



INTRODUCTION TO THE EYE

THINK

A mother brings her son to see you because his eyelid was injured while playing with a stick. You have to decide what to do.

How would you describe what was wrong with the child's eye in your examination records?

How would you describe the problem to another eye care worker?

If you decided to refer the boy to an eye specialist, what would you write in your referral letter if you did not know that part of the eye was called the "eyelid"?

AIM

This unit introduces you to some of the different parts of the eye – what these parts are called and what they do.

LEARNING OUTCOMES

When you have worked through this unit you should be able to:

- identify and name parts of the eye
- describe what each of those parts do.

INTRODUCING THE EYE

The eyes let us see shapes, colours, and sizes of objects in the world. We use our eyes in almost every activity we perform, whether reading or writing, working in the kitchen, watching television, or riding a bicycle.

Sometimes people do not see well, or have pain or redness because there is a problem with some part of their eyes. It is important to know what the different parts of the eye do, so that you know what the effect will be and what complaints (also called “symptoms”) the person may have if a certain part does not work properly. This information can help you decide what is wrong with a person’s eyes and what you need to do about it.

LOOKING AT EYES

Some parts of the eye can be seen just by looking at a person’s face. Other parts of the eye are inside the eye and can only be seen when using special instruments.

We will begin by naming the parts that we can see without needing to use special instruments. When we examine eyes closely, it helps if we have a good light like a lamp, torch or flashlight. If you do not have these things you can also use sunlight.

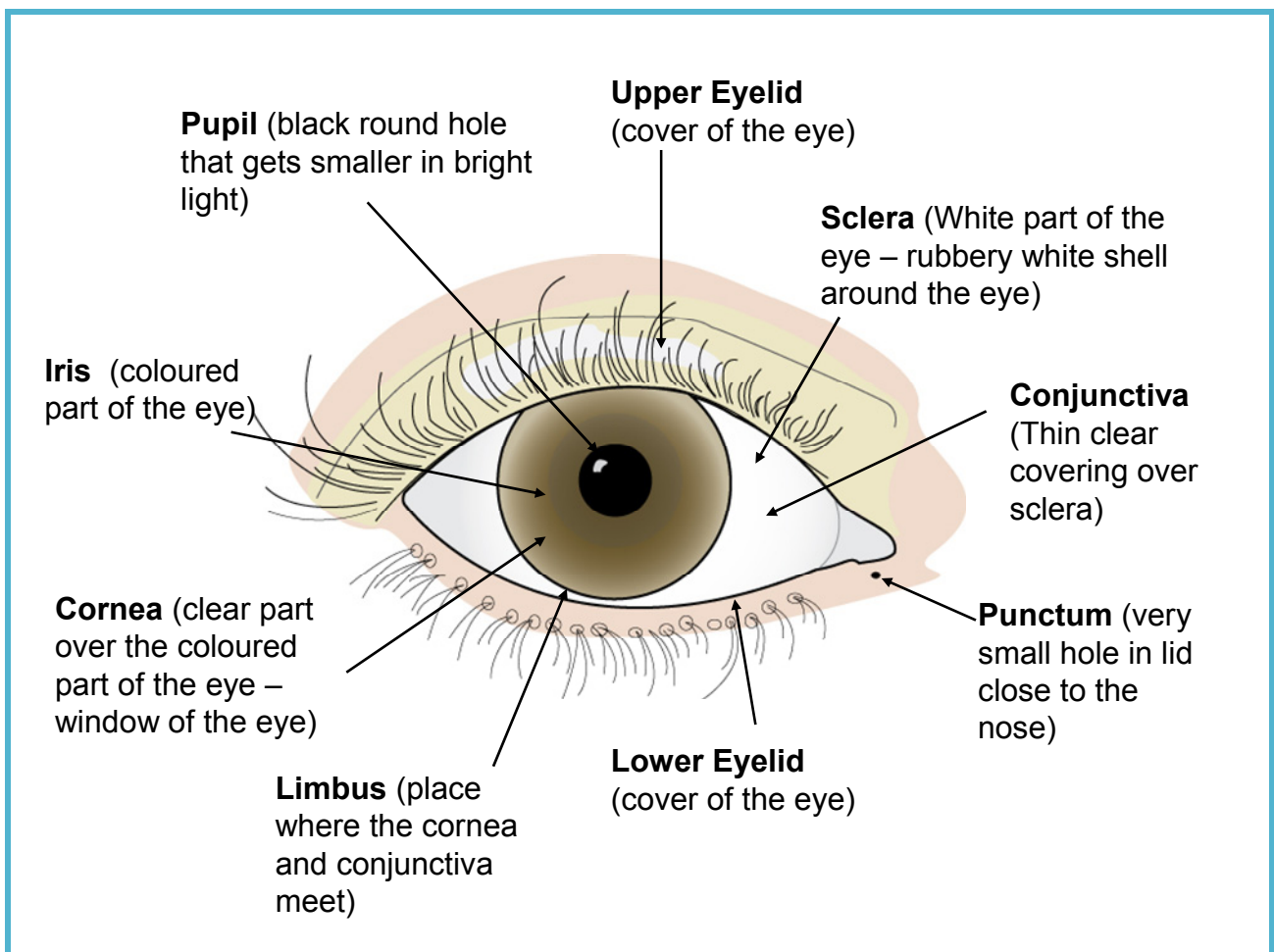


Figure 1.1: The external eye

If we take away the eyelids and cut the eyeball in half like we might do with an orange or a coconut, it would look like the diagram below.

