Vision Part 1

Physiology of The Eye & Refraction

Color index

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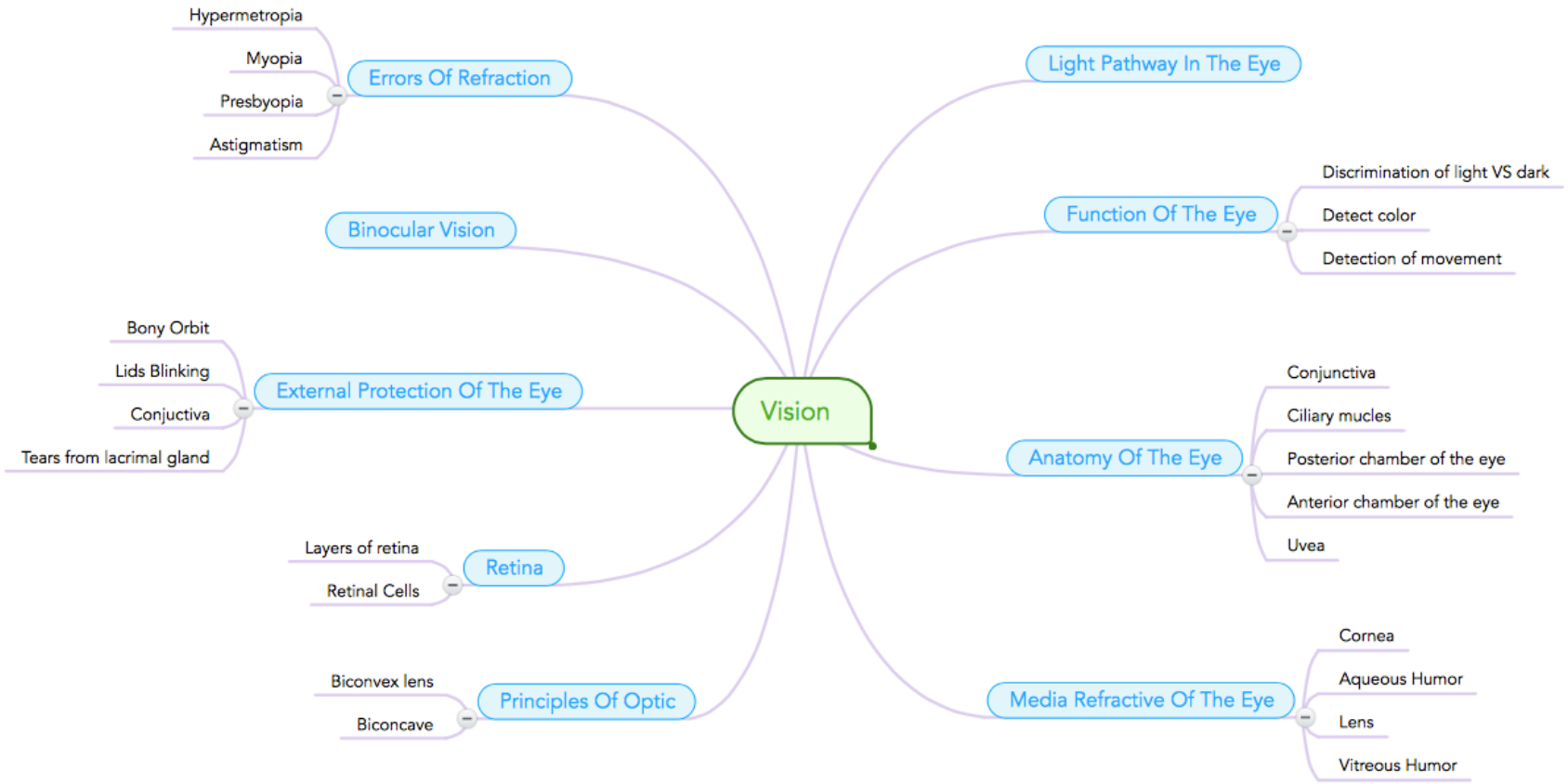
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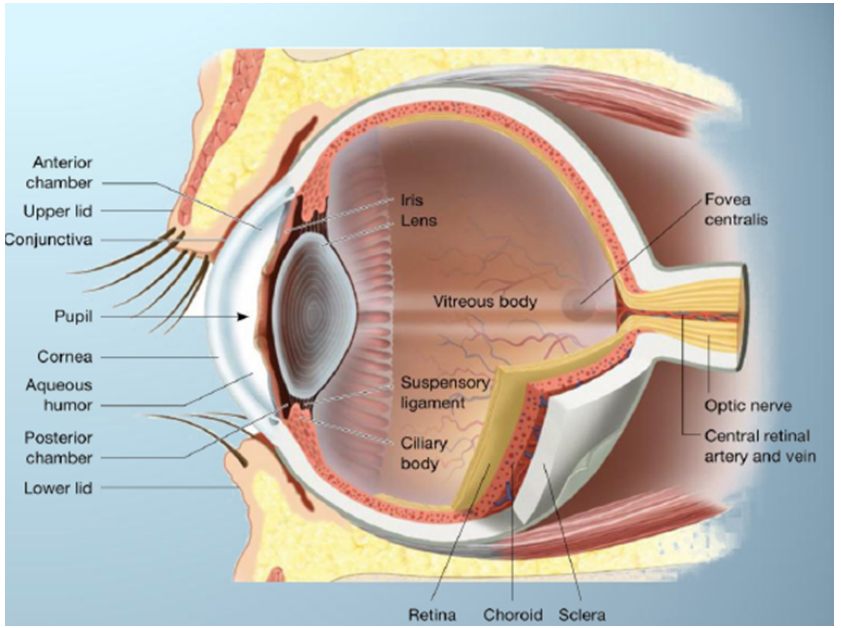
Mind Map

