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Optics and Refraction

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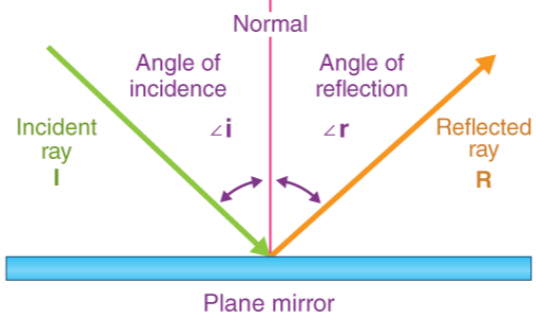
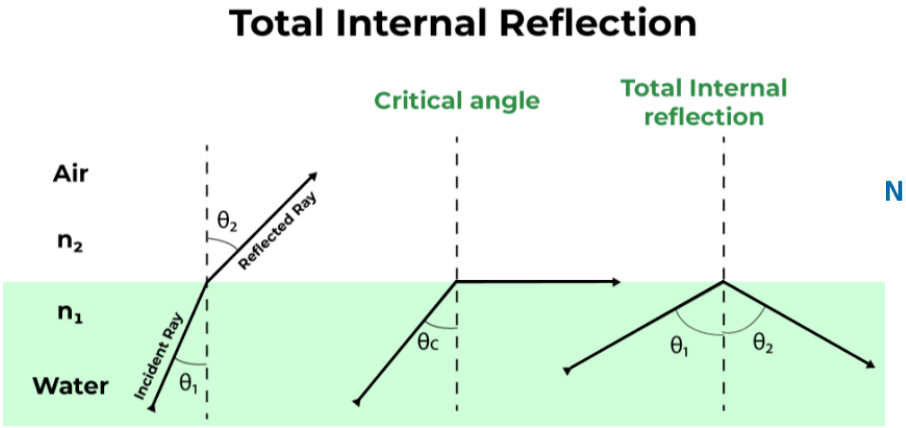
This is me 👋

- Qualified as an optometrist in 2011
- Worked on the high street until 2021
- Since being in hospital practice completed IP and prof certs
- Studying for my ACP masters (1 year left!)





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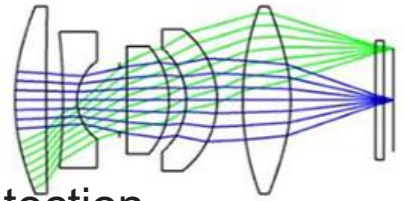
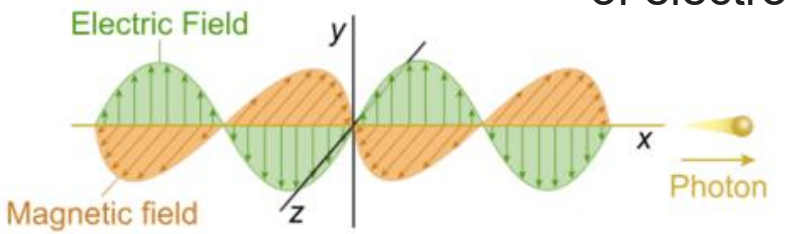
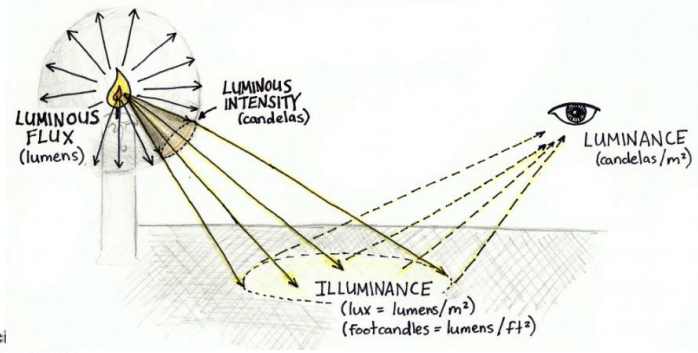
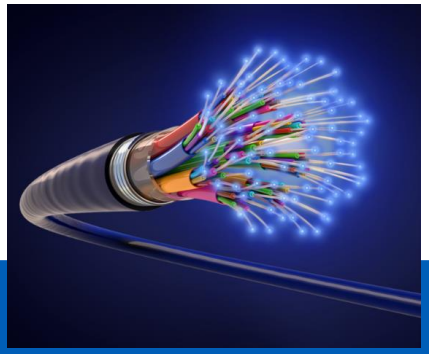
What is Optics?