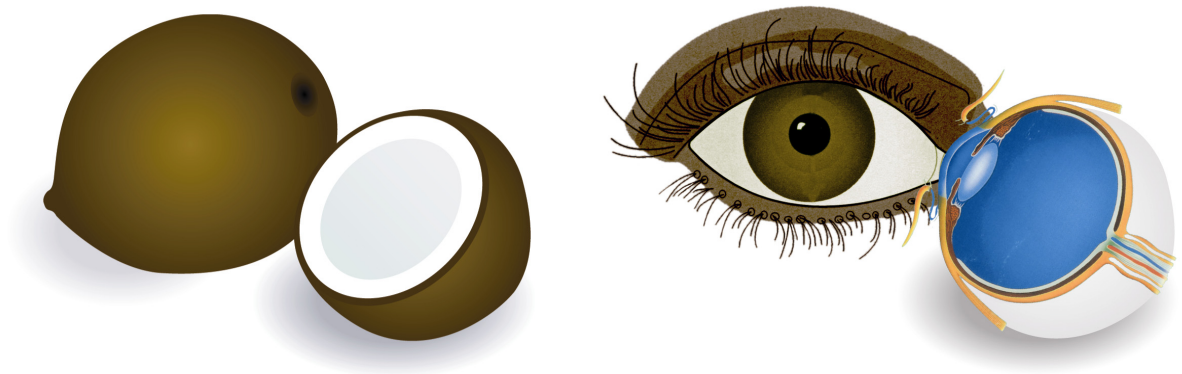


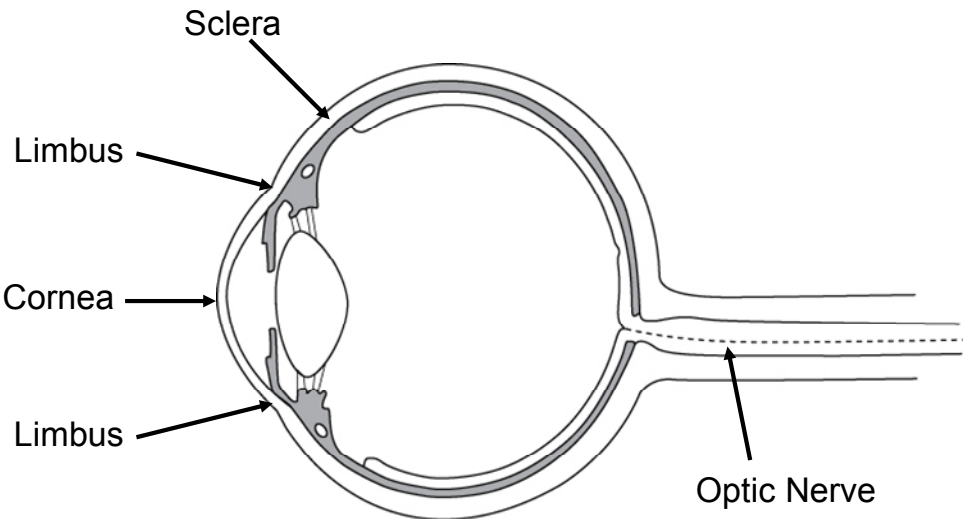



Figure 1.2: Cutting the eye in half

PARTS OF THE EYE

ORBIT	<p>The eye is enclosed by a bony socket in the skull called the orbit.</p> <div data-bbox="451 387 1506 517">  <p>The orbit helps to protect the eye.</p> </div>
TEAR FILM	<p>The tear film is the watery layer at the front of the eye.</p> <p>The tear film keeps the outside of the eye wet, and provides nutrients to the cornea. It also creates a smooth surface for light to pass through to the cornea, and provides protection from infection.</p> <div data-bbox="451 750 1506 880">  <p>The tear film helps to protect and nourish the eye, and helps light to enter the eye easily.</p> </div> <div data-bbox="451 943 1506 1534">  <p>The diagram shows a cross-section of the eye. Labels with arrows point to the Sclera (the outer white layer), the Limbus (the junction between the sclera and cornea), the Cornea (the clear front window), and the Optic Nerve (the nerve exiting the back of the eye).</p> </div> <p>Figure 1.3: Looking at the eye from the side</p>
SCLERA	<p>The diagram above shows the outside of the eyeball which is called the sclera. The sclera is white in colour and can be thought of as a rubbery <i>white shell</i> around the eye. Attached to the outside of the sclera are six extraocular muscles (that control eye movements), and the optic nerve (that connects the eye to the brain).</p> <div data-bbox="451 1749 1506 1879">  <p>The sclera is very strong. It protects the inside of the eyeball and gives the eye its shape.</p> </div>

PARTS OF THE EYE (cont.)

CORNEA

The picture below shows the front of the outside of the eyeball, which is the cornea. The cornea is different to the sclera because the cornea is not white in colour, but transparent (clear), like glass. The cornea can be thought of as the *window of the eye*.

When we look at a person's eye we can see through the clear cornea to the coloured part of the inside of the eye. The cornea needs to be clear so that it can let light into the eyeball so we can see.

