Unit
1A

Chapter 8
Communication systems

Figure 8.1 An efficient communication system ensures that the body functions in a coordinated way

Unit content

Body systems

The body is organised from cells to tissues, organs and systems. The major body systems are the digestive, excretory, skeletal, muscular, respiratory, circulatory, nervous, endocrine, immune and reproductive systems and are related to life processes.

Organisation:
- hierarchy of organisation in the body
- location of organs associated with each body system in the body.

Functions:
- function of each organ system related to life processes .

Cells, metabolism and regulation

The senses allow the body to respond to external stimuli.

Stimuli:
- the senses; touch, taste, smell, sight and hearing
- stimuli detected include light, sound, smell, taste, temperature, texture and pressure
- simple responses *e.g. pupil size and blinking.*

Imagine that you are starting a race. You hear the gun go off and the muscles of your legs start working. The muscles must contract and relax at exactly the right time. You will breathe heavily to take in more oxygen. Your heart will speed up to get extra oxygen to the contracting muscles. You will begin to sweat to lose heat so that your body temperature remains constant. Many other changes will occur in the way your body is functioning. For all these changes to occur at the right time communication is required.

The body needs an efficient communication system to coordinate the activities of the cells, tissues, organs and systems and to enable you to respond to external or internal changes. The nervous and endocrine systems are the body systems that are involved in communication and detection of changes.

The nervous system

The nervous system consists of the brain and spinal cord and the nerves that are attached to them. Closely associated with the nervous system are the sense organs that are sensitive to changes occurring outside the body.

Nerve cells

Nerve cells, or **neurons**, make up the nervous system. Neurons vary in size and shape but they all have a cell body and extensions from the cell body. The extensions are able to carry messages, called **nerve impulses**, towards or away from the cell body (see Fig. 8.2).

As Figure 8.2 shows, **axons** are cell extensions that carry nerve impulses away from the cell body. **Dendrites** are extensions that carry impulses towards the cell body. Axons and dendrites are also called **nerve fibres**. **Nerves** are bundles of nerve fibres (axons and dendrites) held together by connective tissue (see Table 8.1).

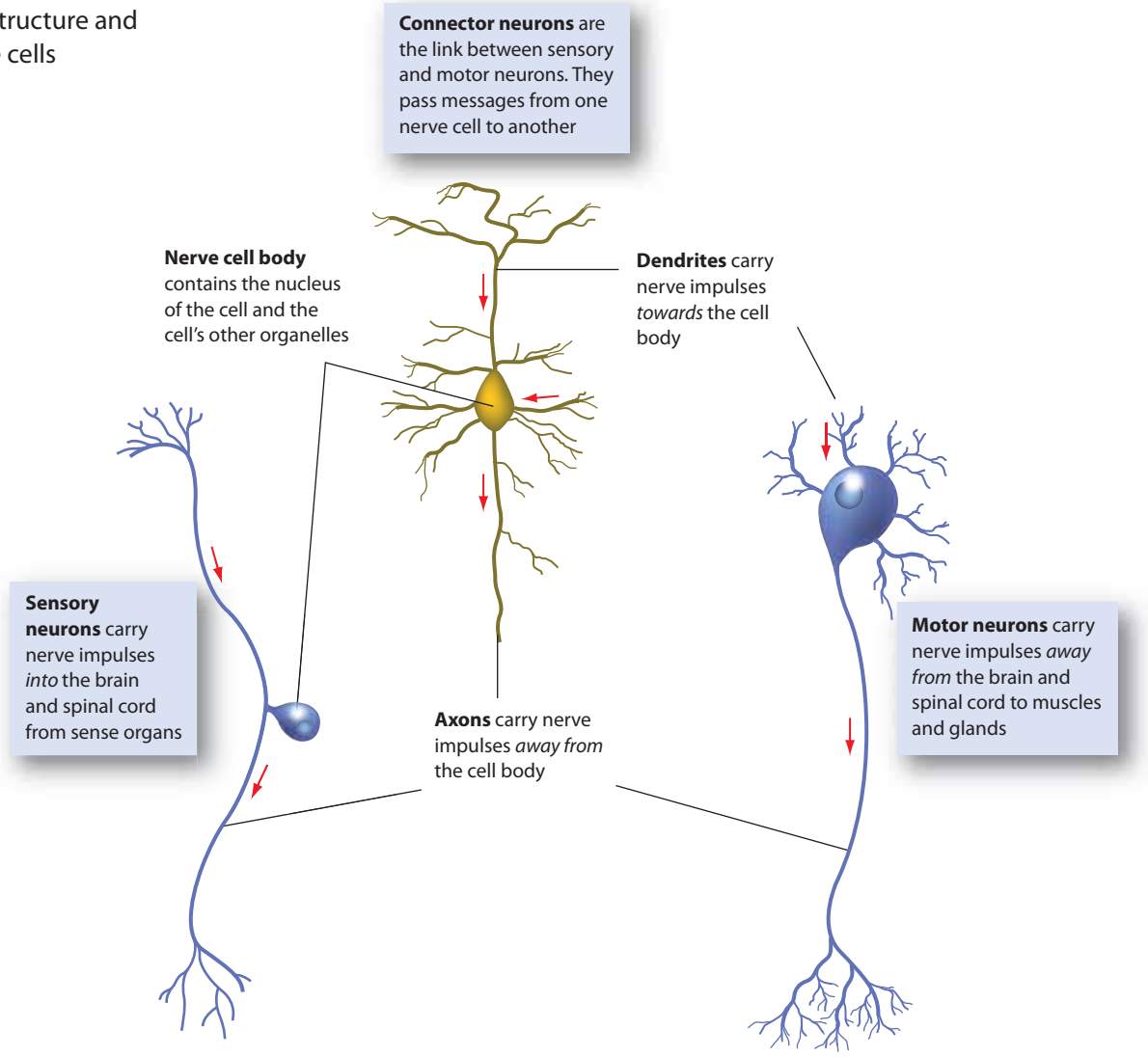
Table 8.1 The difference between nerves, nerve fibres and neurons

Neuron	A nerve cell
Nerve fibre	Any long extension from the body of a nerve cell (an axon or a dendrite)
Nerve	A bundle of nerve fibres held together by connective tissue

Parts of the nervous system

The brain and spinal cord make up the **central nervous system** while the nerves that take messages into and out of the central nervous system are called the **peripheral nervous system**. This does not mean that there are two separate nervous systems. The parts are named for convenience. The central and peripheral nervous systems are both part of the body's one nervous system (see Fig. 8.3).

Figure 8.2 The structure and function of nerve cells



The peripheral nervous system is made up of twelve pairs of nerves that are connected directly to the brain and thirty-one pairs of nerves that are connected to the spinal cord. The twelve pairs of nerves connected to the brain are called **cranial nerves**. They take messages to and from places in the head, neck and shoulders. The nerves connected to the spinal cord are the **spinal nerves**. They have branches that take messages to and from most parts of the body.

The brain

Of all the characteristics that make humans different from other species of organisms, the human brain is perhaps the most significant. Our brains have allowed us to communicate by language, to develop complex tools like computers and to explore beyond the earth on which we live. At the same time the brain regulates functions like body temperature, breathing and heart beat. Figure 8.5 summarises some of the important functions of parts of the brain.

The brain is a very delicate organ. It is protected by the bones of the skull and by three layers of membrane that surround it. The membranes around the brain are called the **meninges**.

