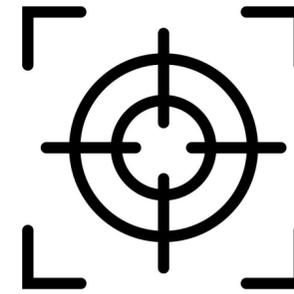




Topic 12: Human Eye

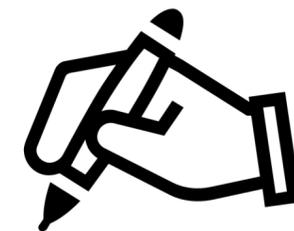


Chapter Analysis



FOCUS

- one of the three chapters under umbrella topic of Co-ordination and Response in Humans
- Linked to nervous system



EXAM

- commonly tested in MCQ and structured questions
- tested once in section B in the past 5 years



WEIGHTAGE

- Constitute to around 2.5% in Paper 2 in the past 5 years

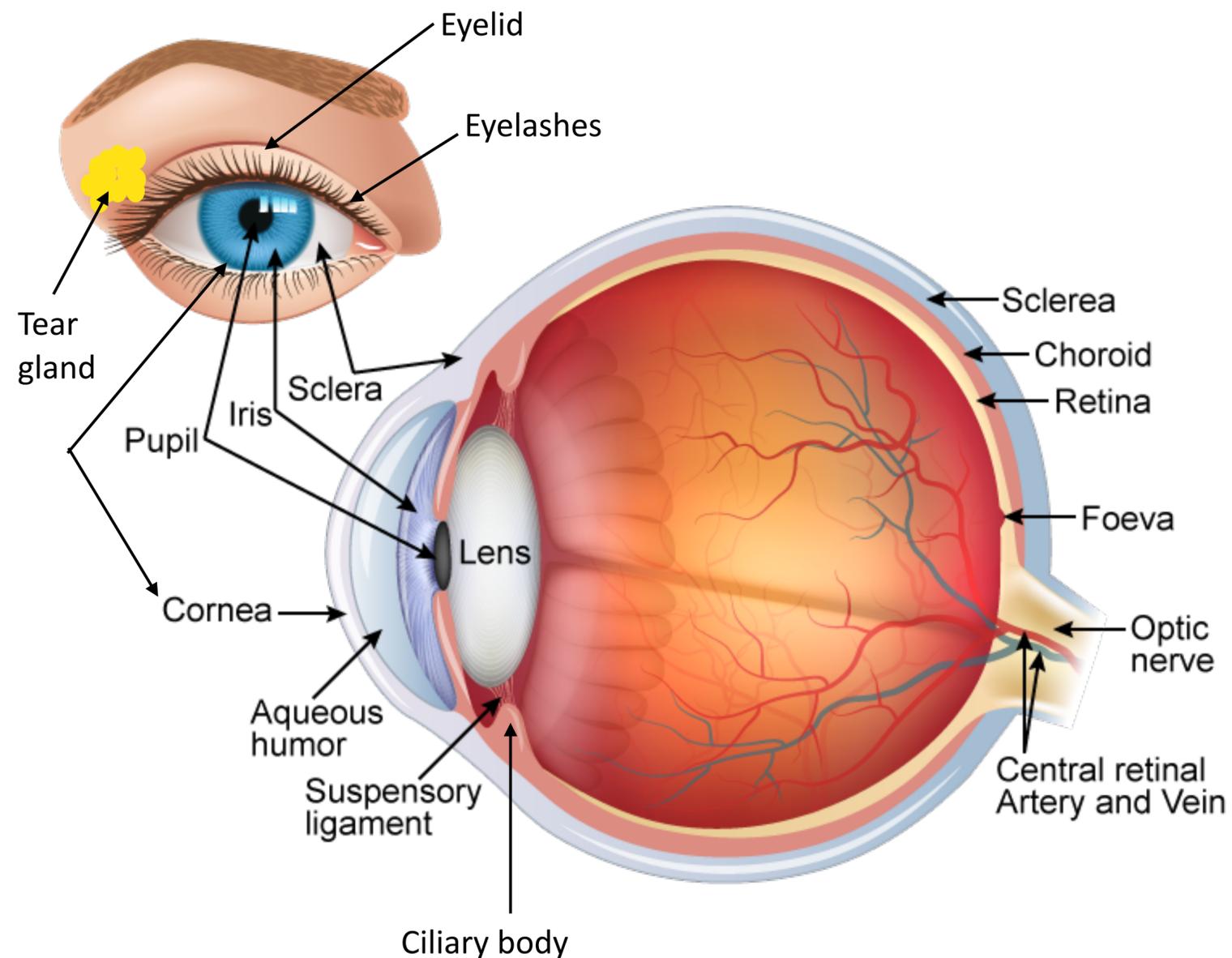
Key Concept

structure of eyes
accommodation
pupil reflex



structure of eyes

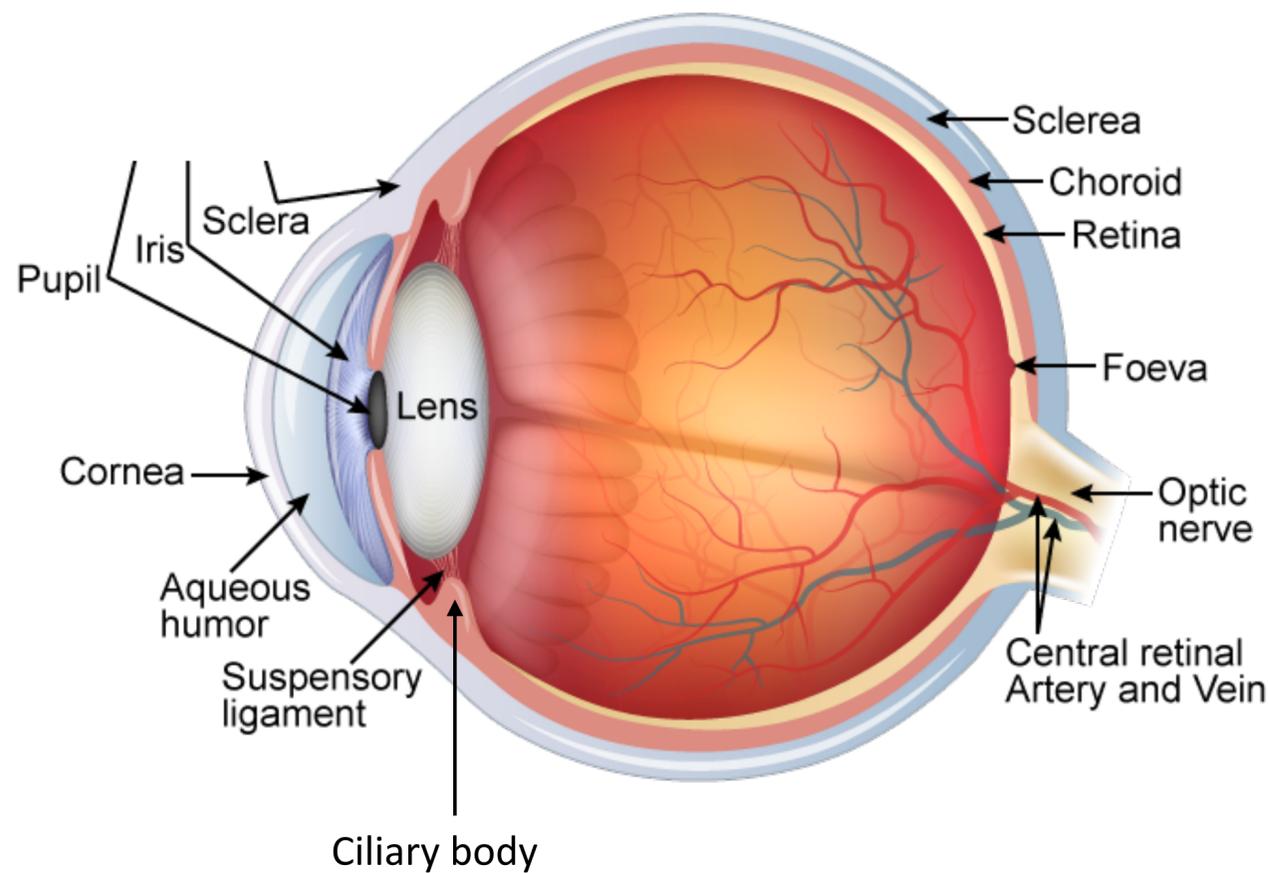
external



Tear gland	Secretes tears which lubricate the eye, nourish the cornea and keeps it free from dust.
Eyelid	<ul style="list-style-type: none"> • Squinting is the partial closure of eyelids. This prevents excess light from entering the eye and damaging the light-sensitive tissues • Blinking spreads tears over the cornea and conjunctiva and wipes dust particles off the cornea
Eyelashes	Shield eyes from dust particles
Iris	<ul style="list-style-type: none"> • Contain radial and circular muscles that control the size of pupil • Pigment of iris gives the colour of eyes
Pupil	Allows light to enter the eye
Sclera	<ul style="list-style-type: none"> • Tough white outer layer of connective tissue • Continuous with cornea
Conjunctiva	<ul style="list-style-type: none"> • Thin, transparent mucous membrane that covers the sclera • Secretes mucous to lubricate the eye
Cornea	<ul style="list-style-type: none"> • Transparent refractive layer covering the iris and pupil. • continuous with the sclera.