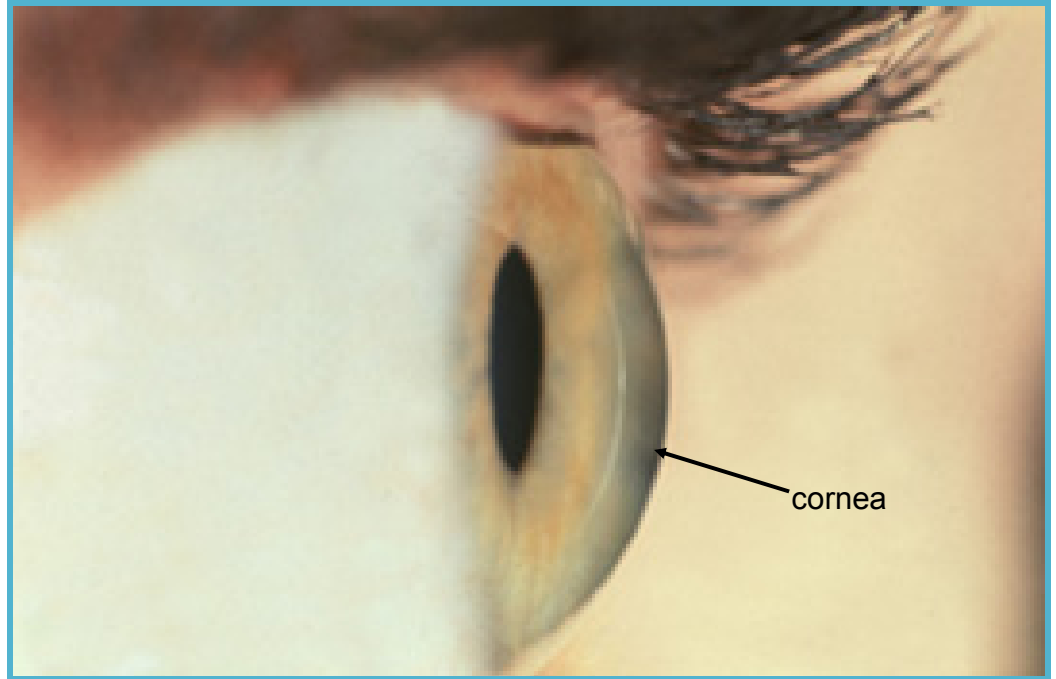


Figure 1.4: The cornea

The cornea is thin (only 0.5 mm thick), but it is also very strong. The cornea helps to protect the eye.

If something damages the cornea it will be very painful. This is because the cornea contains many nerve endings that send pain messages to the brain.

The cornea also helps to focus light that enters the eye. It provides $\frac{2}{3}$ rds of the eye's total focusing power.



The cornea:

- lets light into the eyeball
- protects the eye
- helps the eye to focus light.

PARTS OF THE EYE (cont.)

CONJUNCTIVA

The conjunctiva is the thin, clear layer that covers the front part of the sclera and the inside of the eyelids. When you look at a healthy eye you can see the white sclera through the clear conjunctiva. You will see a few small blood vessels in a healthy conjunctiva.

The conjunctiva has two parts:

- **Bulbar conjunctiva:** covers the sclera on the front part of the eye.
This part of the conjunctiva covers some of the sclera, but it does not cover the cornea.
- **Palpebral conjunctiva:** covers the inside of the top (upper) and bottom (lower) eyelids. Also called the conjunctiva of the eyelid.

You can see the conjunctiva of the bottom lid by pulling the eyelid down. To see the palpebral conjunctiva under the top lid you need to evert (or flip) the eyelid.

Because the palpebral conjunctiva is clear, you can see the pink eyelid underneath it.

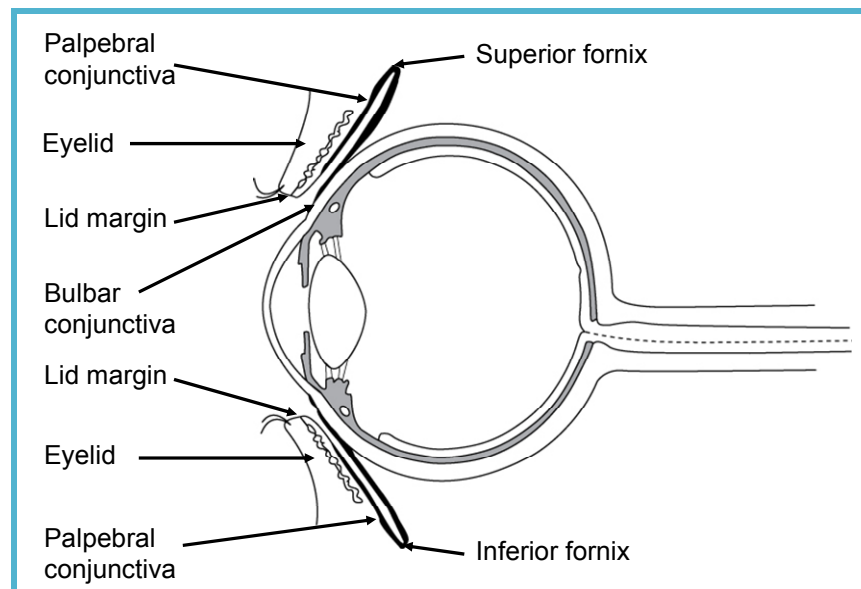


Figure 1.5: Conjunctiva and eyelids of the eye

There is no way for foreign bodies like grains of sand, pieces of stone or metal to slip behind the eyeball. This is because the bulbar conjunctiva joins the palpebral conjunctiva to form a fold (like a small pocket). Foreign bodies can go no further than the folds in the conjunctiva. These folds are called the superior (upper or top) fornix and the inferior (lower or bottom) fornix.

If there is a problem affecting the conjunctiva, the blood vessels in the conjunctiva may dilate (get bigger) and the conjunctiva will look red. The conjunctiva does not have as many nerves as the cornea. If there is an eye problem that affects the conjunctiva, it will usually not be as painful as an eye problem that affects the cornea.



The conjunctiva helps to protect the eye from infection and from damage by foreign bodies.

PARTS OF THE EYE (cont.)

LIMBUS

The limbus is where the cornea meets the bulbar conjunctiva. The previous diagrams also show the limbus.

Both the cornea and the conjunctiva are clear. The coloured part of the eye is behind the cornea and the white sclera is behind the conjunctiva. When we look at a person's eye, the limbus is the place where it looks like the coloured part of the eye meets the white part of the eye.



The limbus can be thought of as a landmark in the eye.

THE EYELIDS

The front of the eyeball can be covered or uncovered by two folds of skin called the eyelids. The edge of each eyelid is called the lid margin. Along the front of the lid margin are the eyelashes.

