The eye

4.5.2.3 · Homeostasis and response · revision notes

The structure of the eye, how it focuses on near and distant objects (accommodation), how it adapts to dim and bright light, and how short and long sight are corrected. Expect labelling, 'explain how the eye focuses' chains and ray diagram questions. This subtopic is in GCSE Biology only.

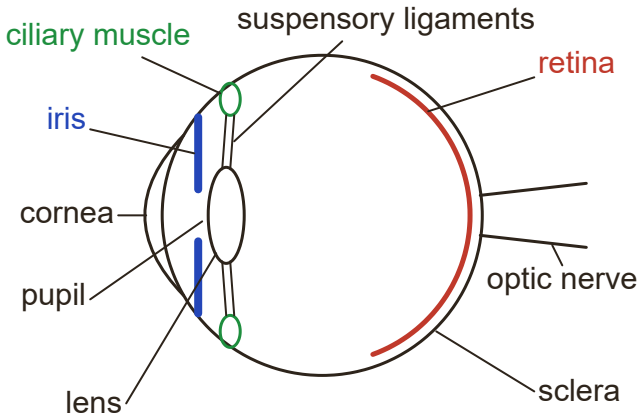
Key facts

- Cornea refracts light; iris controls pupil size; lens focuses light on the retina
- Near object: ciliary muscles contract, ligaments slacken, lens thicker, more refraction
- Dim light: pupil dilates; bright light: pupil constricts
- Hyperopia (long sight): focus behind the retina → convex lens
- Retina = light receptors; optic nerve = impulses to the brain; sclera = tough protective outer layer
- Distant object: ciliary muscles relax, ligaments tight, lens thinner, less refraction
- Myopia (short sight): focus in front of the retina → concave lens
- Other treatments: contact lenses, laser surgery on the cornea, replacement lens

Notes

Structures and their functions

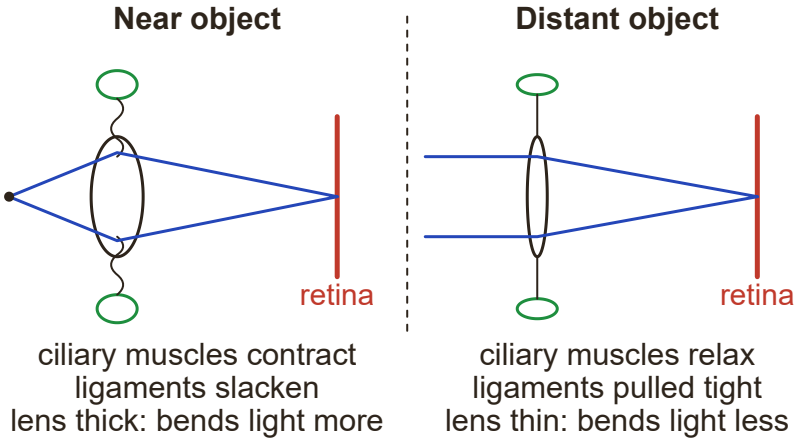
- The eye is a sense organ containing **receptors** sensitive to **light intensity and colour**.
- **Cornea**: transparent front layer that refracts (bends) light into the eye.
- **Iris**: coloured ring of muscle that controls the size of the **pupil** (the hole light passes through), and so how much light enters.
- **Lens**: focuses light onto the retina. Its shape is changed by the **ciliary muscles** and **suspensory ligaments**.
- **Retina**: contains the light receptor cells. **Optic nerve**: carries impulses from the retina to the brain.
- **Sclera**: tough white outer layer that protects the eye.



Structure of the eye (light enters from the left).

Accommodation (focusing)

- **Accommodation** is changing the shape of the lens to focus on near or distant objects.
- **Near object**: ciliary muscles **contract** → suspensory ligaments **loosen** → lens becomes **thicker** → light is refracted **more strongly**.
- **Distant object**: ciliary muscles **relax** → suspensory ligaments are **pulled tight** → lens is pulled **thin** → light is refracted **only slightly**.



