

Optics and Refraction

lens

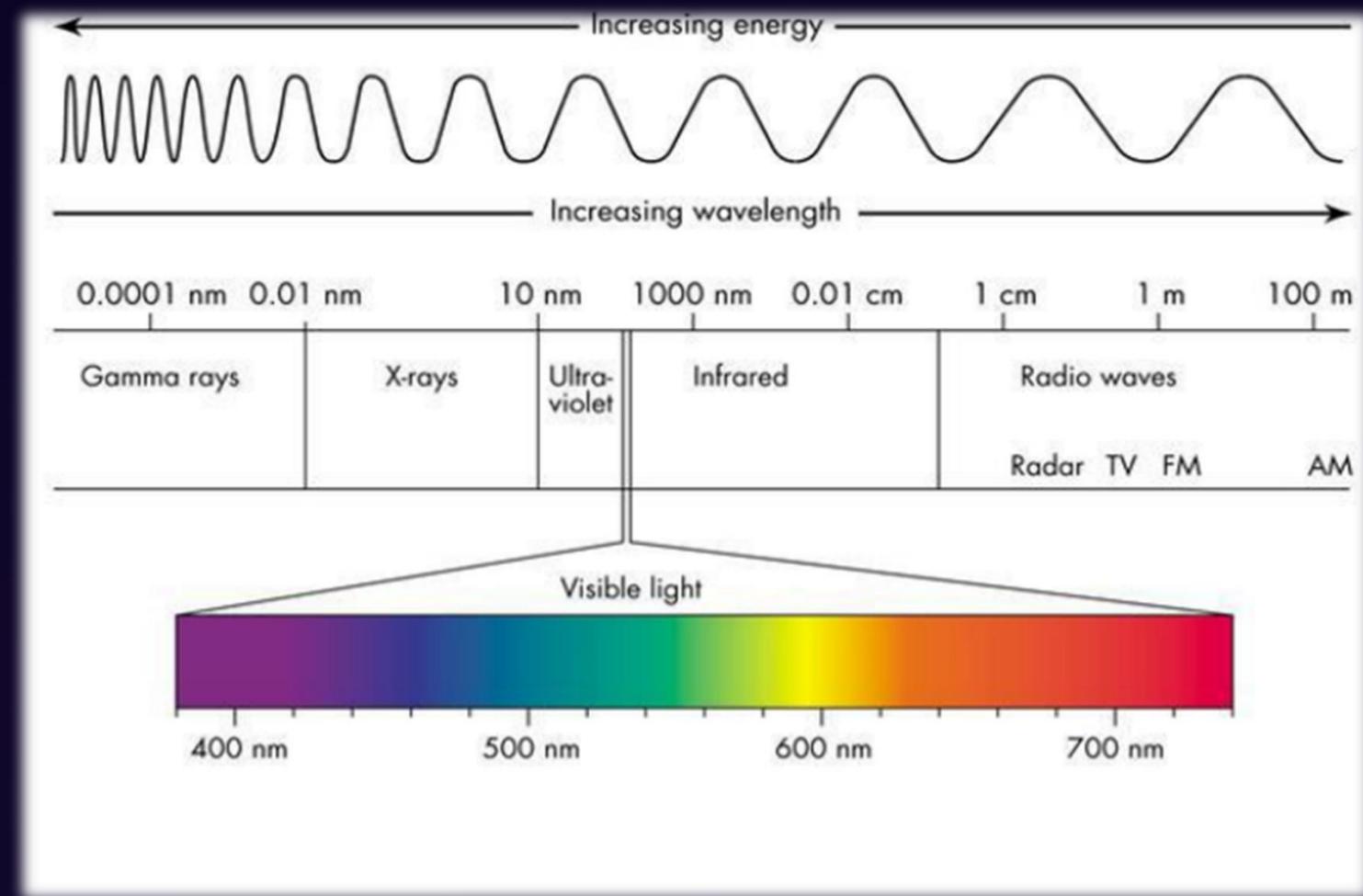
CORNEA
LENS

Presented by :

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Wesam Alqatawneh**

LIGHT

- **Light** can be defined as that part of the electromagnetic spectrum to which the retina is sensitive.
- The visible part of the spectrum lies between the wavebands **390 nm and 760 nm**.



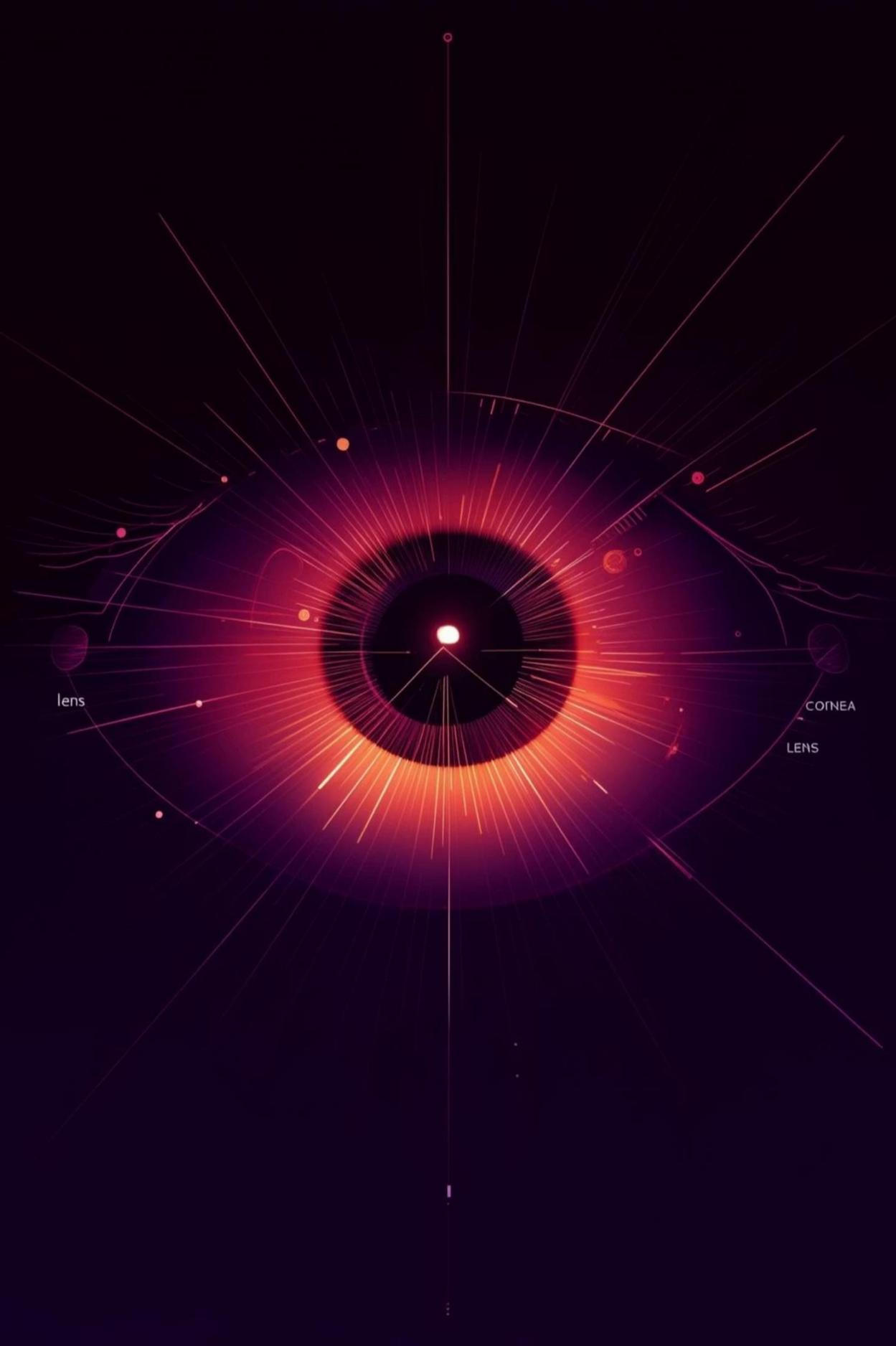
- For the eye to generate accurate visual information, light must be correctly focused on the retina.
- The focus must be adjustable to allow equally clear vision of near and distant objects.
- The **cornea**, or actually the air/tear interface is responsible for **two-thirds** of the focusing power of the eye, and the **crystalline lens** for **one-third**.