The eyelids and eyelashes protect the eyes from wind, dust, too much light, foreign bodies and infection.

The eyelids also spread out the tears each time we blink. This stops the eye from drying out and keeps the front surface of the eye smooth.



The eyelids and eyelashes protect our eyes from the environment and from too much light. They also spread out the tears each time we blink to keep the eye wet.

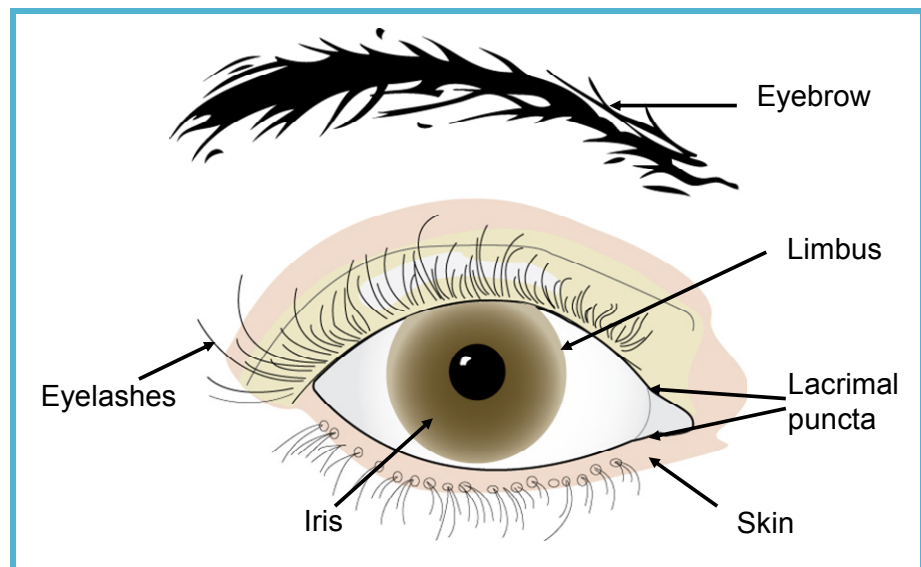


Figure 1.6: The outside of the eye

EYEBROWS

The eyebrows are the arches of hair located above each eye.



The eyebrows help to protect the eye from perspiration (sweat) and foreign bodies.

PARTS OF THE EYE (cont.)

LACRIMAL PUNCTA

Fresh tears are always being made, and tears need a way to drain out of the eyes. The openings to the tear drainage system are called the lacrimal puncta, or simply the puncta. These tiny drainage holes are located on the eyelid margins near the inside corners of the eyes.



The tears drain into the nose through the puncta. This is why your nose runs when you cry.

Sometimes people (especially older people and babies) have a blocked punctum. The tears then run over their cheeks and it may look like they are crying. When this happens the punctum might need to be opened or unblocked.

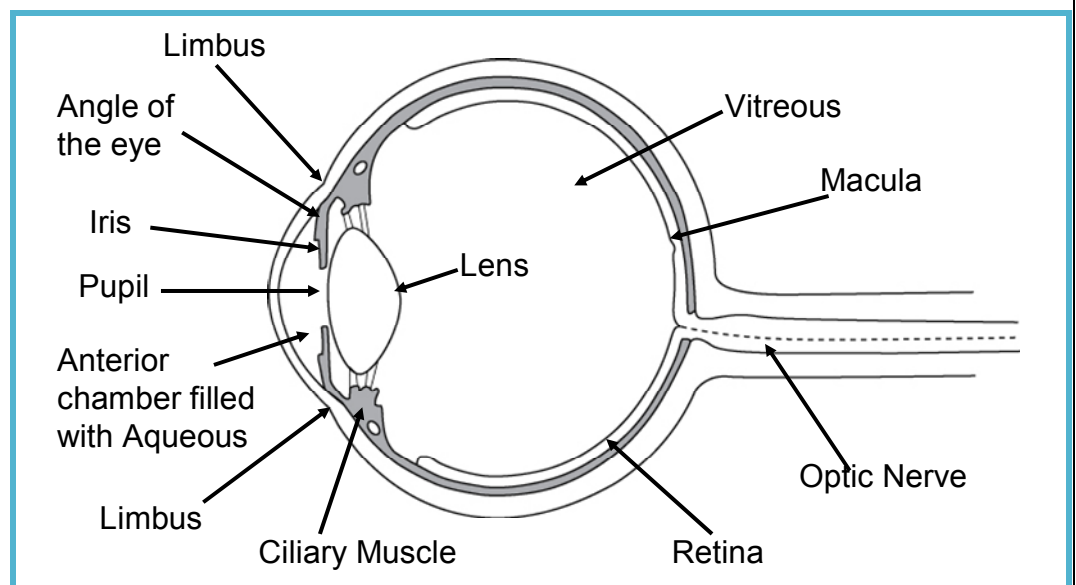


Figure 1.7: The internal eye

IRIS AND PUPIL

The coloured part of the eye is called the iris.

The iris is shaped like a compact disc – it is round and flat with a hole in the middle of it. It is located behind the cornea and the aqueous and in front of the vitreous.

The iris divides the eye into the anterior chamber (between the cornea and the iris), and the posterior chamber (between the iris and the retina).

Iris colour is different in different people. It can be brown, green, blue, or grey.

In the middle of the iris is a round hole called the pupil. The pupil usually looks black because the inside of the eyeball is dark.

Muscles in the iris change the pupil's size to let in the right amount of light.



In bright light the pupil is small and in dim light the pupil is large.

PARTS OF THE EYE (cont.)

AQUEOUS

The anterior chamber of the eye, between the cornea and the iris, is filled with a watery liquid called the aqueous humour, or simply the aqueous. The aqueous gives the front of the eye its shape.



The eyelids and eyelashes protect our eyes from the environment and from too much light. They also spread out the tears each time we blink to keep the eye wet.