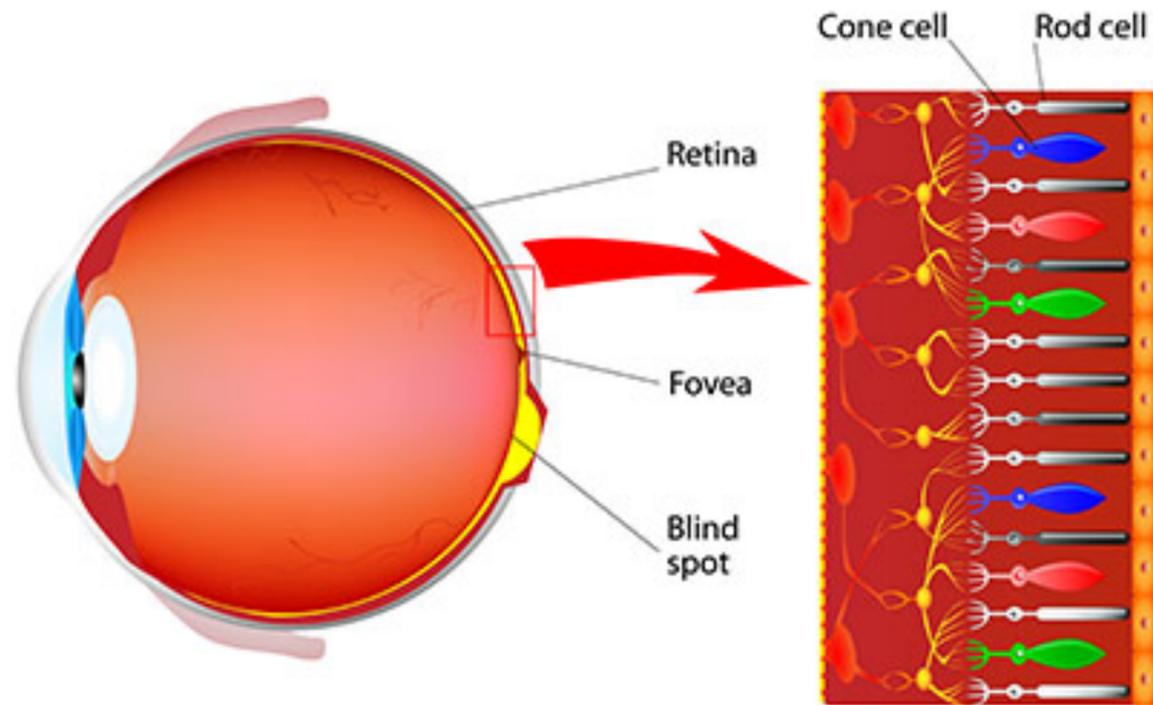
structure of eyes

internal



Choroid	<ul style="list-style-type: none"> • Middle layer of the eyeball, between the sclera and retina. • Contains blood vessels that supply oxygen and nutrients, and remove metabolic waste products. • Pigmented black to prevent an internal reflection of light.
Retina	Innermost layer of the eyeball which contains photoreceptors , which are connected to the optic nerve .
Lens	<ul style="list-style-type: none"> • Transparent biconvex structure that refracts light onto the retina. • The lens can change its curvature to focus light onto retina
Fovea	<ul style="list-style-type: none"> • Also called yellow spot, a small depression in the retina where images are usually focused • The fovea contains the greatest concentration of cones, but no rods.
Ciliary body	Contains ciliary muscles which control the curvature of the lens . It is also responsible for producing aqueous humour .
Suspensory ligament	Connects the ciliary body to the lens