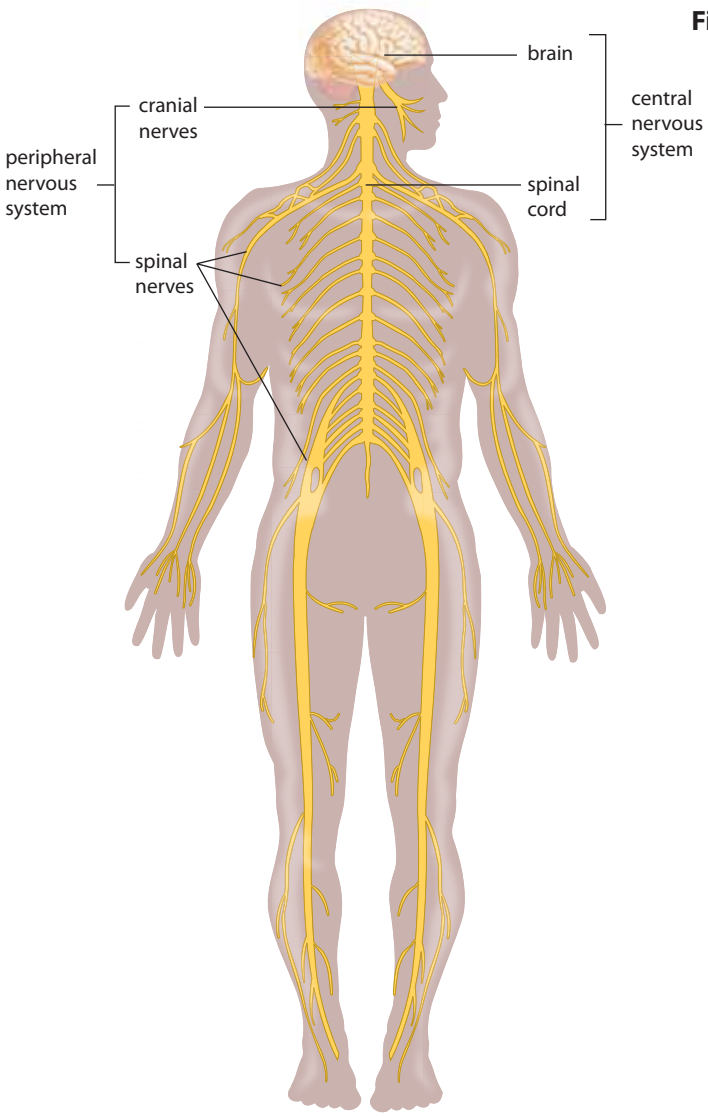


Figure 8.3 The nervous system

Figure 8.4 A spinal cord cut across showing the H-shaped area of grey matter (coloured brown in this photo) surrounded by white matter

If the brain of a mammal is cut open the outside layer appears grey and the inside is white. The outer layer, the **grey matter**, is made up of nerve cell bodies. The inner part, the **white matter**, is made up of nerve fibres—the extensions from nerve cell bodies.

The spinal cord

Like the brain, the spinal cord is well protected. It runs through openings in the **vertebrae**, the bones that make up the backbone. Inside the openings in the vertebrae are meninges, the same three membranes that protect the brain (see Fig. 8.6).

In the spinal cord the grey matter forms an H-shaped area in the middle while the white matter is on the outside (see Fig. 8.4).

Reflex responses

A change in the internal or external environment is called a **stimulus**. The stimulus is detected by a **receptor**. A message is sent to the central nervous system and a change occurs as a result of the stimulus. This is called the **response**. The muscle or gland that carries out the response is called the **effector**.

There are many websites devoted to the nervous system, including:

- http://www.betterhealth.vic.gov.au/bhcv2/bhcarticles.nsf/pages/Nervous_system
- http://www.innerbody.com/image/nervov.html

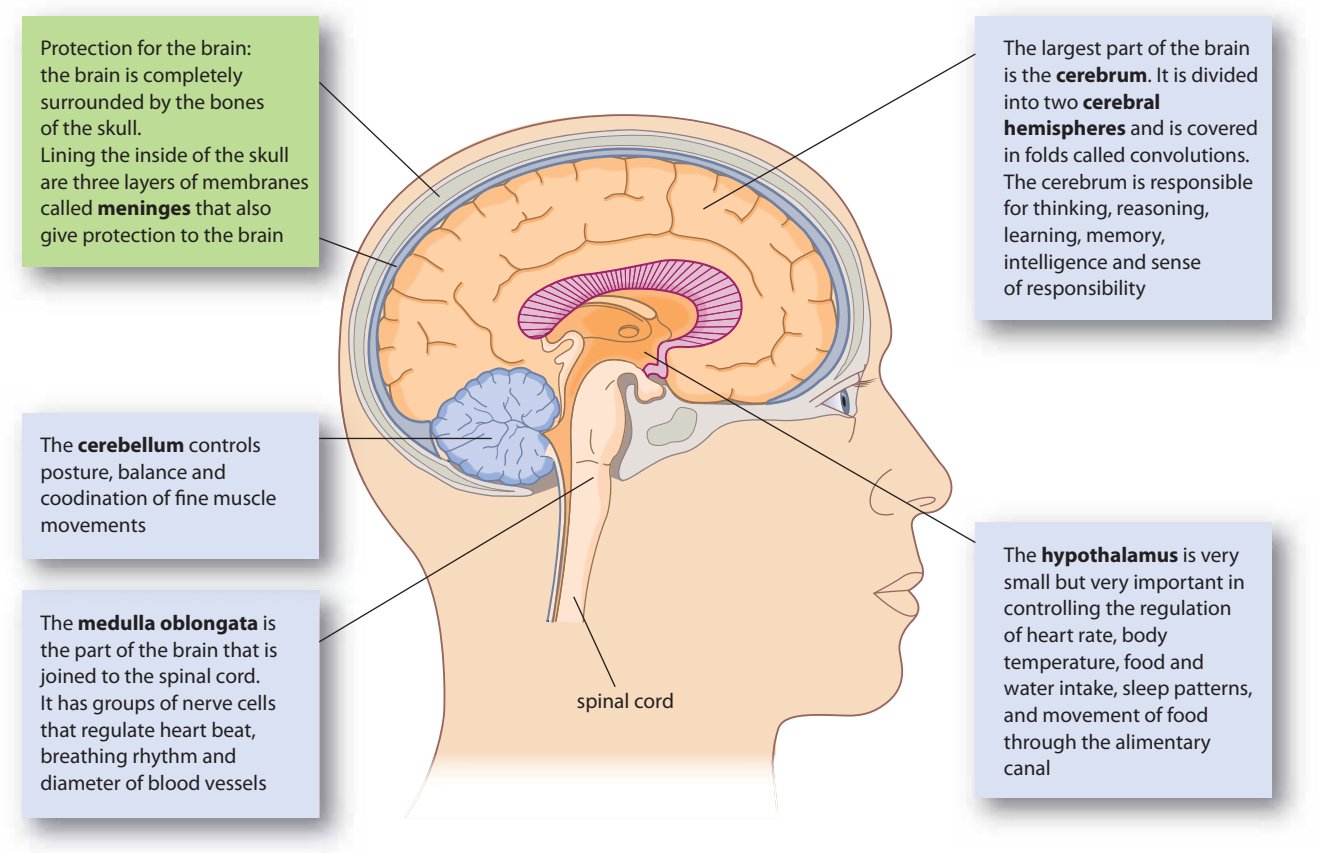


Figure 8.5 The main parts of the brain and their functions

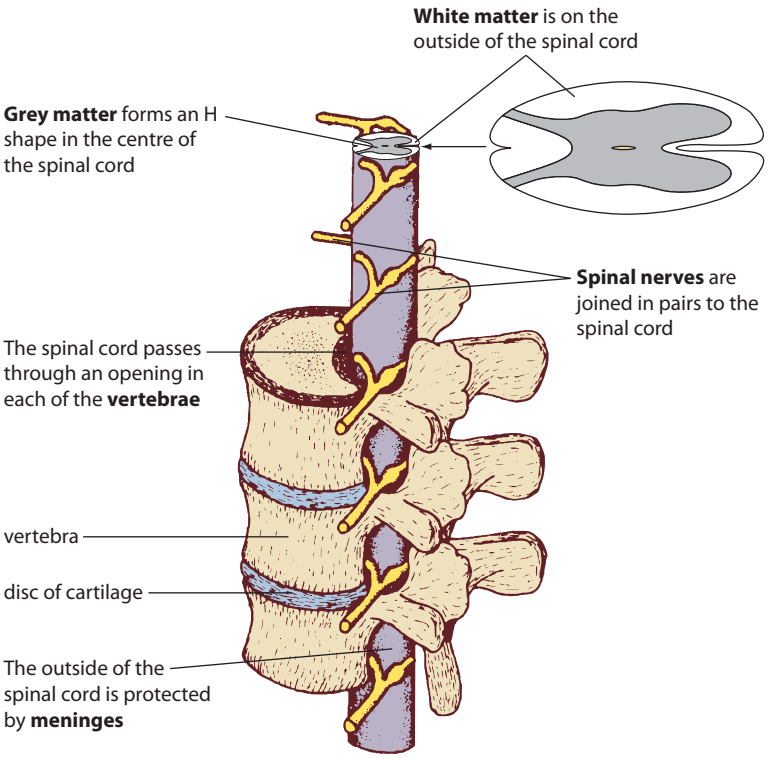


Figure 8.6 The spinal cord is protected by the bones of the spine

For example, if you step on a sharp object, the object pressing into your foot is the stimulus. Pain receptors in your foot send a message to the spinal cord. The spinal cord sends messages to the muscles of your leg. The leg muscles are the effectors and they contract, pulling your foot away from the painful stimulus. Such a response is called a **reflex**.