Functions of Vision

- Discrimination light VS dark
- Detect color (adaptive value of color vision)
- Detection of movement



Anatomy of the eye

- The eye is a fluid-filled sphere enclosed by **3** specialized tissue layers:

Sclera

thick ,white fibrous tissue for :
(protection- spherical appearance)

Choroid

the middle layer that contain blood vessels to supply retina

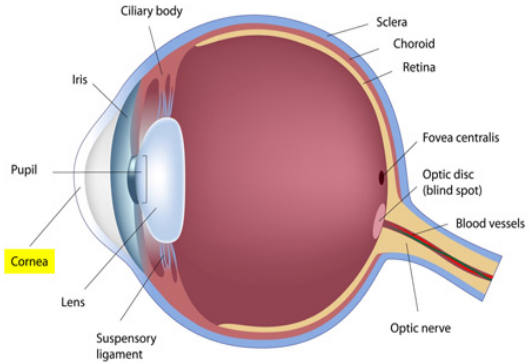
the capillaries underlying the pigment epithelium are the primary source of nourishment for retinal photoreceptors & oxygen to rods and cones

Retina

is the innermost layer which contains light sensitive cells, posterior 2/3 of choroid has retina

cornea:

- **Modified ant 1/6 of sclera**
- **Transparent** — That's why it does not have blood vessels
- **Diopteric power is 40-45 D at its anterior surface**
- **human only** — Cornea has resident immune cells
- **Receives nutrients via**
  - Diffusion from the tear fluid from outside
  - Aqueous humour from inside
  - Neurotrophins
- **Avascular**
  - Gets oxygen directly through the air if the eye is open
  - In close eye 2/3 of oxygen demands met by diffusion from the capillaries and the rest from the anterior chamber

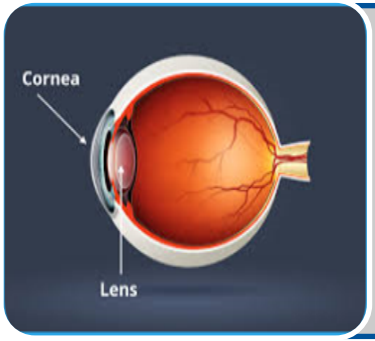


Iris colored part

- has radial muscle dilate the pupil as in dim light (supplied by sympathetic)
- circular muscles constrict the pupil as in bright light(by parasympathetic)
- the eyes appear brown to black when the iris contains a large amount of melanin, and blue due to low melanin

Pupil

- behind center of cornea
- Control & allow light to enter the eye
- appears black because, as you look through the lens, you see the heavily pigmented back of the eye (choroid and retina)



Lens

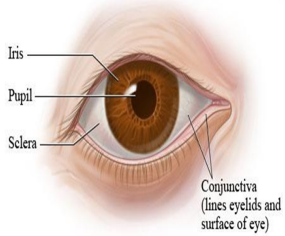
- transparent, biconvex, semisolid, dioptric power 15-20 D.
- held in place by zonule (lens ligament= suspensory ligament) attached to ant part of ciliary body.
- the lens helps focus images on the retina to facilitate clear vision
- within the cells of the lens, proteins called crystallins are arranged like
- the layers of an onion, this makes up the refractive media of the lens.

Anatomy of the eye

Conjunctiva

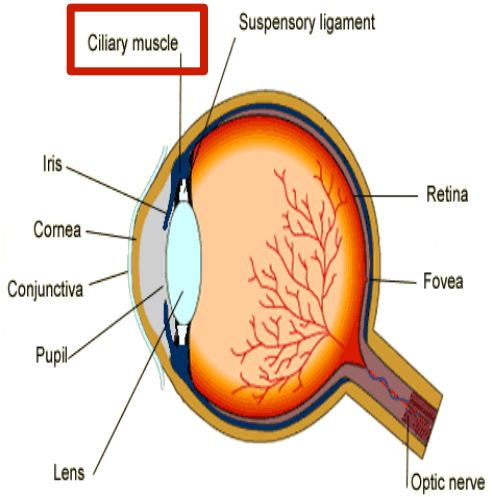
Covered with thin film of tears for Cleaning, wetness and protection.

Transparent membrane cover anterior surface of eye, reflected on inner surface of eye lids



Cilliary muscles (body)

Thick ant part of choroid to witch attached suspensory ligaments (zanule)