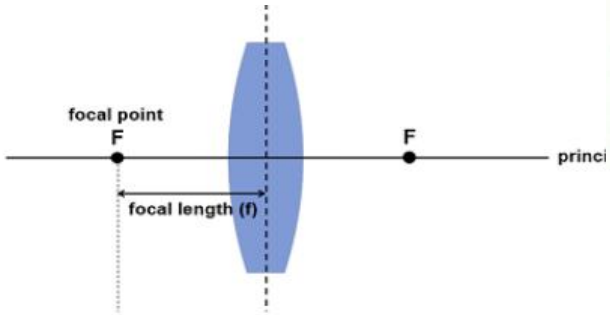


A branch of physics that studies the behaviour and detection of electromagnetic radiation









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?

We're interested in eyes!

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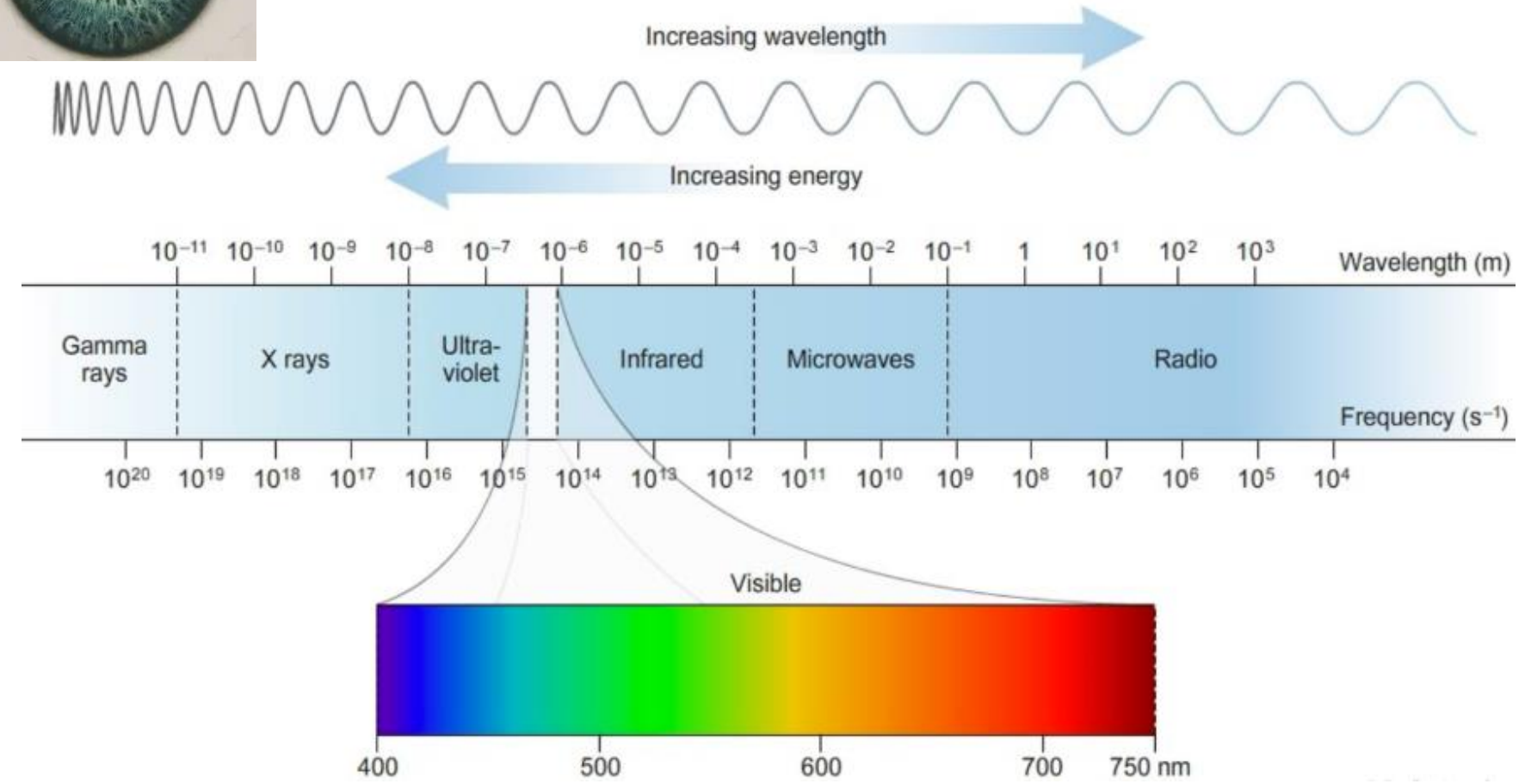
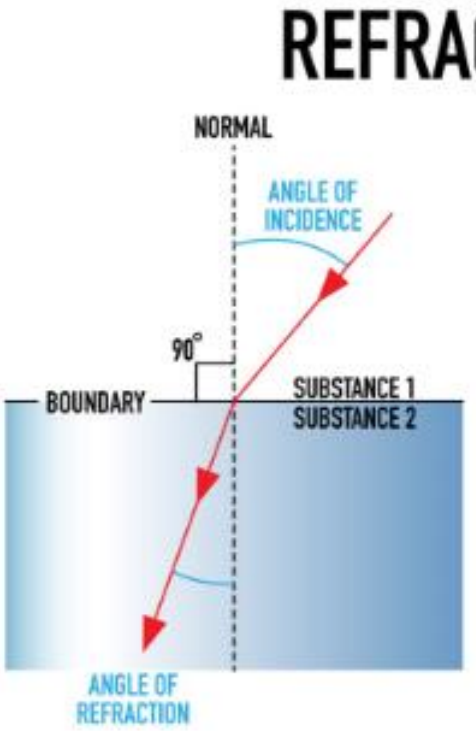


