

# The **A** to **Z** of **Eyes**



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T  
HE  
A TO Z  
OF EYES  
INTRODUCTION



**Feedback appreciated**  
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## Acknowledgement

Thank you Aspen Pharmacare Australia for your support and assistance in this valuable project, particularly Greg Lan, Rob Koster, Richard Clement and Robbie Drew.

## Dedication

*To Greg Lan - this book is his suggestion.*

## How to use this book

The format of this A to Z book has been maintained. The Common terms section has been expanded and illustrated. Simple definitions and explanations along with many of the pathological ophthalmic conditions are listed here. The first section - **The Eye – Adnexae, Components & Relations** lists the major components of the eye and its surroundings, in the A to Z way i.e. alphabetically. Of course in a unit such as this the structure may be demonstrated in a number of ways and with other structures, which is indicated where appropriate. The second section **The Eyes - Examination, Malfunction & Testing** focuses on common eye conditions, their presentations and causes. So as usual **think of it and then find it** is the motto of **the A to Zs**. Eyes are complex, and they cannot be considered without some optic theory which is included in the second section.

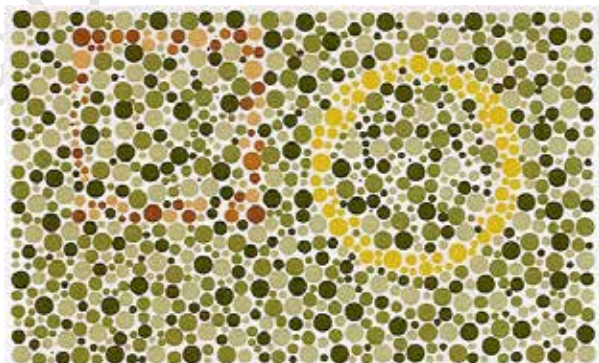
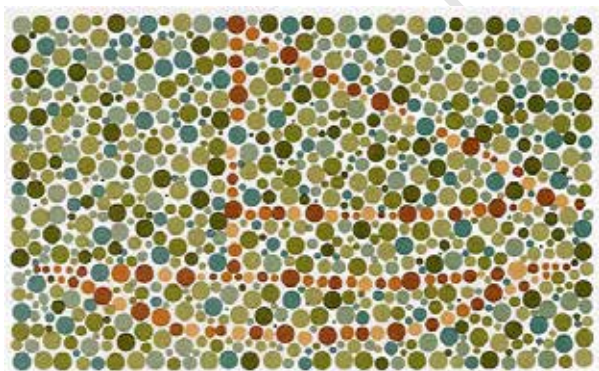
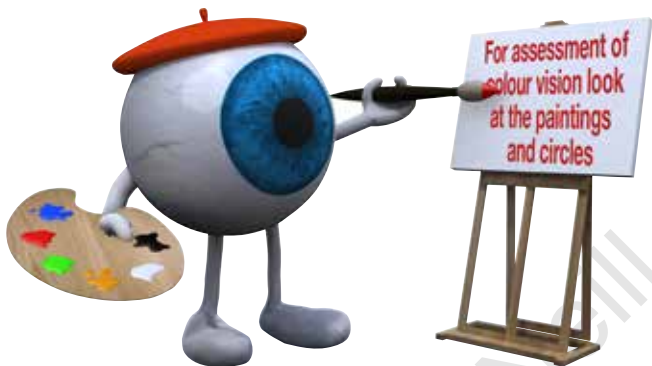
Please note also that additional material may be found in the other A to Zs: **the A to Z of the Brain and Cranial Nerves**, **the A to Z of Major Organs** and **the A to Z of Hair, Nails & Skin** in particular.

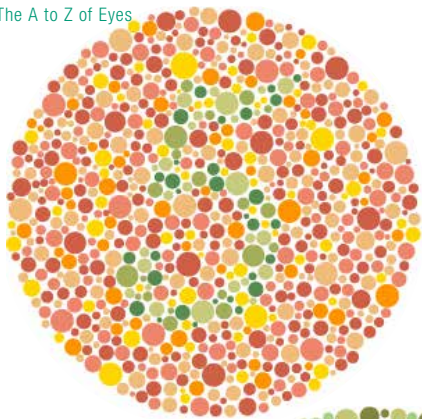
For an interactive educational Ophthalmic App, visit the App store and search Aspen Eye. Password: ophthalmics



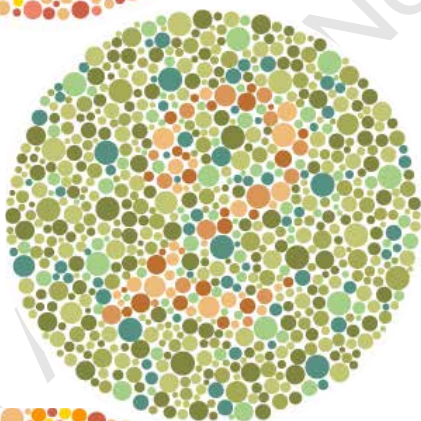
Thank you  
**A. L. Neill**

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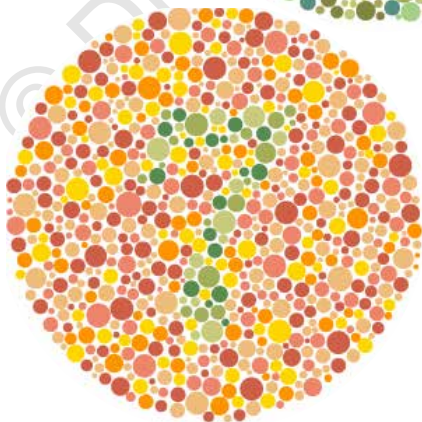




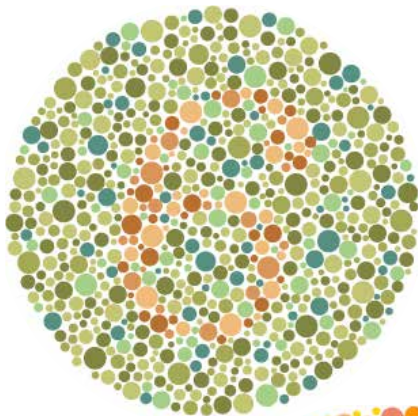
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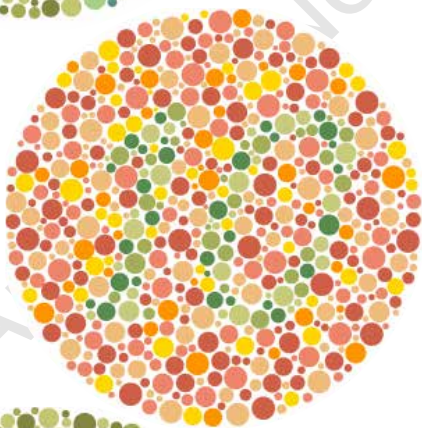
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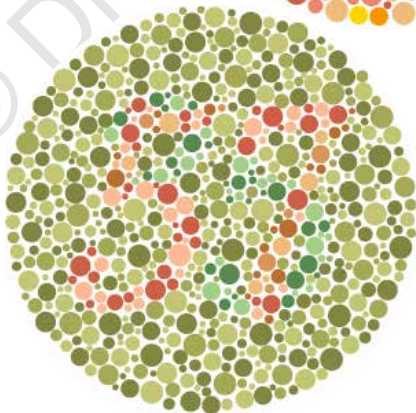
C



