

Sense organs

Revision notes · Sense organs and the structure and function of the eye, the pupil reflex, accommodation, and rods, cones and the fovea.

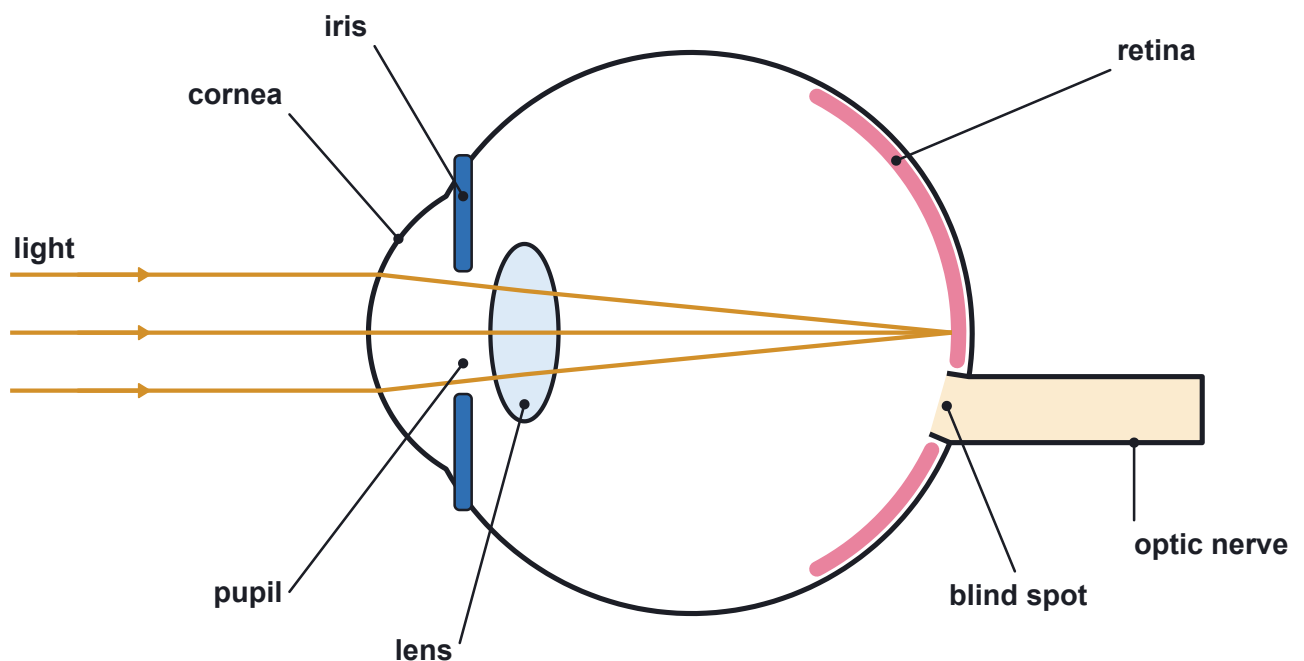
For Cambridge IGCSE Biology 0610 (and 0970, which has the same content). **Supplement** is Extended content, only examined on Papers 2 and 4.

Sense organs Spec 14.2

Sense organs and the eye Spec 14.2.1, 14.2.2, 14.2.3

Sense organs are groups of **receptor cells** responding to **specific stimuli**: light, sound, touch, temperature and chemicals. The eye is a sense organ that responds to light.

Structures of the eye	
Structure	Function
Cornea	Refracts (bends) light as it enters the eye
Iris	Controls how much light enters the pupil
Pupil	The hole in the centre of the iris through which light enters
Lens	Focuses light on to the retina
Retina	Contains light receptors, some sensitive to light of different colours
Optic nerve	Carries impulses to the brain
Blind spot	The place where the optic nerve leaves the eye. It has no receptors, so it is not sensitive to light



Structures of the eye. The **blind spot** is where the optic nerve leaves the eye.

*Exam tip: Give the job of each structure with the exact verb: the cornea **refracts** light, the lens **focuses** light, the iris **controls how much light enters**. The optic nerve carries impulses, not images, to the brain.*

The pupil reflex Spec 14.2.4, 14.2.5

The **pupil reflex** changes the diameter of the pupil when the light intensity changes. It is an automatic response, which protects the retina and lets enough light in to see.