The area in the anterior chamber where the cornea and iris meet is known as the angle of the eye. This is the place where the aqueous humour drains from the eye.

When aqueous humour is made it travels through the pupil into the anterior chamber and eventually exits the eye through the angle of the eye.

The balance between production and drainage of aqueous fluid determines the eye's intraocular pressure (IOP). If the IOP is too high for long periods of time, it can cause blindness.

LENS

The diagram above shows the crystalline lens which is usually simply called the lens. The lens is located behind the iris and the pupil. The lens is normally transparent, like clear glass, and can usually only be seen with the help of special instruments.

Sometimes the lens can become cloudy, especially in older people. This is called cataract. If the cataract is very dense, we can see the lens through the pupil because it looks white or yellow instead of black.

The lens is suspended behind the pupil by zonular fibres. Zonular fibres are often simply called zonules. One end of the zonule is joined to the lens and the other end is joined to the ciliary muscle. When the ciliary muscle contracts or relaxes, the zonules change the shape of the lens, which changes the focusing power of the lens.



The purpose of the lens is to change the focus of the eye so that we can see things at different distances. When we are young the lens is soft and flexible and we can focus to see things that are very close to the eye. This is called accommodation.

CILIARY MUSCLE

The ciliary muscle is a ring of muscle located around the lens. The ciliary muscle is joined to the lens by the zonules.

The ciliary muscle changes the shape of the crystalline lens so that the eye can accommodate.



When the ciliary muscle contracts (pulls together) the lens changes focus.

When the ciliary muscle contracts, the zonules, which connect the ciliary body to the lens, loosen and the lens becomes thicker – this increases the focusing power of the lens. When this happens we say that the eye is accommodating.

When the ciliary muscle relaxes, the zonules become taut (stretched tightly) and the lens becomes thinner – this decreases the focusing power of the lens.



A good way to think of the zonules is to imagine them as strands of a spider's web that join the ciliary muscle to the lens.

PARTS OF THE EYE (cont.)

CILIARY MUSCLE (cont.)

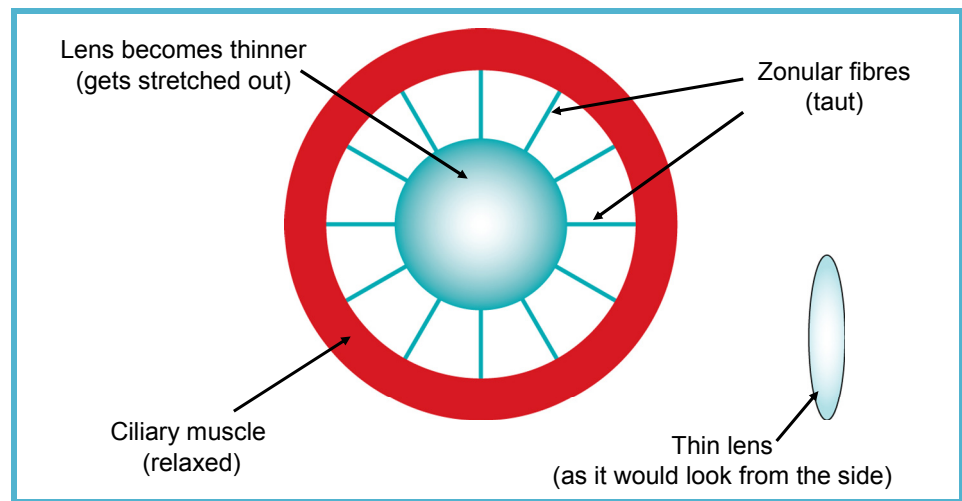


Figure 1.8: When the ciliary muscle relaxes it moves away from the lens. When this happens the zonules become taut and pull the lens outwards so that it is thinner

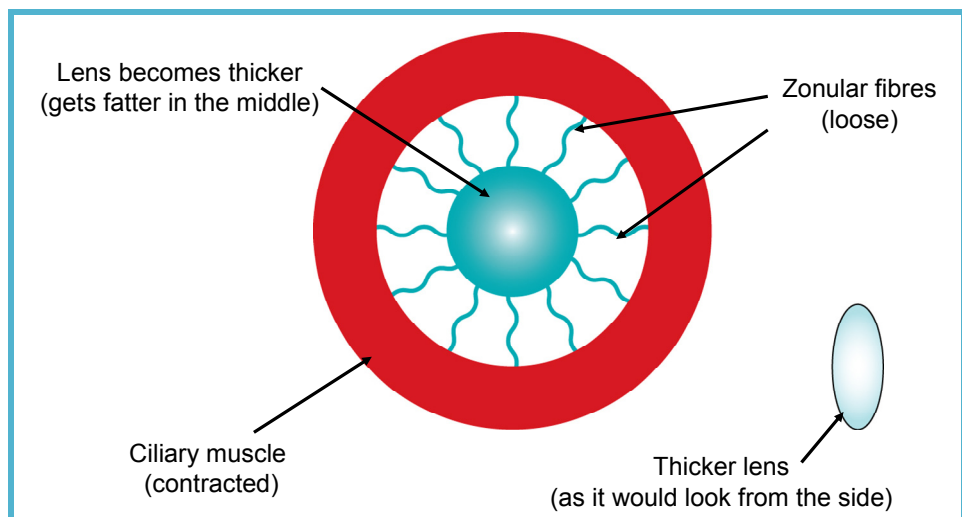


Figure 1.9: When the ciliary muscle contracts it gets closer to the lens. When this happens the zonules become looser and let the lens become thicker

As we get older, the lens slowly gets harder and less flexible and cannot change shape so easily. This means that we cannot change our focus so well. We can no longer hold things close to us and still see them well. This usually happens around the time we are 45 years old, and is called presbyopia.