D



E



F

## Answers

a brown boat

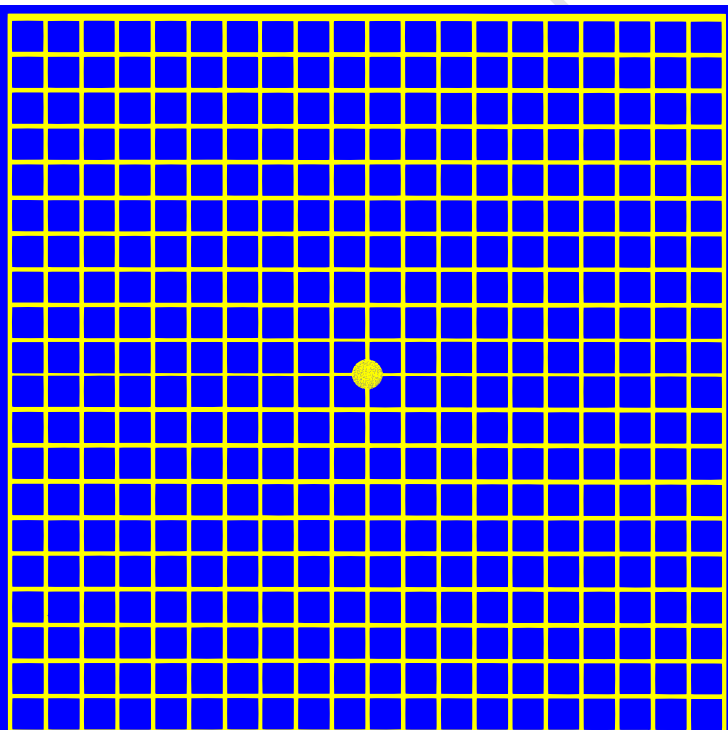
a yellow circle + a brown square

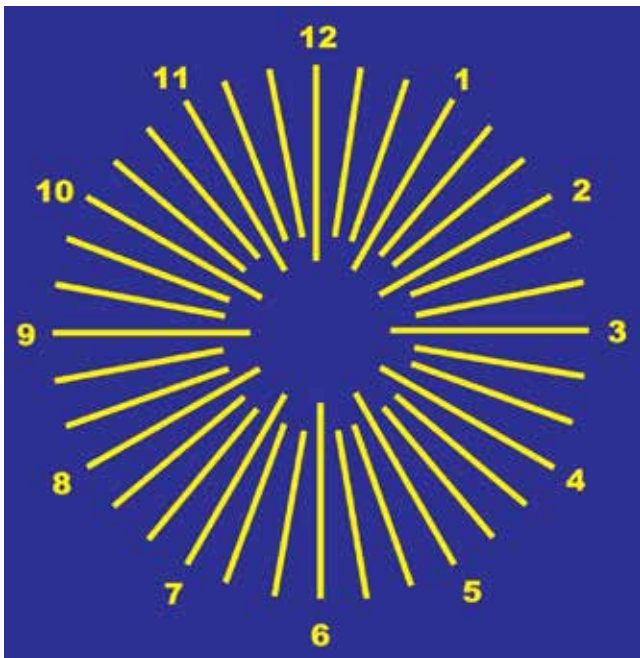
A: 5, B: 2, C: 7, D: 6, E: 10, F: 57

To further check on eye function - stare at the centre of this Amsler grid, with one eye, wearing glasses or CLs if needed. If all the lines are not visible, even & straight, and the grid is not rectangular & clear see the

### **Visual Acuity Assessment.**

Similarly the Astigmatic clock should also appear to have even, regular straight spokes. MT p286 for assessment.







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## Abbreviations, Acronyms & Symbols

Note these abbreviations include those in common use in the study and examination of the eyes as well as the ones used in this book

### A

<b>a</b>	= artery
<b>aa</b>	= anastomosis (ses)
<b>AA</b>	= amino acid
<b>Ab</b>	= antibody
<b>AC</b>	= anterior chamber
<b>ACG</b>	= acute angle glaucoma
<b>ACTH</b>	= adrenocorticotrophic hormone / adrenal cortical hormone
<b>ADH</b>	= antidiuretic hormone
<b>adj.</b>	= adjective
<b>ADP</b>	= adenosine diphosphate
<b>ADV</b>	= adenovirus
<b>Ag</b>	= antigen
<b>AH</b>	= aqueous humour
<b>AI</b>	= autoimmune
<b>AKA</b>	= also known as
<b>alt.</b>	= alternative
<b>AMD</b>	= age-related macular degeneration
<b>AMP</b>	= adenosine monophosphate
<b>ANS</b>	= autonomic nervous system
<b>ant.</b>	= anterior
<b>AO</b>	= adult onset
<b>AODM</b>	= adult onset diabetes mellitus
<b>AS</b>	= Alternative Spelling, generally referring to the diff. b/n British & American spelling
<b>ATP</b>	= adenosine triphosphate
<b>av</b>	= arterial-venous / arteriole-venule

### B

<b>B</b>	= blood
<b>b</b>	= bone
<b>bb</b>	= basal bodies
<b>BBB</b>	= blood-brain-barrier
<b>bc</b>	= because
<b>BCC</b>	= basal cell carcinoma
<b>BDR</b>	= background diabetic retinopathy
<b>BM</b>	= basement membrane / basal lamina / terminal lamina / plasma lamina
<b>b/n</b>	= between
<b>BP</b>	= blood pressure
<b>br</b>	= branch
<b>BS</b>	= Blood Supply / blind spot
<b>BStem</b>	= brain stem

### C

<b>CB</b>	= ciliary body
<b>Ch</b>	= choroid
<b>Ci</b>	= cilium (a)
<b>CC</b>	= cerebral cortex
<b>C/D</b>	= cup to disc ratio
<b>c.f.</b>	= compared to
<b>CG</b>	= ciliary ganglion
<b>CH</b>	= cerebral hemispheres
<b>CL</b>	= contact lens
<b>CM</b>	= cellular membrane / plasma membrane
<b>CN</b>	= cranial nerve
<b>CNS</b>	= central nervous system
<b>CNV</b>	= choroidal neovascularization
<b>Co</b>	= collagen

<b>CP</b>	= cervical plexus
<b>collat.</b>	= collateral
<b>Cr</b>	= cranial
<b>CSF</b>	= cerebrospinal fluid
<b>CT</b>	= connective tissue / computed tomography
<b>CTR</b>	= common tendinous ring

**D**

<b>D</b>	= diopter / detachment
<b>DD</b>	= differential diagnosis
<b>DES</b>	= dry eye syndrome
<b>DF</b>	= Decemet's fold
<b>diff.</b>	= difference(s)
<b>dist.</b>	= distal
<b>DM</b>	= diabetes mellitus / dura mater
<b>DNA</b>	= deoxyribonucleic acid
<b>DOPA</b>	= dihydroxyphenylalanine
<b>DT</b>	= digestive tract
<b>DVM</b>	= optic disc + retinal blood vessels + macula
<b>Dx</b>	= diagnosis

**E**

<b>E</b>	= energy / eye
<b>EAM</b>	= external acoustic meatus
<b>EB</b>	= eyeball
<b>ec</b>	= extracellular
<b>e.g.</b>	= example
<b>EL</b>	= eyelid
<b>ELM</b>	= external limiting membrane (of the retina)
<b>EM</b>	= eye movements
<b>EMD</b>	= exudative macular degeneration
<b>EO</b>	= extraocular
<b>EOM</b>	= extraocular muscles
<b>epi.</b>	= epithelium
<b>ER</b>	= endoplasmic reticulum

