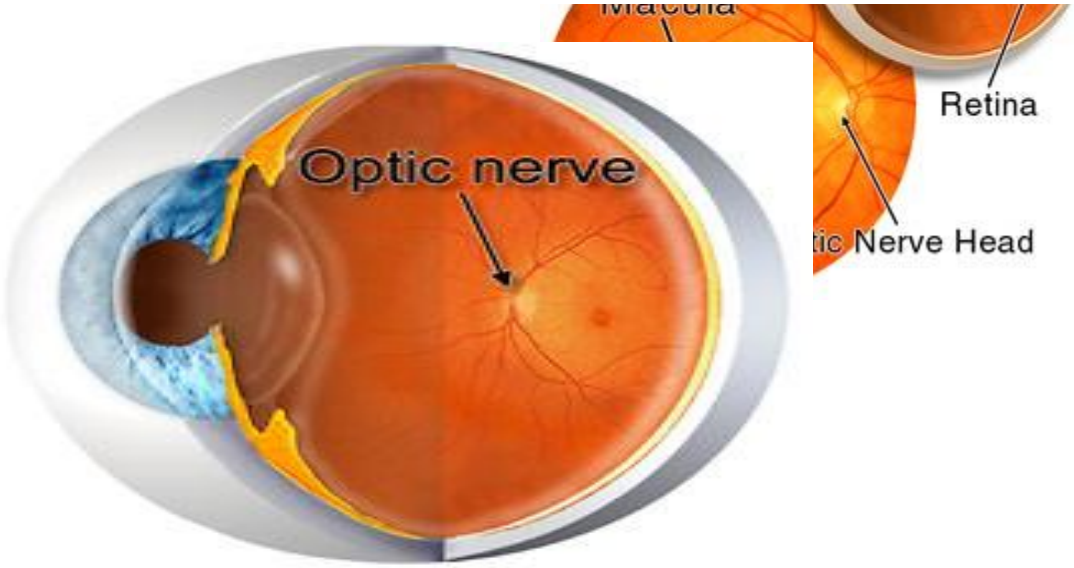
- **3-FOVEA CENTRALIS :-depression in macula lutea**
  - yellow pigmented spot at post pole of eye + only cones + high visual acuity + for colors vision & details detection



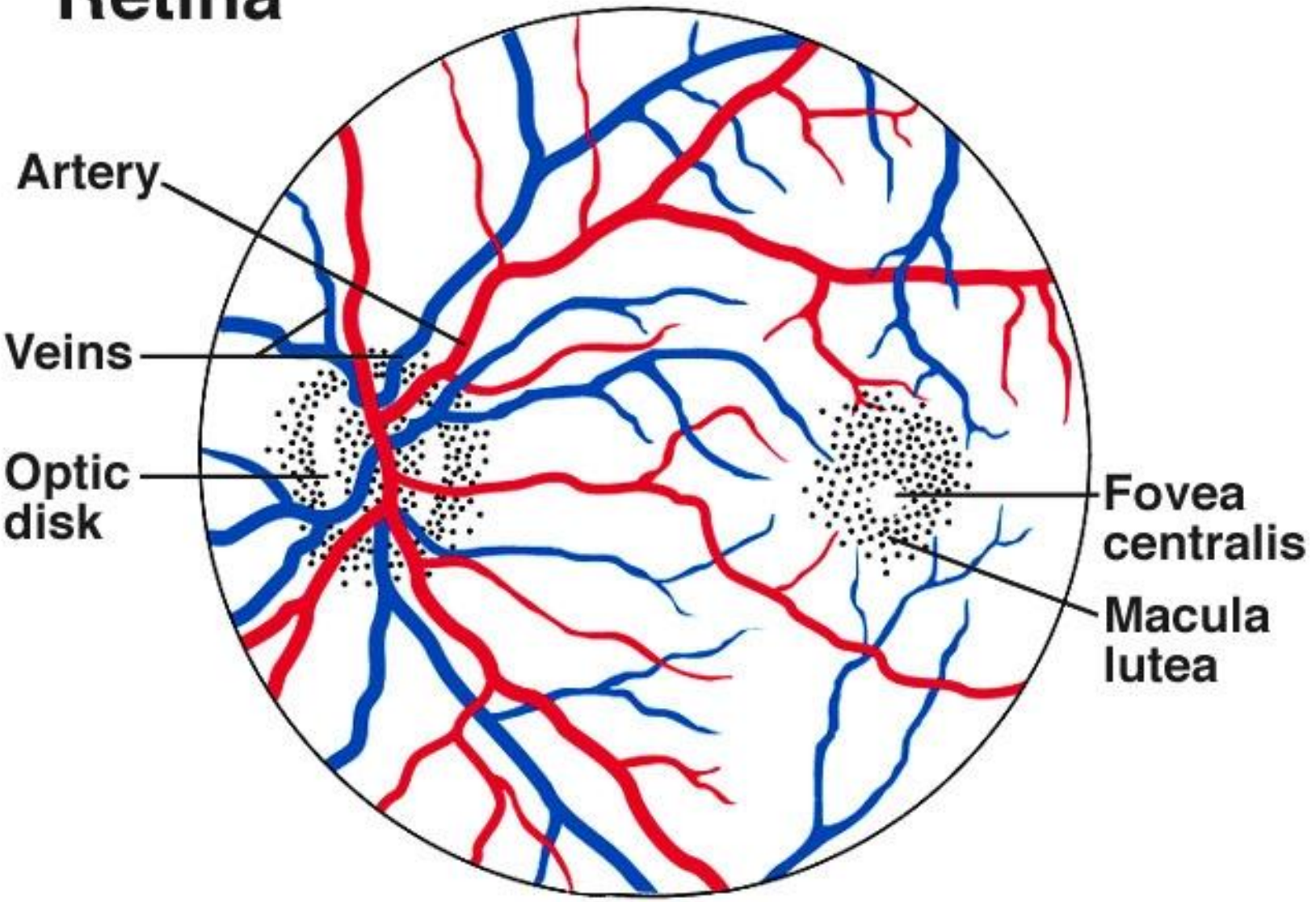
(a)


Arteriole
Venule
Fovea centralis
Optic disc
Macula lutea

(b)


Optic nerve
Retina
Nerve Head

Retina



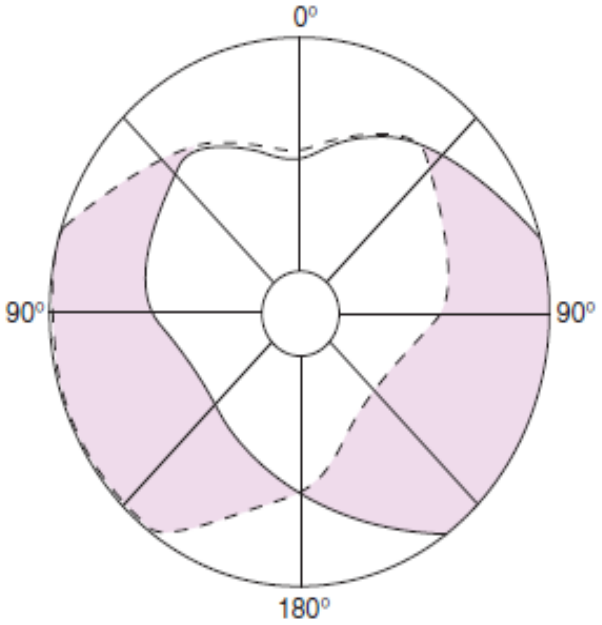
BINOCULAR VISION for :-

1- Large visual field

2- cancel the effect of blind spot

3- stereoscopic vision

4- one eye lesion does not affect vision



Monocular and binocular visual fields. The dashed line encloses the visual field of the left eye; the solid line, that of the right eye. The common area (heart-shaped clear zone inthe center) is viewed with binocular vision. The colored areas areviewed with monocular vision.