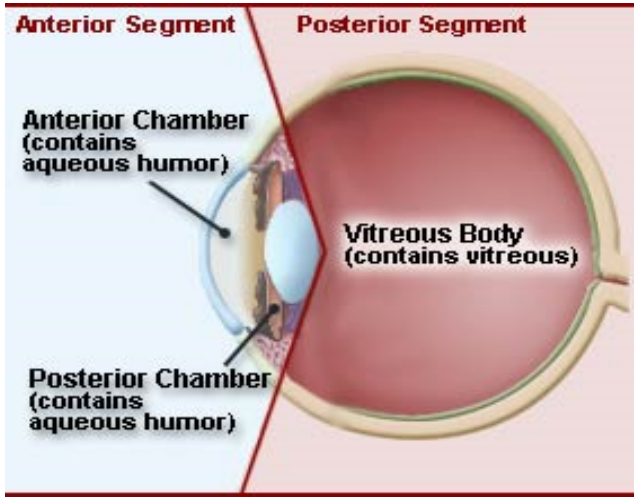


Posterior chamber of the eye

Between iris and cillary muscles

Anterior chamber of the eye

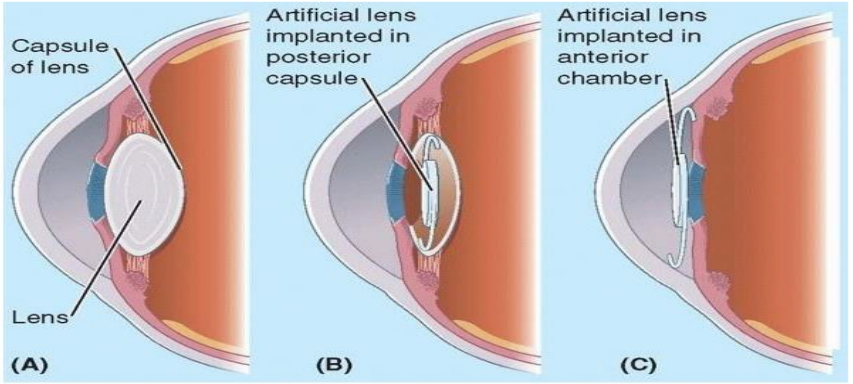
Between iris and cornea



Uvea

Choroid
iris
cillary muscles

Cataracts occurs in older people.
is a cloudy or opaque area
or areas in the lens.



- the proteins in some lens fibers become <u>denatured</u> and coagulate to form opaque areas.
- When a cataract has obscured light transmission so greatly that it impairs vision.

Intracapsular lens Extraction

removing the lens and capsule, and implanting a synthetic lens in the anterior

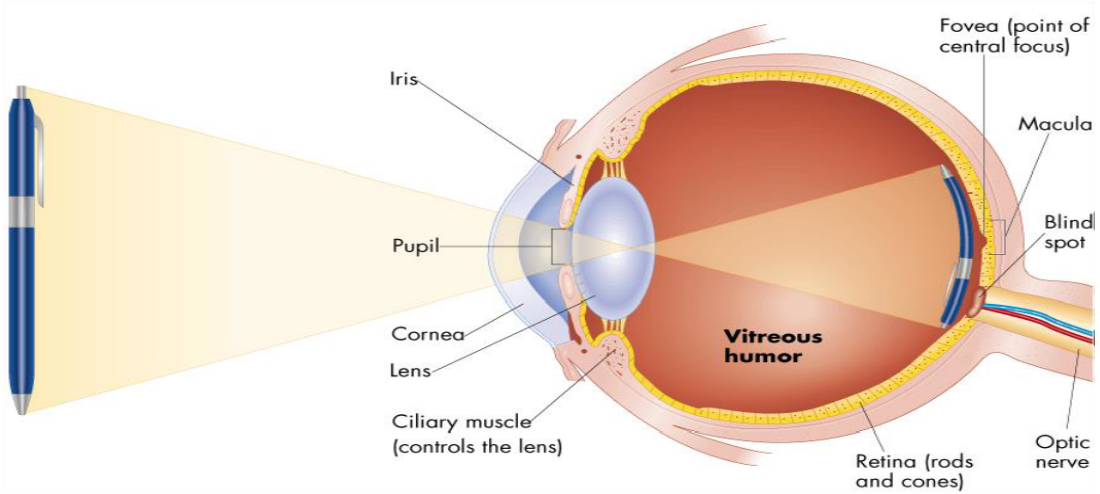
Extracapsular Cataract Extraction

involves removing the lens but leaving the capsule to put synthetic lens .
chamber

The image is protected onto the retina upside down:

- The lens system of the eye will focus an image on the retina upside down
- The image is inverted and reversed with respect to the object
- However, the brain perceives objects in the upright position despite the upside-down orientation on the retina

The reason the world does not look inverted and reversed is that the brain 'learns' early in lift to coordinate visual images with the orientations of objects.



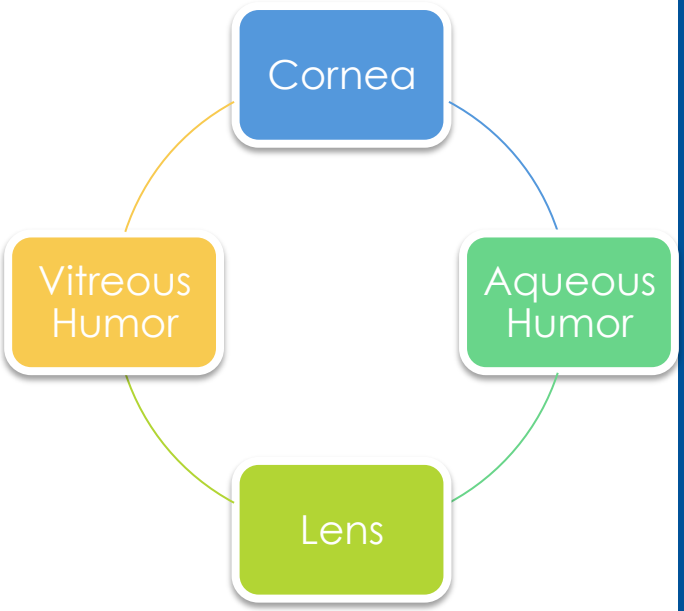
Refractive Media Of The Eye:

The interface between air and the anterior surface of the cornea

The interface between the posterior surface of the cornea and the aqueous humor

The interface between the aqueous humor and the anterior surface of the lens of the eye

The interface between the posterior surface of the lens and the vitreous humor



- The total refractive power is *59 diopters*, when the lens is accommodated for distant vision.