<b>Es</b>	= eyelash
<b>E-W</b>	= Edinger-Westphal nucleus
<b>ext.</b>	= extensor (as in muscle to extend across a joint)

**F**

<b>F</b>	= fibre
<b>FB</b>	= foreign body
<b>FEM</b>	= fast eye movements
<b>Fi</b>	= filament / fibril
<b>FHx</b>	= family history
<b>FP</b>	= foot process / focal point
<b>FS</b>	= fibrous sheath
<b>FUO</b>	= fever of unknown origin
<b>FVP</b>	= fibrovascular proliferation

**G**

<b>GA</b>	= Golgi apparatus
<b>GCL</b>	= ganglion cell layer (of the retina)
<b>gen.</b>	= generally
<b>GH</b>	= growth hormone
<b>gld</b>	= gland
<b>Gk.</b>	= Greek
<b>GM</b>	= grey matter
<b>Gr</b>	= granule

**H**

<b>h</b>	= hour
<b>H</b>	= hormone
<b>HA</b>	= headache
<b>Hb</b>	= haemoglobin
<b>HBP</b>	= high blood pressure
<b>HCL</b>	= hard contact lens
<b>H&amp;E</b>	= haematoxylin & eosin
<b>Hg</b>	= haemorrhage
<b>HP</b>	= high pressure
<b>HR</b>	= heart rate

## The A to Z of Eyes

<b>HS</b>	= Herpes Simplex
<b>HTN</b>	= hypertension
<b>Hx</b>	= history

### I

<b>IAM</b>	= internal acoustic meatus
<b>ic</b>	= intracellular (inside the cell)
<b>ICP</b>	= intracranial pressure
<b>If</b>	= inflammation
<b>Ig</b>	= immunoglobulin
<b>IHD</b>	= ischaemic heart disease
<b>IIL</b>	= idiopathic intracranial hypertension
<b>In</b>	= infection
<b>INL</b>	= inner nuclear layer (of the retina)
<b>int.</b>	= internal
<b>IO</b>	= intraocular / Inferior Oblique muscle
<b>IOM</b>	= intraocular muscles
<b>IOP</b>	= intra-ocular pressure
<b>IPD</b>	= interpupillary distance
<b>IPL</b>	= inner plexiform layer (of the retina)
<b>IR</b>	= inflammatory reaction/ response / Inferior Rectus muscle
<b>IT</b>	= inferior turbinate (of the nose)
<b>IV</b>	= intravenous

### J

<b>Jc</b>	= junctional complex
<b>jt(s)</b>	= joints = articulations

### K

<b>KP</b>	= keratic precipitate
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### L

<b>I</b>	= lymphatic
<b>L</b>	= lumbar / left
<b>LA</b>	= lacrimal apparatus
<b>LE</b>	= left eye
<b>lig</b>	= ligament
<b>LL</b>	= lower limb / lower eyelid
<b>LP</b>	= lamina propria
<b>LPS</b>	= Levator Palpebrae Superioris muscle
<b>LR</b>	= Lateral Rectus muscle
<b>LT</b>	= lymphoid tissue
<b>Lt.</b>	= Latin
<b>LIF</b>	= left iliac fossa
<b>LUQ</b>	= left upper quadrant

### M

<b>m</b>	= muscle
<b>M</b>	= macula / magnification
<b>MA</b>	= microaneurysm
<b>MD</b>	= macular degeneration
<b>med.</b>	= medial
<b>mem</b>	= membrane
<b>MH</b>	= macular hole
<b>MI</b>	= myocardial infarction / heart attack
<b>M-G</b>	= Marcus- Gunn pupil
<b>mito</b>	= mitochondrion (a)
<b>MM</b>	= mucus membrane / millimeters
<b>mmHG</b>	= millimeters of mercury (pressure)
<b>MNC</b>	= mononuclear cells
<b>monos</b>	= monocytes
<b>MR</b>	= Medial Rectus muscle
<b>MRA</b>	= magnetic resonance angiography
<b>MRI</b>	= magnetic resonance imaging
<b>mRNA</b>	= messenger RNA

<b>mt</b>	= microtubule
<b>MT</b>	= main text
<b>mu</b>	= muscle
<b>mv</b>	= microvillus (i)
<b>MVR</b>	= massive vitreous retraction

**N**

<b>n</b>	= noun
<b>N (s)</b>	= nerve(s)
<b>N/A</b>	= not applicable
<b>Na</b>	= sodium
<b>NAD</b>	= normal (size, shape)
<b>NAD</b>	= no abnormality detected
<b>NFL</b>	= nuclear fibre layer (of the retina)
<b>NLD</b>	= nasolacrimal duct
<b>NM</b>	= nuclear membrane / nucleolemma
<b>No</b>	= nucleolus
<b>Np</b>	= nuclear pore
<b>NP</b>	= near point
<b>NR</b>	= nerve root origin
<b>NS</b>	= nerve supply / nervous system / normal saline
<b>NT</b>	= nervous tissue
<b>Nu</b>	= nucleus
<b>nv</b>	= neurovascular bundle
<b>NV</b>	= neovascularization / near vision
<b>NVM</b>	= neovascular membrane

**O**

<b>O</b>	= origin (gen. muscle)
<b>OA</b>	= over active (gen. muscle)
<b>OD</b>	= optic disc
<b>OD</b>	= right eye (oculus dexter) - not used here as a ref only
<b>ON</b>	= optic nerve

<b>ONH</b>	= optic nerve head
<b>ONL</b>	= outer nuclear layer (of the retina)
<b>OO</b>	= orbicularis oculi
<b>OP</b>	= ocular pressure (of the EB)
<b>ophthal.</b>	= ophthalmology / ophthalmic
<b>OPL</b>	= outer plexiform layer (of the retina)
<b>OS</b>	= left eye (oculus sinister)
<b>OU</b>	= both eyes
<b>OZ</b>	= optical zone

**P**

<b>PaNS</b>	= parasympathetic nervous system
<b>PC</b>	= posterior chamber / posterior commissure
<b>PERL</b>	= pupils equal and reactive to light
<b>pH</b>	= measure of alkalinity / acidity of a solution
<b>PH</b>	= pinhole visual acuity / past history
<b>pl.</b>	= plural
<b>PN</b>	= peripheral nerve
<b>PNS</b>	= peripheral nervous system
<b>prn</b>	= as required / as needed (pro re nita)
<b>post.</b>	= posterior
<b>proc.</b>	= process
<b>prox.</b>	= proximal

**R**

<b>R</b>	= right / resistance
<b>RBC</b>	= red blood cell
<b>RD</b>	= retinal detachment
<b>Re</b>	= retina
<b>RE</b>	= refractive error