LIGHT

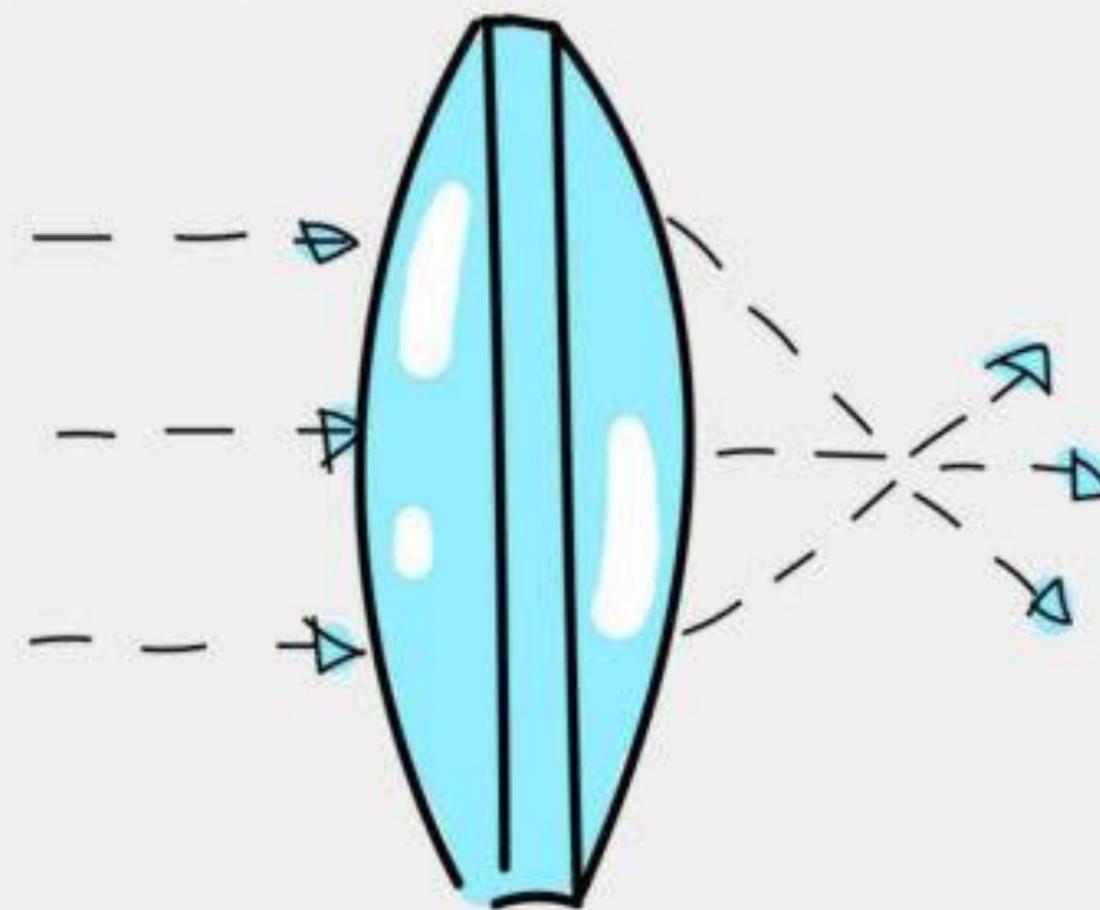
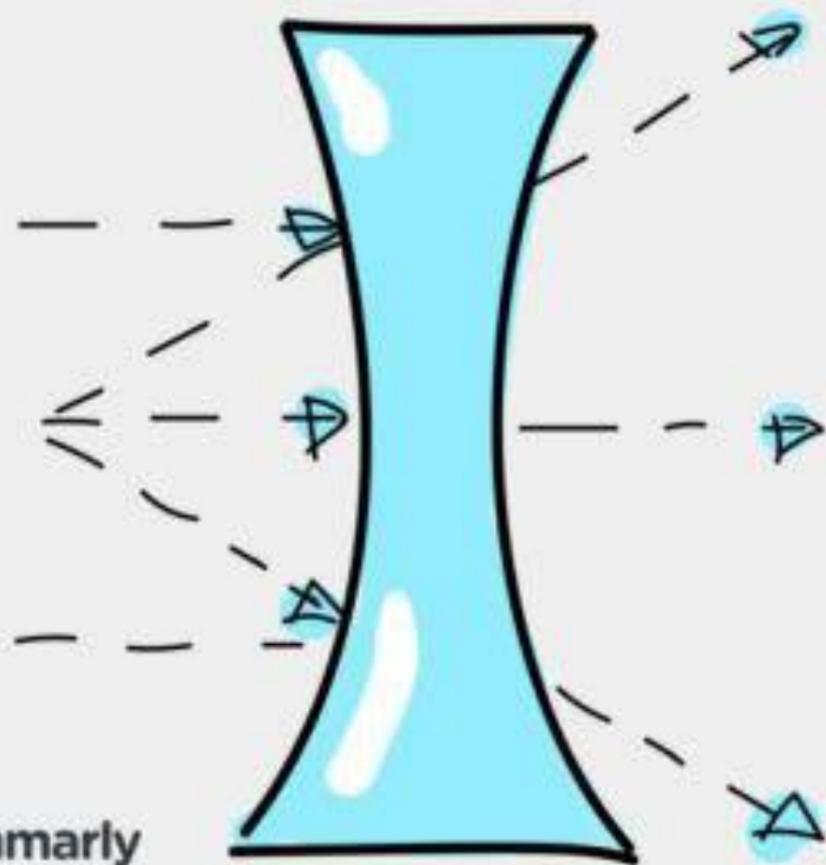
These two refracting elements in the eye converge the rays of light because:

- The refracting surfaces of the cornea and lens are **spherically convex**.
- The cornea has a **higher refractive index** than air. The lens has a **higher refractive index** than the aqueous and vitreous humor that surround it. The velocity of light is reduced in a dense medium so that light is refracted towards the normal.

So when passing from the air to the cornea, or from the aqueous to the lens, the rays therefore converge.

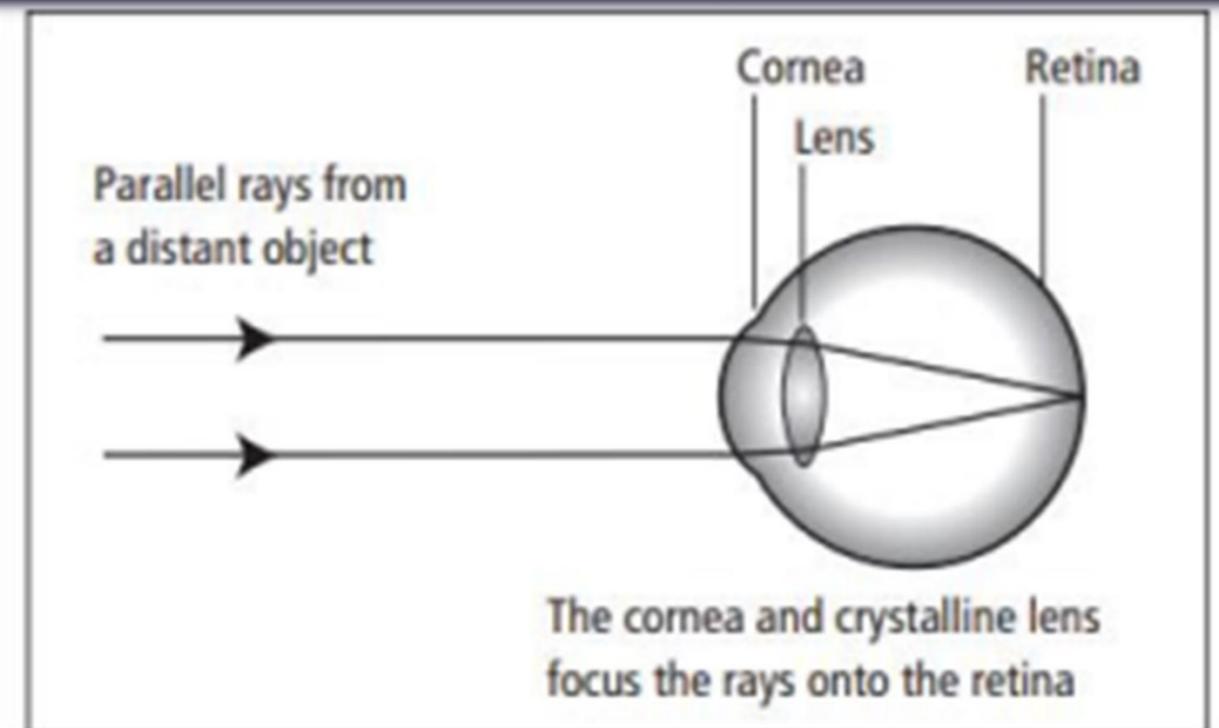
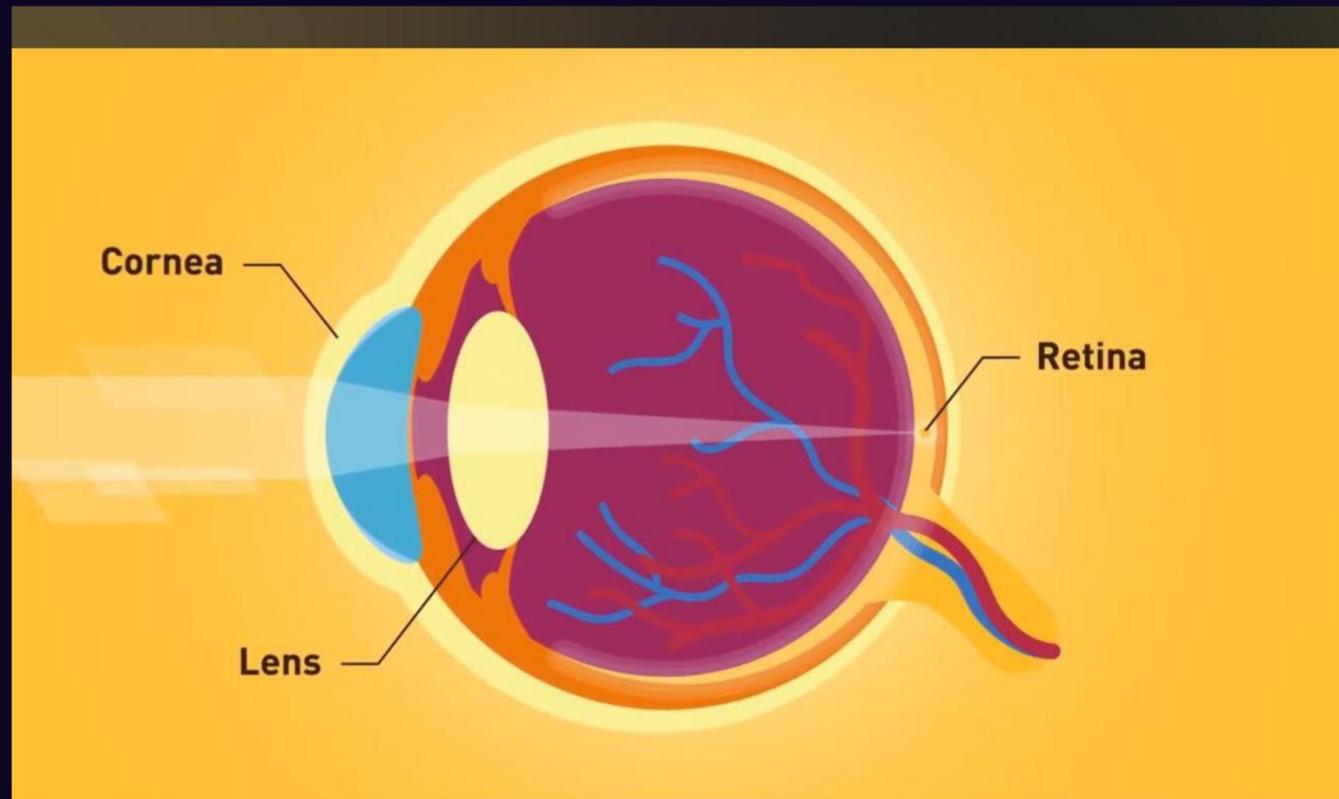