Presbyopia can be corrected with reading spectacles. As the years go by the reading spectacles need to be made stronger because the lens gets harder and the presbyopia increases.

PARTS OF THE EYE (cont.)

VITREOUS BODY

The inside of the eye is filled with a transparent gel, or clear jelly. This is called the vitreous body, vitreous humour, or simply the vitreous. The vitreous is mainly water and accounts for about $\frac{2}{3}$ ^{rds} of the eye's volume.



The vitreous helps give the eyeball its shape.

FUNDUS

The fundus is a general term which refers to the inside of the eye that can be seen when looking through the pupil with a special instrument. The fundus includes the retina, the optic disc, and the blood vessels at the back of the eye. When we use a special instrument, such as an ophthalmoscope, to examine this part of the eye, we call it a fundus examination.

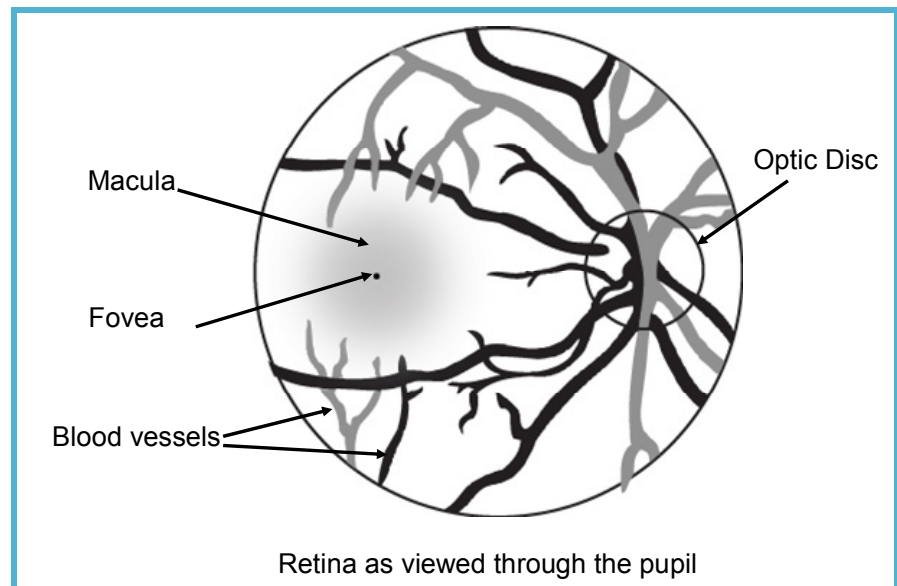


Figure 1.10: Diagram of the fundus when viewed with an ophthalmoscope

RETINA

The retina is the inside layer of the eyeball.

The retina is covered with millions of photoreceptor cells – almost like tiles on a bathroom floor. There are two different types of photoreceptor cells, namely rod cells and cone cells (or simply rods and cones). The rods are responsible for vision in dim light conditions. The cones are responsible for colour vision and good central vision.

When light rays enter the eye, they are received by the photoreceptor cells and changed into nerve messages. These nerve messages travel to the brain through the optic nerve.



The retina catches light that comes into the eye and changes it into nerve messages that are sent to the brain.

The centre of the retina is called the macula. It is a small and highly sensitive part of the retina that is responsible for clear central vision. The centre of the macula is called the fovea. The macula lets us see small details and do tasks that require good central vision like reading and sewing.

PARTS OF THE EYE (cont.)

OPTIC NERVE

The optic nerve can be thought of as a telephone wire that lets the eye talk to the brain – it tells the brain what it sees.



The optic nerve sends nerve messages from the retina to the brain.

When looking at the fundus through the pupil (using a special piece of equipment such as an ophthalmoscope), a part of the optic nerve can be seen. This part of the optic nerve is called the optic disc. The optic disc is sometimes also called the optic nerve head.

There is no retina over the optic disc, so this part of the back of the eye is not able to receive light, and is not able to send visual messages to the brain. This area is called the blind spot, and everyone has one in each eye.

The brain is very clever at disguising (hiding) the blind spot from us so most people never know that they have one.

EXTRAOCULAR MUSCLES

There are six muscles attached to the outside of each eye. These muscles are known as the extraocular muscles (EOMs) and are responsible for controlling eye movements.



The extraocular muscles move the eyeballs to point in different directions.