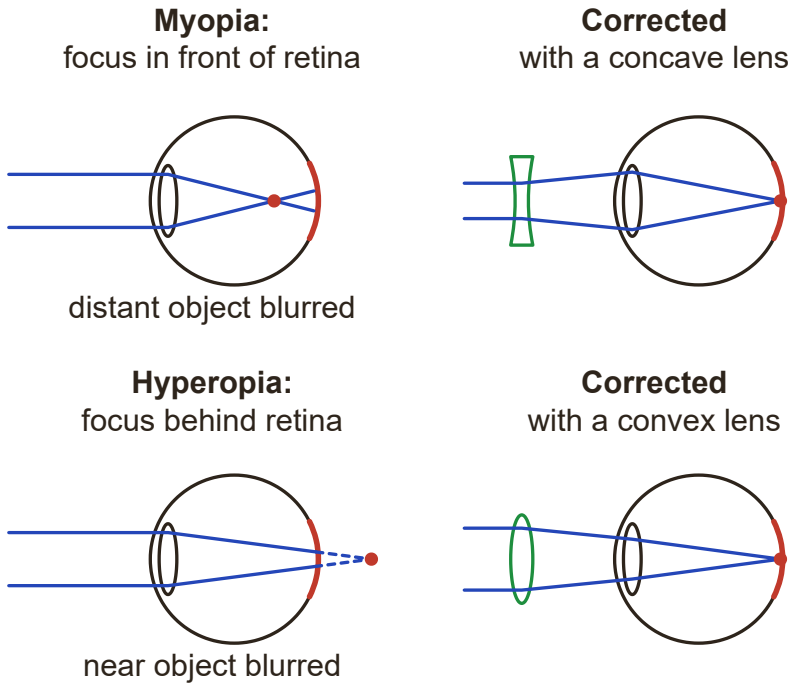
Accommodation: the lens changes shape so the light is always focused on the retina.

Adapting to light levels

- In **dim light** the pupil **widens** (dilates) so more light reaches the retina. In **bright light** it **narrows** (constricts), protecting the retina. This is a reflex.
- The iris has two sets of muscles. In dim light the **radial muscles contract** and the circular muscles relax, widening the pupil. In bright light the **circular muscles contract** and the radial muscles relax. Grade 7+ only

Defects of vision

- **Myopia (short sight)**: distant objects look blurred because light focuses **in front of** the retina (lens too curved or eyeball too long). Corrected with a **concave (diverging)** lens.
- **Hyperopia (long sight)**: near objects look blurred because light focuses **behind** the retina (lens too flat or eyeball too short). Corrected with a **convex (converging)** lens.



Defects of vision and their correction (red dot = where the light is focused).

- Newer treatments: **hard and soft contact lenses**, **laser surgery** to change the shape of the cornea, and a **replacement lens** inside the eye.

How to answer each type of question

Name a part of the eye or give its function

1 mark each | Grade 4

1. Give the exact name (e.g. 'suspensory ligaments', not 'strings').
2. For a function, say what the part does, not where it is.

Example. (a) Name the part of the eye that contains light receptors.
(b) Give the function of the optic nerve.
(c) Give the function of the iris.

Model answer.

(a) Retina	(1)
(b) Carries (nerve) impulses from the retina to the brain	(1)
(c) Controls the size of the pupil / how much light enters the eye	(1)

Explain how the eye focuses on a near or distant object

3 marks | Grade 5

1. Ciliary muscles: contract (near) or relax (distant).
2. Suspensory ligaments: slacken (near) or are pulled tight (distant).
3. Lens: thicker and refracts more (near) or thinner and refracts less (distant), so light is focused on the retina.

Example. A student looks up from reading a book to watch a bird in a distant tree.
Explain how the eye changes so that the bird is in focus.