Wavelengths of EMR which are visible to the human eye are form 380nm-780nm. This is what we call white light.

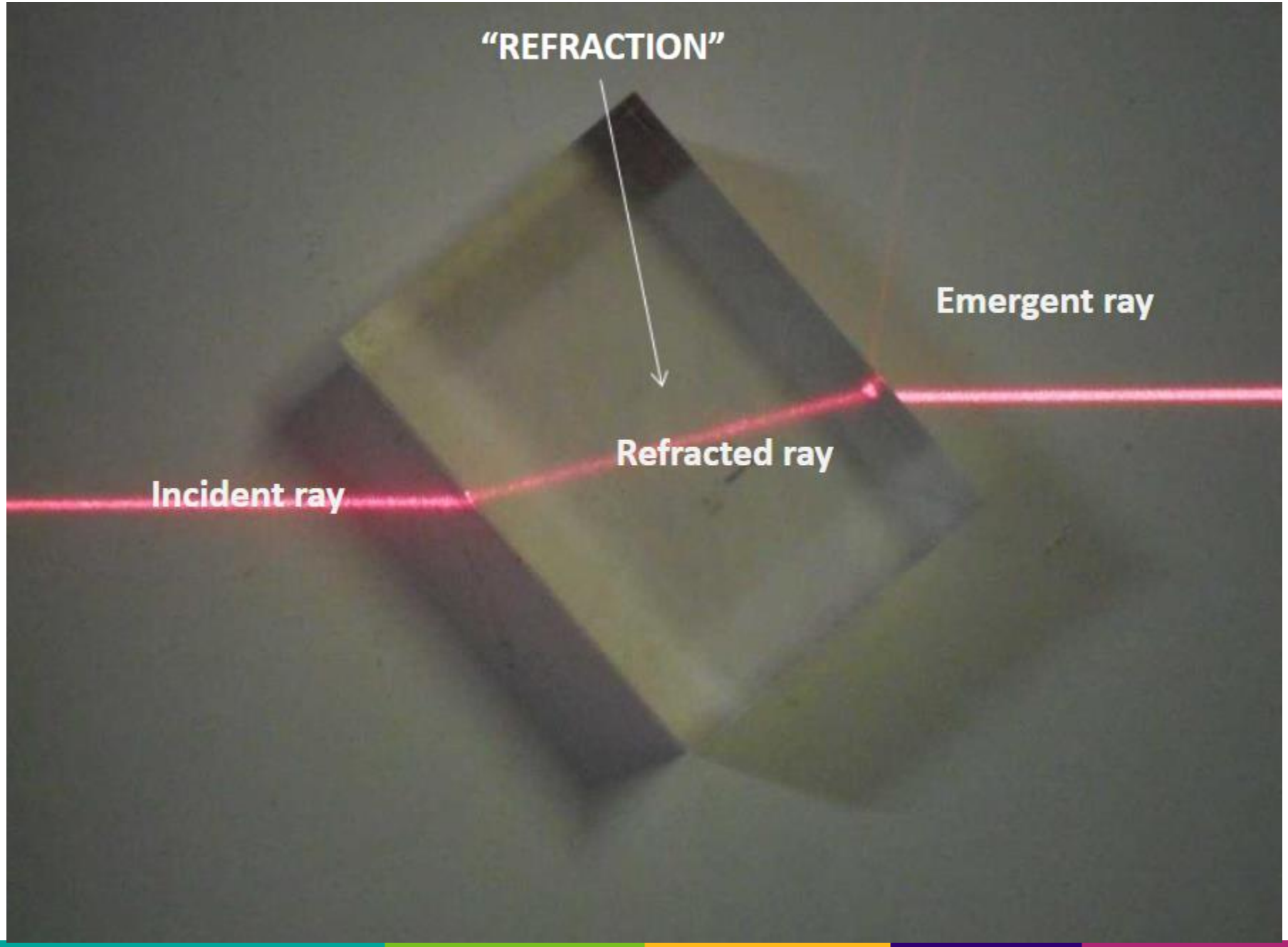
Refraction- is the change in direction of a wave of white light due to a change in its speed.