CONCAVE VS. CONVEX



EMMETROPIA

- In the Emmetropic (**normally refracted**) eye, entering light rays are focused on the retina by the cornea and the lens, creating a sharp image that is transmitted to the brain.
- Such an individual can see sharply in the distance without accommodation. So it's the optically perfect eye, that requires no correction for a distance



AMETROPIA / REFRACTIVE ERROR

① In **Ammetropia** (the presence of **refractive error**), the eye is unable to converge parallel rays from infinity directly to the retina without the aid of the elastic lens so a change in refraction is required to achieve sharp vision.

- Refractive errors are failure of the eye to focus images sharply on the retina, causing blurred vision

Ametropia may be divided into:

1-Myopia

(near-sightedness)

2-Hyperopia

(far-sightedness)

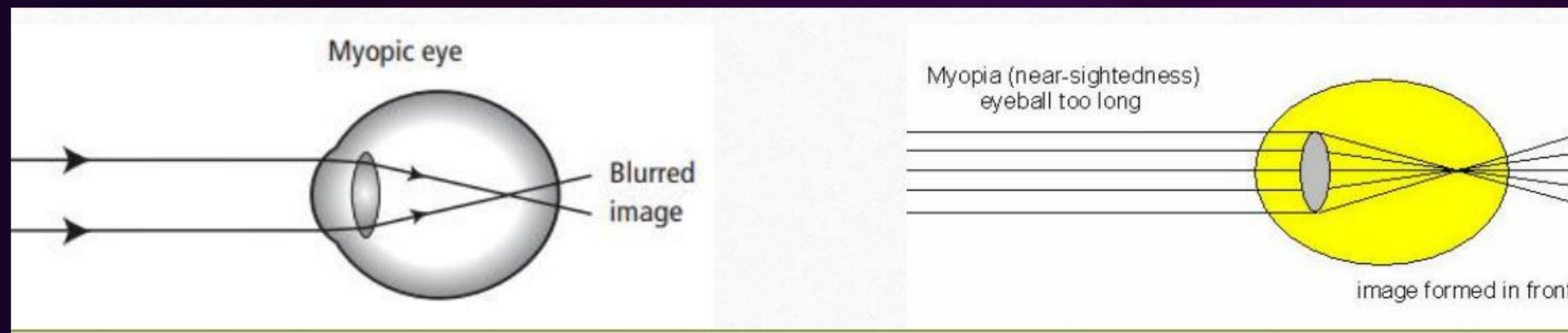
3-Astigmatism

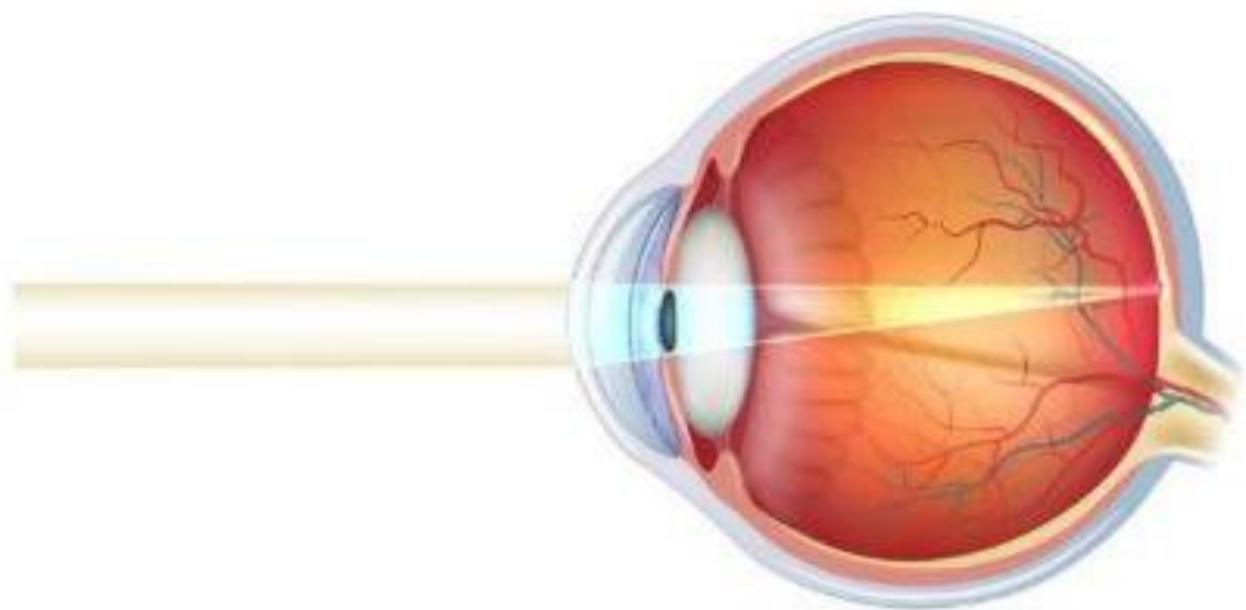
MYOPIA

In **myopia (nearsightedness)**, the point of focus is **in front** of the retina because the cornea is **too steeply curved**, the axial length of the eye is **too long**, or both.

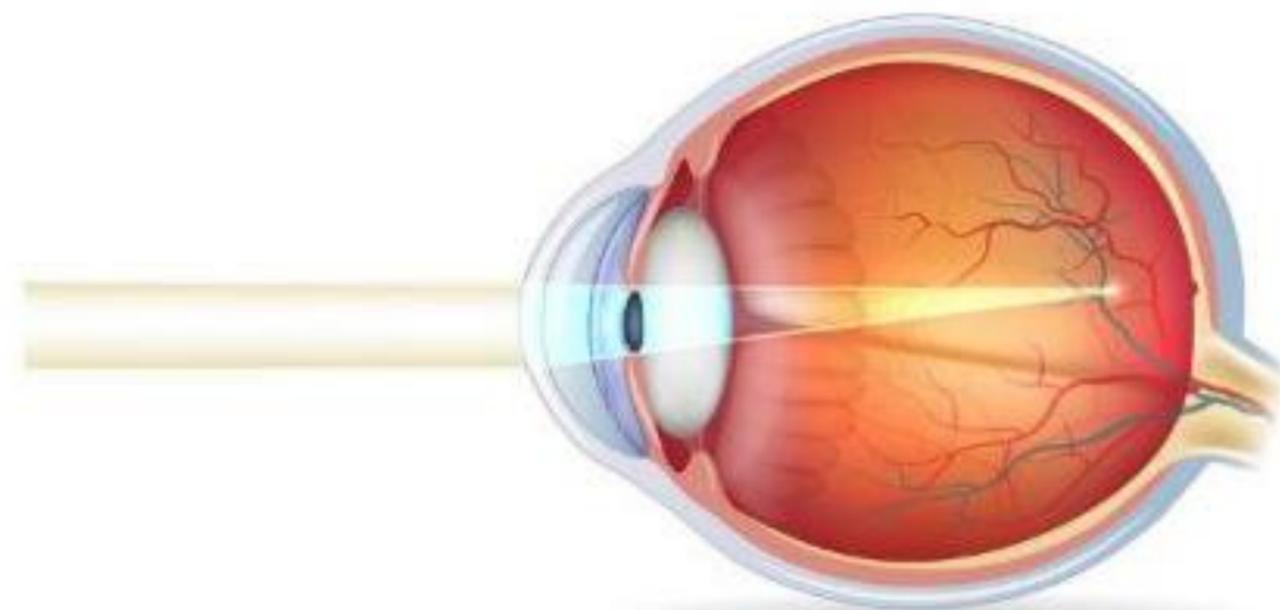
Distant objects are blurred, but near objects can be seen clearly.