Reflex responses are fast and involuntary—they happen automatically without any conscious thought. The pathway taken by the nerve impulses in a simple reflex is called a **reflex arc** (see Fig. 8.8). Reflex responses also occur when there are internal changes, such as when your heart speeds up during exercise.

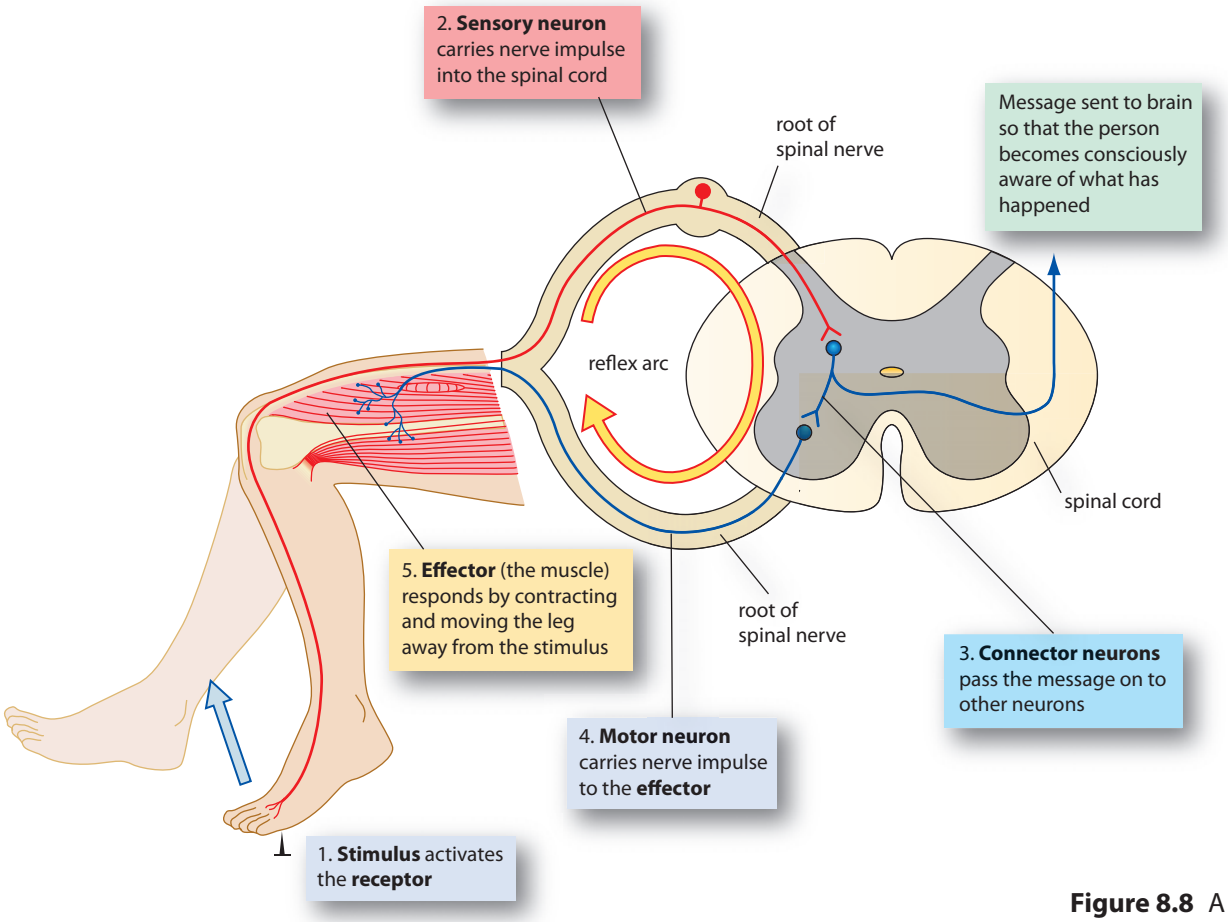


Figure 8.8 A reflex arc

Nervous system problems

Spinal cord injury

Injury to the spinal cord can be caused when vertebrae are broken or dislocated. The damage to the spinal cord stops nerve impulses from travelling past the point of injury. This results in loss of feeling and voluntary movement below the point where the damage occurred. Spinal cord injury in the neck can cause **quadriplegia**, inability to move the upper and lower limbs. Damage lower down the spinal cord may cause **paraplegia**, paralysis of the lower limbs.

Stroke

A stroke occurs when blood supply to part of the brain is interrupted. It may be due to a clot that blocks a blood vessel, or to bleeding due to a burst blood vessel. Some brain cells die because they no longer receive the oxygen carried by the blood. Strokes may be quite mild, with passing dizziness or blackout, or they may be very severe, causing paralysis or death.

To see animations of a reflex arc go to http://www.mhhe.com/cgibin/netquiz_get.pl?qfooter=/usr/web/home/mhhe/biosci/genbio/animation_quizzes/animate_93fq.htm&afooter=/usr/web/home/mhhe/biosci/genbio/nimation_quizzes/animate_93a.txt

Cerebral palsy

The term **cerebral palsy** is used to describe disorders that disrupt normal movements and which appear in the first few years of life. The problems are caused by damage to, or faulty development of, areas in the brain that control movement and posture. Symptoms may be mild, such as a weakness in a hand, or may be severe, with slow, jerky or unpredictable movements. There is no cure for cerebral palsy but much can be done to manage the condition to enable people to lead near normal lives.

Effects of alcohol, sedatives and anaesthetics

There are many drugs that affect the transmission of nerve impulses. **Anaesthetics** are used to block the sensation of pain from all or part of the body. **Sedatives** tend to slow down body functioning and have a calming effect. **Alcohol** may also have a relaxing effect but other effects include slowing reaction time, reducing coordination and reducing concentration.

Meningitis

Meningitis is inflammation of the meninges, the membranes that cover the brain and spinal cord. The usual cause is an infection of the meninges by bacteria, viruses or other micro-organisms. The most common bacterial infection is known as meningococcal disease; it is very serious and can cause death. Vaccines are available that protect against some bacterial forms of the disease.

Amoebic meningitis occurs in some parts of Australia. It is caused by a single-celled animal, called an *Amoeba*, which may reproduce in the warm water of swimming pools, ponds and lakes during summer. When swimming or playing in water containing amoebae the organism can be sniffed up the nose, causing infection.

Symptoms of meningitis include stiffness of the neck, severe headache and fever.

Sense organs

The ability to detect stimuli is essential for our survival. By detecting changes inside and outside the body we are able to respond so that all of our cells continue to function normally. In this section we will be mainly concerned with the detection of light by the eye and sound by the ear.

Receptors detect stimuli and then produce nerve impulses. In some cases receptors may be widely distributed over the body, such as touch receptors in the skin. In other cases, particular receptors are concentrated in a **sense organ**, such as the light receptors in the eye (see Fig. 8.10). If the nerve impulses produced by a receptor are conducted to the cerebrum we become consciously aware of the stimulus. This awareness is called a **sensation**. Some impulses from receptors may only go as far as the spinal cord or unconscious parts of the brain and result in involuntary responses such as the one illustrated in Figure 8.8.

The eye

The eye is a highly specialised organ that focuses light rays onto light sensitive cells. The structure of the eye and the functions of its parts are shown in Figure 8.10.