## The A to Z of Eyes

**RF** = refractive index

**RNA** = ribonucleic acid

**rRNA** = ribosomal RNA

**RP** = refractive power

**RPE** = retinal pigmented epithelium

**RUQ** = right upper quadrant

## S

**s** = without (sine)

**sc** = subcutaneous / w/o visual aids

**SC** = spinal cord

**SCC** = squamous cell carcinoma

**SCL** = soft contact lens

**SD** = standard deviation

**SEM** = slow eye movements

**sep** = separation

**SI** = small intestine

**sig** = instructions (signeteur)

**sing.** = singular

**SL** = Schwalbe's line

**SMD** = senile macular degeneration

**SN** = spinal nerve

**SO** = Superior Oblique muscle

**SOB** = shortness of breath

**SOF** = superior orbital fissure

**soln** = solution

**SOV** = superior orbital vein

**SR** = Superior Rectus muscle

**SRH** = subretinal haemorrhage

**SRM** = subretinal membrane

**ss** = signs & symptoms / scleral spur

**subcut.** = subcutaneous (just under the skin)

**supf** = superficial

**sv** = synaptic vesicle

**SymNS** = sympathetic nervous system

## T

**T** = tissue

**tab** = tablet

**TED** = thyroid eye disease

**TIA** = transient ischaemic attacks

**Tm** = tumour

**TNF** = tumour necrosis factor

**TNTC** = too numerous to count

**TP** = tarsal plates

**tRNA** = transfer RNA / transport RNA

**tu** = tubule

**tw** = terminal web

**Tx** = treatment / therapy

## U

**UA** = underactive (muscle)

**UCVA** = uncorrected visual acuity

**UL** = upper limb / upper eyelid

**ULC** = upper eyelid crease

**ung** = ointment (unguentum)

## V

**V** = vein

**v** = very

**va** = vacuole

**vb** = verb

**VA** = visual acuity

**VAA** = visual association areas

**VB** = vitreous body

**VECP** = visually evoked cortical potential

<b>VEGF</b>	= vascular endothelial growth factor
<b>VER</b>	= visual evoked response
<b>VF</b>	= visual field
<b>VH</b>	= vitreous haemorrhage
<b>Vi</b>	= virus
<b>VL</b>	= vision loss / loss of vision
<b>VP</b>	= visual pathway
<b>vs</b>	= vesicle
<b>VMT</b>	= vitreomacular traction
<b>VOD</b>	= vision of the right eye
<b>VOR</b>	= vestib-ocular reflex
<b>VOS</b>	= vision of the left eye
<b>VOU</b>	= vision of both eyes
<b>VZV</b>	= varicella zoster virus

## W

<b>WM</b>	= white matter
<b>w/n</b>	= within
<b>w/o</b>	= without
<b>wrt</b>	= with respect to

## X

<b>X</b>	= exophoria / power of magnification
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## YZ

<b>ZA</b>	= zonula adherans
<b>ZO</b>	= zonula occludens / tight junction

## Symbols

<b>&amp;</b>	= and
<b>#</b>	= fracture
<b>↓</b>	= decreased / depressed
<b>↑</b>	= increased / elevated
<b>&gt;</b>	= greater than
<b>&lt;</b>	= less than
<b>∩</b>	= intersection with
<b>≠</b>	= opposite of / unequal to



# Pronunciation Key & Colour Guide

**Most terms are listed in black.**

**Pathological terms are in green**

**Prefixes and Suffixes are in blue**

**The pronunciation guide to words in this section are in bold red lettering**

Stressed syllables are in **CAPITAL LETTERS**

Vowel sounds are pronounced as indicated below

<b>A</b>	<b>May</b> <b>map</b> <b>mark</b>	<b>ay</b> <b>a</b> <b>ah</b>
<b>E</b>	<b>Me</b> <b>met</b> <b>term</b>	<b>ee</b> <b>e</b> <b>ur</b>
<b>I</b>	<b>eye / sight</b> <b>tin</b>	<b>ī</b> <b>i</b>
<b>O</b>	<b>go</b> <b>mother</b> <b>mop</b> <b>more</b> <b>boy</b> <b>lose</b> <b>nook</b> <b>loose</b>	<b>oh</b> <b>uh</b> <b>o</b> <b>or</b> <b>oi</b> <b>oo</b> <b>oe</b> <b>ou</b>
<b>U</b>	<b>blue</b> <b>cute</b> <b>cut</b>	<b>ou</b> <b>ew</b> <b>uh</b>
<b>Y</b>	<b>family</b> <b>myth</b> <b>eye</b>	<b>ee</b> <b>i</b> <b>ī</b>

## Common Terms used to describe the eyes; their structure & functions

### A

**ab externo** surgical term to describe excisions which go from the outside to the inside

**ab interno** surgical term to describe excisions which go from the inside to the outside

**Abduction** movement away from the midline e.g. outward rotation of the eye from straight ahead ( $\neq$  **Adduction**)

**Abducens AKA Abducent AKA Abducen N** CN VI has the longest intracranial route of all the CNs

**Aberration (ab-er-RAY-shon)** blurred or distorted image quality results from internal physical properties of an optical device e.g. comma aberration when dots outside the optical axis appear as commas - a form of astigmatism  
*adj aberrant*

**Aberrant** unusual, abnormal

**Aberrant regeneration** functional defect e.g. the abnormal regrowth of a N after ly e.g. CN III br to the IR grows to the upper EL & causes it to rise when looking down instead of following the direction of the EB

**Ablate** remove or destroy surgically or radiologically (*n ablation*)

**Ablepharon (a-BLEF-ar-on)** absence of ELs

**Abrasion** removal of top layers of a structure in ly *see Corneal abrasion (vb abrade - to scrape away a surface/ layer)*

**Acanthamoeba (ay-kan-thuh-MEE-buh)** single cell MO protozoan found in the soil & contaminated water which causes keratitis with CLs

**Accommodation** ability to change the shape of the lens via the muscles of the CB to focus on close objects

**Achromat AKA Monochromat** an individual w/o the ability to distinguish b/n colours or who can only see 1 colour due to an absence of cones or only having one cone type

**Achromatic lens** lens to reduce chromatic aberration -splitting of colours

**Actinic** related to sun exposure

**Acuity see Visual acuity**

**Adduction** movement towards the midline e.g. inward rotation of the eye from straight ahead ( $\neq$  **Abduction**)

**adeno- related to glands**

**Adenoid** glandular

**Adenopathy** generally refers to the swelling of LNs due to In or IR

**Adenovirus** group of viruses causing: conjunctivitis, If of the mms, URTIs,

**Adherence syndromes AKA Cicatricial strabismus AKA Johnson's syndrome** syndromes which limit the movements of the eyes because of adhesions b/n the sheaths of EOM, post ly or trauma to the muscle cone

**Adherent leukoma (LOO-koh-muh)** dense corneal opacity to which the iris is attached, may or may not encroach upon the pupil



**Adie's pupil AKA Pupillotonia AKA Tonic**

**pupil ↓** pupillary constriction to light & sluggish redilatation, & poor accommodation for near objects – due to ly to the ciliary ganglion

**Adjunctive Tx** a Tx which enhances / assists the therapeutic effect of a medication or other Tx

**Adjustable sutures** used in the Tx of strabismus to adjust the attachment site of the EOMs in the fine tuning of the operation

**Adjuvant Tx** a Tx that enhances the body's response to a medication

**Adnexa (ae) (AD-nex-a/ee)** appendages & associated structures of the primary structure or organ *wrt eye* the EL, eyebrow, orbit & its contents **cf adnexae oculi**

**Advancement** the surgical reattachment of an EOM to a more forward position on the EB – to strengthen its action

**Aerial haze** atmospheric effects which give distant objects a blue haze - assists in monocular depth perception

**Afebrile** w/o fever (**≠ Febrile**)

**Afferent pupillary defect AKA Gunn pupil AKA Marcus-Gunn pupil** slow light reaction 2° to ON disease where there is slow conduction of the ON - Ex with the swinging flashlight

**After-cataract** an opacity developing after the removal of the lens - generally on the lens capsule **see also Elschnig pearls**

**After-image** an image which persists after 1 or both eyes are exposed to a bright light this phenomenon can be used to test if retinal correspondence is normal – using different images for each eye & determining the after-images of each

**Age-related macular degeneration (AMD)** a disease entity causing VL due to the dissociation &/or interruption of the retina from its BS in the macular region which ↑ with age (**see also Drusen, Macular Degeneration**)

**Agnosia (ag-NOHZ-ee-uh)** inability to recognize objects despite having an intact VP **see also Alexia**

**Agonist / Primary mover** *wrt eye* the main EOM responsible for the eye movement direction

**Air/Fluid exchange** *wrt eye* replacing the vitreous fluid with air or gas after Tx for retinal detachment (**see also vitrectomy**)

**Alacrima** lack of tear production

**Albinism** an hereditary condition with the absence of melanin pigment, which includes lack of pigment in the retina & iris comprising VA, bc of too much light w/n the EB.