To correct myopia, a **concave lens is used. (they are minus or divergent.)**





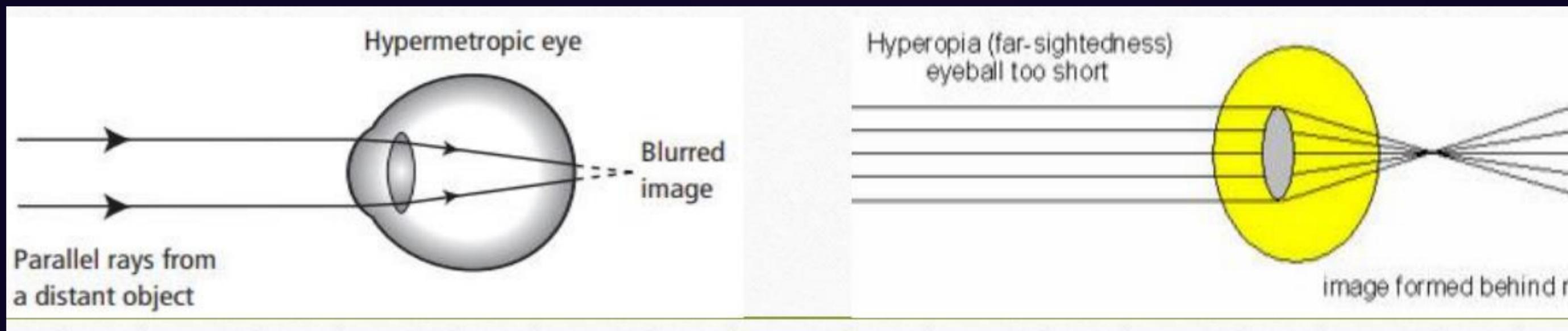
NORMAL VISION

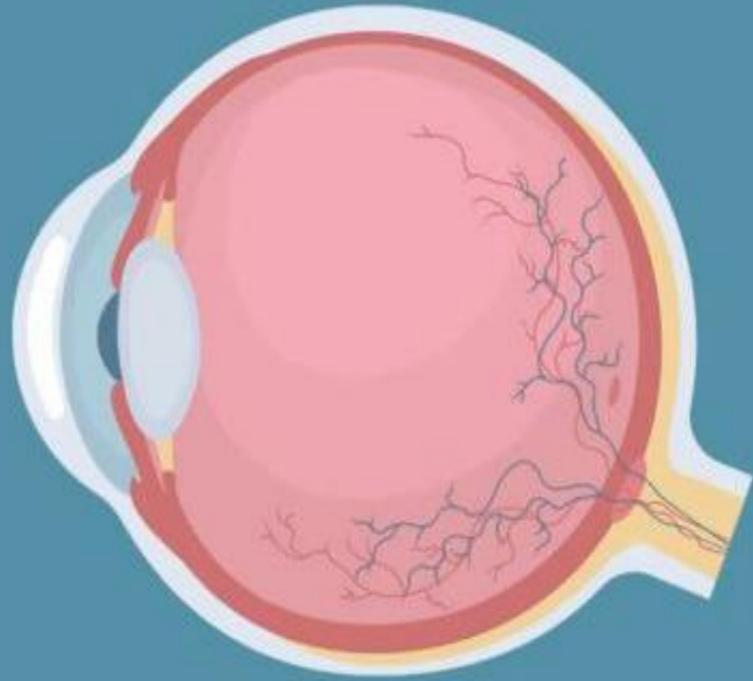


MYOPIA

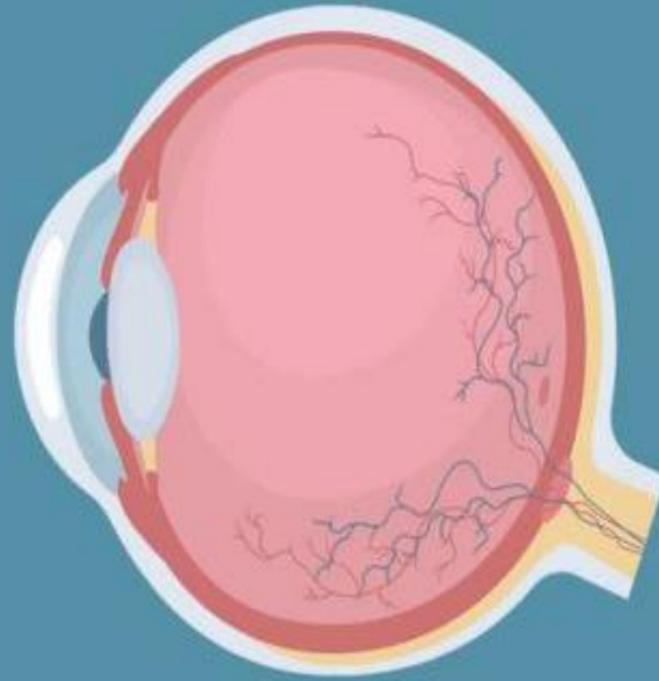
HYPEROPIA

- In hyperopia (**farsightedness**), the point of focus **is behind** the retina because the cornea is **too flatly curved**, the axial length is **too short**, or both.
- In adults, both near and distant objects are blurred.
- To correct hyperopia, a convex lens is used. (they are plus or convergent.)