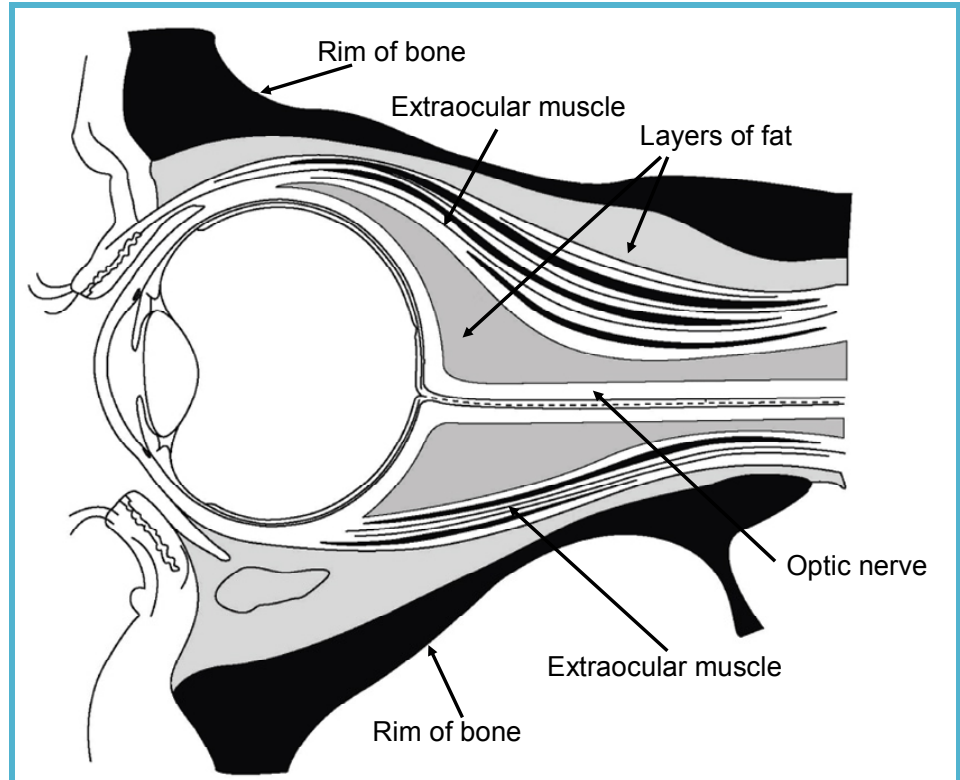


Figure 1.11: The orbit and the optic nerve

HOW DOES THE EYE SEE?

Being able to see depends on three things:

1. The tear film, cornea, aqueous humour, crystalline lens, and vitreous must be clear, so that light can reach the retina without being interrupted. These ocular structures all lie in a line along the visual axis of the eye.
2. The light from the image must be focused by the cornea and the crystalline lens so that it forms a clear image on the retina at the back of the eye.
3. The optic nerve must carry the information received by the retina to the brain, so that it can be translated into a meaningful visual image.

ANATOMICAL TERMS OF LOCATION

Directional Terms for the Eyes

A man comes to you complaining of a painful eye. When you examine him you discover that he has a piece of metal (a "foreign body") that has become stuck in his eye. You need to write a referral letter to a health professional so that he can have the metal foreign body removed. In order for you to describe the location of the foreign body when you write your letter, you need to know the appropriate "directional" terms to use:

Anterior:	In front of	<i>Example:</i> The cornea is anterior to the iris.
Posterior:	Behind	<i>Example:</i> The retina is posterior to the crystalline lens.
Superior:	Above	<i>Example:</i> The eyebrow is superior to the eye.
Inferior:	Below	<i>Example:</i> The mouth is inferior to the eye.
Nasal:	Closer to the nose; further away from the ear.	
Temporal:	Further away from the nose; closer to the ear.	

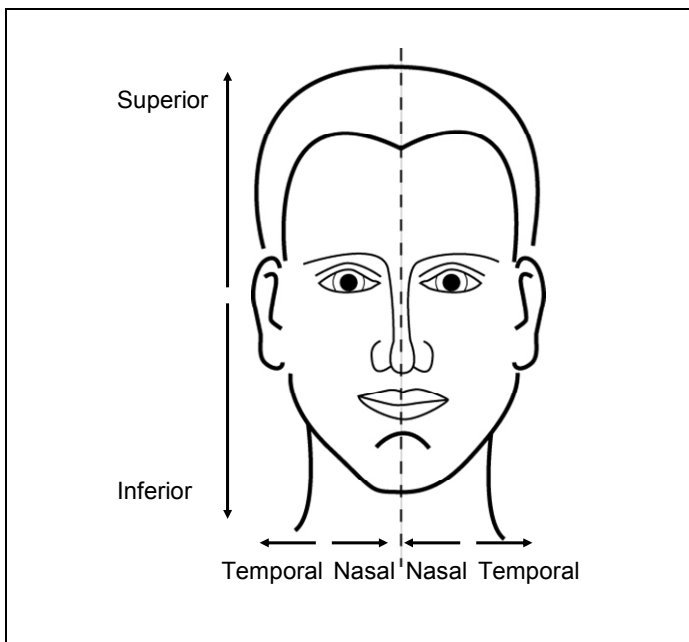


Figure 1.12: Front view of the head

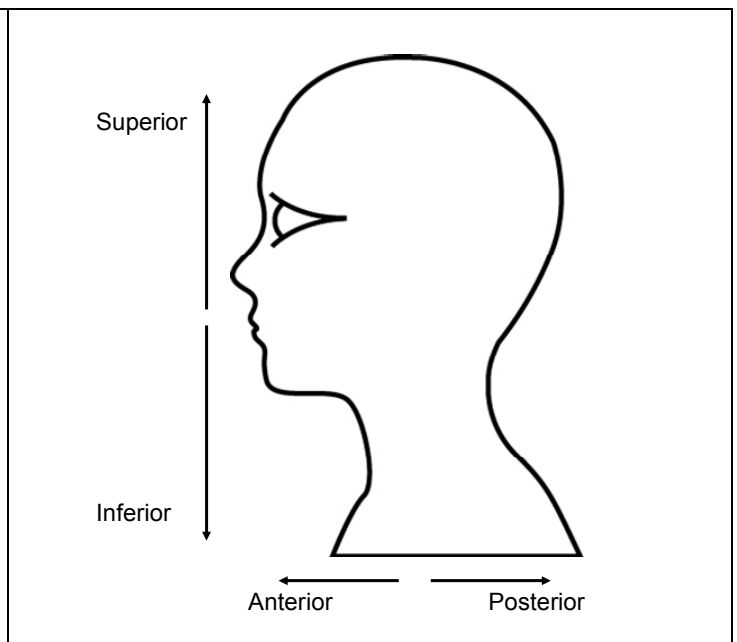


Figure 1.13: Side view of the head

SUMMARY: PARTS OF THE EYE

ORBIT

- The bony socket in the skull that holds and protects the eye.

TEAR FILM

- Provides nutrients to and protects the cornea, and keeps the eye wet.

SCLERA

- Strong white covering of the eyeball.
- Protects the eye and gives it its shape.

CORNEA

- Like the window of the eye.
- Transparent, so that it can let light into the eyeball to allow us to see.
- Helps to focus light that enters the eye.
- Contains many nerve endings, so is very sensitive to pain.