**Alexia** word blindness with perfect vision (due to brain damage) **see also Agnosia**

**Allen cards** - picture cards used for the illiterate or children to examine VA **see also Snellen charts**

**Alveolus (al-VEE-oh-lus)** air filled cavity e.g. sinus **adj - alveolar** (as in air filled bone in the Frontal bone or Maxilla)

**Amacrine cells AS Amacrine** long retinal neural cells of the IPL facilitating communication across & w/n the retina connecting the bipolar & ganglion cells

**Amaurosis (am-uh-ROH-sus) AKA Leber's congenital amaurosis** blindness or near-blindness due to ↓ retinal function possibly involving the amacrine or interconnecting cells of the INL.

**Amaurotic pupil** the pupil of a blind eye due to ON disease; it contracts in response to light only when the normal eye is stimulated with light, but the normal eye does not react when the amaurotic pupil is so stimulated.

**Amblyopia (adj amblyopic) AKA Lazy Eye ↓ VA** which cannot be explained by analysis of the VP; generally the vision of one eye is suppressed in favour of another due to the mal-alignment of the EOM

Types: **Ametropic/ Refractive** - large uncorrected RE in one or both eyes

**Anisometropic** - large RE difference b/n the 2 eyes

**Deprivation / Occlusion/Disuse** - loss of VA in an eye bc of loss of central fixation disuse, maybe 2° to Tx to enhance the VA in a deviated eye & so suppressing input from the normal eye, or some other obstruction to the retina e.g. cataract – reversed with removal of the deprivation from the incident light

**Hysterical** - non-physiological cause usually presents as tunnel vision

**Meridional** - VA loss or reduction due to uncorrected astigmatism

**Nutritional /Toxic** - due to Vita. B deficiency ± alcohol & drug

**Receptor** - pathology in the rods &/or cones

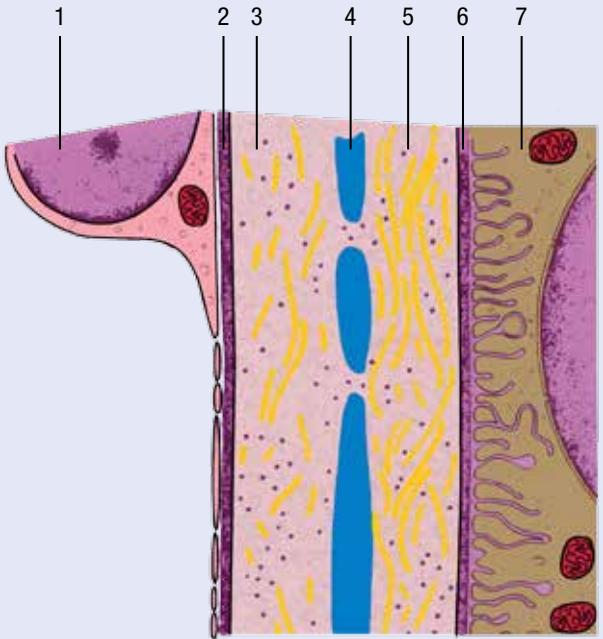
**Strabismic** - assoc with crossed eyes - cf inward deviation of one eye in childhood will suppress the input in that eye in favour of the eye which fixates centrally. This is reversible up to 9yo prior to maturation of the VP

## **Bruch's membrane AKA Vitreous Lamina AKA Lamina Vitrea**

### *Schema HP*

Bruch's membrane is a modified thickened clear basal lamina lying underneath the RPE. It has several layers of fibres, acting as filters and support, which may become thickened with deposits from the diffusion of the capillaries of the choriocapillaris (eg Drusen). If this occurs it will compromise the nutrient flow to the RPE and ends of the special sensory cells of the retina - the rods and cones.

- 1 endothelium of the choriocapillaris
- 2 interrupted BM of the choriocapillaris
- 3 outer collagenous zone
- 4 elastic layer
- 5 inner collagenous zone
- 6 BM of RPE - note invaginations of the BM
- 7 RPE



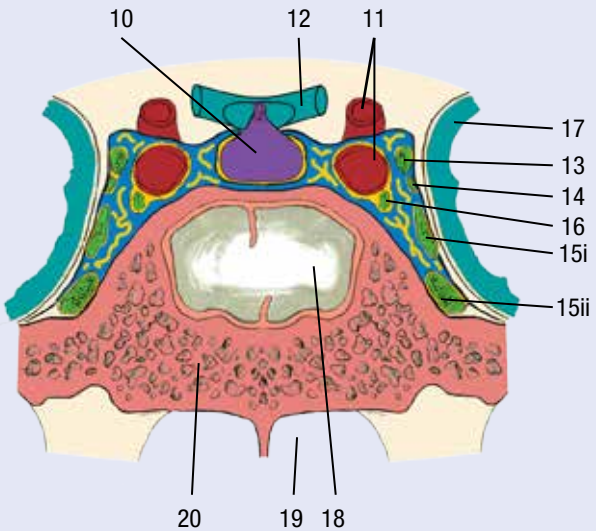
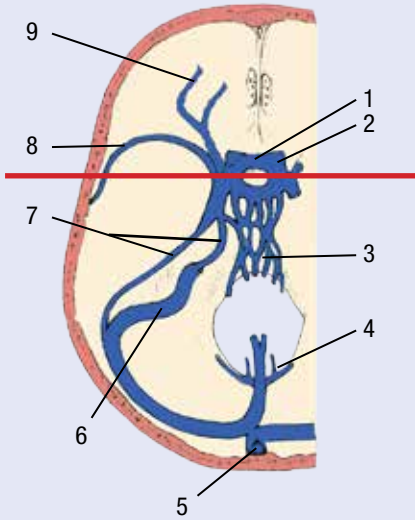
## Cavernous venous sinus

*Superior view - looking at the base of the skull*

*Coronal view - looking through the sinus - at the level of the red line*

The cranial venous drainage is via a number of slow flowing venous lakes - or sinuses. These thin-walled amuscular channels receive CSF from arachnoid granulations. The cavernous sinus positioned superior to the sphenoid sinus is intimately related to the arterial & nerve supply of the eye, as well as part of its venous drainage.