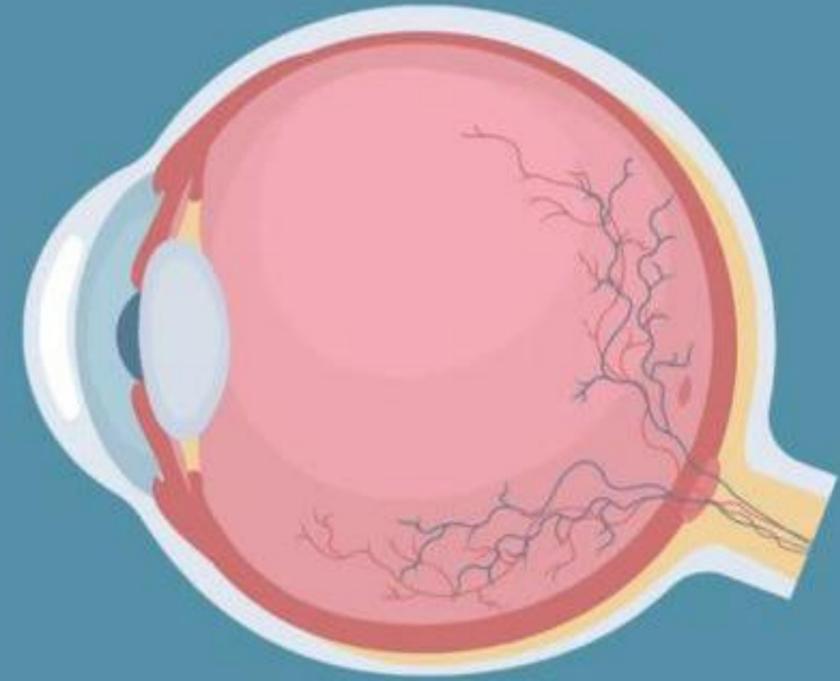




Normal Eye



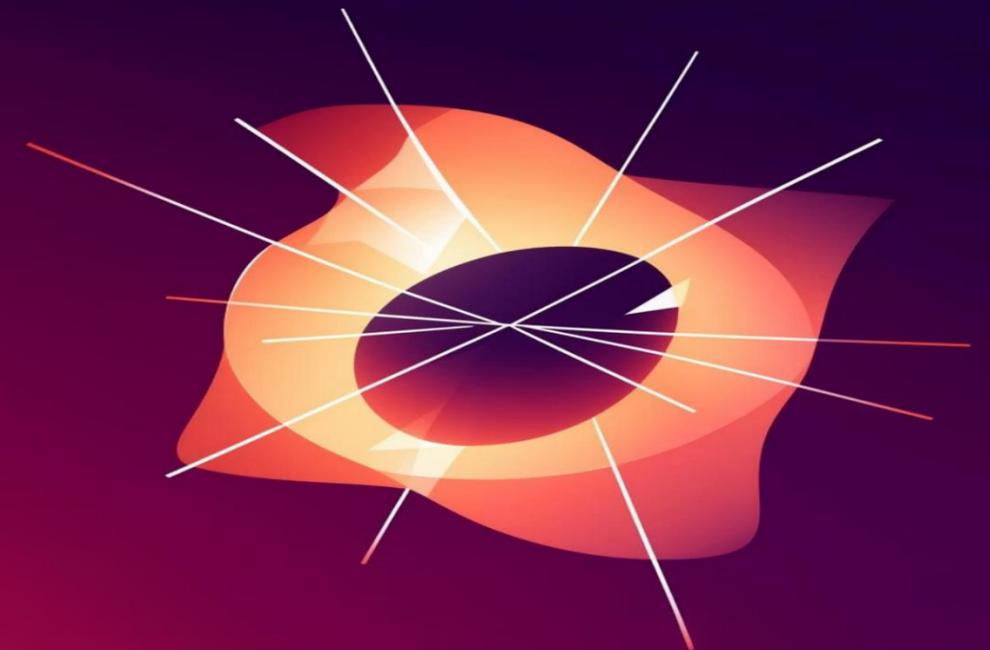
Hyperopic Eye

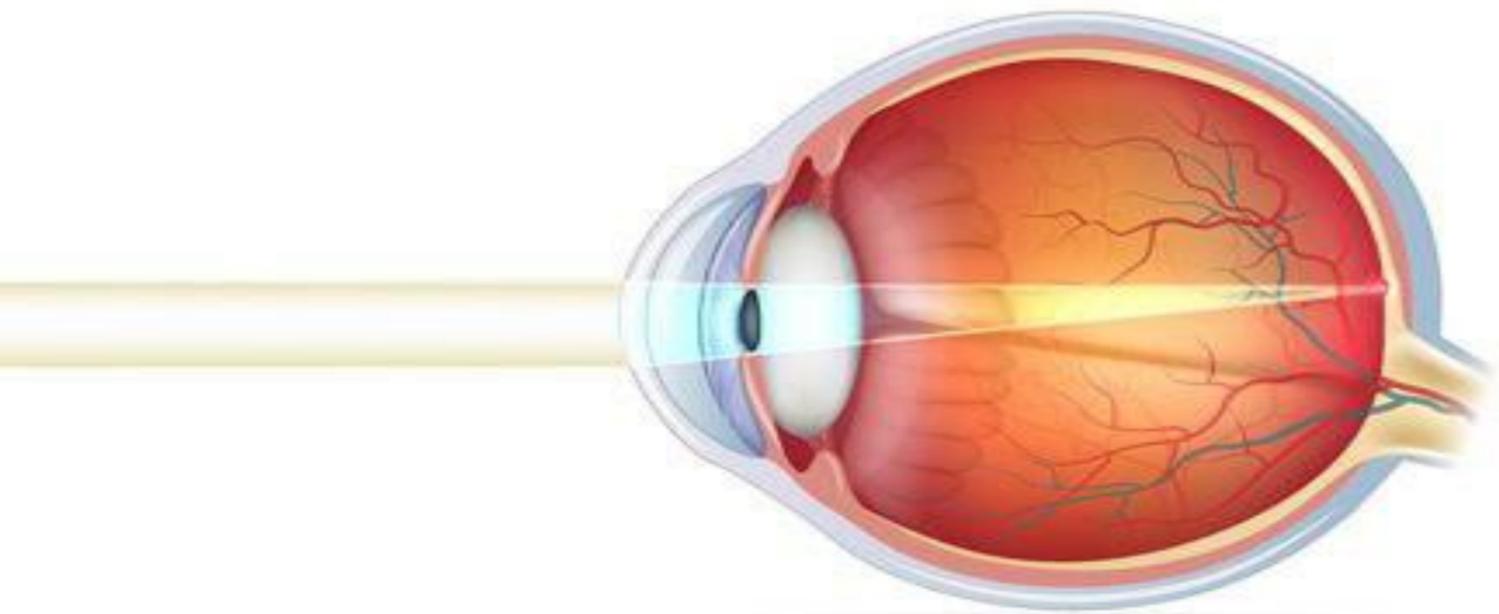


Myopic Eye

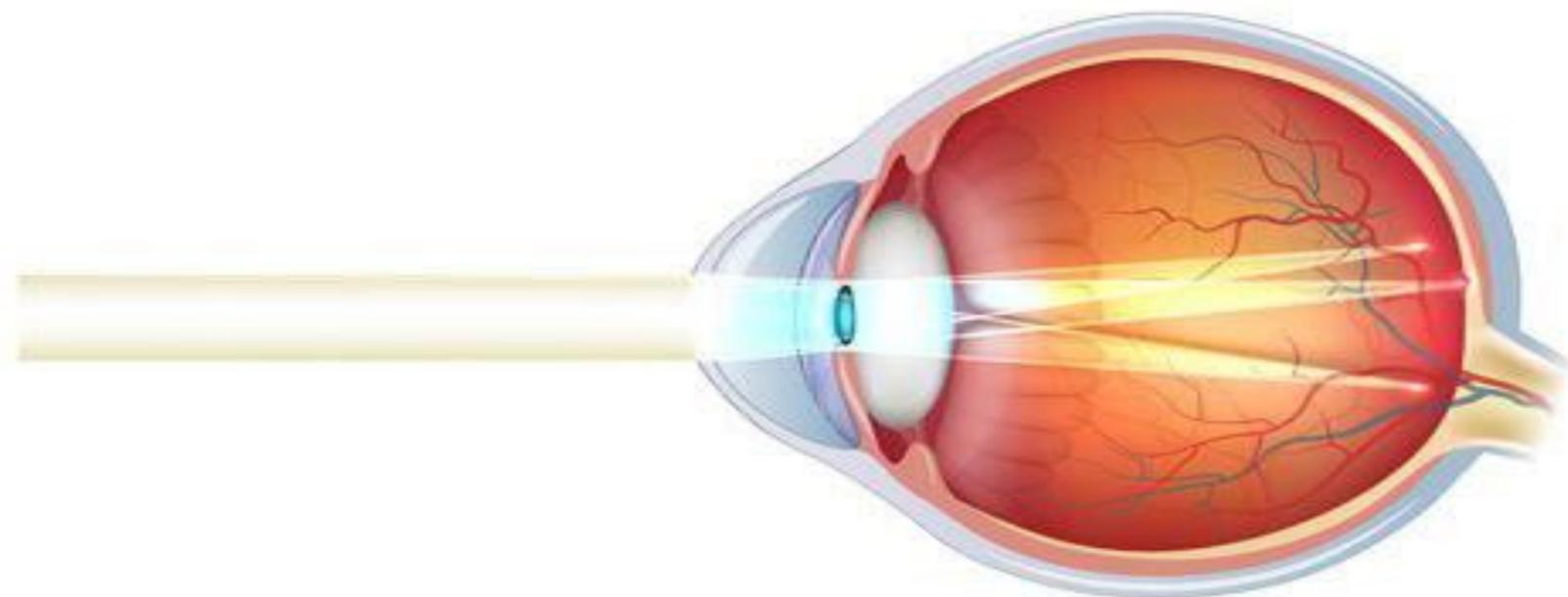
ASTIGMATISM

- In **astigmatism**, the cornea or lens has a **non-spherical** (variable) curvature. This causes light rays of different orientations (e.g., vertical, oblique, horizontal) to **focus at multiple points**, not a single one, on the retina.
- To correct astigmatism, a **cylindrical lens** is used. These lenses have no refractive power along one axis, but are concave or convex along the perpendicular axis, helping to bring light rays to a single focal point.