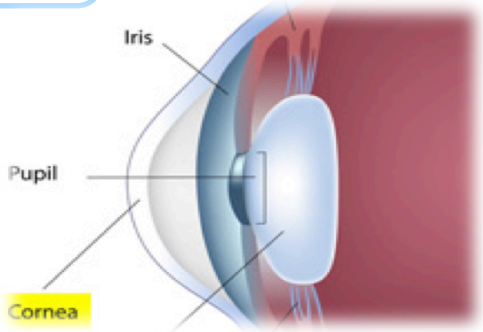
1-Cornea

- Its dioptric power is 40-45 diopter at its anterior surface
- Two thirds of the 59 diopters of refractive power of the eye is provided by : The anterior surface of the cornea
- The principal reason for this is that the refractive index of the cornea is markedly different from that of air.

Although the refractive index of the eye lens is not greatly different from the indices of the aqueous humor and vitreous humor

N.B:

- Internal index of air is 1
- The cornea, 1.38
- The Aqueous humor, 1.33
- The Crystalline lens, 1.40
- The Vitreous humor, 1.34



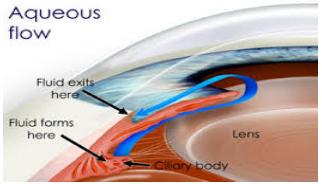
2-The Aqueous Humor

- The aqueous humor is a transparent, slightly gelatinous (Gel-like) fluid similar to plasma
- Is continually being formed and reabsorbed
- The balance between its formation and reabsorption regulates the total volume and pressure of the intraocular fluid

Nourishes the cornea and iris	It causes intraocular pressure 10-20 mmhg
Obstruction of this outlet leads to increased intraocular pressure, a critical risk for glaucoma	Produced in the ciliary body by an active secretion by ciliary processes

It goes to:

Posterior chamber → pupil → Anterior chamber → Drained into canal of Schlemm in the anterior chamber angel



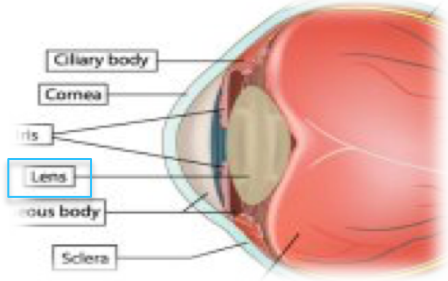
It's a venous channel at the junction between the iris & cornea

3-Lens

- Has dioptric power 15 - 20 diopter
- 1/3 refractive power of eye

More important than cornea:

- Importance of the internal lens is that, in response to nervous signals from the brain, its curvature can be increased markedly to provide accommodation.



4- The Vitreous Humor

For nourishing retina & keep spheroid shape of the eye

Between the posterior surface of the lens and retina
It is the transparent, colorless, gelatinous mass
It fills the vitreous chamber between the lens of the eye and the retina
The vitreous humor is clear and allows light to pass through
Both water and dissolved substances can diffuse slowly in the vitreous humor

Vitreous humor remains from birth

Glaucoma

✧Intraocular pressure more than 20mm Hg

Obstruction of AQH outlet leads to increased intraocular pressure

Excessive aqueous humor pushes the lens backwards into vitreous, which pushes against the retina

This compression causes retinal & optic nerve damage that can cause blindness if not treated

The axons of the optic nerve are compressed at the optic disc. This lack of nutrition of the optic nerve fibers, which causes death of the involved fibers & blindness.

- Lens–retina distance = 15mm
- Diopter(s)= 1/ Focal length (in meter)

Dioptric power of the eye:

Cornea : 40-45 D (max refraction)

Lens: 15-20 D

Accommodation by lens: +12 D

External Protection Of The Eye

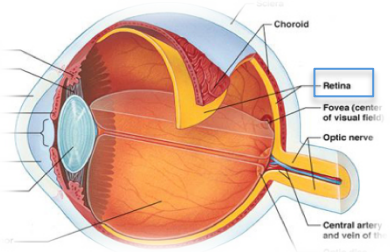
1-Bony orbit

2-Lids blinking keep cornea moist

3-Conjuctiva

4-Tears from lacrimal gland has antibacterial, lubricating effect, keep moist& clear & provide nutrition to the cornea

Retina



✧The one place in the body where arterioles are visible.

✧Examination by ophthalmoscope is of great value in the diagnosis of:

- Diabetes mellitus, hypertension, and other diseases that affect blood vessels.

Photoreceptors

Rods + Cones

Optic Disc (blind spot)

3mm medial & above post pole of eye

Optic nerve leave & retinal blood vessels enter

No photoreceptors so it is blind

Fovea Centralis

Depression in macula lutea

Yellow pigmented spot at post pole of eye, only cones ,high visual acuity for colors, vision & details detection

When attention is attracted to or fixed on an object, the eyes are normally moved so that light rays coming from the object fall on the fovea.