- 1 intercavernous sinus
- 2 cavernous sinus
- 3 basilar venous plexus
- 4 marginal sinus
- 5 confluence of the cranial venous sinuses
- 6 sigmoid sinus
- 7 inferior & superior petrosal sinuses
- 8 sphenoparietal sinus
- 9 ophthalmic veins
- 10 pituitary gland
- 11 internal carotid artery
- 12 CN II - optic N
- 13 CN III - oculomotor N
- 14 CN IV - trochlear N
- 15 CN V divisions 1 & 2 = ophthalmic N (i) & maxillary N (ii)
- 16 CN VI - abducens N
- 17 Temporal lobe
- 18 sphenoid air sinus
- 19 nasal cavity
- 20 Sphenoid bone





## Choroid

*Cross-section through the sclera, choroid & RPE*

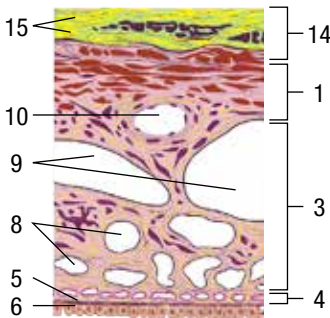
*Schema - 3D HP confocal view of the interconnections b/n the choroid & adjacent layers*

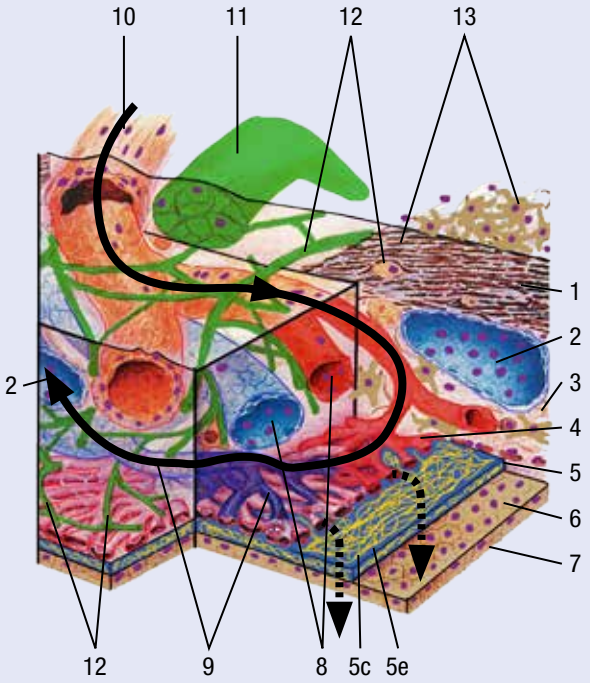
The choroid is the vascular layer of the retina, part of the uvea. It is in close proximity to Bruch's membrane through which it supplies the RPE & the specialist sensory ends of the rods & cones, and the deeper layers of the retina.

BF through this vascular T is as follows:

short ciliary a → arterioles → choriocapillaris → venules → vortex v.

- 1 **suprachoroidea**
- 2 **large vortex veins**
- 3 **stroma of the choroid**
- 4 **choriocapillaris**
- 5 **Bruch's membrane -**
  - 5c = collagen layers (upper & lower)
  - 5e = middle elastica - elastic fibre network in the centre of the membrane
- 6 **RPE**
- 7 **brush border of the RPE with sensory endings emmeshed**
- 8 **medium BVs in the choroid stroma**
- 9 **venules**
- 10 **short ciliary a**
- 11 **short ciliary N**
- 12 **network of N fibres throughout the choroid layers**
- 13 **stellate melanocytes of the choroid**
- 14 **sclera**
- 15 **CT in the sclera**





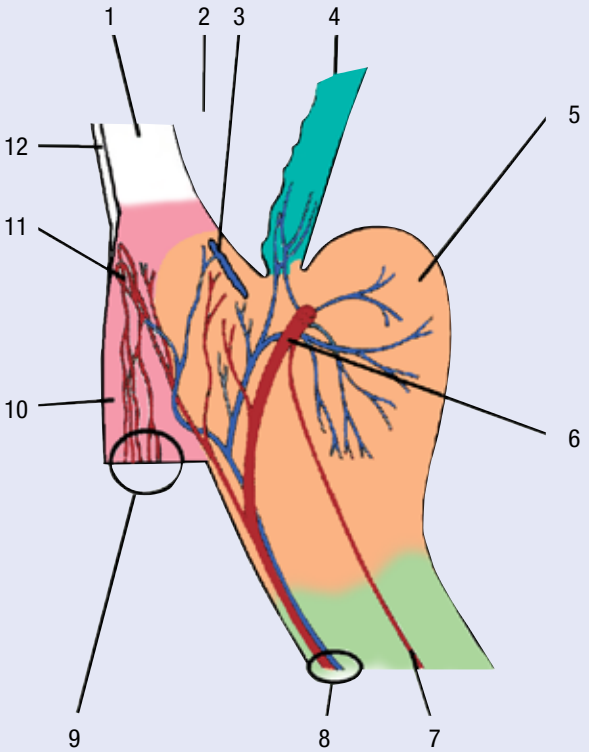
## Ciliary Body (CB)

### Blood Supply

#### *Sagittal view – cut through the body of the CB & the ring of the iris*

The BS of the CB is part of the choroid plexus. The venous drainage is via the canal of Schlemm a venous sinus similar to those found in the CNS, and which also drains the fluid of the ant. chamber. If this drainage is reduced or blocked the IOP will pathologically increase and glaucoma may develop, with irreversible loss of vision.

- 1 cornea
- 2 anterior chamber
- 3 canal of Schlemm
- 4 iris
- 5 CB
- 6 major arterial circle of the iris
- 7 long post. ciliary a
- 8 ant. ciliary a & v
- 9 conjunctival plexus
- 10 bulbar conjunctiva
- 11 conjunctival capillary loops
- 12 corneal epithelium



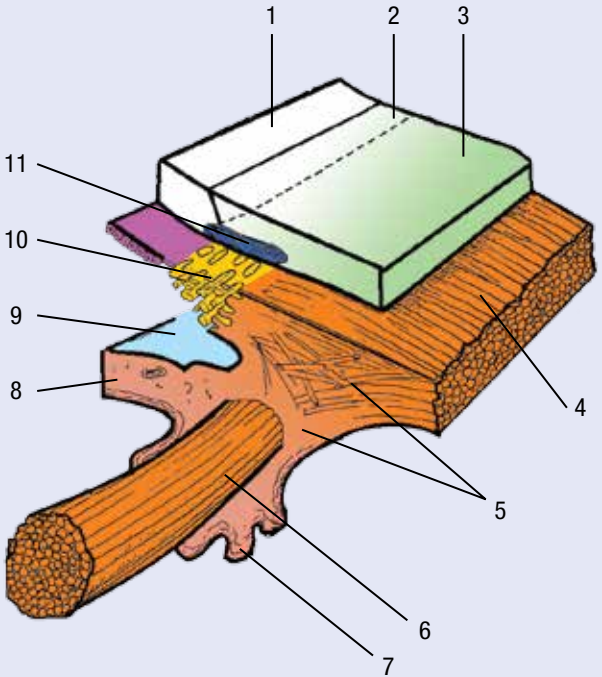
## Ciliary Body (CB)

### Muscles

#### *transverse view – cut through the ring of structures*

The CB is intimately related to the choroid & iris. The processes hold the lens in place, and the muscles control the aperture of the pupil, and curvature of the lens. The ciliary epithelium produces the fluid for the anterior chamber.