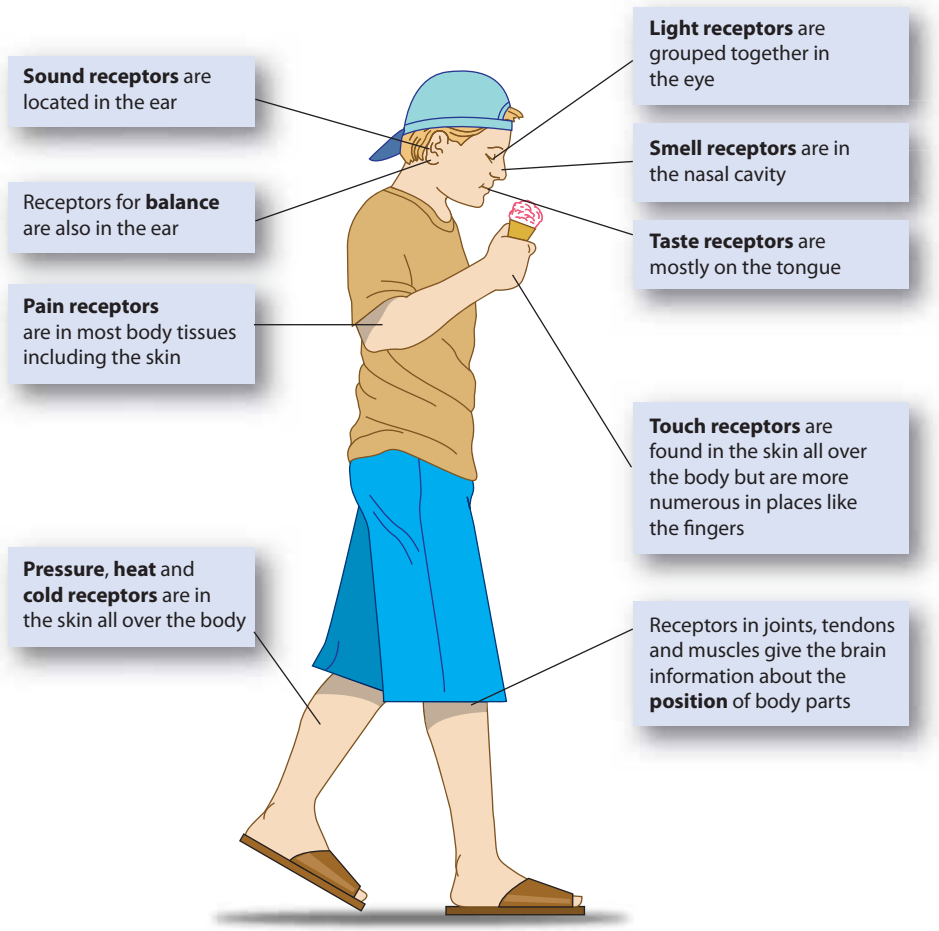


Figure 8.9 Receptors may be concentrated in sense organs or may be widely distributed over the body

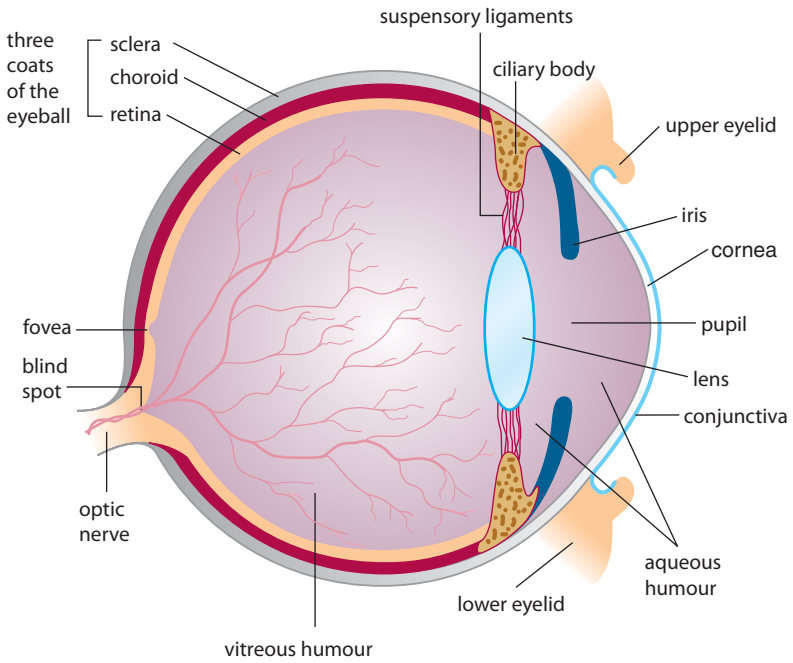


Figure 8.10 A section through the eye showing the parts

Table 8.2 Functions of parts of the eye

Sclera	The part we see as the white of the eye. It is tough and fibrous	The three coats of the eyeball
Choroid	Lines most of the inside of the sclera. Contains many blood vessels and has a dark pigment that prevents light from being reflected inside the eyeball	
Retina	Lines the rear part of the inside of the eyeball. Contains the rods and cones, the nerve cells that are sensitive to light	
Fovea	A small depression in the middle of the retina. It has a high concentration of cones and is the area of sharpest vision when we look directly at an object	
Optic nerve	Contains nerve fibres that connect the eye to the brain	
Blind spot	Located at the point where the optic nerve leaves the eye. There are no light sensitive cells at this spot	
Lens	A curved, transparent structure. Muscles can change its curvature so that it can focus light rays from near and far objects onto the retina	
Ciliary body	Contains muscles that can change the shape of the lens	
Ligaments	Join the ciliary muscles to the lens	
Aqueous humour	A watery fluid that fills the front chamber of the eye	Maintain shape of the eyeball
Vitreous humour	A jelly-like fluid that fills the back chamber of the eyeball	
Cornea	A transparent area of the sclera at the front of the eye. It allows light to pass into the eyeball	
Conjunctiva	A thin membrane that covers and protects the delicate cornea	
Iris	A continuation of the choroid at the front of the eye. Pigments in the iris give the eye its colour. Muscles in the iris can regulate the amount of light entering the eye by changing the diameter of the pupil	
Pupil	An opening in the centre of the iris through which light enters the eye	

The **lens** of the eye bends light rays so that they are focused on the retina at the back of the eyeball (see Fig. 8.11). It is able to change shape to focus on objects that are close to the eye or objects that are far away. This is called **accommodation**.

Light receptors in the eye are of two types: rods and cones. **Cones** are sensitive to bright light and they enable us to distinguish colours. They are concentrated in and around the fovea in the centre of the retina. **Rods** are specialised for vision in dim light. They cannot distinguish colours and are mostly around the sides of the retina.

For more information about the eye visit http://hyperphysics.phy-astr.gsu.edu/Hbase/vision/retina.html

For viewing close objects, the muscles around the lens (ciliary muscles) contract and the lens bulges. When viewing distant objects, the ciliary muscles are relaxed and the lens is flatter (see Fig. 8.12).

The **iris** is the coloured part of the eye around the pupil. It contains muscles that can increase or decrease the size of the pupil, the opening through which light enters the eye. In dim light the pupil is wide open (dilated) while in bright light the pupil is constricted (see Fig. 8.13). The automatic response of the iris to changes in light intensity is a good example of a reflex response.