Model answer. The ciliary muscles relax (1). The suspensory ligaments are pulled tight (1). The lens is pulled thinner, so it refracts light less and the light is focused on the retina (1).

Explain a defect of vision and its correction

3 to 4 marks | Grade 5

1. Say where light focuses: in front of the retina (myopia) or behind it (hyperopia).
2. Name the correcting lens: concave for myopia, convex for hyperopia.
3. Say what the lens does to the rays so that they focus on the retina.
4. On a ray diagram, use a ruler and make the corrected rays meet exactly on the retina.

Example. A person cannot see distant objects clearly. Light from distant objects is focused in front of their retina.
(a) Name this defect.
(b) Explain how a spectacle lens corrects it.

Model answer.

(a) Myopia / short sight (1)

(b) A concave / diverging lens (1) spreads the light rays out before they enter the eye (1), so they are focused on the retina (1).

Evaluate treatments for defects of vision

3 to 4 marks | Grade 7

1. Give advantages and disadvantages of each option in the question.
2. Think about convenience, risk, cost and whether it is permanent.
3. Finish with a justified conclusion.

Example. Evaluate the use of laser eye surgery rather than glasses to correct short sight.

Model answer.

Any three from:

surgery is a permanent correction, so no glasses need to be worn or replaced (1)

more convenient, e.g. for sport (1)

surgery carries risks, e.g. damage to the eye or infection, or vision may not be fully corrected (1)

surgery is expensive, whereas glasses are cheap and have no risk (1)

plus a justified conclusion, e.g. surgery suits someone who wants to be free of glasses and accepts a small risk (1)

Don’t lose marks

- Saying the suspensory ligaments contract. Only muscles contract; ligaments are pulled tight or go slack.
- Getting accommodation the wrong way round: for a near object the muscles contract and the lens gets thicker.
- Saying the lens focuses light 'on the pupil' or 'on the optic nerve'. Light is focused on the retina.
- Calling the black hole in the middle the iris. That is the pupil; the iris is the coloured muscle around it.
- Swapping the lenses: concave corrects short sight, convex corrects long sight.

More tips

Memory tricks

- Reading is hard work: the ciliary muscles contract for near objects. Looking into the distance is relaxing: they relax.
- Muscles and ligaments do the opposite: muscles contract → ligaments slacken; muscles relax → ligaments tighten.
- Short sight: the focus falls short (in front of the retina). Long sight: the focus goes too far (behind the retina).
- Myopia needs a 'minus' (concave) lens; hyperopia needs a 'plus' (convex) lens.

Exam technique

- Accommodation answers need the chain in order: ciliary muscles → suspensory ligaments → lens shape → refraction. Each link is usually a mark.
- Say the lens refracts light 'more' or 'less', and finish with 'so the light is focused on the retina'.
- On ray diagrams, draw straight lines with a ruler and add arrows showing the direction of the light.

What each grade needs

What you need to be able to do, from the first marks up to the top grade.

Grade 3 — **Label the main parts of the eye**
Cornea, iris, pupil, lens, ciliary muscles, suspensory ligaments, retina, optic nerve and sclera.

Grade 4 — **State the function of each part**
E.g. the retina contains light receptors; the optic nerve carries impulses to the brain.

Grade 5 — **Describe how the pupil changes with light**
The pupil widens in dim light to let more light in and narrows in bright light.

Grade 5 — **Explain accommodation for near and distant objects**
Ciliary muscles contract or relax, suspensory ligaments slacken or tighten, and the lens changes shape.

Grade 5 — **Describe myopia and hyperopia and their correction**
Short sight: light focuses in front of the retina, concave lens. Long sight: behind the retina, convex lens.

Grade 5 — **Interpret ray diagrams of eye defects**
Show where light focuses and how a spectacle lens moves the focus onto the retina.

Grade 7 — **Evaluate treatments for defects of vision**
Compare glasses, contact lenses, laser surgery and lens replacement for convenience, risk and cost.

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