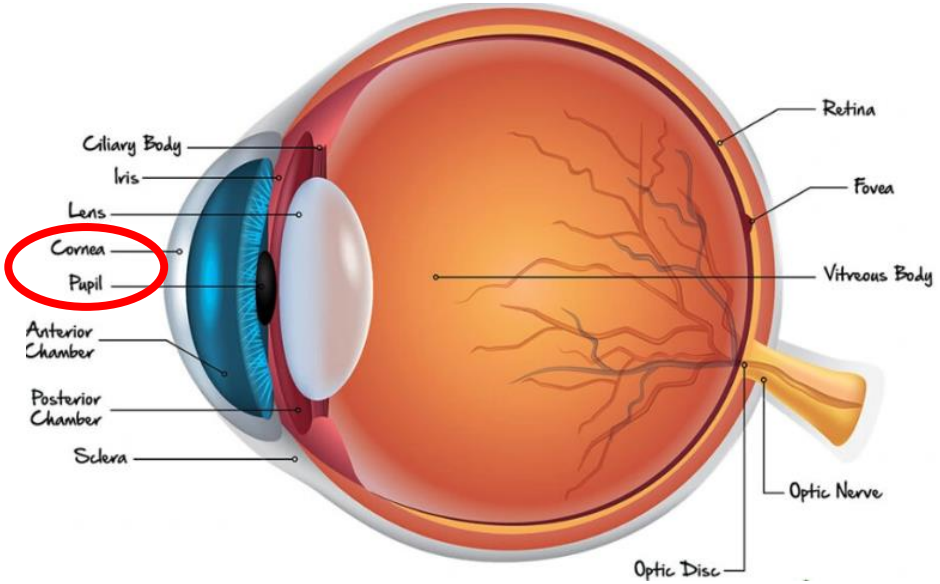


RI air = 1.00
RI water = 1.33

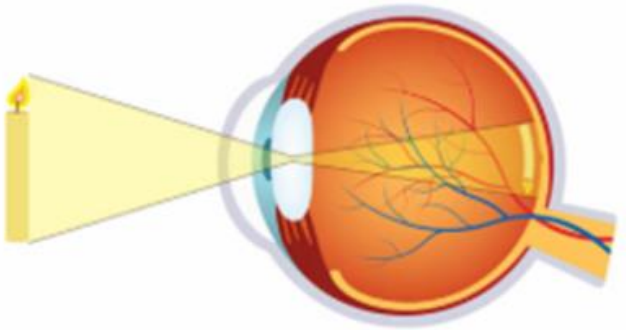
Why does the light change speed in this scenario?