Aqueous chamber	<ul style="list-style-type: none"> • The space between the lens and the cornea. • Transparent aqueous humour keeps the front of the eyeball firm and helps to refract light into the pupil.
Vitreous chamber	<ul style="list-style-type: none"> • The space behind lens • Transparent vitreous humour keeps the eyeball firm and helps to refract light onto the retina.
Optic nerve	<ul style="list-style-type: none"> • Transmits signal from the retina to the brain. • There are no photoreceptors in the area of the retina where the optic nerve leaves. This area is called the blind spot.

photoreceptors



- Photoreceptors in the retina consist of rods and cones.
- The photoreceptors are connected to the nerve endings from the optic nerve.

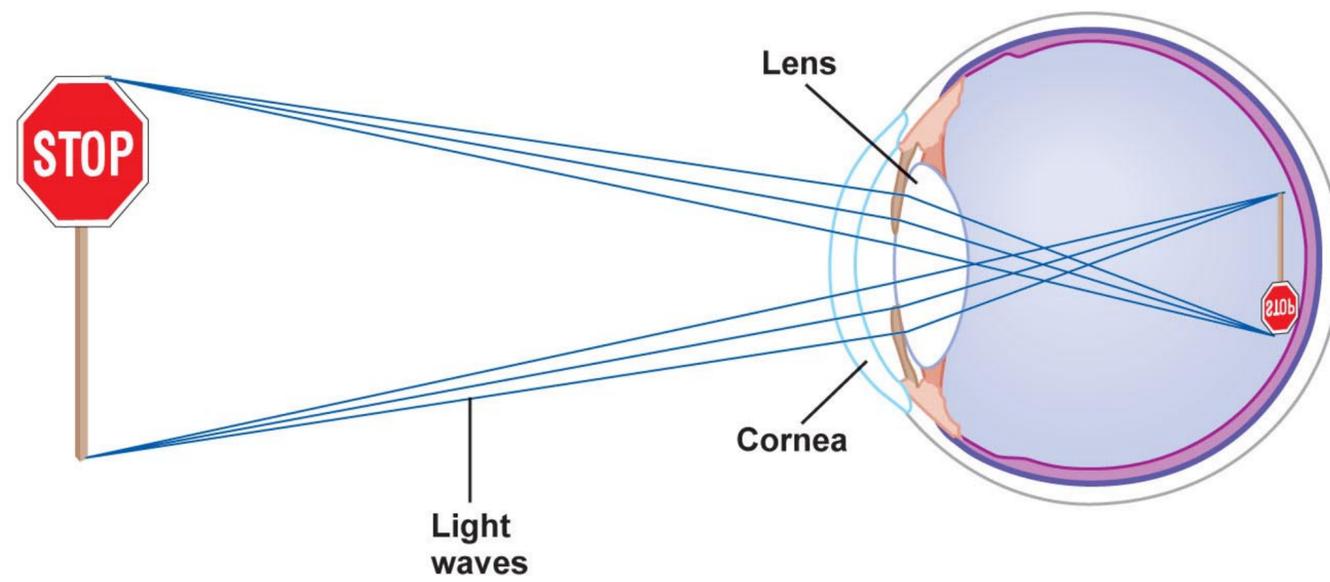
CONES

- Cones enable us to **see colours** in **bright light**.
- There are three types of cones, **red, blue, and green** (RBG) that allow us to see a wide variety of colours by containing different pigment which absorbs light of different wavelengths.
- Cones **do not work well in dim light**.

