5.2 Brain, eye and temperature

Name: _____ Class: _____ Date: _____ **Total: 20 marks**

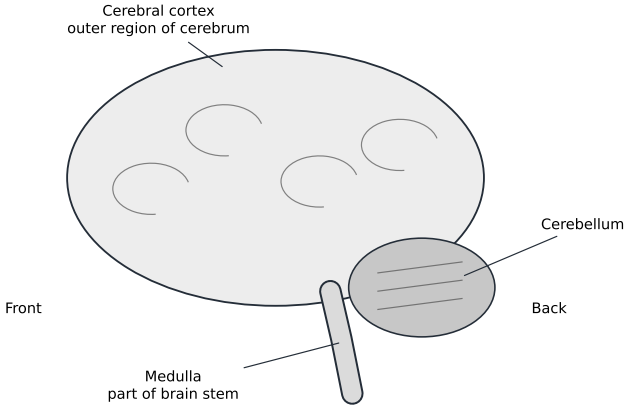
KEY WORDS accommodation • myopia • thermoregulatory centre

Objective

Identify brain regions, relate eye structures to functions, explain accommodation, eye defects and temperature control. Biology only. Original questions for spec statements 4.5.2.2–4.5.2.4.

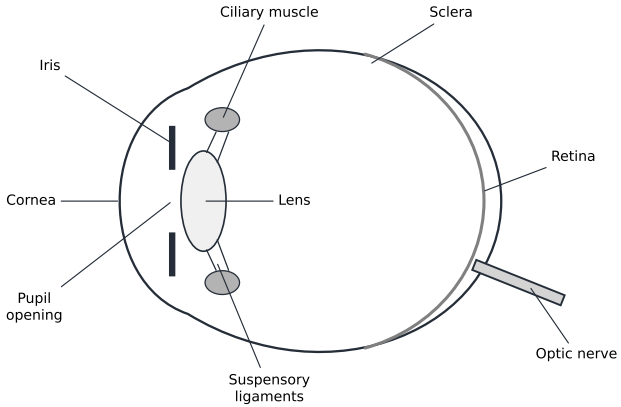
1 Key knowledge and worked examples

Brain: cerebral cortex – consciousness, memory, language; cerebellum – balance and coordination; medulla – heartbeat and breathing.

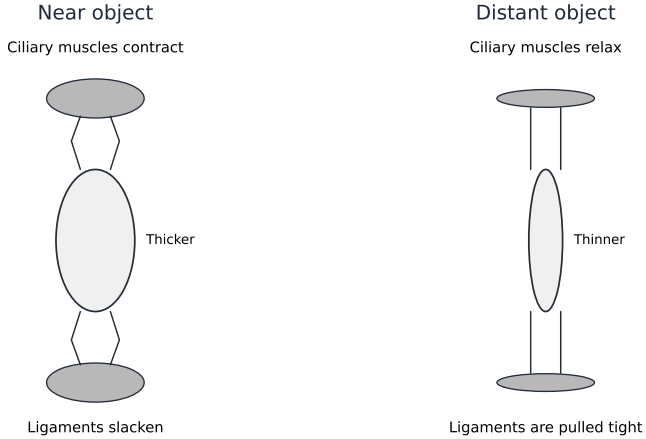


Simplified side view; positions, not neuron connections

(HT) Damage studies, electrical stimulation and MRI help map brain regions. Connections, complexity and delicate tissue make conclusions and treatment difficult. Weigh evidence and expected benefit against possible harm; an MRI image alone does not prove causation.