- 1 cornea
- 2 corneo-scleral junction – limbus
- 3 sclera
- 4 longitudinal m – AKA meridional m – responsible for opening the pupil aperture  
Dilator Pupillae m
- 5 oblique radial muscle fibres of the CB - responsible for the tension on the Zonular fibres and lens
- 6 circular m AKA Constrictor Pupillae - closes the pupil and inhibits fluid drainage
- 7 ciliary body processes – site of attachment of the zonules & production of fluid for the ant. chamber
- 8 iris
- 9 anterior chamber
- 10 trabecular network - when open fluid drainage is facilitated
- 11 canal of Schlemm – venous sinus draining the area of blood & fluid



## Conjunctiva

### Schema

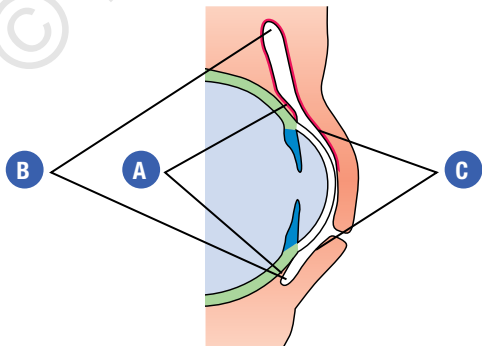
The conjunctiva is a thin stratified epithelial covered fascial layer which lines the inside of the ELs and covers the sclera. It is continuous with the avascular epithelium of the cornea. It contains BVs which supply these structures. Goblet cells facilitate the smooth blinking of the eye, by supplying mucous & oil and the resident T & B cells provide immune protection. If irritated the CT layer thickens and the BVs ↑ forming a pterygium which may grow and encroach upon the cornea.

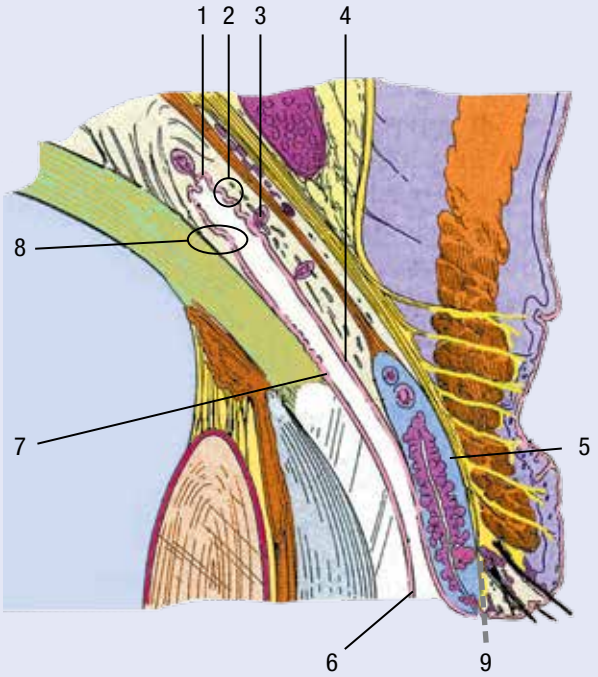
**A bulbar conjunctiva (on the EB)**

**B fornix of the conjunctiva (corners of EB)**

**C palpebral conjunctiva (on the EL)**

- 1 fornix
- 2 palpebral conjunctiva CT layer containing resident immune cells
- 3 sebaceous & mucous glands
- 4 stratified epithelium of the palpebral conjunctiva containing goblet cells
- 5 tarsal plate
- 6 stratified epithelium of the cornea w/o an underlying CT layer
- 7 junction b/n corneal & conjunctival epithelium
- 8 bulbar conjunctiva
- 9 "grey line" demarkation b/n inner mm and outer skin of the EL







# Cornea

## Structure

*A - epithelium + upper stroma*

*B - endothelium + Descemet's membrane + deepest stromal layers*

*C - stroma - fibroblasts + collagen layers*

*D - NS of the cornea*

These views are of the central cornea. There are 3 merging layers: the surface stratified epi. which changes from rounded basal cells to flattened - "wing cells" joined together tightly to secure the surface & maintain the tear film, (this epi. turns over every 7 days); the largest middle CT stroma of empty fibrocytes & collagen layers in a strict lattice formation (90% of the cornea) and the deep thin flattened endothelium which faces the interior of the ant. chamber. The cornea makes up 2/3 of the EB's RP.

### 1 epithelium

b = basal cells - site of new epithelial layers

t = tight junctions

L = lymphocyte in basal layer

m = microvilli

t = tight junctions

w = wing cells

### 2 BM of the surface epithelium

2b = Bowman's membrane a development from the BM

### 3 corneal N

### 4 collagen fibres of the stroma -

in organized lamellae (o) clear

disorganized cornea (d) cloudy

D = collagen fibres in Descemet's membrane

### 5 stroma

k = keratocytes/fibrocytes

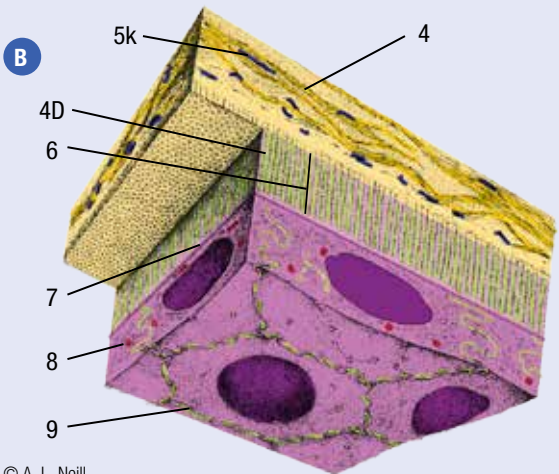
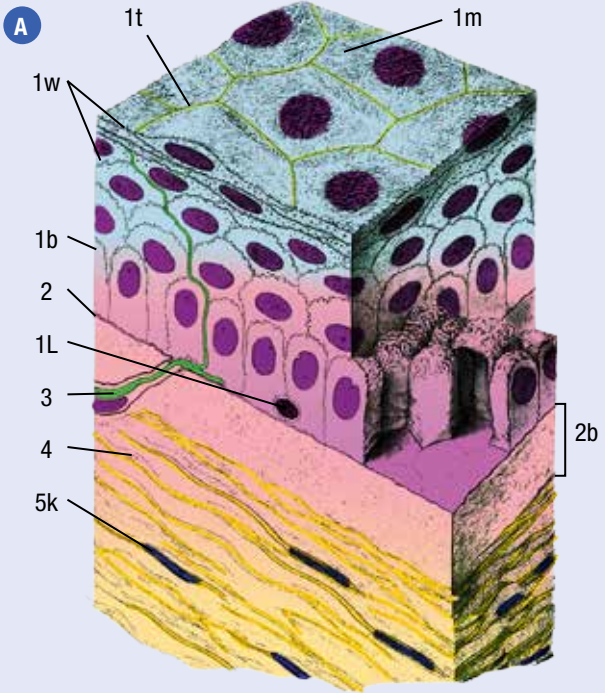
m = macula occludans b/n the cells - only in the corneal fibrocytes

### 6 Descemet's membrane

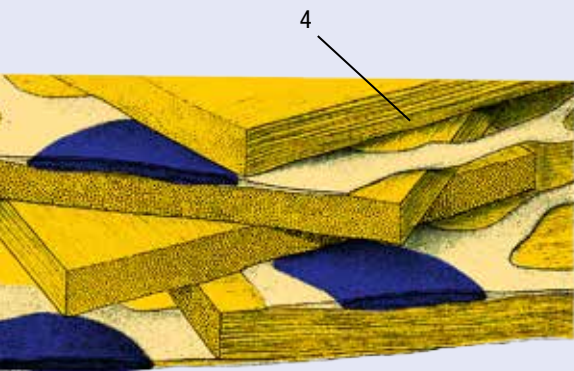
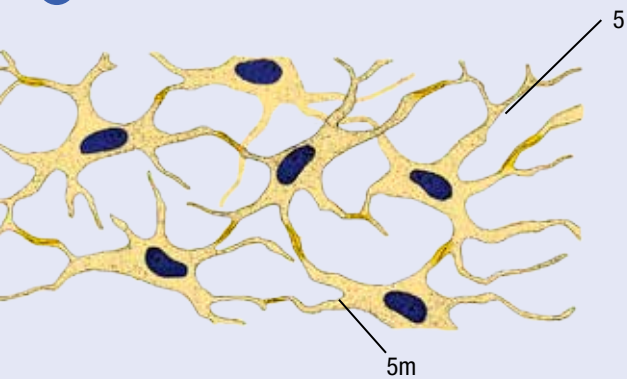
### 7 BM of the endothelium