Priciples of optics:-

--Biconvex lens(converge) & biconcave lens(diverge)

-Diopter (measure of refractive power = RF) = 1 / Principal focal distance in meters

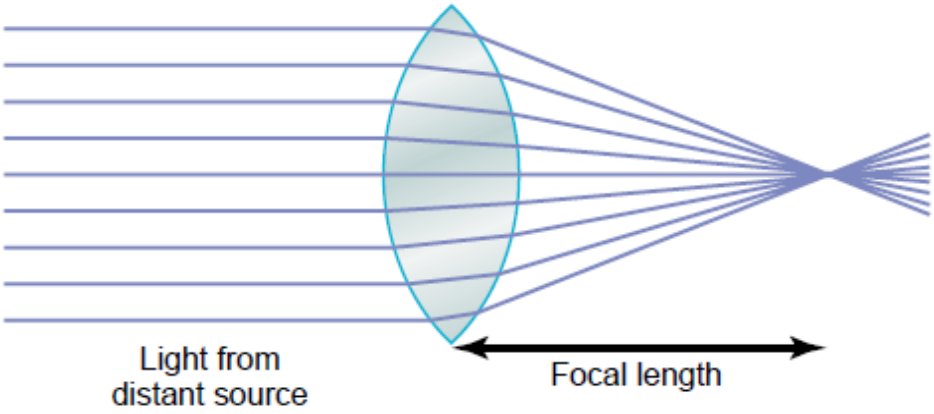
Exp/ if Principal focal distance of a lens is 25cm, so its R.P=1/ 0.25 meter = 4D

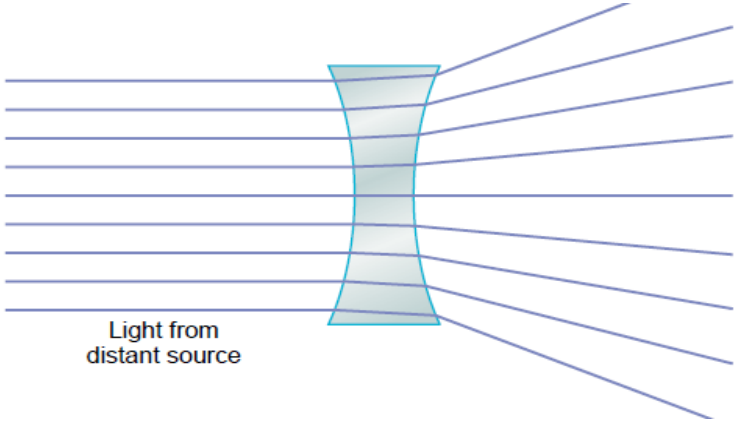
-

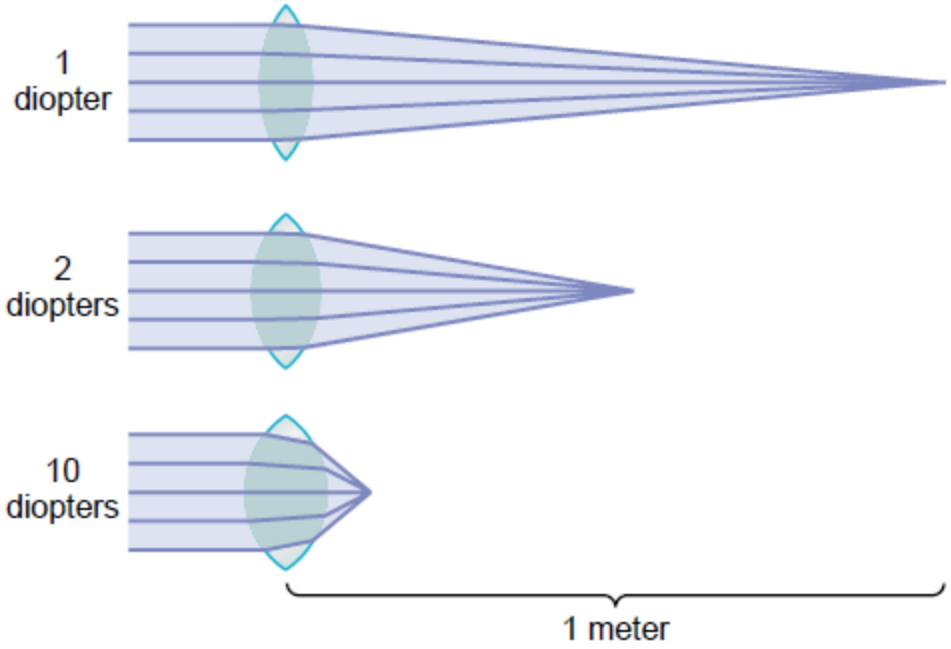
--The greater the curvature of the lens, the greater the refractive power of the eye

Emmetropic eye;-normal eye has image on retina, has diopteric power 60D

•

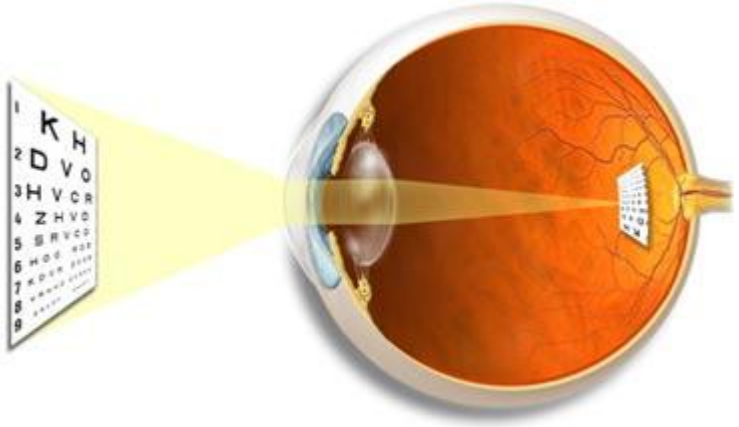

Light from
distant source
Focal length


Light from
distant source


1
diopter
2
diopters
10
diopters
1 meter

Normal eye = Emmetropia

Errors of refraction:-



Errors of refraction:-

1-Hypermetropia (hyperopia = farsightedness)