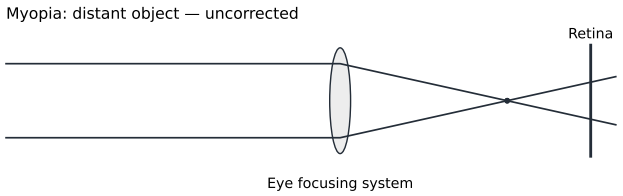


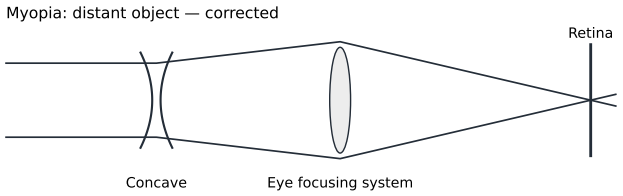
Retina detects light; **optic nerve** carries impulses; **sclera** protects; **cornea** refracts. The **iris** controls the pupil opening. Bright light: circular muscles contract, pupil narrows, less light enters. Dim light: radial muscles contract, pupil widens, more light enters. Opposing muscles relax. This brain-coordinated reflex needs no conscious decision.



Mechanism model: ligament tension changes lens shape; not pupil size

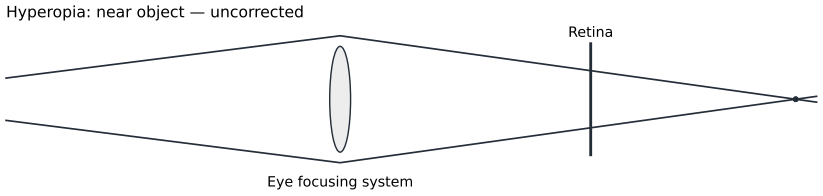
Accommodation: near – ciliary muscles contract, ligaments slacken, lens thickens and refracts more strongly. Distant – muscles relax, ligaments tighten, lens thins and refracts less strongly. Ligaments do not actively contract. Iris changes light entry; ciliary muscles change focus.

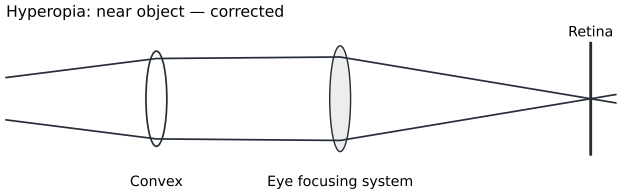




Simplified optical model: cornea and eye lens act together; distances not to scale

Myopia: distant image in front of retina; concave lens diverges incoming rays.





Simplified optical model: cornea and eye lens act together; distances not to scale

Hyperopia: near image behind retina; convex lens adds convergence. Both corrections bring the image onto the retina. Spectacles/contact lenses alter entering rays; laser surgery reshapes the cornea; replacement lenses alter internal focusing. Compare suitability and risks using supplied evidence.

Temperature: the thermoregulatory centre monitors blood; skin receptors send impulses. Hot – skin arterioles dilate, more blood near the surface; sweat evaporates and transfers energy away. Cold – arterioles constrict, less surface flow; less sweating reduces evaporation; shivering increases respiration and energy release. These responses oppose the temperature change. Capillaries do not actively constrict.

Worked context (HT). In AQA 2021 Q03, ice-cold water cools blood in the mouth/stomach; this blood flows to the brain. Impulses reduce sweating; less evaporation reduces cooling. The graph starts at 37.4 °C and shows less sweating, not zero sweating. Movement is controlled because it releases extra energy.

Worked explanation (3 marks, teacher-written). Shivering needs muscle contraction; increased respiration supplies energy and transfers heat to the blood; circulating blood distributes energy and raises core temperature toward normal.

2 Practice

2.1 Name the brain region controlling balance and the region controlling breathing. [2]

2.2 Copy and complete: to focus on a near object, the ciliary muscles _____, the suspensory ligaments _____, and the lens becomes _____. [3]

2.3 Name the defect in which light focuses in front of the retina, and one way it is treated. [2]

3 Exam-style questions

3.1 Explain how the eye responds to dim light and why this is a reflex. [4]

3.2 A person moves from looking at a distant hill to reading a book. Explain the changes in the eye that focus the book, and compare them with a person with hyperopia reading the same book. [5]

3.3 *(HT)* Explain two ways the body responds to a fall in body temperature and how each response helps restore normal temperature. [4]