RODS

- Rods enable us to **see in dim light**, but only in **black and white**.
- Rods are **sensitive to light of low intensity** as they contain pigment called **visual purple**. When the eye is exposed to **bright light**, all the visual purple is **bleached**.
- **Visual purple must be reformed** for a person to see in the dark. Therefore, it takes awhile for one to see in dark after being in a bright environment as time is taken for visual purple to reform.
- Formation of visual purple requires **vitamin A**.

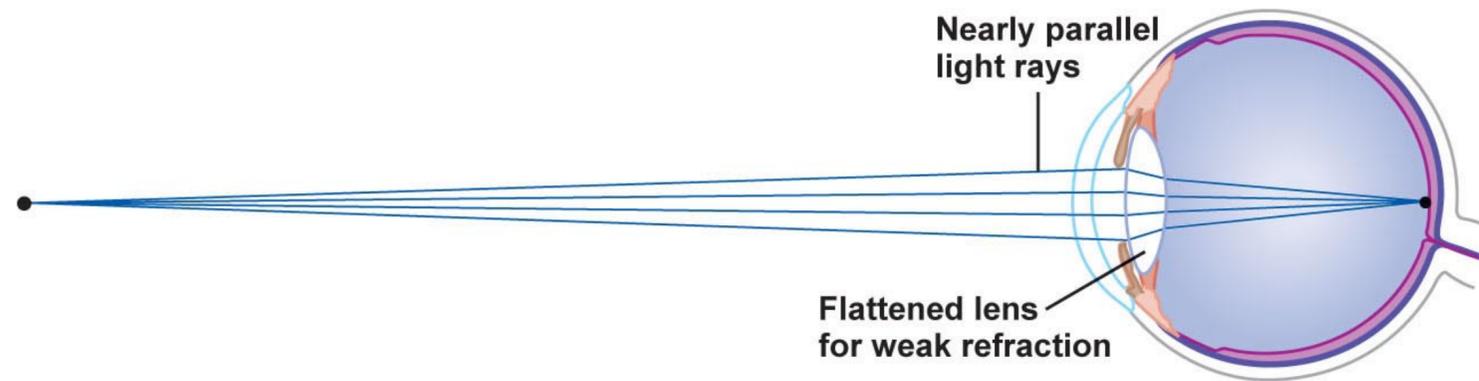
How we see



1. When light falls on an object, **light rays are reflected from the object**
2. Light rays are **refracted through the cornea** and the **aqueous humour** onto the **lens**
3. The lens causes **further refraction** and the rays are brought to a **focus on the retina.**
4. The image on the retina **stimulates the photoreceptors**, either the rods or the cones, depending on the intensity of the light.
5. Nerve impulses are produced and **sent to the brain via optic nerve.** The brain interprets the impulses and the person sees the object.

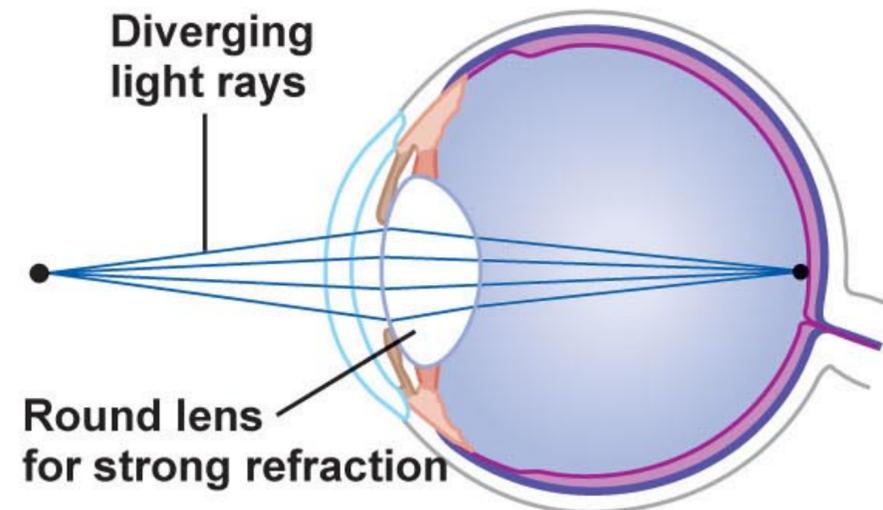
- **Accommodation:** it is a **reflex action** where the **lens is adjusted** so that clear images of objects at different distances are formed on the retina.
- Light rays reflected from the object and refracted into the eyes depend on the distance of object