(small eyeball, focus behind retina,

Headache & blurred vision

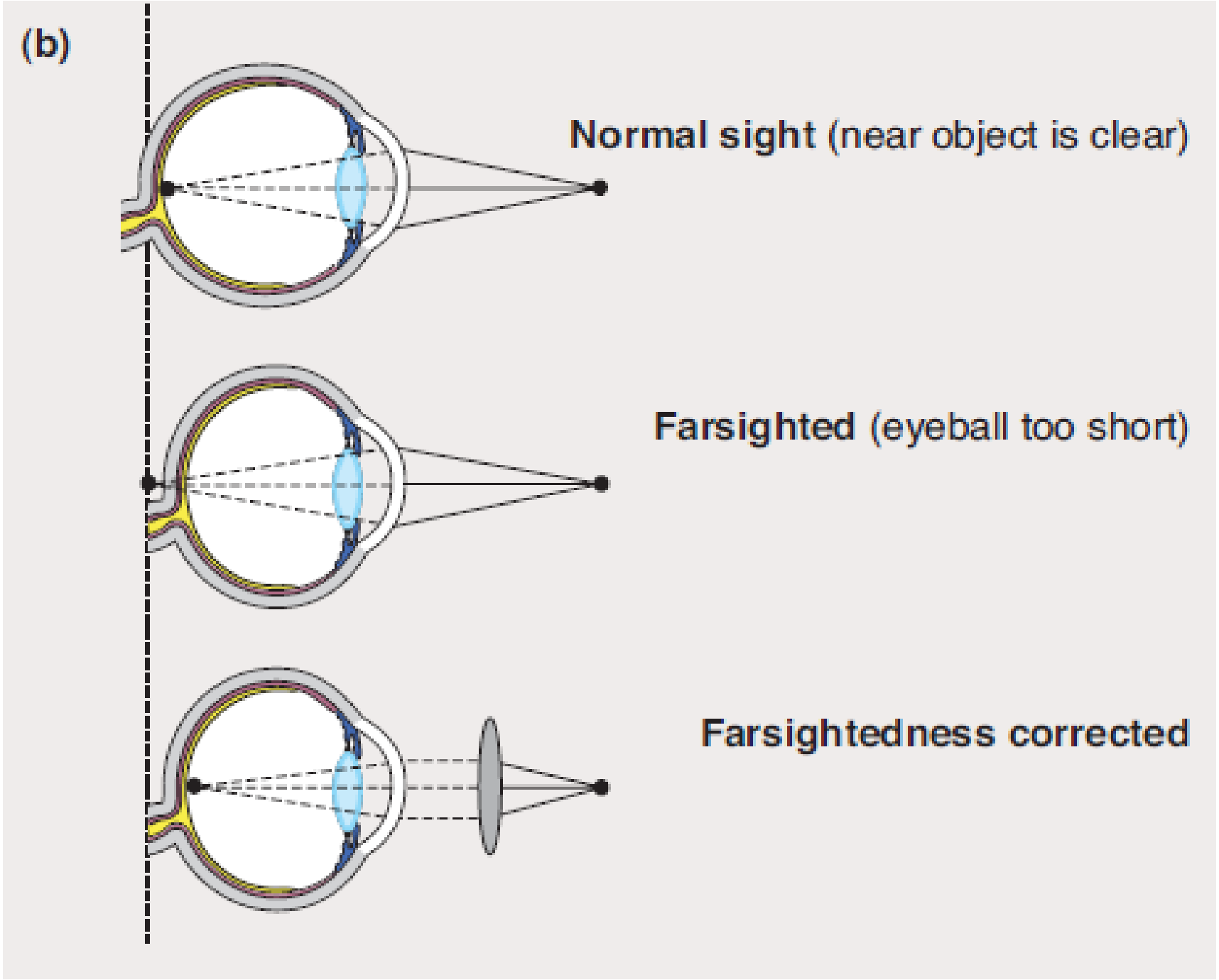
-continuous accomodation to bring image on retina>>>>>>muscular effort>>>>>cause headache, prolonged covergence by accomodation->>>>squint

correction by biconvex lens

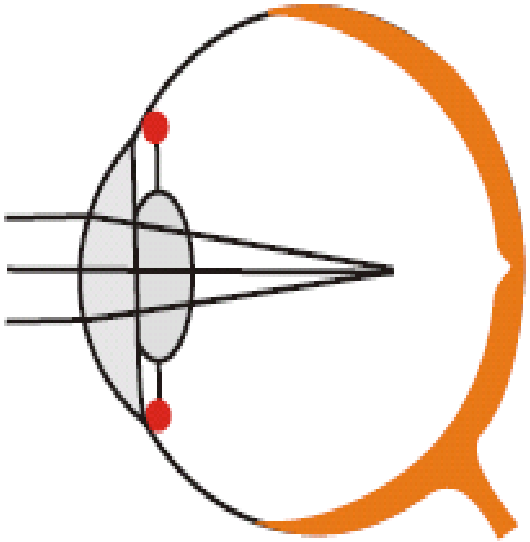
2-Myopia(nearsightedness)

(genetic, large eye ball, long antero-posterior diameter, or extensive close work as in studying>>>>cause focus in front of retina

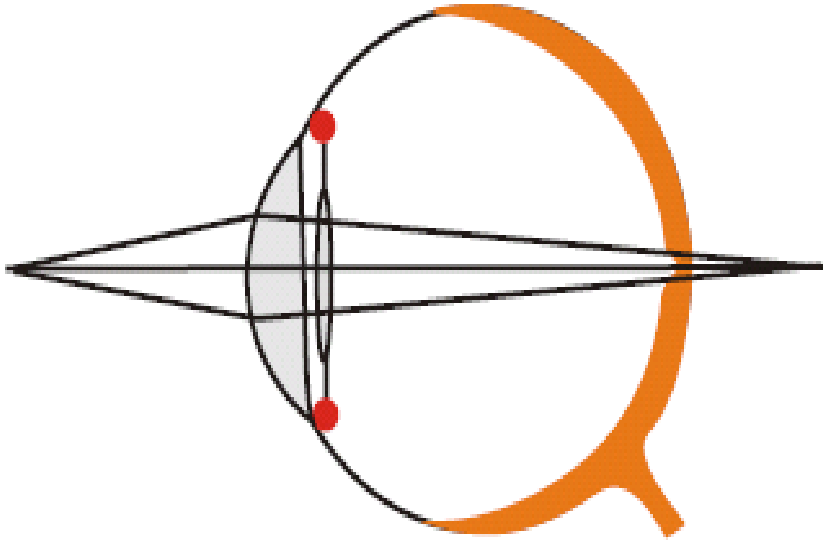
-- correction by biconcave lens (to diverge rays before strike lens)


(b)
Normal sight (near object is clear)
Farsighted (eyeball too short)
Farsightedness corrected