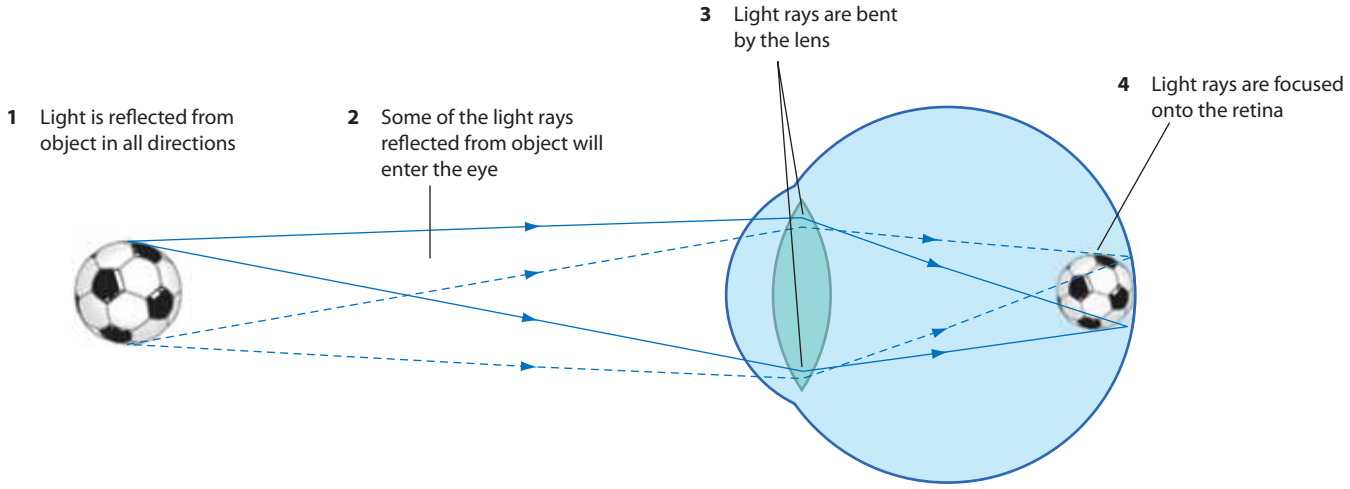
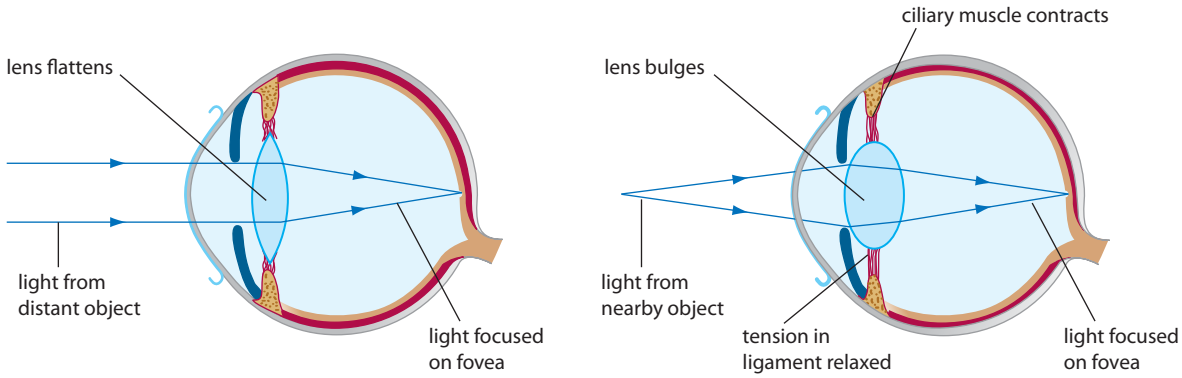


Figure 8.11 The lens bends light rays so that they are focused onto the retina



(a) Accommodated for distant vision

(b) Accommodated for near vision

Figure 8.12 Accommodation of the lens for near and distant viewing

Figure 8.13 Constriction of the pupil in bright light and dilation in dim light

In humans both eyes face forwards. This means that there is overlap between what is seen with the right eye and what is seen with the left. Each eye sees a slightly different view of an object because the two eyes are a few centimetres apart. The brain puts the images seen by each eye together so that we see depth as well as height and breadth. This is called **stereoscopic** or **binocular vision** (see Fig. 8.14). Binocular vision enables us to judge depth and distance.

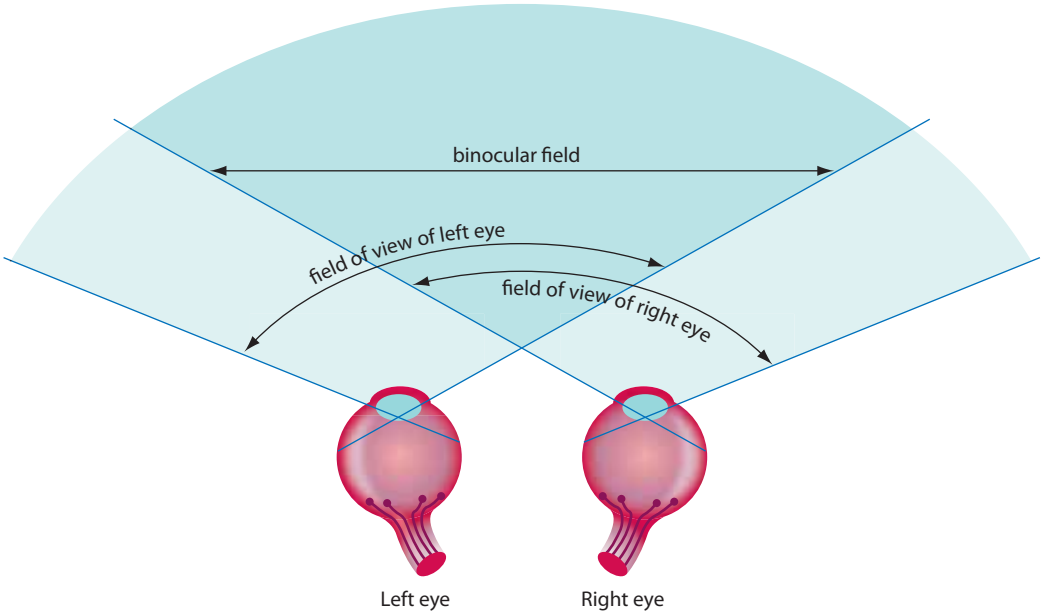


Figure 8.13 Binocular vision in humans

Defects of vision

Short sight

A short sighted person can see clearly objects that are close, but objects in the distance appear fuzzy. This is because only light rays from close objects can be brought to a focus on the retina. Rays from distant objects are focused in front of the retina. The usual cause of short sight is that the eyeball is too long. Most cases can be corrected by spectacles with concave (inward curving) lenses worn for distance viewing. The lenses cause parallel light rays to spread out slightly before they enter the eye and they can then be focused accurately onto the retina (see Fig. 8.15).

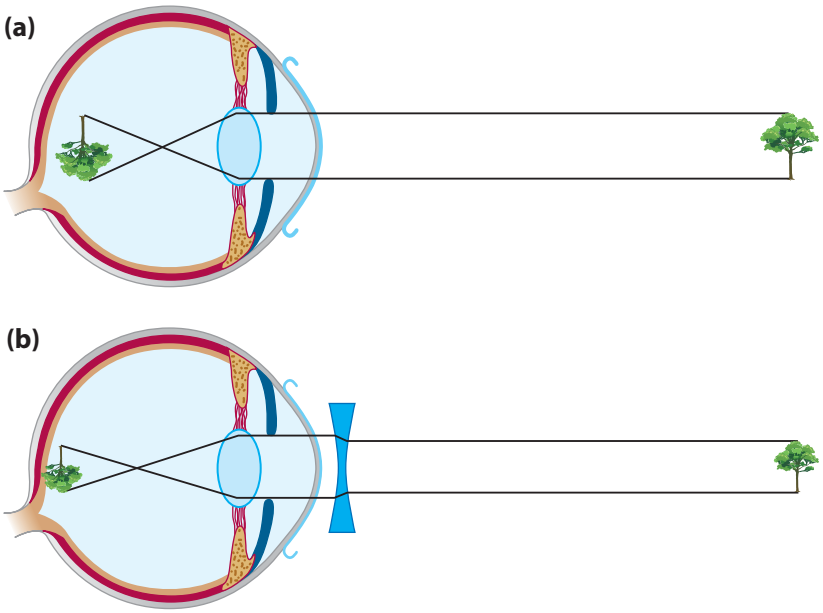


Figure 8.15 Short sight: **(a)** parallel light rays from distant objects are focused in front of the retina; **(b)** corrected by use of spectacles with concave lenses

Long sight

A long sighted person can see distant objects clearly but close objects appear fuzzy. Parallel light rays from distant objects are focused onto the retina but the lens cannot bulge enough to focus rays from close objects onto the retina. Usually this occurs because the eyeball is too short. Spectacles with convex (outward curving) lenses can be used to correct most cases of long sight. They cause the light rays to bend inwards slightly before entering the eye and the lens of the eye can then bend the rays so that they focus to a point on the retina (see Fig. 8.16).

Effects of age

As a person becomes older the lens gradually loses its flexibility. It becomes unable to bulge sufficiently to bend light rays from close objects to focus them onto the retina. A person with normal vision has to hold books further and further away in order to read them. Eventually, it ecomes necessary to wear spectacles with convex lenses for reading and close work. The spectacle lens bends the light rays slightly inwards before they enter the eye and the eye lens can then complete the bending and focus the rays to a point on the retina. At some time between forty and fifty years of age most people begin wearing spectacles for close work.