accommodation



Focusing on a distant object

1. Light rays reflected off distant objects are nearly parallel and enter the eyes
2. Ciliary muscles relax, causing suspensory ligaments to tighten
3. Suspensory ligaments become taut, pulling on the edge of the lens.
4. Lens becomes thinner and less convex, increasing its focal length, causing less refraction of the rays of light
5. Light rays from the distant object are sharply focused on the retina.



Focusing on a close object

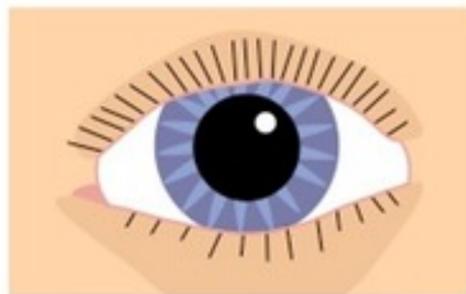
1. Light rays reflected off close objects are diverging and enter the eyes
2. Ciliary muscles contract, causing suspensory ligaments to become relax
3. Suspensory ligaments slacken, relaxing their pull on the lens.
4. The lens becomes thicker and more convex, decreasing its focal length, causing more refraction of the rays of light,
5. Light rays from the near object are sharply focused on the retina.

pupil reflex

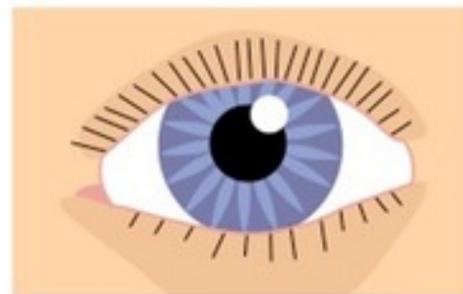
- Reflex action (involuntary) where the pupil changes size in response to changes in light intensity.
- In low light intensity, pupils dilate allow more light to enter the eye for better vision
- In high light intensity, pupils contract to restrict light to enter to prevent excessive light from damaging the retina

Reflex action:
Stimulus (change in light intensity) → receptor (retina) → send signal via optic nerve to the brain → motor neuron → effector (iris circular muscles and radial muscles)

DIM LIGHT



BRIGHT LIGHT

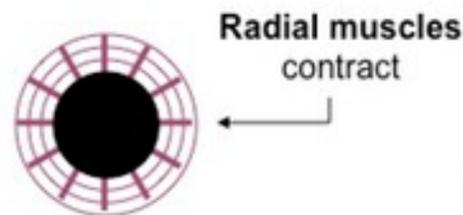


In dim light,

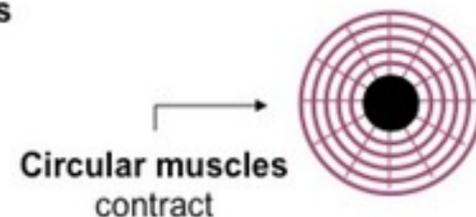
1. Radial muscles of the iris contract
2. Circular muscles of the iris relax
3. The pupil enlarges or dilates, increasing the amount of light entering the eye.

In bright light,

1. Circular muscles of the iris contract
2. Radial muscles of the iris relax
3. The **pupil** becomes smaller or **constricts**, reducing the amount of light entering the eye.



Pupil Dilation



Pupil Contraction

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