Refractive index: the ratio of velocity of light in a vacuum to its velocity in a specified medium


"REFRACTION"
Emergent ray
Refracted ray
Incident ray



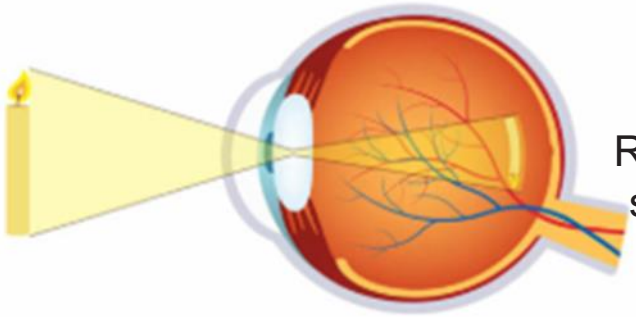
- Cornea- 40-43 dioptres of power accounting for about 2/3 of the eye's optical power
- Lens- 19 dioptres of power when relaxed and up to about 15 dioptres when focusing
- The aqueous and vitreous humour will also have a refractive effect



Emmetropic vision

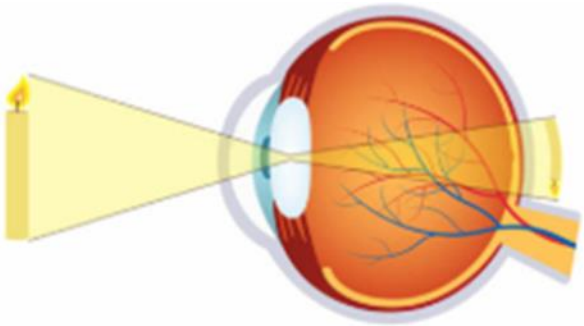
Light is refracted correctly to the fovea providing a clear image. Average AL 23-23.5mm

Refracting medium	Refractive index
Air	1.000
Cornea	1.376
Aqueous humour	1.336
Lens (cortex-core)	1.386-1.406
Vitreous humour	1.336



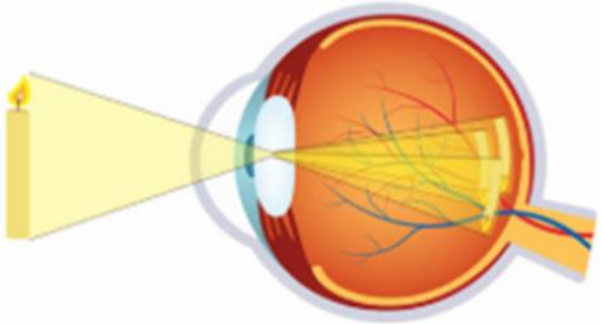
AL over 24mm. Refracted light falls short of the retina resulting in a blurred image

Myopia



AL under 22.5mm. Refracted light falls behind the retina resulting in a blurred image

Hyperopia



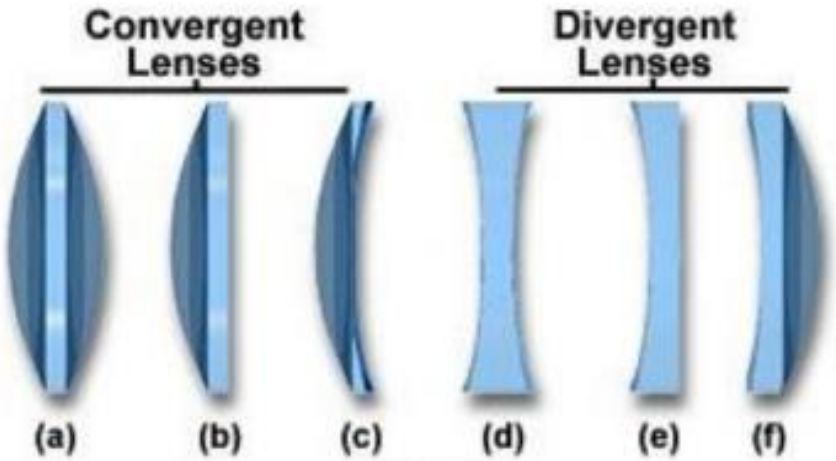
Irregular corneal or lenticular structure causing multiple refractive focal points

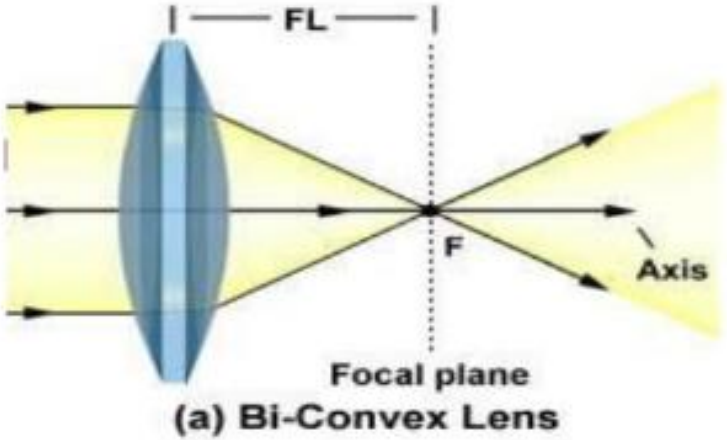
Astigmatism

How do we correct this refractive error?