Layers Of Retina

10 layers, the most important are:

1-Pigment cell layer

- Outer most layer
- Stores large quantities of vitamin A, which is important precursor of the photosensitive chemicals of rods & cons
- Absorb light & prevent its reflection back

2- Rods & Cones

- Their outer & inner segments, but not cell bodies
- Rods: 90 -120 million
- Cones:4.5 - 6 million

3-Outer nuclear layer

- Cell bodies of rods & cons

4- Outer plexiform layer

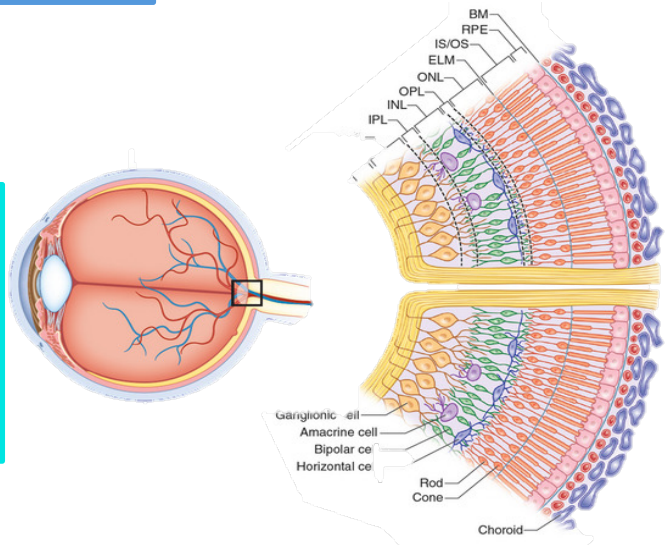
- Mainly of horizontal cells
- Make synaptic connections with receptors

5- Inner nuclear layer

- Bipolar cells

6- Inner plexiform layer

- Amacriane cells
- Make synaptic connections with ganglion cells



Retinal Cells

- There are five basic classes of neurons in the …….

Photoreceptors

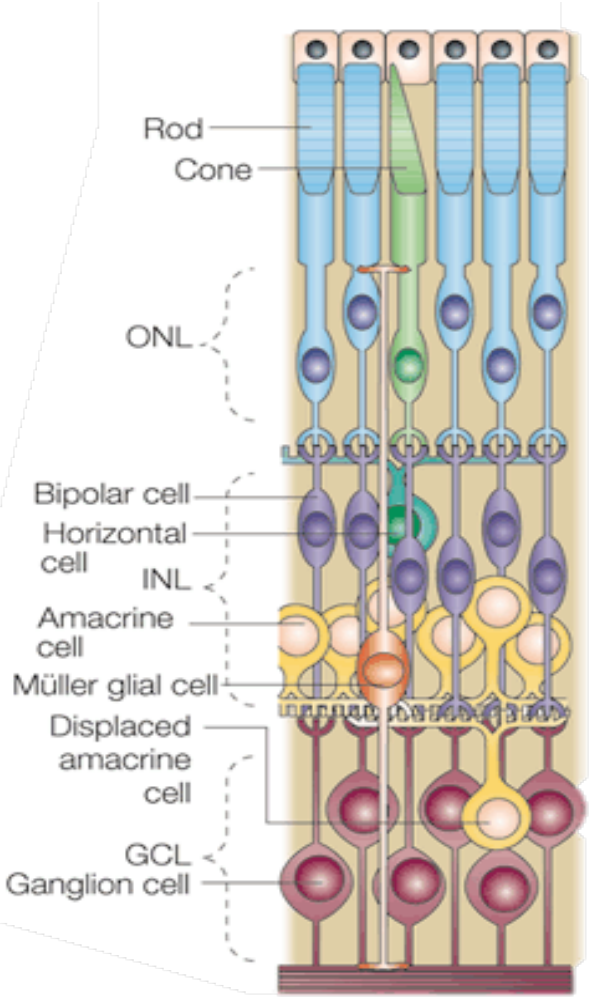
Bipolar cells

Ganglion cells

Horizontal cells

Amacrine cells

Photoreceptor cells are responsible for capturing light and transforming this into generator potential to be used by the nervous system