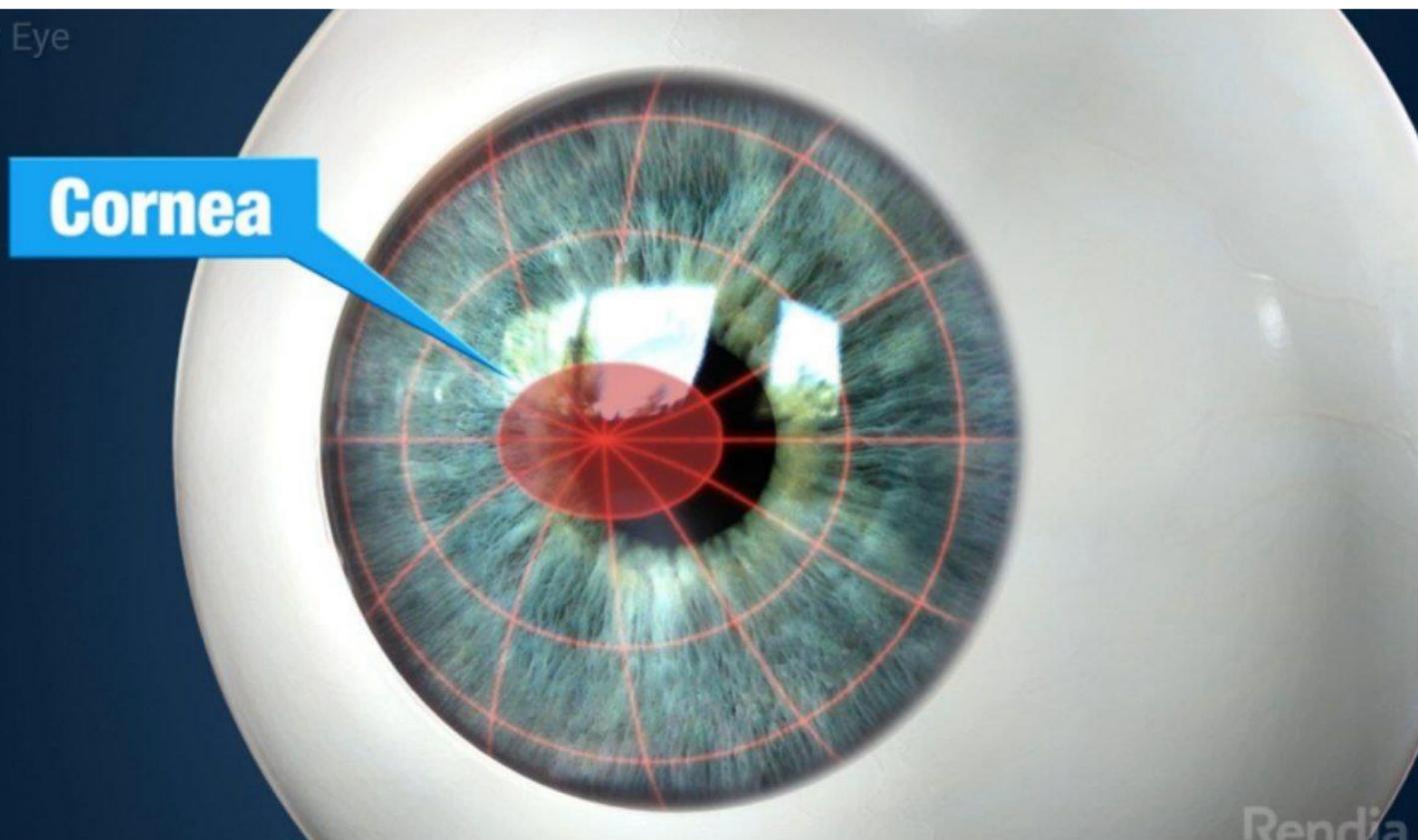


NORMAL VISION

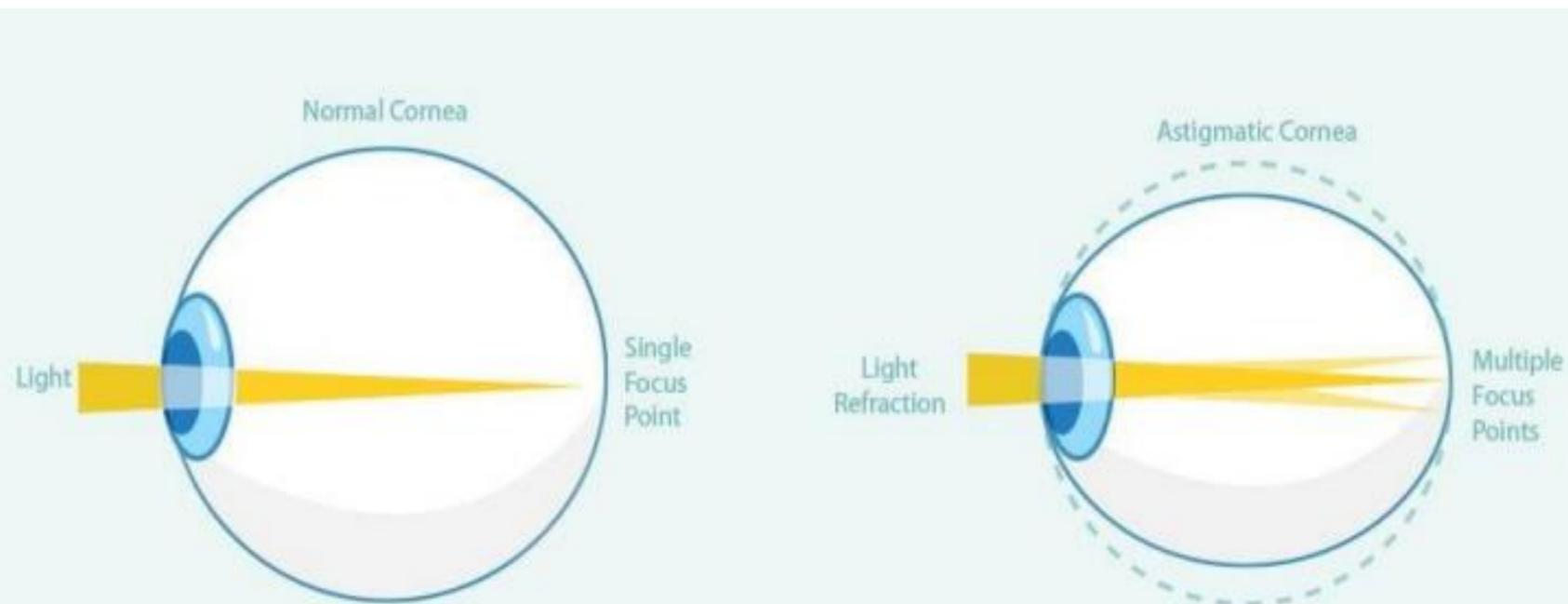


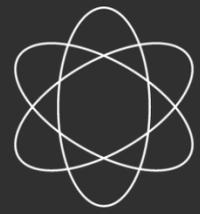
ASTIGMATISM

Exeter Eye



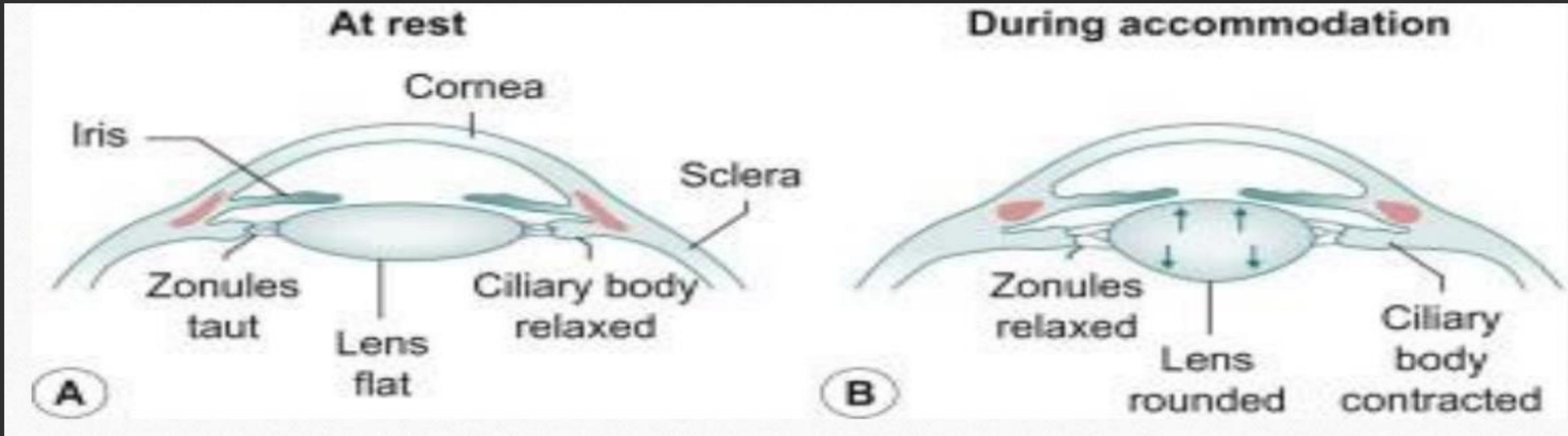
Rendia

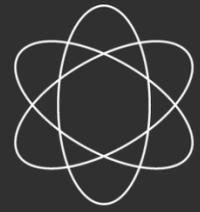




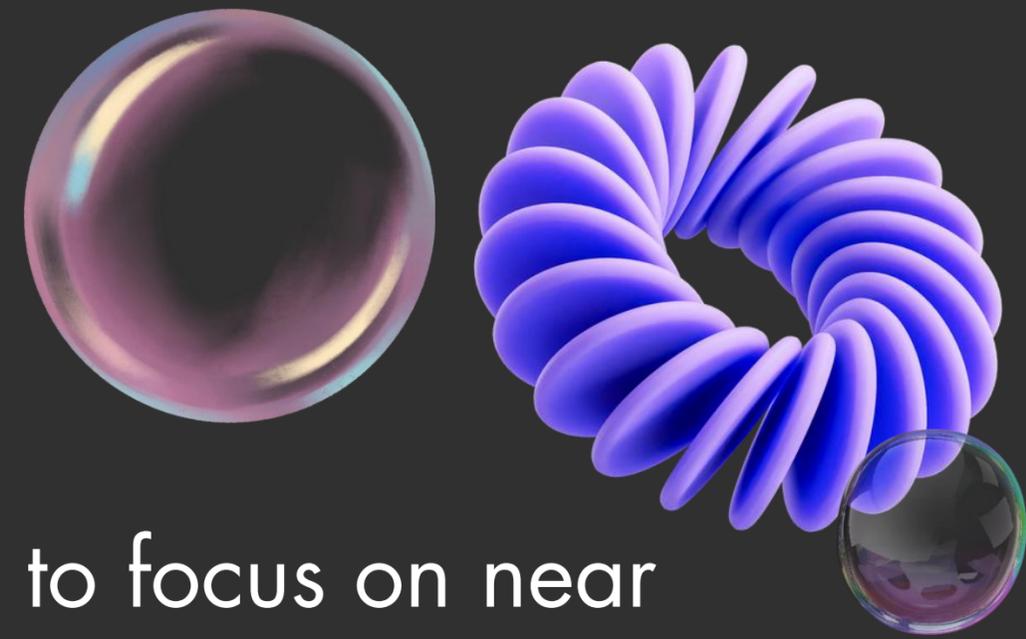
Accommodation & Presbyopia

Accommodation : increase in the power of the eye as an object is brought nearer to the eye .





Presbyopia



Presbyopia is loss of the lens' ability to change shape to focus on near objects due to aging.

Typically, presbyopia becomes noticeable by the time a person reaches the early or mid 40s.

A convex (plus) lens is used for correction when viewing near objects.

- These lenses may be supplied as separate glasses or built into a lens as bifocals or variable focus lenses
- Occurs earlier in hypermetropes