The pupil reflex		
	Bright light	Dim light
Pupil diameter	Gets smaller (constricts)	Gets larger (dilates)
Amount of light entering the eye	Less	More
Effect	Protects the retina from damage	Allows more light to reach the retina so you can see better

Supplement

Antagonistic muscles in the iris

Supplement

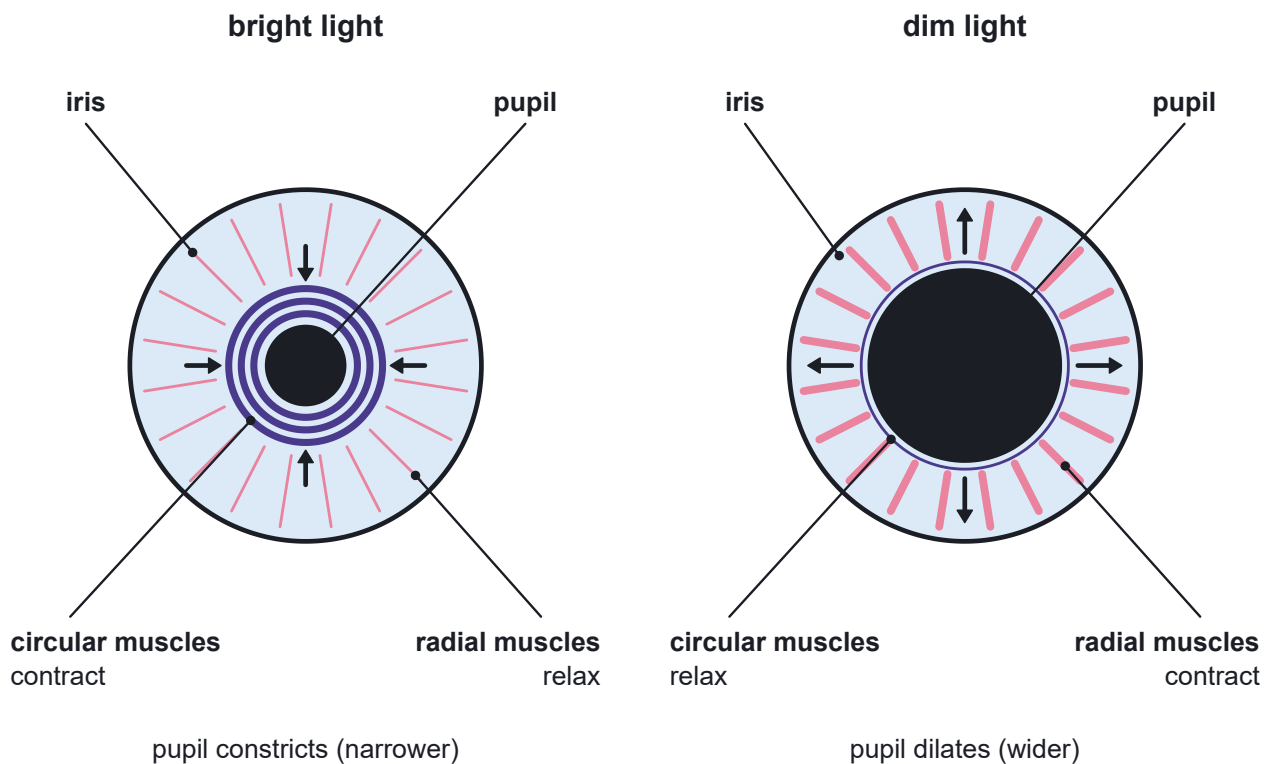
The iris contains two sets of muscles that work against each other. These are **antagonistic** muscles. **Circular muscles** form rings around the pupil. **Radial muscles** run outwards like the spokes of a wheel.

Supplement

Antagonistic action of the iris muscles

	Bright light	Dim light
Circular muscles	Contract	Relax
Radial muscles	Relax	Contract
Pupil	Constricts (narrower)	Dilates (wider)

Supplement



The pupil reflex. Bright light: **circular muscles contract**. Dim light: **radial muscles contract**.

Supplement

Common mistake: Radial muscles contract to make the pupil wider. Circular muscles contract to make it narrower. Always say which set contracts and which relaxes.