b) The shape of the lens

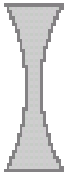


lens too round

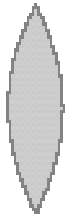


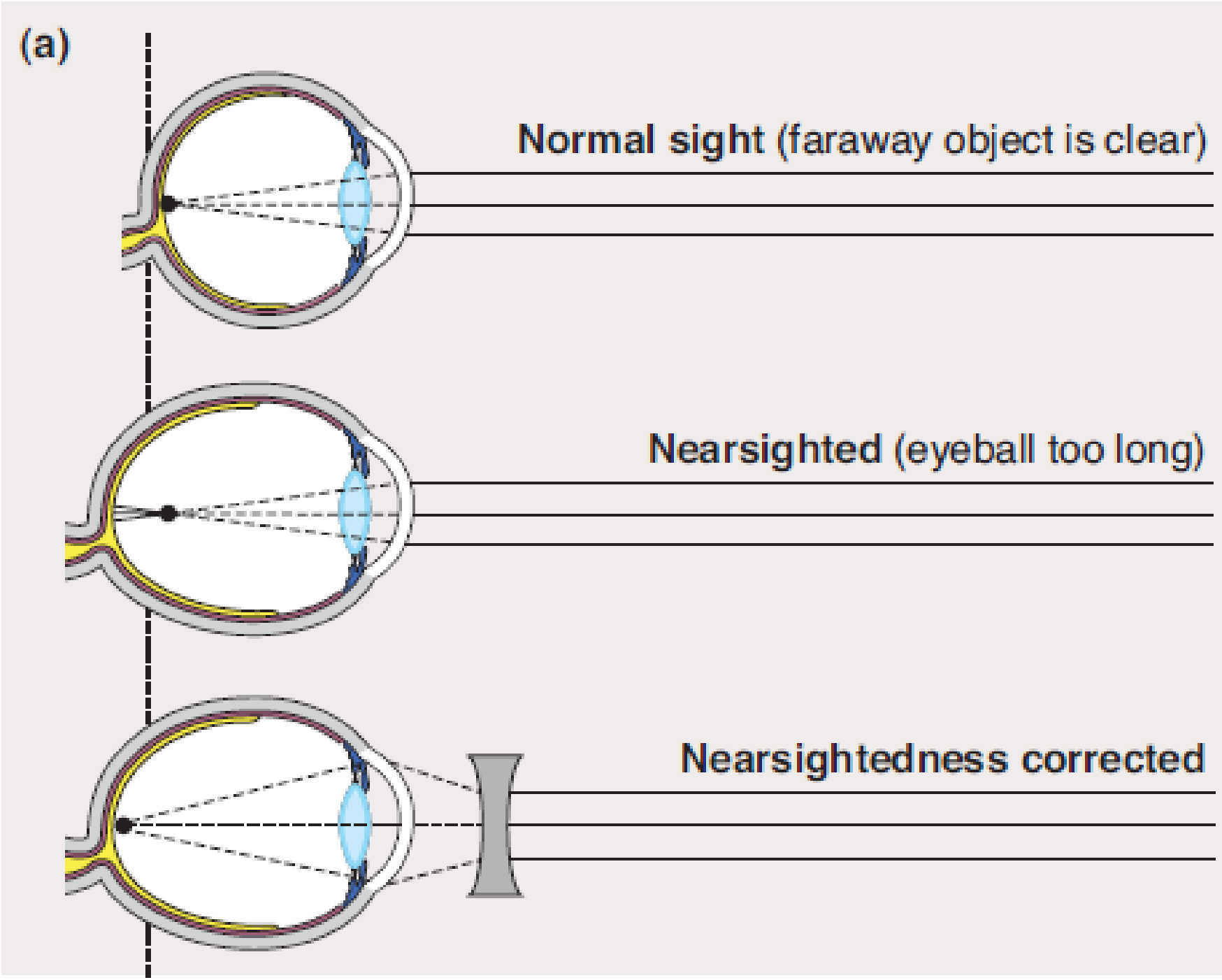
lens too flat

Either of the above
produces someone who
cannot focus on far targets
(**near-sighted**)
and who needs a concave lens.



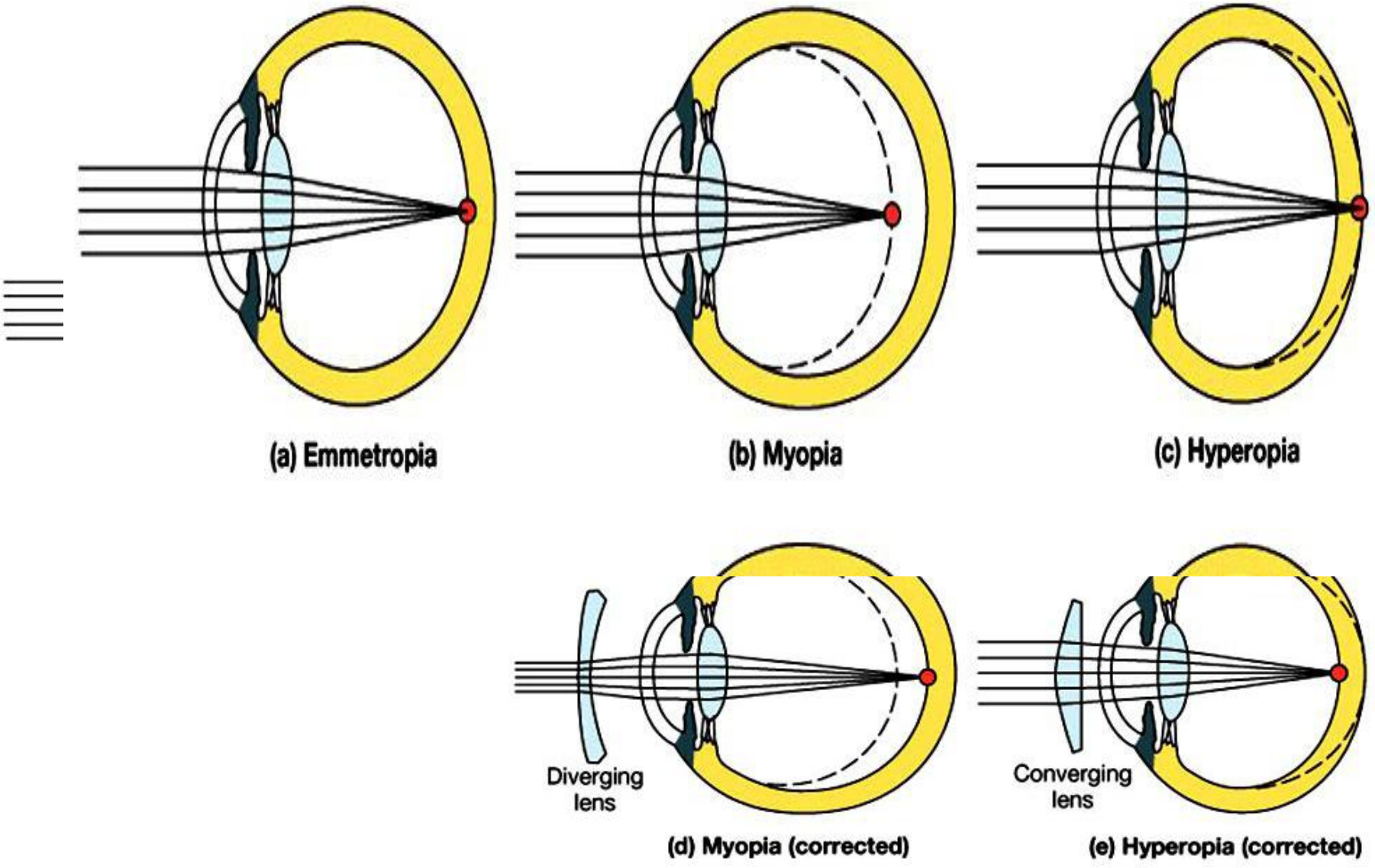
Either of the above
produces someone who
cannot focus on near targets
(**far-sighted**)
and who needs a convex lens.

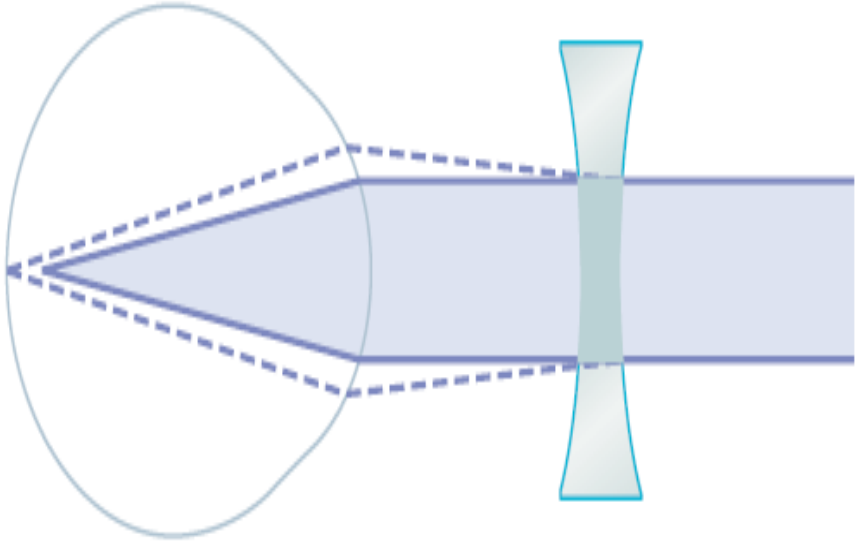


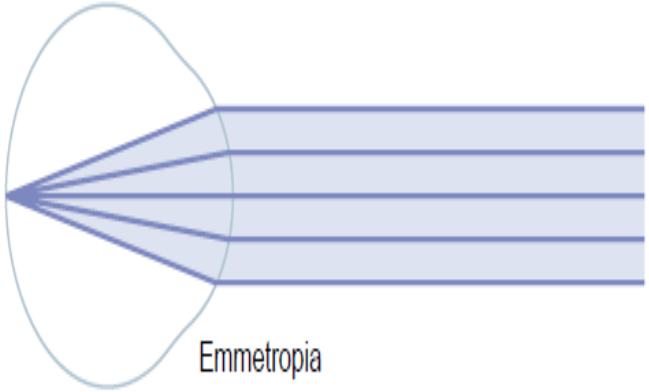

(a)
Normal sight (faraway object is clear)
Nearsighted (eyeball too long)
Nearsightedness corrected