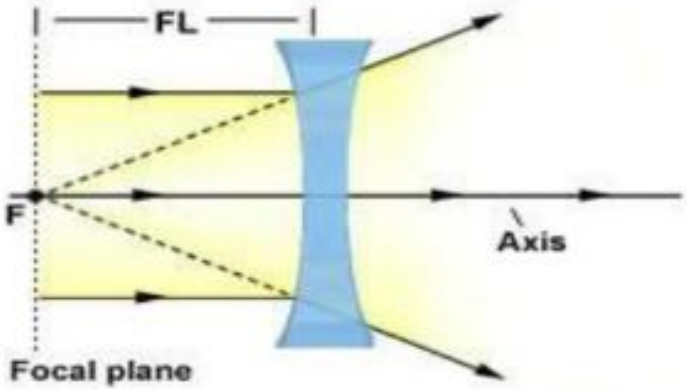
Basic Elements of Optical Systems

LENSES





(a) Bi-Convex Lens



(b) Bi-Concave Lens

A word on prisms…….

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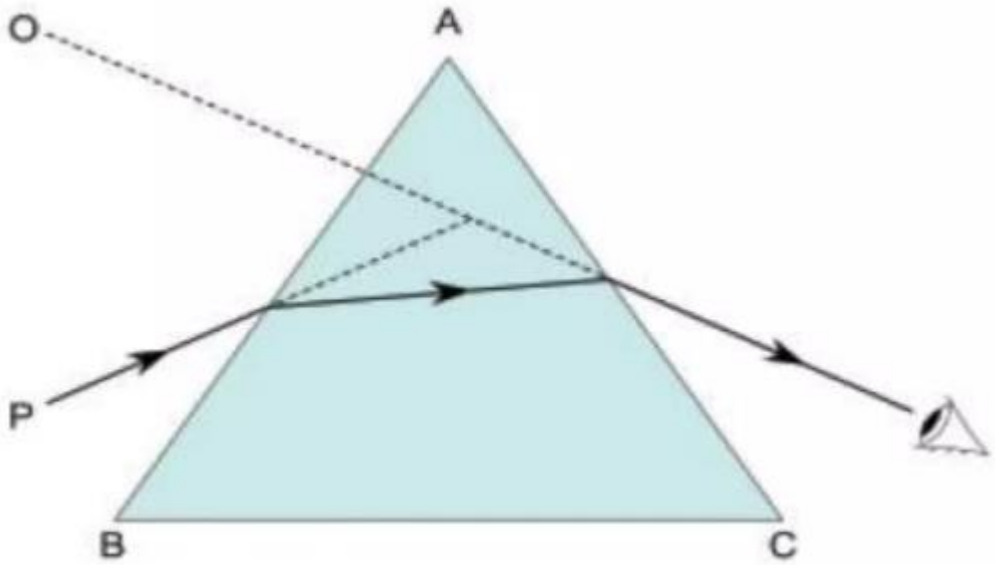
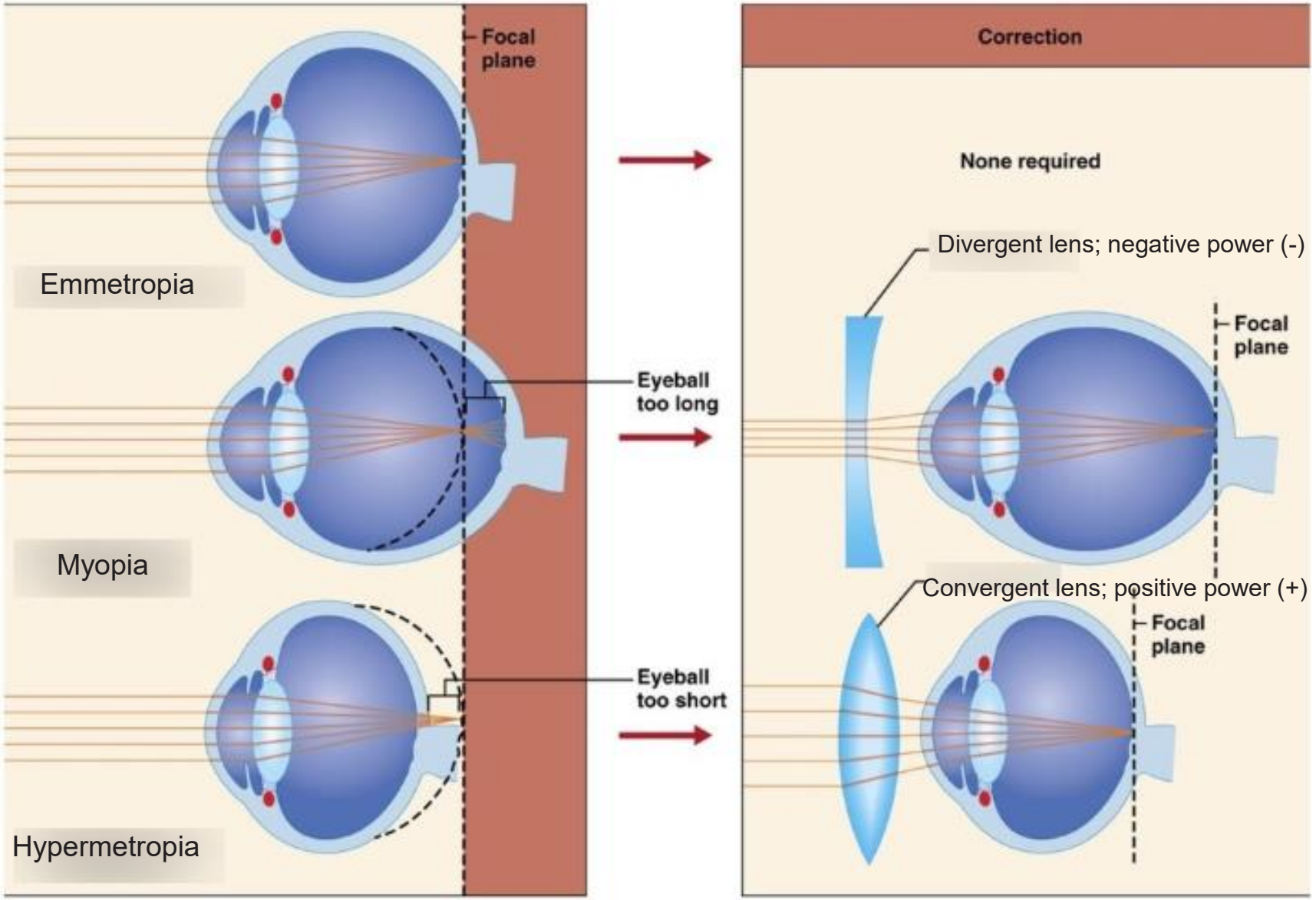
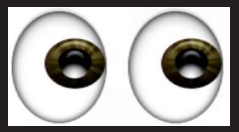