Treatment

Treatment with adding convex lenses

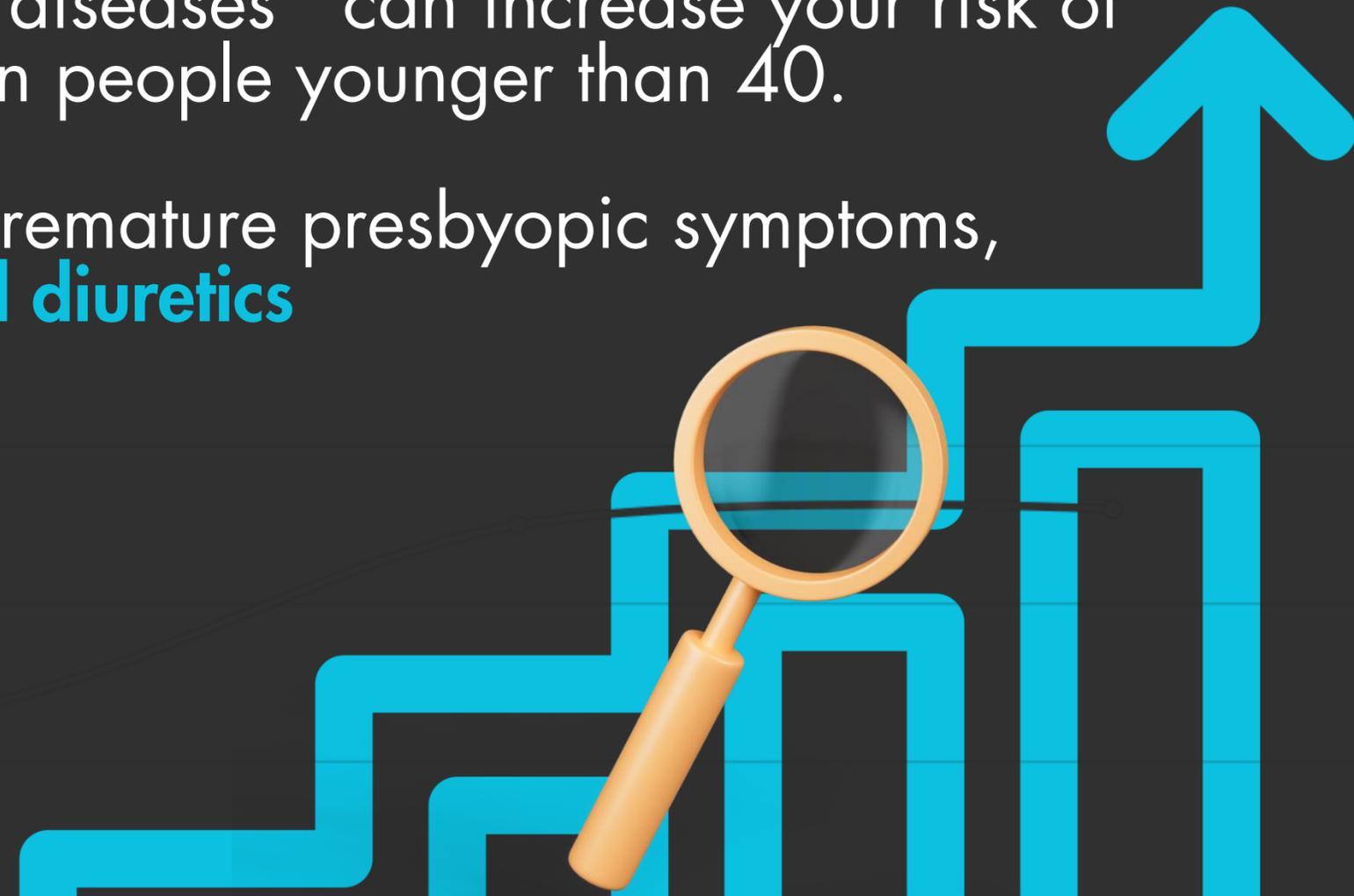
- Forms of correction:

- 1-Separate pairs
- 2-Bifocals
- 3-Multyfocals



Risk factors

- **Age.** Age is the greatest risk factor for presbyopia. Almost everyone experiences some degree of presbyopia after **age 40**.
- **Other medical conditions.** Being farsighted or having certain diseases such as diabetes, multiple sclerosis or cardiovascular diseases can increase your risk of **premature presbyopia**, which is presbyopia in people younger than 40.
- **Drugs.** Certain drugs are associated with premature presbyopic symptoms, including **antidepressants, antihistamines and diuretics**





Optical correction after cataract extraction

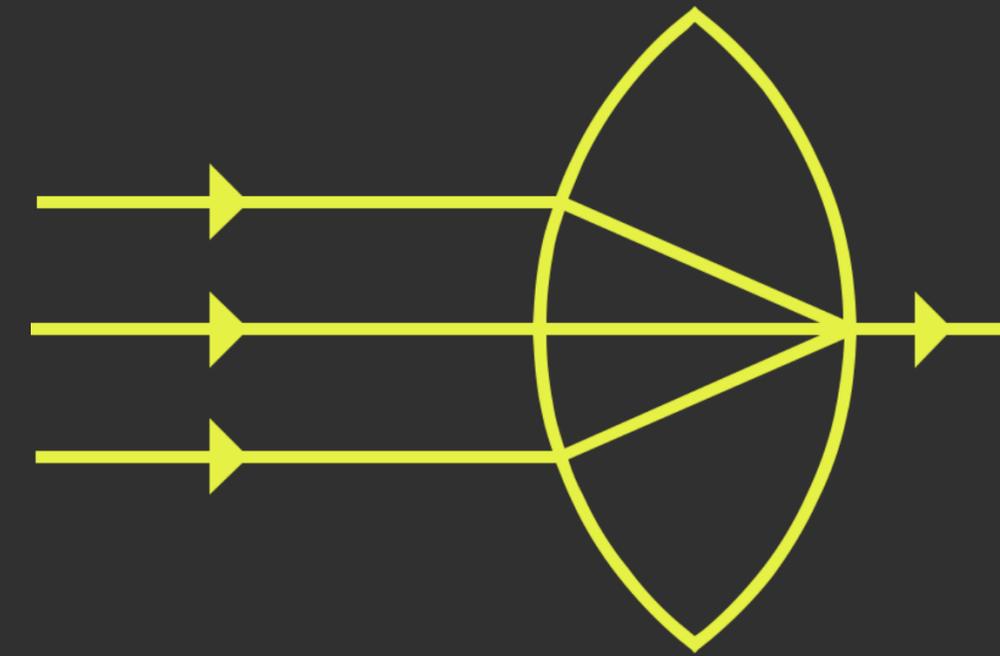


Aphakia = extreme **hypermetropia**

Corrections:

- Aphakic glasses (133% magnification)
- Contact lenses (110%)
- IOL implants (103%) → pseudophakia

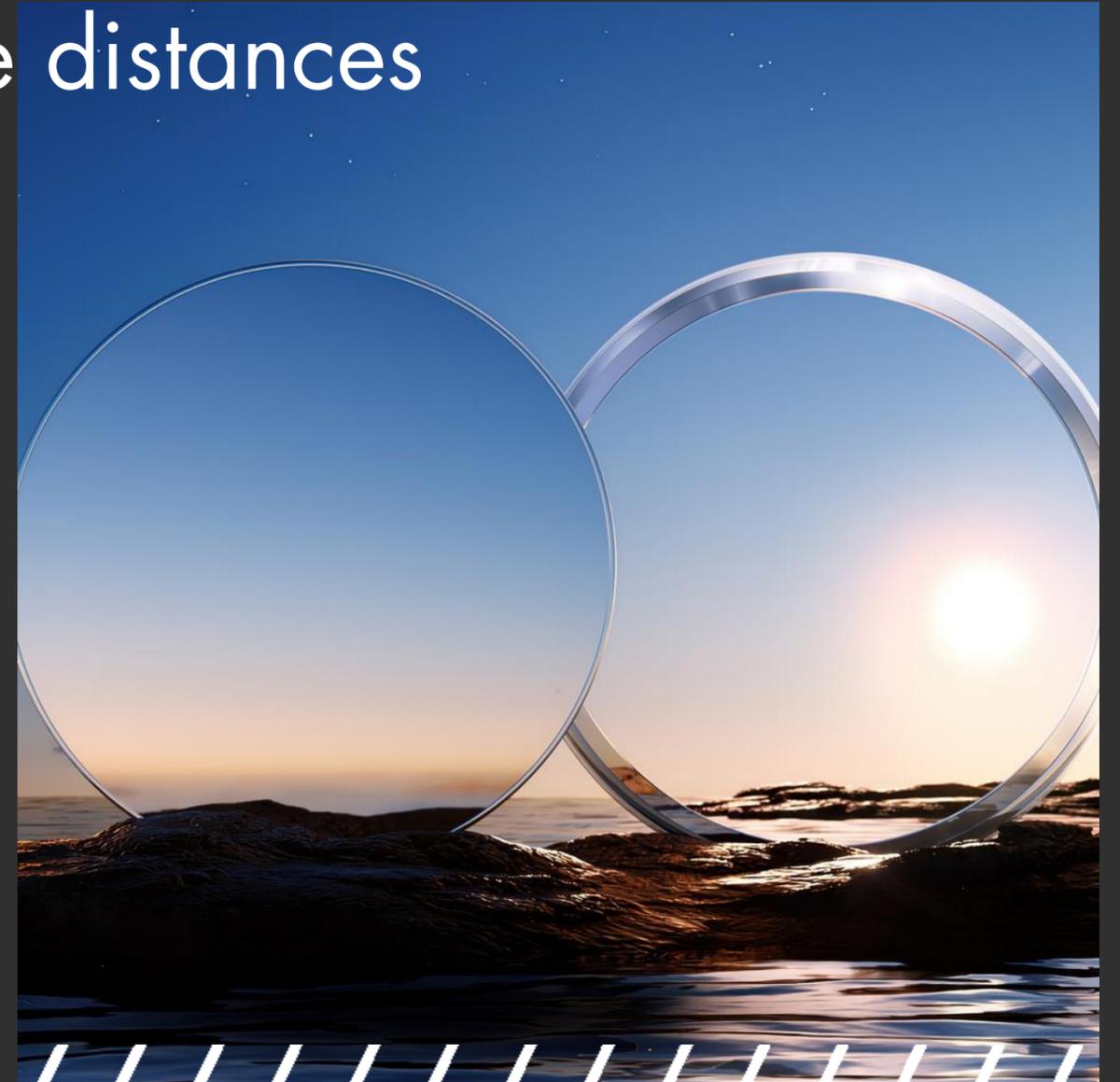
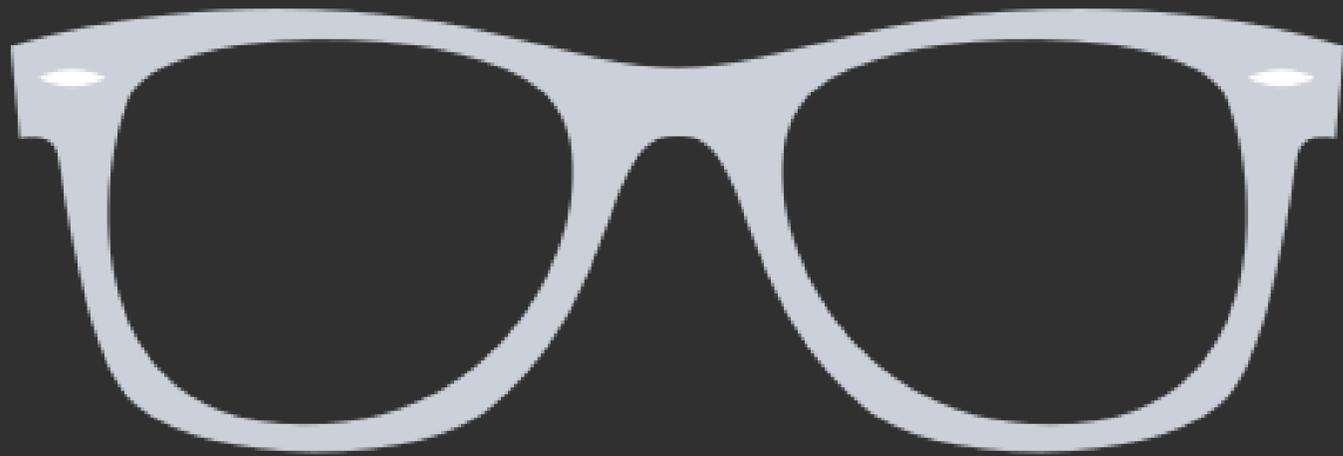
- When the eye has an inserted IOL it is said to be PSEUDOPHAKIC