- **3-Presbyopia (eye near point receeds by age due to loss of accomodation**
- **- correction by biconvex lens**

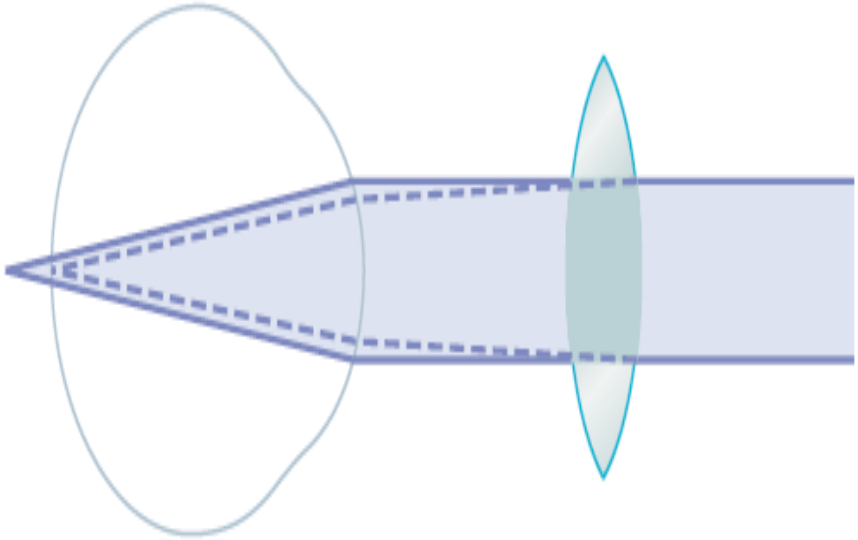
- **4-Astigmatism (uneven & ununiform corneal curvature**
- **-rays refracted to different foci >>>>>>> blurred vision**
- **-correction by cylindrical lens**

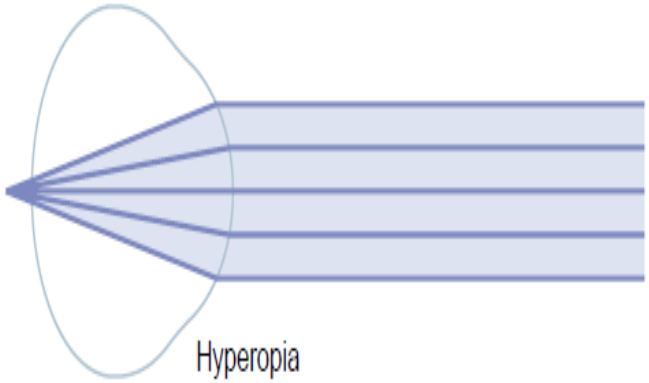

(a) Emmetropia
(b) Myopia
(c) Hyperopia
Diverging lens
(d) Myopia (corrected)
Converging lens
(e) Hyperopia (corrected)