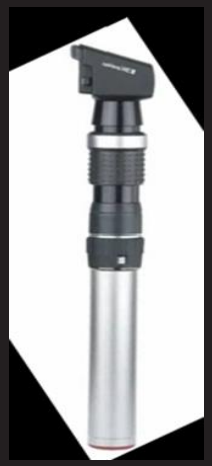
Prisms refract the light towards the base of the prism. This causes the object to be displaced away from the base of the prism towards the apex.

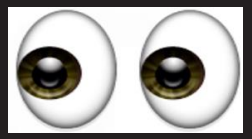

Focal plane
Correction
Emmetropia
None required
Divergent lens; negative power (-)
Eyeball too long
Focal plane
Myopia
Convergent lens; positive power (+)
Focal plane
Eyeball too short
Hypermetropia

Retinoscopy- an objective method for finding refractive error

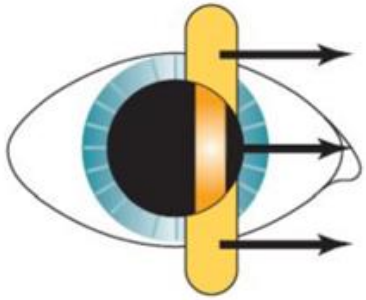
To locate the far point of the eye and bring it to infinity using the appropriate power of lenses