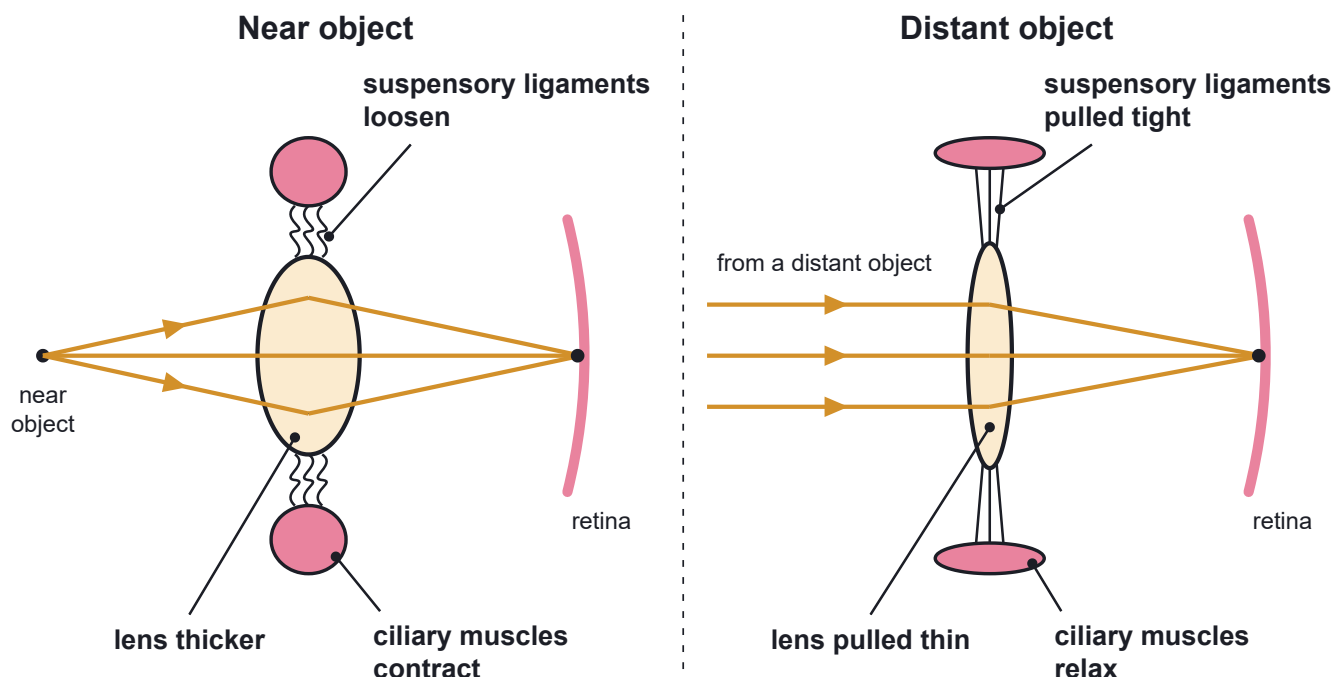
Accommodation Spec 14.2.6 Supplement

Accommodation Changing the shape of the lens to focus on near or distant objects.

The **ciliary muscles** form a ring around the lens. The lens is held in place by the **suspensory ligaments**, which join it to the ciliary muscles. When the ciliary muscles contract or relax, the tension in the suspensory ligaments changes. This changes the shape of the lens, so it **refracts** light by a different amount.

Focusing on near and distant objects

	Near object	Distant object
Ciliary muscles	Contract	Relax
Tension in suspensory ligaments	Decreases (ligaments slack)	Increases (ligaments pulled tight)
Shape of lens	Thicker (more curved)	Thinner (flatter)
Refraction of light	Light is refracted more	Light is refracted less



Accommodation. Near object: muscles contract, ligaments loosen, lens thicker. Distant object: muscles relax, ligaments tight, lens thin.

Common mistake: For a near object the ciliary muscles contract and the ligaments go slack. Many students reverse this. Remember: contracted muscle, slack ligaments, fat lens.