### 8 endothelium

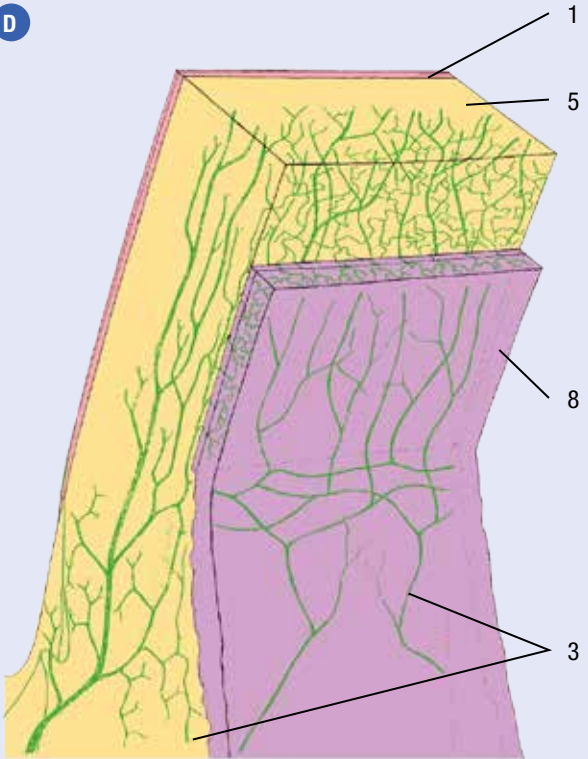
### 9 marginal projections & folds b/n the endo cells also containing cell to cell adhesions



C



D



# Cornea

## Development

*A - 5-6 weeks*

*B - 7-8 weeks*

*C - 12 weeks*

*D - 20 weeks*

*E - 7 months - developed adult structure*

These views are of the central part of the cornea – and do not show the limbus. After 7 months the adult form of the cornea is established. It continues to grow, organize the keratocytes and their collagen fibres until it is filled with densely packed parallel collagen fibres dispersed with thin highly orientated empty cells & their nuclei. The surface epithelium forms flattened surface cells - wing cells which keep the cornea hydrated. With age the turnover of the epithelium ↓ but the surface cells continue to slough, causing “dry eye”.

**1 epithelium – 2 layers**

**b = basal cells - site of new epithelial layers**

**w = wing cells, small flattened surface epithelial cells which support the thin fluid film & keep the cornea hydrated and smooth**

**2 BM of the surface epithelium**

**2b = Bowman's membrane a development from the BM**

**3 cellular space separating the epithelium & endothelium and their BMs invaded by the mesodermal cells**

**4 BM of the endothelium**

**4d = Descemet's membrane a development from the BM**

**5 mesenchyme moving in from the periphery changing into**

**f = fibroblasts and forming**

**k = keratocytes which form the ...**

**s = stroma of the cornea**

**6 endothelium**

**7 keratocytes**

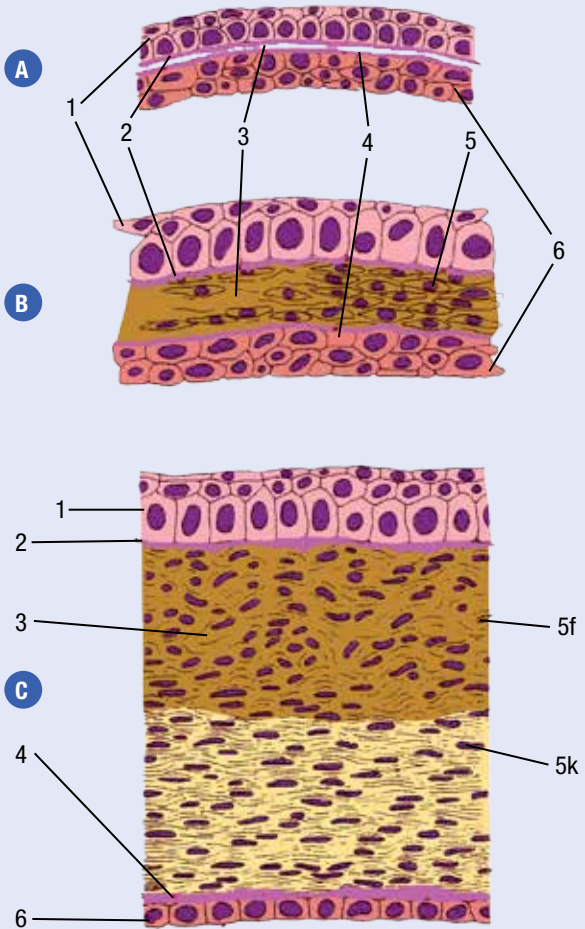
**d = disorganized keratocytes in the superficial region of the cornea**

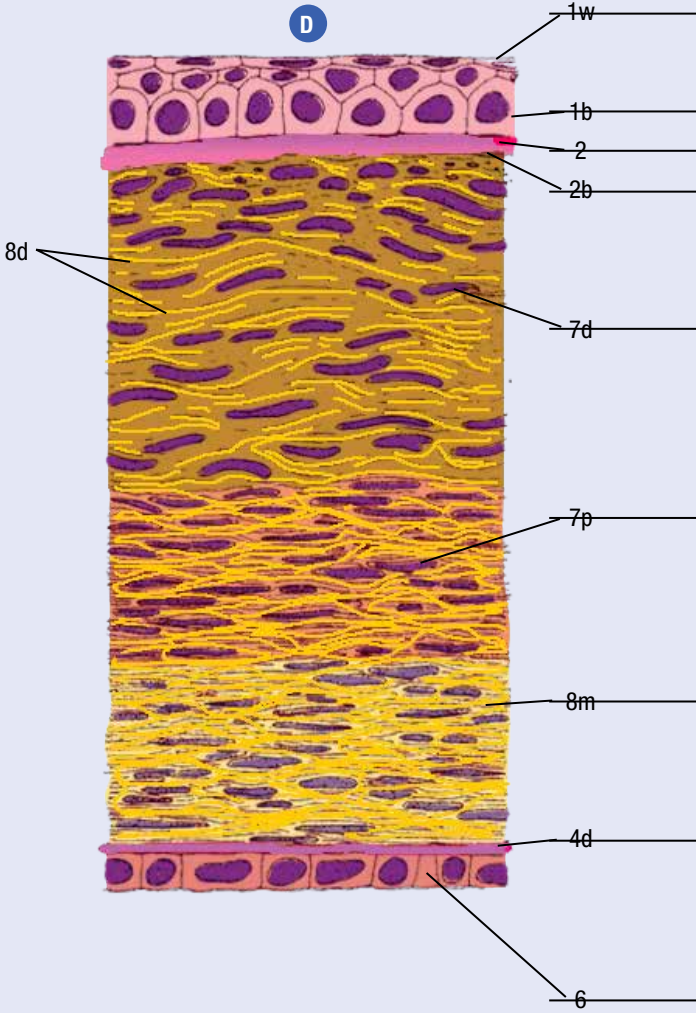
**p = parallel mature organized keratocytes**

**8 collagen fibres**

**d = thicker disorganized fibres**

**m = mature thin parallel fibres**





E