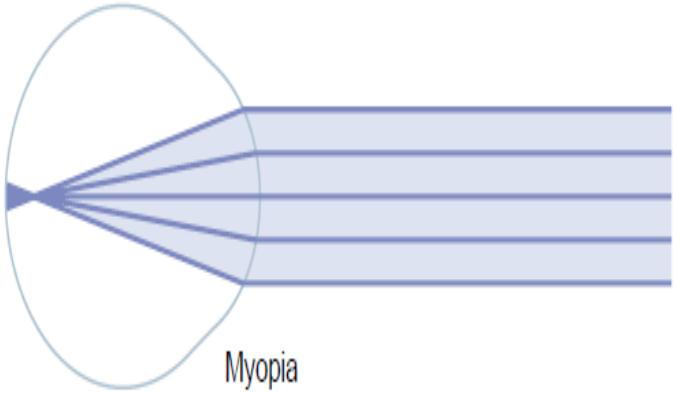


Emmetropia



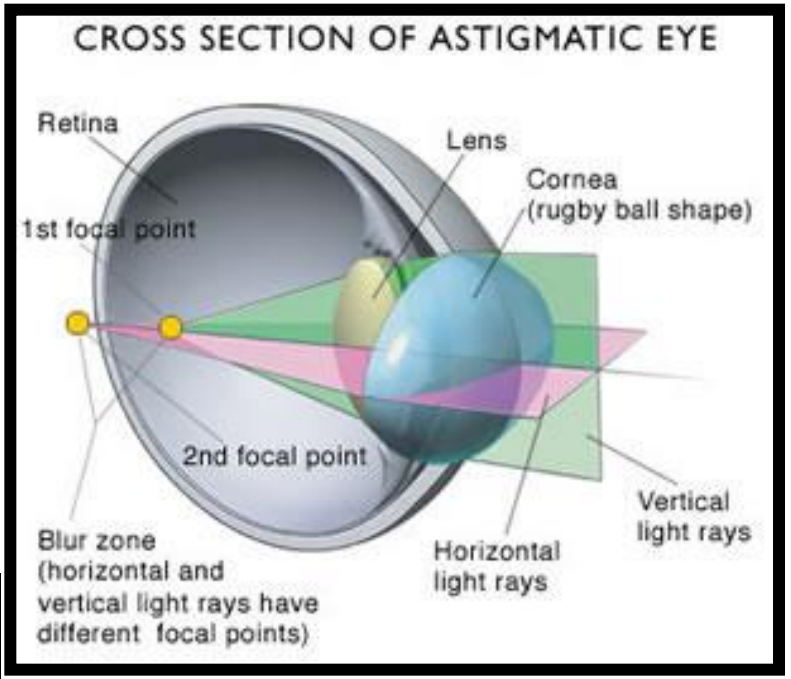


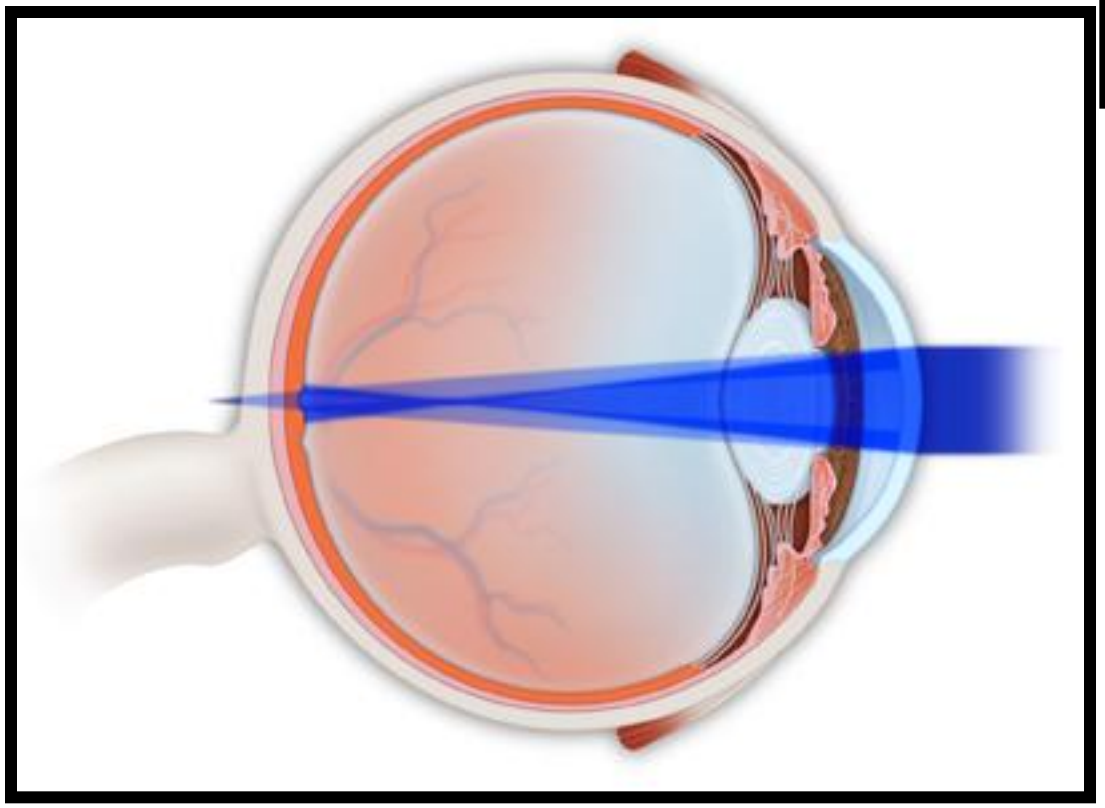
Hyperopia



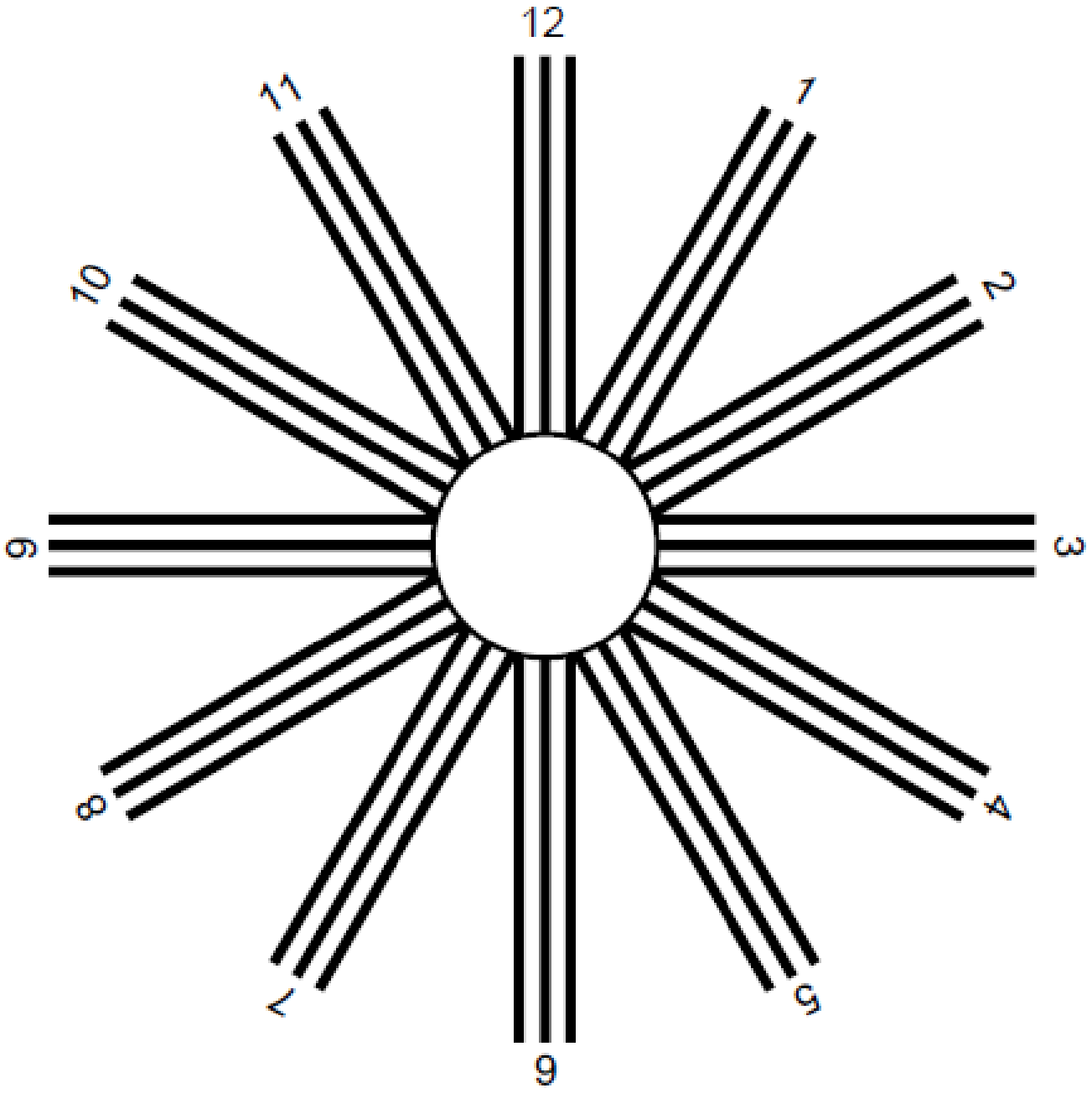
Myopia

Astigmati





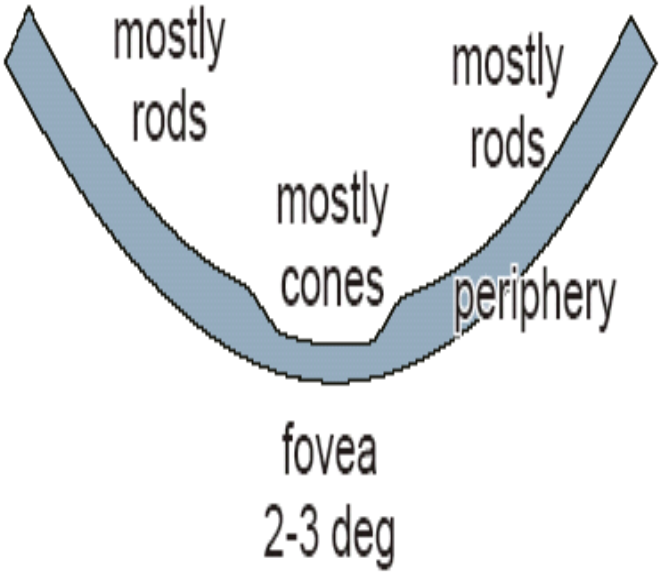
Astigmatism, demonstrating that light rays focus at one focal distance in more than one focal plane


12
1
2
3
4
5
6
7
8
9
10
11

- **<u>LAYERS OF RETINA (10 layers), the most important are :-</u>**

- **1-pigment cell layer (vit A) (outermost layer) .what is its value?**
- **(absorb light &prevent its reflection back)**

- **2- rodes & cones (their outer& inner segments), but not cell bodies(rodes 120 million & cones 6 million) - describe their distribution.)**