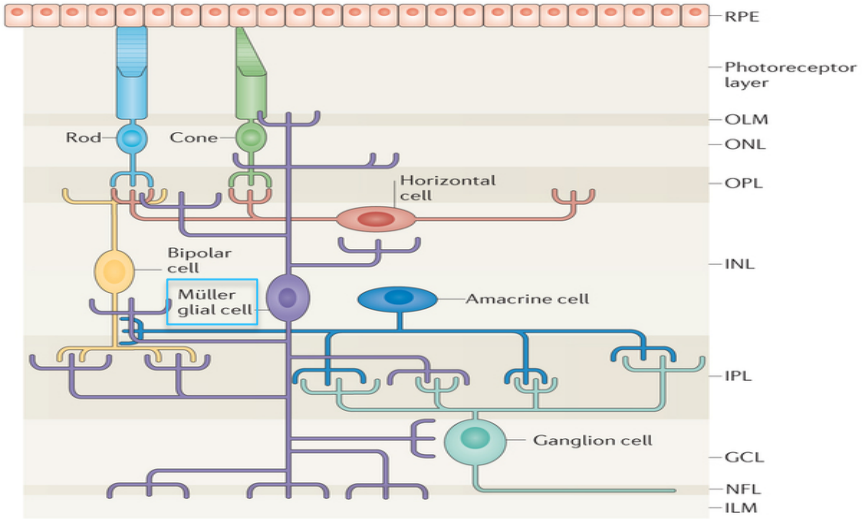


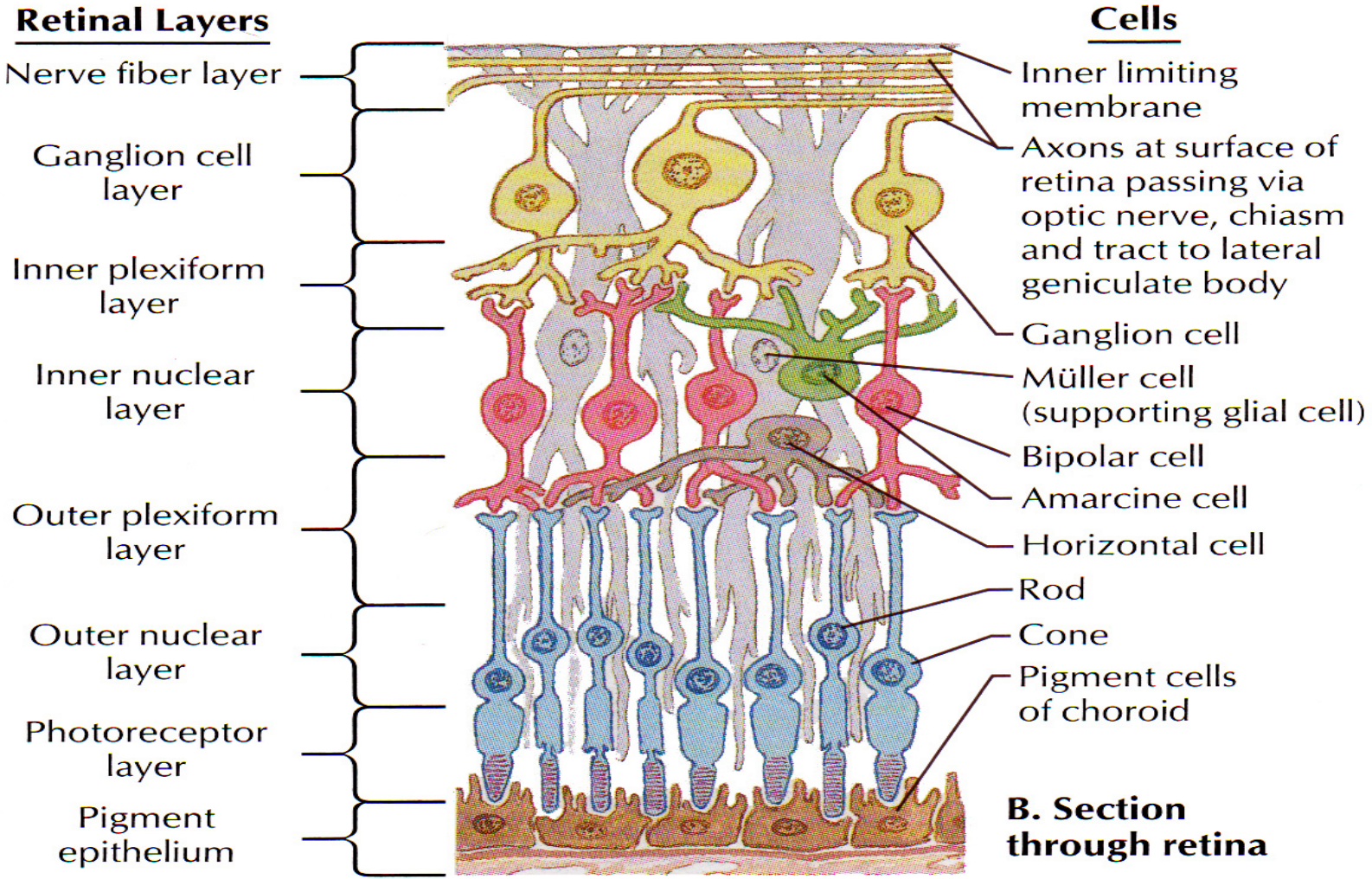
Müller Cells

- ✧Are the major glial element of the retina
- ✧Located in the inner nuclear layer
- ✧Forms architectural support structure, providing metabolic support to retina
- ✧Maintains synaptic levels of neurotransmitters

They can be:

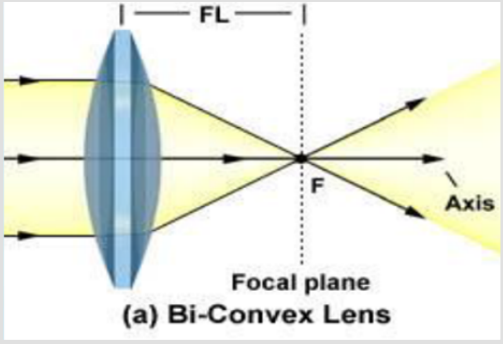
- Differentiate into neural progenitor ,following injury to the retina
- Act as light conductor which funnels light to the rods & cons cells



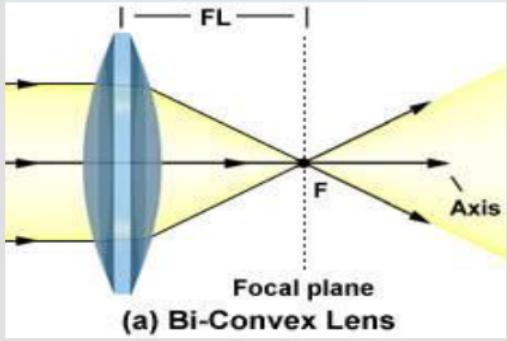

Retinal Layers
Nerve fiber layer
Ganglion cell layer
Inner plexiform layer
Inner nuclear layer
Outer plexiform layer
Outer nuclear layer
Photoreceptor layer
Pigment epithelium
Cells
Inner limiting membrane
Axons at surface of retina passing via optic nerve, chiasm and tract to lateral geniculate body
Ganglion cell
Müller cell (supporting glial cell)
Bipolar cell
Amarcine cell
Horizontal cell
Rod
Cone
Pigment cells of choroid
B. Section through retina

Principles Of Optic :

Biconvex lens (converge)



Biconcave lens (diverge)



Diopter (measure of the refractive power = RF)

$$\begin{pmatrix}\text{Refractive}\\ \text{power of a lens}\end{pmatrix} = \frac{1}{f\,(\text{in meters})}$$

- The greater curvature of the lens , the greater the RF of the eye .
- Exp/ if Principal focal distance of a lens is 25cm
  so its R.P=1/ 0.25 meter = 4D

The greater curvature of the lens , the greater the RF of the eye .