Rods, cones and the fovea

Spec 14.2.7, 14.2.8, 14.2.9

Supplement

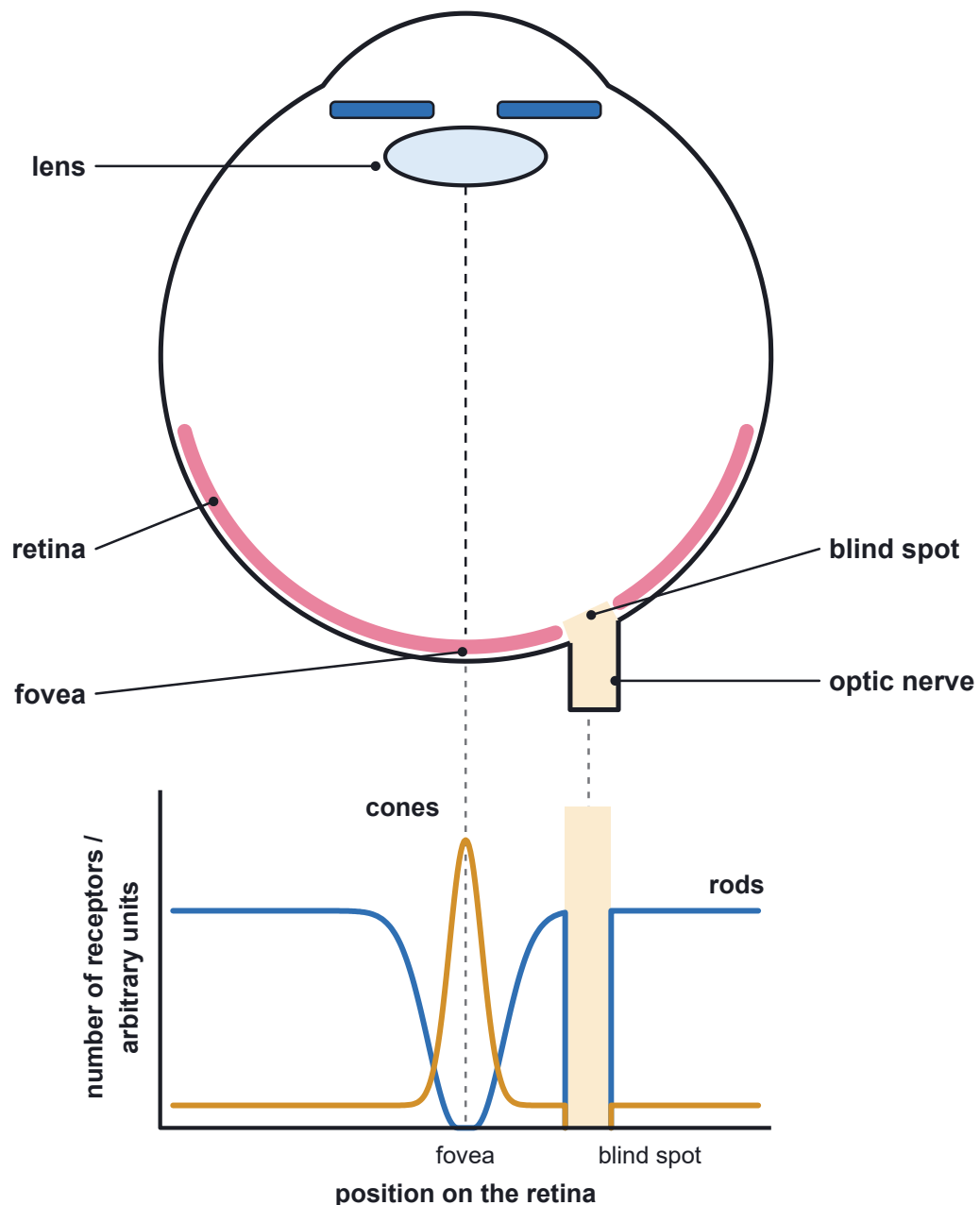
The retina contains two types of light receptor, rods and cones.

Rods and cones		
	Rods	Cones
Distribution in the human retina	Spread over the retina, more towards the edges; none in the fovea	Packed closely in the fovea, with fewer over the rest of the retina
Function	Greater sensitivity to light, so used for night vision (dim light)	Colour vision, in bright light
Types	One type	Three different kinds, absorbing light of different colours

The three kinds of cone absorb red, green and blue light. The brain combines the signals from the three kinds to give colour vision.

The fovea

The fovea is a small area of the retina directly behind the lens. Its function is to give the sharpest vision (the greatest detail) because it has a very high density of cones. When you look straight at an object, its image falls on the fovea.



Cones are packed into the **fovea**; rods are absent there and more common towards the edges. The **blind spot** has no receptors.

Exam tip: Link the receptor to the light level: rods for dim light (night vision) and cones for bright light and colour. Say the fovea has the highest density of cones and no rods, so it gives the sharpest vision.

Quick check

1. Which structure of the eye refracts light as it enters?
2. What is the blind spot?
3. What happens to the pupil in bright light?
4. **Supplement** Which muscles of the iris contract to widen the pupil?
5. **Supplement** What is the function of the fovea?

Quick check answers

Sense organs

1. The cornea.
2. The place where the optic nerve leaves the eye. It has no receptors.
3. It gets smaller, so less light enters the eye.
4. The radial muscles.
5. It gives the sharpest vision because it has a high density of cones.