LIMBUS

- The limbus is where the cornea and the conjunctiva meet.

CONJUNCTIVA

- A very thin layer that is clear except for a few small blood vessels.
- The bulbar conjunctiva covers the anterior sclera, but not the cornea.
→ The white sclera can be seen underneath the bulbar conjunctiva.
- The palpebral conjunctiva covers the inside of the top and bottom eyelids.
→ The pink eyelid can be seen underneath the palpebral conjunctiva.
- The conjunctiva can look red if there is an eye problem.

EYELIDS

- Protect the eyes from the environment.
- Spread tears when blinking to keep the eye wet.

EYEBROWS

- Protect the eye from foreign bodies and perspiration.

LACRIMAL PUNCTA

- Drain tears from the eye.

SUMMARY – PARTS OF THE EYE (cont.)

IRIS AND PUNCTA

- The round coloured part of the eye is called the iris.
→ The iris is shaped like a compact disc – round and flat with a hole in the middle.
- The black, round hole in the middle of the iris is called the pupil.
→ The muscles in the iris change the pupil's size to let the right amount of light into the eye.

AQUEOUS

- Watery liquid in the anterior chamber.
- Provides nutrients to the cornea and the lens.

LENS

- Transparent in a normal eye.
- Suspended behind the pupil.
- Changes in the lens' shape change the eye's focus from distance to near.

CILIARY MUSCLE

- Changes the focusing ability of the eye by changing the shape of the lens.

VITREOUS BODY

- Transparent gel between the lens and the retina.
- Helps give shape to the eyeball.

FUNDUS

- The fundus is the inside of the eye that can be seen when looking through the pupil with a special instrument (such as an ophthalmoscope).
- It includes the retina, optic disc and blood vessels.

RETINA

- Catches the light that comes into the eye and changes it into nerve messages that are sent to the brain.
- The central portion of the retina is the macula.

OPTIC NERVE

- Sends messages to the brain.
- The visible part of the optic nerve (when looking through the pupil) is called the optic disc.

EXTRAOCULAR MUSCLES (EOMs)

- Six muscles are attached to each eye.
- EOMs move the eyeballs in various directions.

SUMMARY – PARTS OF THE EYE (cont.)

THREE KEY REQUIREMENTS FOR GOOD VISION

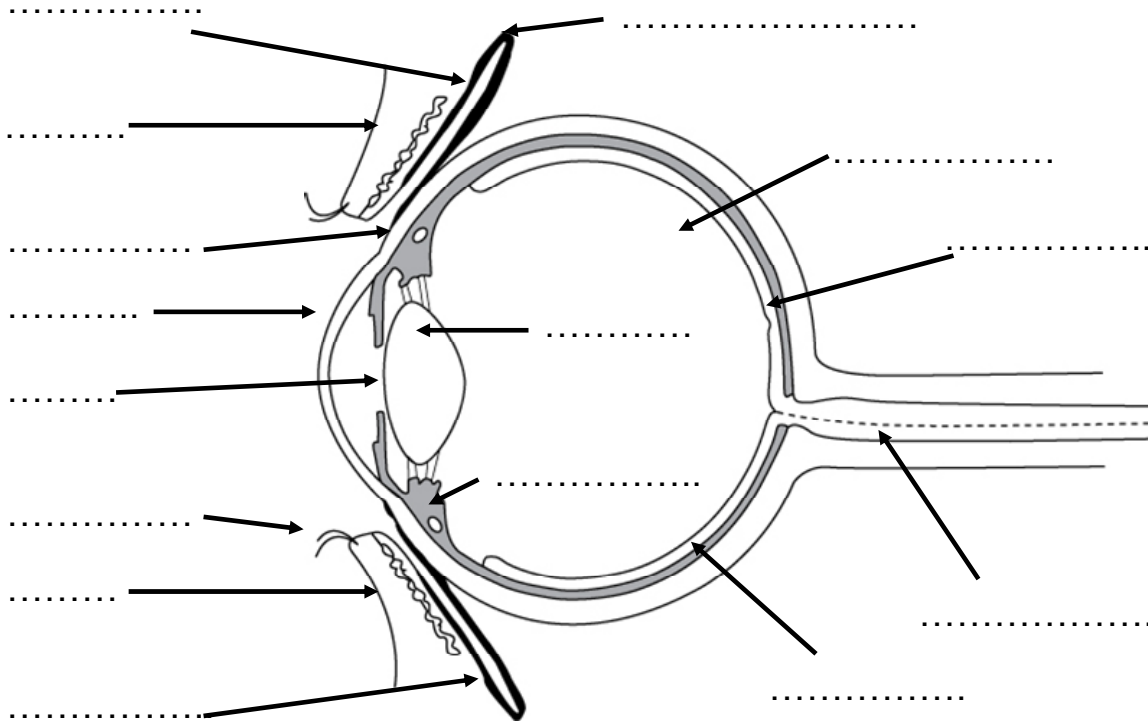
- The cornea, lens and vitreous must be transparent.
- Light is focused by the cornea and the crystalline lens to form a clear image on the retina.
- The optic nerve sends information received by the retina to the brain.

ANATOMICAL TERMS OF LOCATION

- **Anterior** = In front of
- **Posterior** = Behind
- **Superior** = Above
- **Inferior** = Below
- **Nasal** = Closer to the nose; further away from the ear
- **Temporal** = Further away from the nose; closer to the ear.

TEST YOURSELF QUESTIONS

1. Name parts of the eye in this diagram.



2. Complete this table.

PARTS OF THE EYE	WHAT THEY DO
Eyelids and lashes	
Conjunctiva	
Sclera	
Cornea	
Pupil	
Iris	
Lens	
Retina	
Optic nerve	
Punctum	
Vitreous	



NOTES