Ametropic eye: normal eye has image on retina, has dioptric power 60D

Diopters And Concave Lenses

Concave lenses “neutralize” the refractive power of convex lenses.

Thus, placing a 1-diopter concave lens immediately in front of a 1-diopter convex lens results in a lens system with zero refractive power

Diopters for a concave lens are measured by how much it neutralizes the refractive power of a convex lens

The refractive power of concave lenses cannot be standard in terms of the focal distance beyond the lens because the light rays diverge rather than focus to a point

Binocular Vision

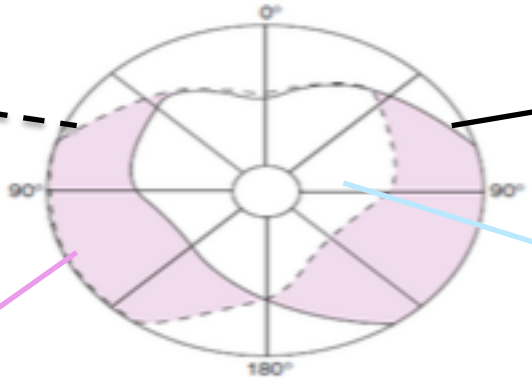
vision using two eyes with overlapping fields of view, allowing good perception of depth.

Binocular Vision

- Large visual field
- Cancel the effect of blind spot
- Stereoscopic vision
- One eye lesion does not affect vision

Monocular & Binocular visual fields

The dashed line encloses the visual field of the left eye



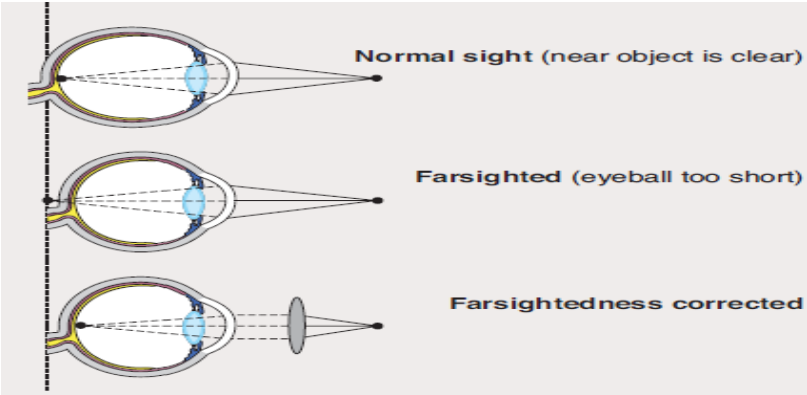
The solid line encloses the visual field of the right eye

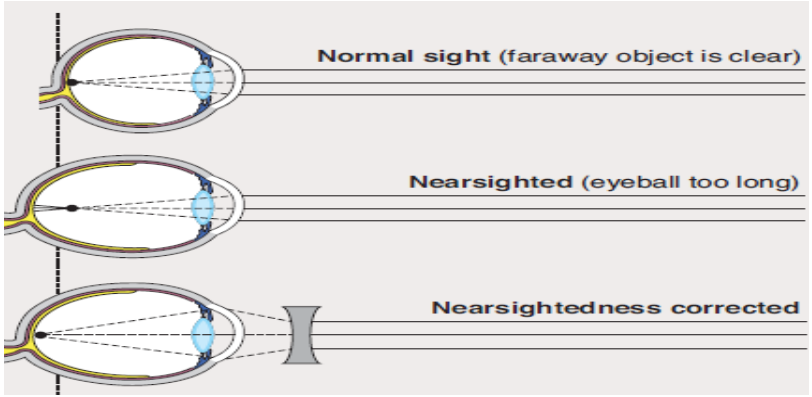
The colored areas are viewed with monocular vision

The common area (heart-shaped in the center)

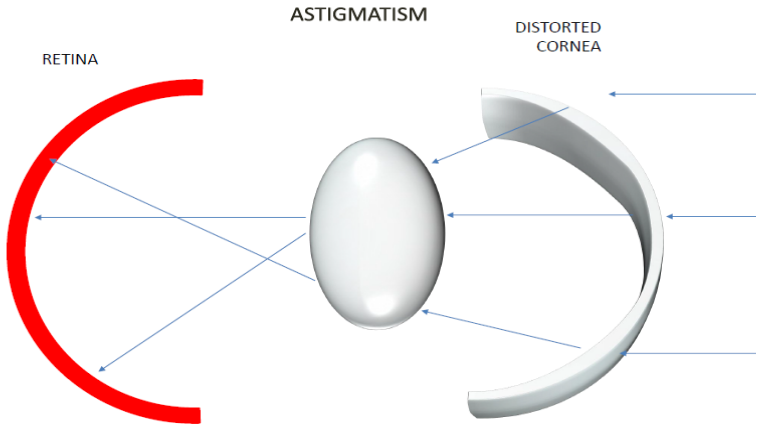
Errors Of Refraction:

Errors	Hypermetropia	Myopia
Definition	It is usually do to either an eye ball that is too short or a lens system that is too weak	This is usually duo to too long an eye ball , genetic , long antero-posterior diameter , extensive work as in studying or it can result from too much refractive power in the lens system of the eye .
Focus	Focus behind the retina	Focus in front of the retina
Correction	Correction by biconvex lens	Correction by biconcave lens



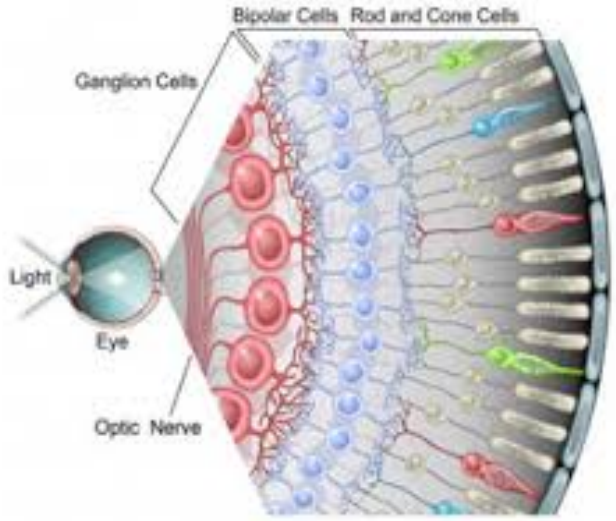


Errors	Presbyopia	Astigmatism (uneven & ununiformed corneal curvature)
Definition	Eye near point recedes by age due to loss of accommodation .	It is a refractive error of the eye causes the visual image in one plane to focus at different distance from the plane at right angle . This often result from too great curvature of cornea in one plane of the eye .
Correction	Correction by biconvex lens	Correction by cylindrical lens



Light Pathway In The Eye

Light passes through the lens system of the eye → To the vitreous humor → It inters the retina from the inside of the eye → then through the plexiform and nuclear layer → Finally it reaches the layer of rods and cones



- Light absorbed by: pigment cell layer that contain melanin pigment
- Impulses pass from rods & cons to rest of layers finally to ganglion cell layer, to optic nerve.

- ✧The visual acuity is decreased by this passage through such non-homogeneous tissue.
- ✧However, in the central foveal region of the retina, the inside layers are pulled aside to decrease this loss of acuity.
- ✧This allows light to pass unimpeded to the cones.

1- Astigmatism is corrected by :
A. biconvex lens
B. cylindrical lens
C. biconcave lens

2-Which one of these diseases the focus will be in front of the retina
A. Myopia
B. Hypermetropia
C. Astigmatism

3-Ametropic eye has dioptric power:
A.60D
B.15D
C.35D

4-Cells are responsible for capturing light and transforming this into generator potential to be used by the nervous system
A. bipolar cells
B. Photoreceptors
C. Ganglion cells

5-Glucoma happens when the Intraocular pressure more than ?
A. 70 mm Hg
B. 40 mmHg
C. 20 mmHg

6- Which eye layer contains thick, white fibrous tissue?
A. retina
B. cornea
C. choroid
D. sclera

7-Which eye layer contains light sensitive cells

A. sclera
B. choroid
C. retina
D. cornea

1.B
2.A
3.A
4.B
5.C
6.D
7.C

MCQs

1- What does Intracapsular lens Extraction means?

Removing the lens and capsule, and implanting a synthetic lens in the anterior.

2-The anterior chamber of the eye is located?

Between iris and cornea

3- Describe the pathophysiology of glaucoma?

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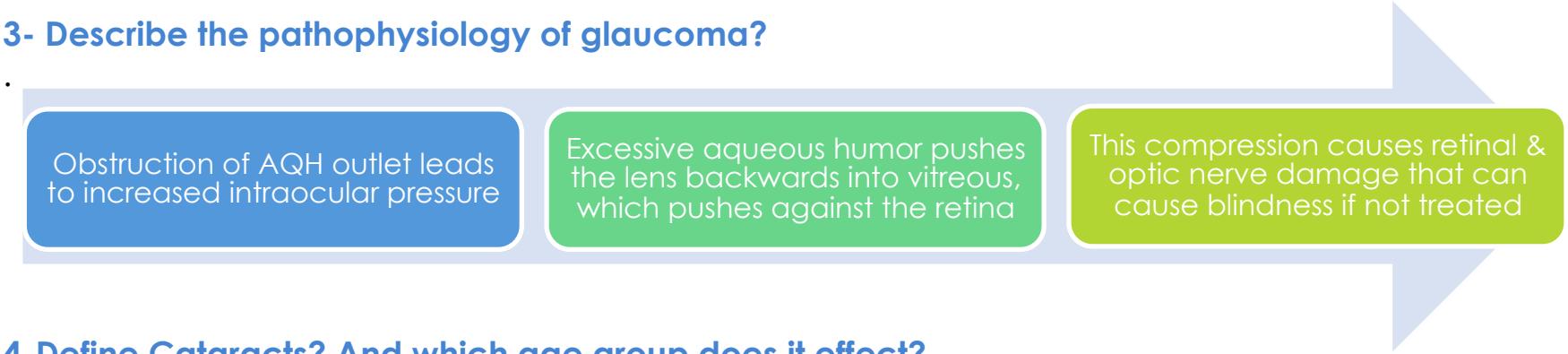

4-Define Cataracts? And which age group does it effect?

Cataracts occurs in older people is a cloudy or opaque area or areas in the lens.

THANK YOU FOR CHECKING OUR WORK!

BEST OF LUCK

Done By:

- Aya AlDayel
- Rana AlHumeamydi
- Sarah Nasser AlJasser