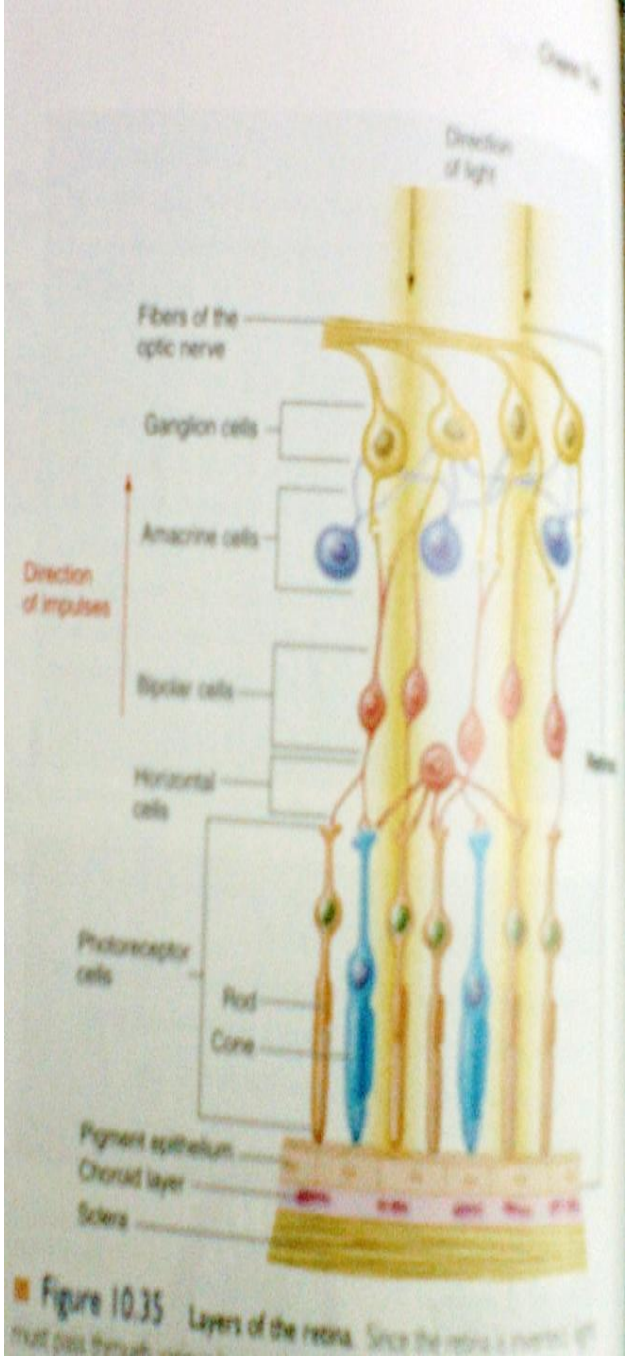


Figure 10.35 Layers of the retina. Since the retina is inverted, light must pass through

3-outer nuclear layer(cell bodies of rodes & cones)

4-outer plexiform layer mainly of Horizontal cells.

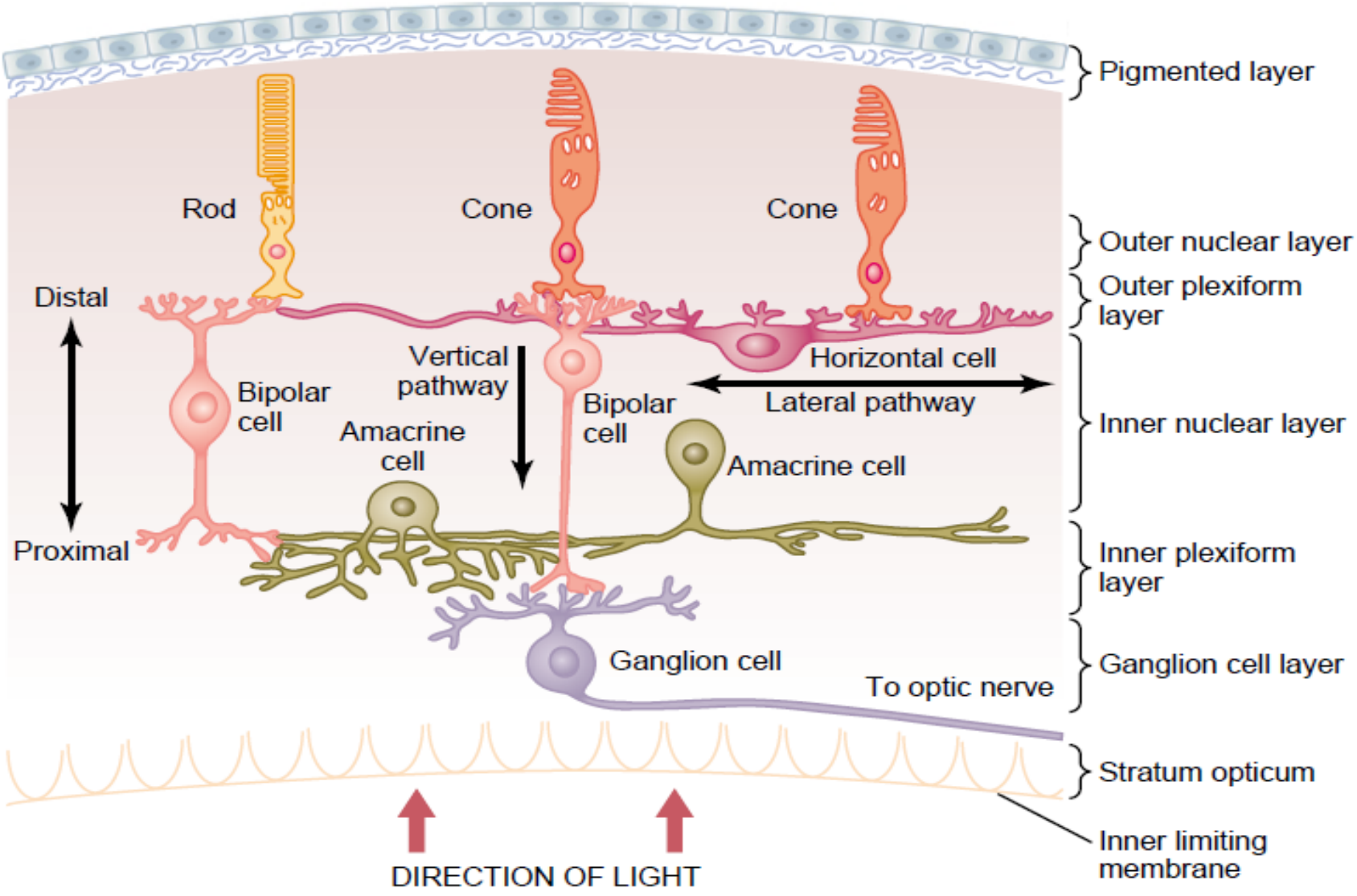
5-Inner nuclear layer (bipolar cells)

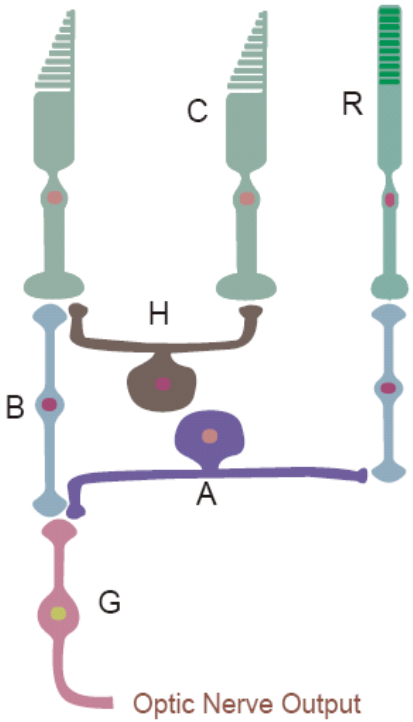
6-inner plexiform layer.(amacrine cells)

7-Ganglion cell layer

8-Optic nerve fibers (1.2 million fibers)

-# Horizontal cells (outer plexiform layer)
(Make synaptic connections with receptors
 # Amacrine cells (inner plexiform layer)
(make synaptic connections with ganglion cells)