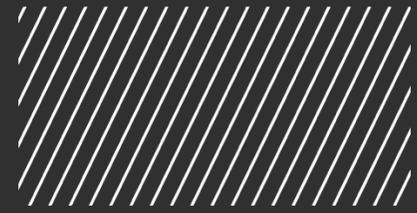




Aphakic spectacle disadvantages

- Image magnification 133% misjudge distances
- Aniseikonia
- Double vision
- Image distortion

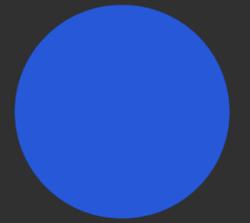
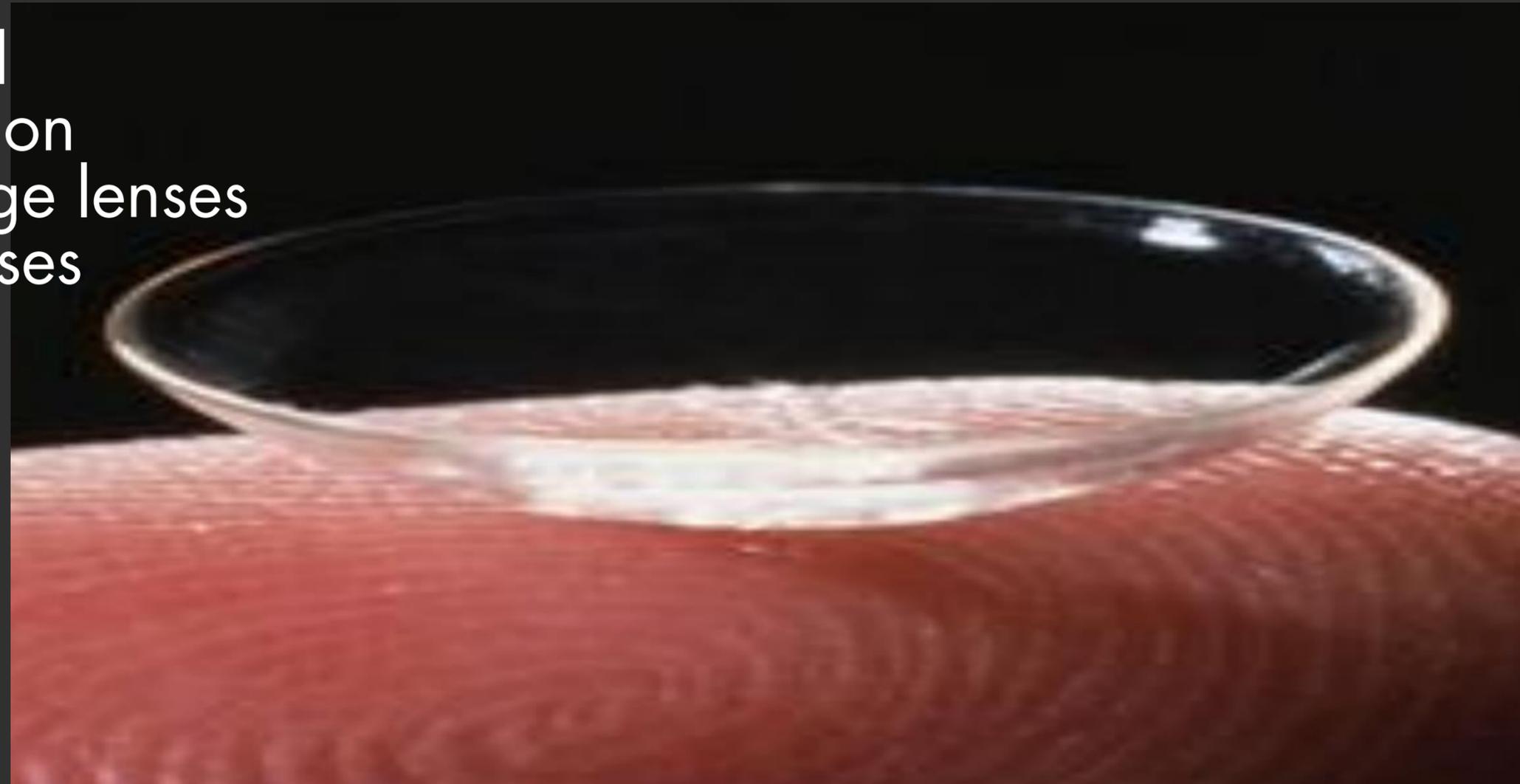




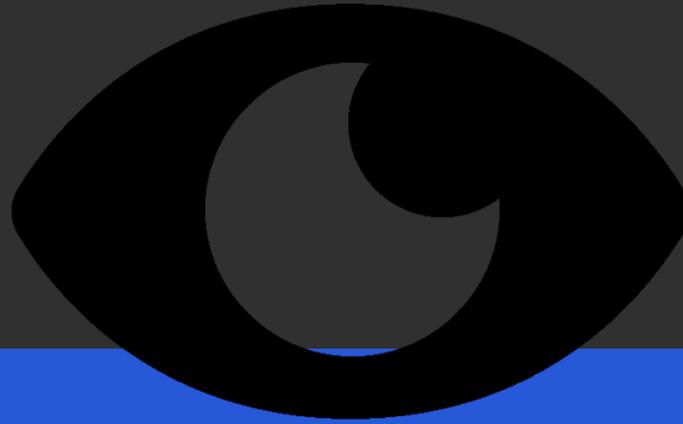
Contact lenses

Uses:

1. Optical correction
2. Bandage lenses
3. Cosmeses



Types



Rigid Gas Permeable

rigid

(gas permeable)



Soft Contact Lens

soft

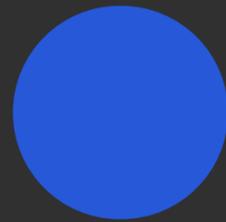
(hydrophilic)



soft-perm

- Neither rigid nor soft contact lenses offer the eyes the protection against blunt or sharp injury that **eyeglasses** **do**

Contact lenses



Care and Complications :

Advantages of **Rigid gas-perm** over soft:

Greater oxygen permeability

Easier cleaning

Less infection

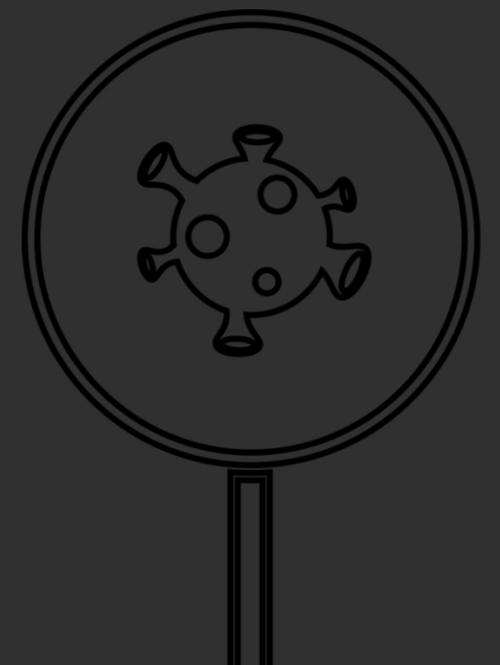
Less proteinaceous debris

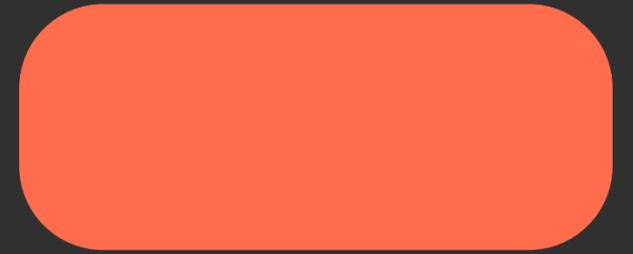
Correction of high astigmatism

Instructions for hygiene and handling lenses must be strictly observed.

Poor contact lens hygiene may lead to infection of the cornea or persistent inflammation.

Contact lenses occasionally cause painless superficial corneal changes





Keratoconus



disease

an uncommon corneal disorder where the central or paracentral cornea undergoes progressive thinning and steepening causing irregular astigmatism

Treatment options include:

1. Spectacles
2. CL
3. PKP (Penetrating KeratoPlasty)
4. INTACS (intrastromal corneal ring segment