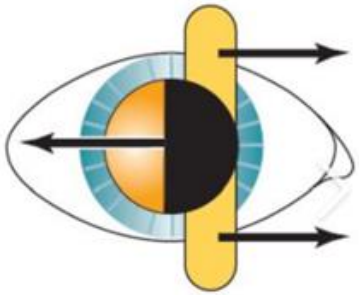




6m or 3m with mirror



With movement



Against movement

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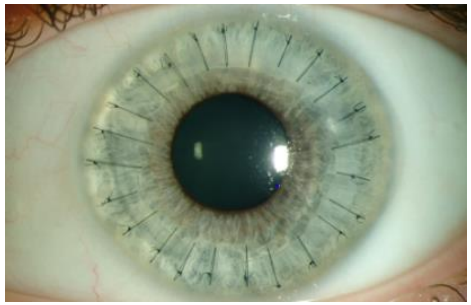
1. If you observe a “with” movement, this is neutralised with PLUS lenses aka hyperopic

2. If you observe an “against” movement, this is neutralised with MINUS lenses aka myopic

3. If you observe no movement, this is NEUTRAL and no lenses are required/you have found the correct prescription

Who do we see?

- Post cataract operation
- Post corneal graft
- Post LASIK/LASEK



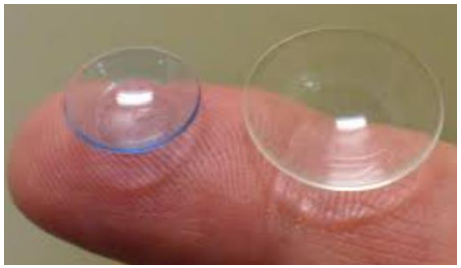
- Emmetropia
- Ametropia

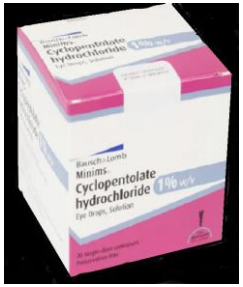
- Myopia
- Hypermetropia
- Astigmatism
- Presbyopia

- Neonates
- Paediatric
- Adult/Elderly

- Cataract
- Sudden drop in vision
- Diabetics
- Keratoconus

- Glasses
- Contact lenses
- Nothing!





Cycloplegic Refraction

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- Refraction using Cyclopentolate Hydrochloride (0.5% or 1%) OR Atropine Sulphate (1%) which causes temporary paralysis of the ciliary body muscles therefore relaxing visual accommodation.
- ***Remember***- the darker the iris, the more time it takes to achieve cycloplegia, so consider use of atropine for dark irises and leave at least 30-45 minutes after instillation to commence refraction.
- Mainly used in children (especially if strabismus or amblyopia is suspected,) latent hyperopes, nonverbal patients or where VA is not as expected.
- This can make the ret reflex trickier to observe due to increased size of pupil and resulting aberrations—look to the centre of the pupil for the most accurate reflex

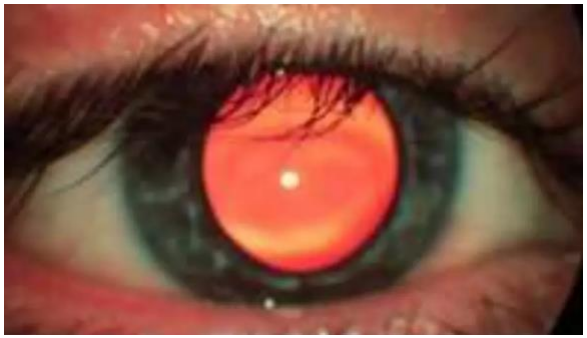
Considerations for paediatric prescribing

1. Frame choice and fit is ***IMPORTANT***

2. Ensure correct IPD is taken- and don't forget, children grow!

3. Do we prescribe the full amount of prescription found on cycloplegic refraction?

Well- that depends on who you ask and which paper you read.
There is a thought amongst some practitioners that you should adjust your ret finding to allow for tonic accommodation- however there is a thought amongst others that you should prescribe the full amount of cyclo ret found.



Cataract:

- Dim/slow reflex
- Ret reflex may not be visible

High refractive error:

- Dim/slow reflex
- Ret reflex may not be visible

Scissor Reflex:

- Irregular Astigmatism (Keratoconus)
- Corneal Opacity
- Tilted lens
- scissoring reflex #medicals #eye #optometrists #opthalmology #refractive #shorts #refractive - YouTube

Thanks for listening!

Any questions?