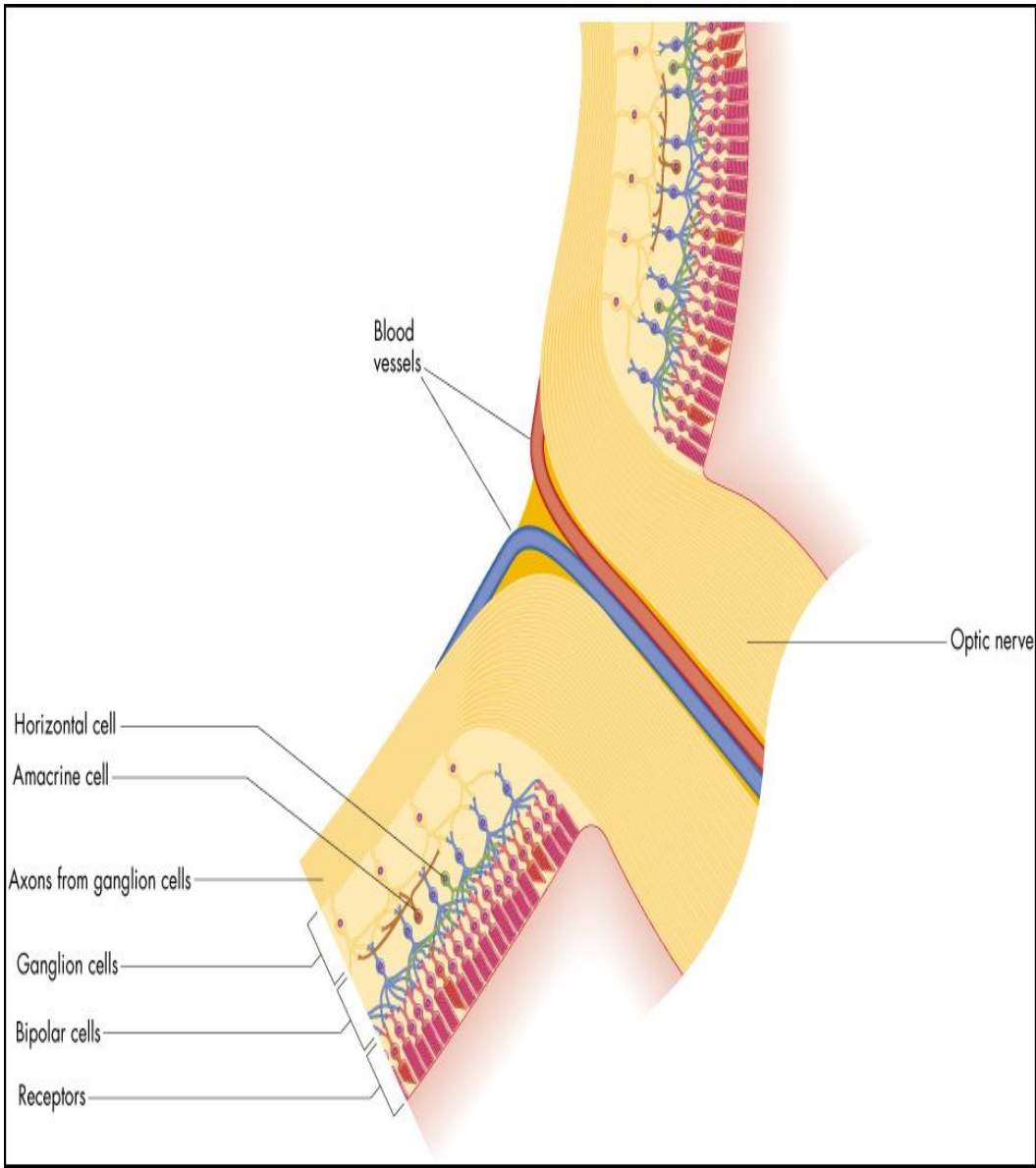

Pigmented layer
Rod
Cone
Cone
Outer nuclear layer
Outer plexiform layer
Distal
Vertical pathway
Horizontal cell
Bipolar cell
Lateral pathway
Bipolar cell
Amacrine cell
Amacrine cell
Inner nuclear layer
Proximal
Inner plexiform layer
Ganglion cell
Ganglion cell layer
To optic nerve
Stratum opticum
Inner limiting membrane
DIRECTION OF LIGHT


C
R
H
B
A
G
Optic Nerve Output

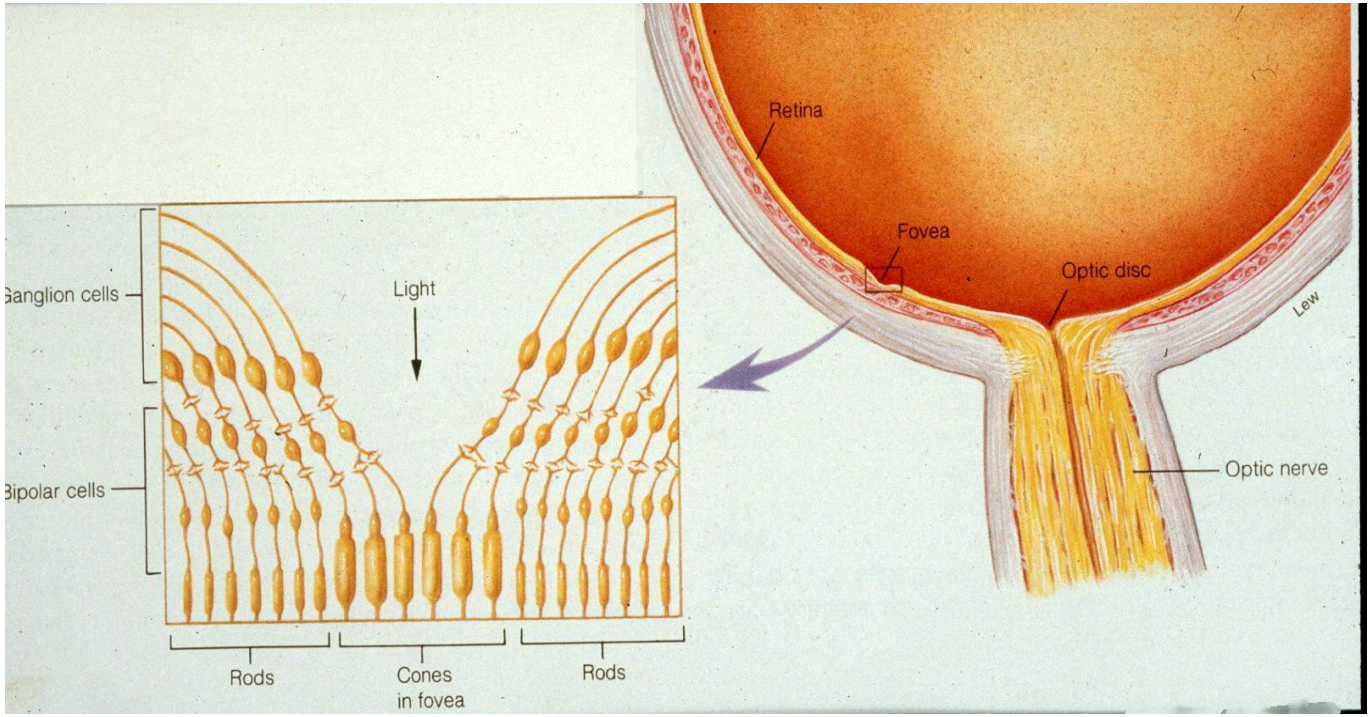
.

a

a


Blood vessels
Optic nerve
Horizontal cell
Amacrine cell
Axons from ganglion cells
Ganglion cells
Bipolar cells
Receptors

Light pathway in the eye:_



- -Light absorbed by pigment cell layer that contain melanin pigment
  - impulses pass from rodes & cones to rest of layers finally to ganglion cell layer ------- to optic nerve

Thank you for listening