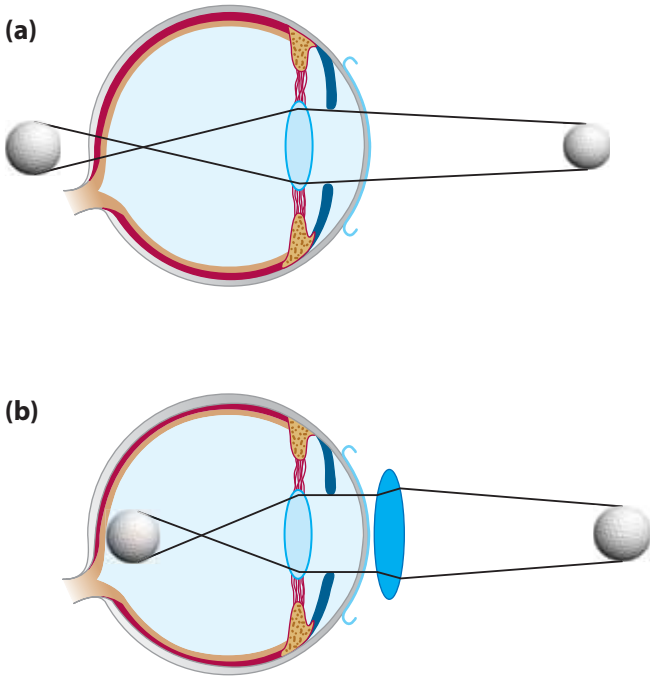


Figure 8.16 Long sight: **(a)** light rays from close objects are focused behind the retina; **(b)** corrected by spectacles with convex lenses

The ear

The ear contains receptors for sound waves and also receptors that detect head position and movement. Thus, the ear is involved both in hearing and in keeping one's balance. In this section we will consider the role of the ear in hearing.

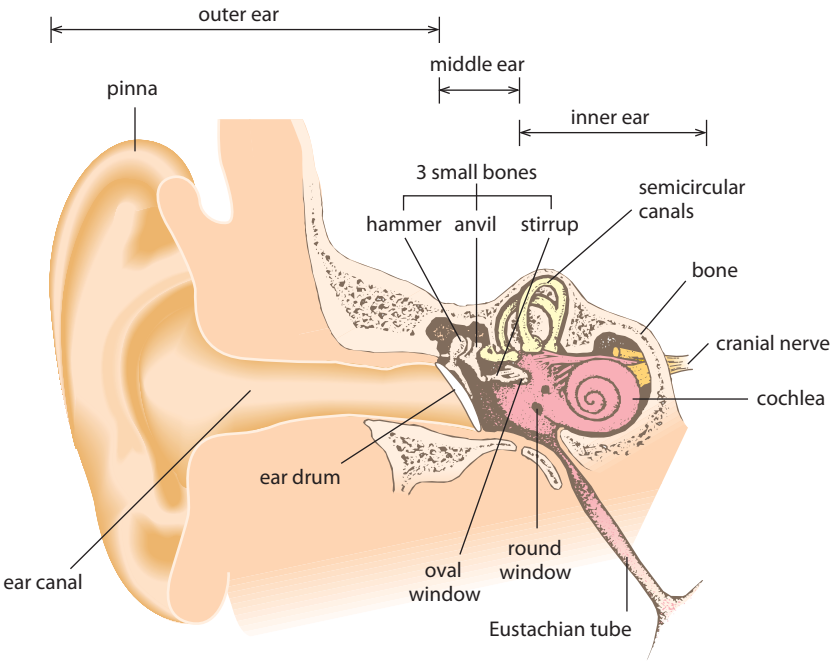


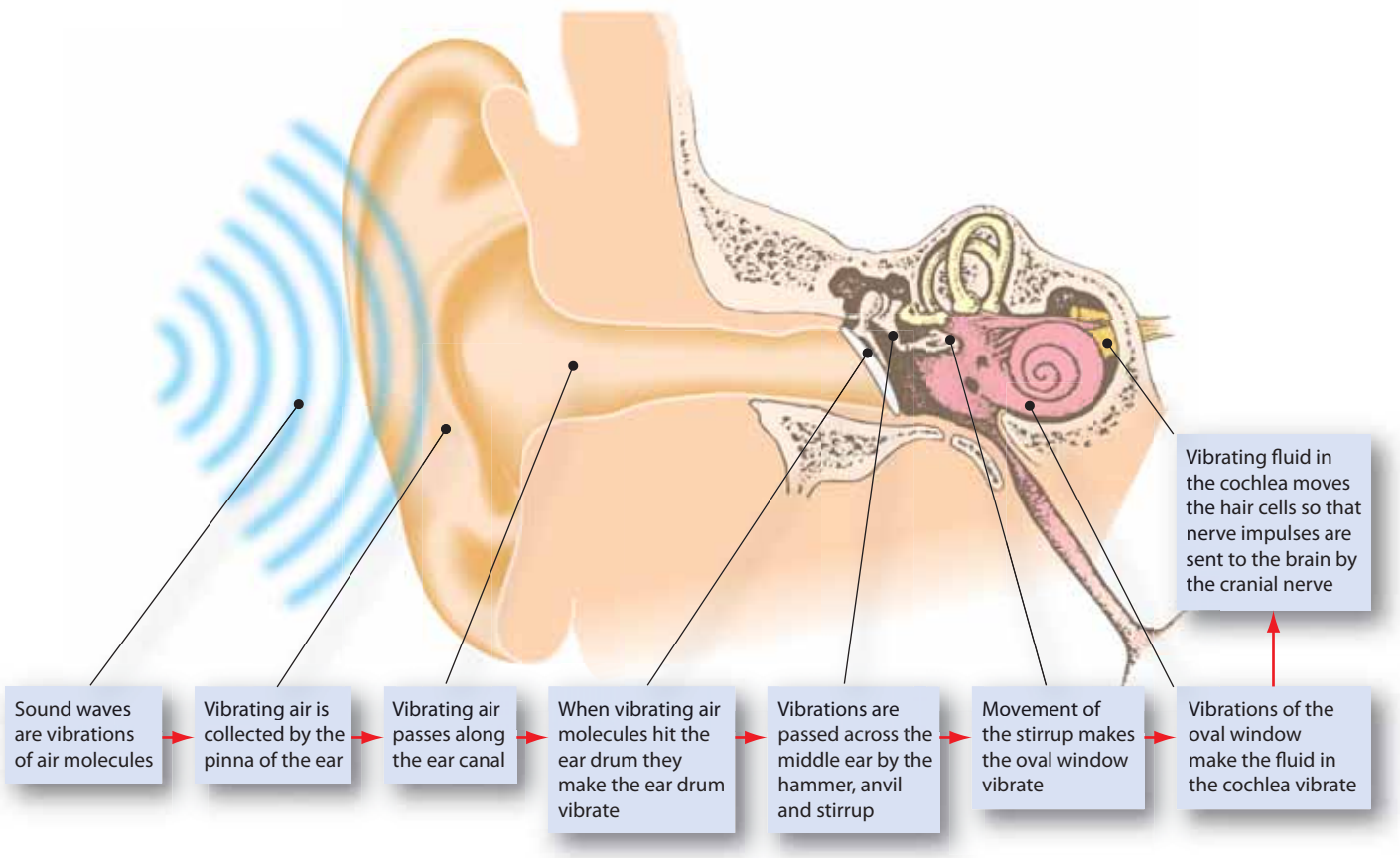
Figure 8.17 Parts of the ear

Figure 8.18 Some of the sensory hairs inside the cochlea of the ear: when the hairs are stimulated by moving fluid they send nerve impulses to the brain

Table8.3 Parts of the ear and their functions in hearing

Pinna	A flap of cartilage covered with skin, which helps to direct sounds waves into the ear
Ear canal	A tube about 2.5 cm long
Eardrum	A membrane that vibrates when hit by sound waves
Eustachian tube	A tube that connects the middle ear with the upper part of the throat. It allows air pressure on each side of the ear drum to be equal
Hammer	Three small bones that conduct the vibrations from the ear drum across the middle ear
Anvil	
Stirrup	
Oval window	A membrane between the middle and inner ear; made to vibrate by the movement transferred by the hammer, anvil and stirrup
Cochlea	A spiral tube filled with fluid; the fluid vibrates when the oval window vibrates; tiny hairs sensitive to movement are stimulated by the vibrating fluid and nerve impulses are sent to the brain where they are interpreted as sound
Round window	A membrane that compensates for movements of the oval window; when the oval window moves in, the round window moves out
Cranial nerve	Takes nerve impulses from receptors in the cochlea to the brain
Semicircular canals	Have no role in hearing but are important for balance

Figure 8.19 How we hear



Ear disorders

Deafness

Deafness may be caused by a problem with the conduction of sound vibrations through the outer or middle ear. This may be due to blockage of the ear canal by accumulated wax or by foreign objects. Other causes are an infection causing build-up of fluid in the middle ear, or the fusing of the small bones so that vibrations cannot be passed from the eardrum to the oval window. Many of these causes of deafness can be corrected by medical treatment.

Another form of deafness results from defects in, or damage to, the sound receptors in the cochlea, the nerve from the cochlea or nerve pathways in the brain. Such hearing loss could be caused by infections, tumours or prolonged exposure to loud noise.

A major advance in medical technology has been the development of the **bionic ear**, which can help people with damage to nerve endings or nerve pathways. It consists of a microphone, a processor that converts signals from the microphone into electrical impulses, and electrodes implanted in the nerve from the cochlea. Such devices cannot yet provide normal hearing, but for the totally deaf any hearing at all is a major advance.

For more details on the ear and hearing go to http://www.howstuffworks.com/hearing.htm
Demonstrations of the way the ear works may be seen at http://www.epd.gov.hk/epd/noise_education/web/ENG_EPD_HTML/m1/intro_2.html

Tinnitus

Tinnitus is a ringing, swishing or other type of noise in the ear. It may come and go, but in severe cases it is there all the time. Sometimes the cause, such as inflammation and accumulation of fluid, can be identified and treated. Often there is no apparent cause and no cure.

Swimmer's ear

This is a bacterial or fungal infection of the outer ear. It can be very painful or maddeningly itchy. Antibiotics are used to kill the infecting micro-organism.

Middle ear infection

Such infections are most common in young children. Infecting micro-organisms pass up the Eustachian tube and cause an infection in the middle ear. These infections can be extremely painful and early treatment is recommended. If untreated the infection can cause permanent hearing loss or may spread to the brain and cause meningitis.

The endocrine system

Like the nervous system, the endocrine system coordinates and regulates many body processes. The nervous system coordinates by sending nerve impulses to and from the various tissues. The endocrine system communicates between different parts of the body by the secretion of substances called hormones. In this section we will discuss just a few of the important endocrine glands.

For information on the endocrine system you could go to:
- http://www.innerbody.com/image/endoov.html
- http://www.betterhealth.vic.gov.au/bhcv2/bhcarticles.Nsf/pages/Hormonal_(endocrine)_system?OpenDocument

Endocrine glands

There are two kinds of glands in the body:

- **Exocrine glands** secrete into a duct that then carries the secretion to the body surface or to one of the body cavities. Sweat glands, mucous glands, salivary glands and the glands of the alimentary canal are examples of exocrine glands.

- **Endocrine glands** secrete into the fluid that surrounds the cells making up the gland. The secretion then usually passes into the capillaries to be transported by the blood. Endocrine glands are sometimes called ductless glands.

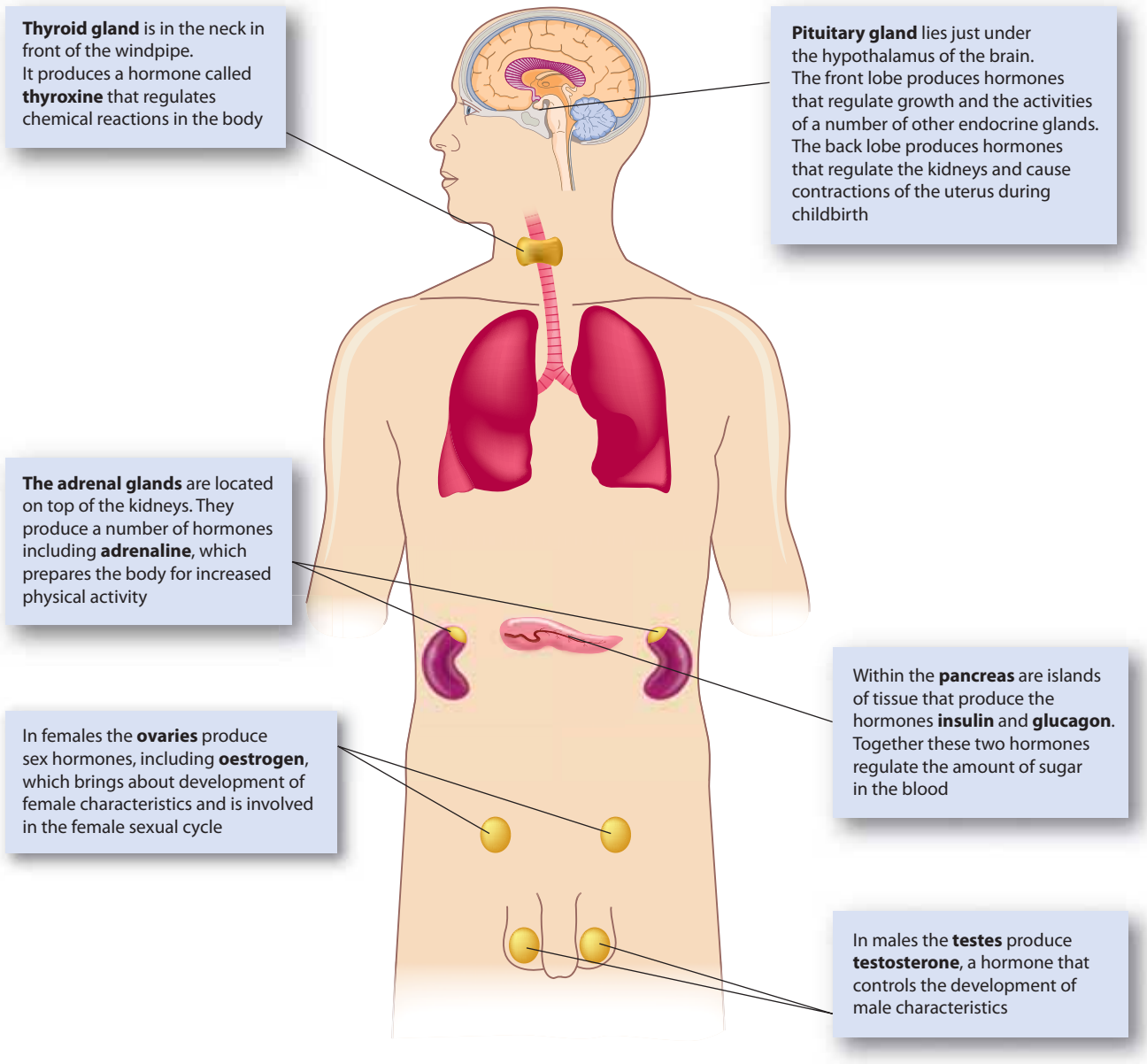


Figure 8.20 Some major endocrine glands and their functions

Hormones

The substance secreted from an endocrine gland is called a **hormone**. Hormones help the body to maintain a constant internal environment by changing the activity of cells. The bloodstream transports most hormones throughout the body. A hormone may affect all the cells of the body or may affect only particular groups of cells. The cells, or organs, affected by the hormone are called **target cells** or **target organs**.

Hormones are *not* enzymes, but in many cases they change the activity or concentration of enzymes.

Working scientifically

Activity 8.1 The brain

A sheep's brain is similar to that of a human, so examination of a sheep's brain can help you to understand what a human brain is like.

You will need

Sheep's brain; dissecting instruments; dissecting board or tray; gloves; safety glasses

What to do

1. Place the brain on the dissecting board and locate the cerebrum, cerebellum and medulla oblongata (refer to Fig. 8.4). There will probably also be some of the spinal cord attached to the brain.
2. Notice the folding of the cerebrum. These are called convolutions. A human brain has many more convolutions than a sheep.
3. Locate the deep cleft that divides the cerebrum into two halves, or hemispheres.
4. Using forceps, peel off a little of the membrane that covers the surface of the cerebrum. This membrane is the inside layer of the meninges, the membranes that protect the brain from injury.
5. Using a scalpel in the cleft between the two hemispheres of the cerebrum, cut the brain lengthwise into two halves.
6. Draw a diagram of one side of the brain looking at the cut surface. Label the meninges, cerebrum, cerebellum, medulla oblongata and spinal cord.
7. Using a scalpel, slice into the cerebrum and look at the cut surface. Which is at the surface of the cerebrum, grey matter or white matter?
8. Cut open the cerebellum. Are the grey and white matter arranged in the same way as in the cerebrum?

Summary

Draw up a table with three columns. In the first column list the following structures: cerebrum, cerebellum, medulla oblongata, spinal cord, convolutions, meninges, grey matter, white matter. In the second column describe what each of these structures looked like and in the third column describe the function of each of them.

Activity 8.2 Structure of the eye

Sheep, cows and pigs have eyes that are almost identical in structure to the eye of humans. In this activity you will examine the eye of a sheep, cow or pig.

You will need

Sheep, pig or cow's eye; dissecting instruments; dissecting board or tray; piece of newspaper; gloves; safety glasses

What to do

1. Cut away any fatty tissue that is on the outside of the eyeball.
2. Identify the following structures on the outside of the eyeball (refer to Fig. 8.9): iris, pupil, cornea, sclera, optic nerve. You will probably also be able to see the ends of the muscles that moved the eyeball.
3. Arrange the eyeball so that you are looking at it from the side. Draw a diagram of the eyeball as seen from the side and label the structures listed in (2) above.
4. Using the sharp point of your dissecting scissors pierce the eyeball mid-way between the front and the back. You will need to press hard—the sclera is tough. Cut the eyeball around the middle so that you have a front half and a back half. Separate the two halves.
5. Using a blunt probe gently remove the clear jelly-like material. This is the vitreous humour. On the back half of the eye identify the choroid (which is black) and the retina (a pale blue colour). You will also be able to see the blind spot, which will have blood vessels radiating from it.
6. Examine the front half of the eye. Identify the lens with a black ring around it. The black ring is the ciliary body. It contains muscles. Gently remove the lens without damaging its structure.
7. Place the lens on a piece of newspaper and look at the print through the lens. What do you notice? This occurs because the lens has curved surfaces and light rays are bent as they pass through it.

Summary

Draw up a table with three columns. In the first column list the following structures: iris, pupil, cornea, sclera, optic nerve, blind spot, ciliary body, retina, choroid, lens, vitreous humour. In the second column describe what each structure looked like and in the third column describe the function of each of the structures.

Activity 8.3 The eye and vision

What we see depends not only on the response of the retina of the eye to light, but also on the way the brain interprets messages from the retina. In this activity we look at some aspects of how the eye works and how the brain interprets information from the eye.

You will need

Metre (or half metre) rule; sheet of paper

What to do

Work in pairs with one person acting as the subject and the other as the observer. Reverse roles for each part of the activity.

I Accommodation A person with normal vision is able to see distant objects clearly when the muscles of the eye are relaxed, because light rays coming from more than 6 m away are parallel. Rays of light from objects closer than 6 m are spreading out. To focus these rays onto the retina the muscles around the eye must contract and make the lens bulge more. This ability of the lens to change shape to focus the image of both near and far objects on the retina is called accommodation.

The distance from the eye to the nearest point that can be focused clearly is the **near point** of vision. Find the near point of your right eye by placing a hand over your left eye and focusing your right eye on the tip of a pencil held at arm's length. Slowly bring the pencil closer to your eye until the tip becomes fuzzy. Get your partner to measure the distance from your eye to the tip of the pencil. Repeat the measurement for your left eye.

1. What is the near point for your right eye?
2. Is the near point for your left eye the same as the right? How can you explain any difference? If you wear glasses, find the near point for each eye with, and without, the glasses.
3. Explain the effect of the glasses on your near point.
4. How does your partner's near point compare with yours?
   Repeat the test with the pencil, this time getting your partner to move the pencil away until the pencil tip becomes fuzzy.
5. Does your eye have a far point? Explain why some people have a far point and others do not.

II The blind spot Close your right eye and focus the left eye on the + in Figure 8.21. Although you are looking at the + you will notice that the green circle is seen by indirect vision. Starting with the page about 15 cm from the eye, slowly move the page away until the circle disappears. Make sure you stare at the + all the time.

Figure 8.21

1. Explain why the circle disappears.
2. When the circle disappeared, was there a gap in the red line?

III Dominant eye Few people use both eyes equally. Unconsciously they depend more on one eye, which is known as the **dominant eye**. Identify your dominant eye in the following way. Use a sheet of paper to make a tube about 3–4 cm in diameter. Hold the tube about 15 cm from your face and look through it with *both* eyes at an object on the other side of the room. Keeping the tube steady, close first one eye, and then the other.

1. Which is your dominant eye? How do you know?
2. Do right-handed people have a dominant right eye and vice versa? Check by asking other members of the class for their results.

IV Superimposed images Each eye forms a slightly different image of an object and the brain joins the two images together to form a single image. Use a sheet of paper to make a tube about 3–4 cm in diameter. Hold the tube close to your left eye. Place your right hand, palm open and facing you, next to the tube in front of your right eye. Keep both eyes open.

1. Describe what you see.
2. How can you explain what you see?

Now hold both hands at arm's length, palms towards you and fingertips touching but fingers slightly spread. Look through the spaces between your fingers and focus on an object on the other side of the room.

1. Describe the appearance of your fingertips.
2. Explain why they appear as they do.

Studying your observations

Write a short paragraph explaining what you have learned about the eye from this activity. In your paragraph explain what you found out about the way the brain interprets what the eyes see.

Activity 8.4 Investigating the near point

Does near point of vision (see Activity 8.3:I) change with age?

Suggest a hypothesis that links age and near point.

Design an investigation to test your hypothesis.

If your teacher wants you to collect data for your investigation you could combine your data with that of other students to improve the reliability of your results.

REVIEW QUESTIONS

1. What systems are responsible for communication within the body?
2. **(a)** Draw a nerve cell and label the parts.
   (b) What differences are there between nerve cells and other cells of the body?
3. Describe the two main parts of the nervous system.
4. List the main parts of the brain.
5. Explain the difference between grey matter and white matter.
6. Describe how the central nervous system is protected from injury.
7. **(a)** What is a reflex response?
   (b) Describe the parts of a reflex arc.
8. What effect does alcohol have on the nervous system?
9. **(a)** What is meningitis?
   (b) Why is amoebic meningitis more likely to occur in summer?
10. What are the two different light receptors in the eye and what are their functions?
11. Explain how the eye is able to see clearly objects that are close up and objects that are a long way away.
12. **(a)** What is binocular vision?
    (b) What are the advantages of binocular vision?
13. As people become older they often have to wear glasses for reading. What is the reason for this?
14. **(a)** In what part of the ear are the receptors for hearing?
    (b) Explain how the vibrations of sound waves are passed from the ear drum to the part of the ear that contains the receptors.
15. Describe some of the causes of deafness.
16. Describe the two different types of glands that are in the body.
17. What is **(a)** a hormone and **(b)** a target organ?

18. What important hormone is produced by the thyroid gland and what is its function?
19. What hormones do the ovaries and testes produce and what are their functions?

APPLY YOUR KNOWLEDGE

1. The structures that protect the brain and the spinal cord are the same but they are arranged in a slightly different way. The spinal cord has a layer of fat and other tissue between the meninges and the bones of the vertebrae. The brain has no such layer. Suggest a reason for this difference between the brain and spinal cord.
2. To see an object more clearly in the dark it is recommended that you do not look directly at the object, but slightly to one side of it. Can you explain why this would enable you to see the object more clearly?
3. **(a)** Describe three situations in which detection of external stimuli would be essential for survival.
   (b) Describe three situations in which detection of stimuli would be essential for the body to keep working normally.
4. Blinking and coughing are reflexes. For each of these two reflexes describe the:
   - stimulus
   - receptor
   - effector
   - response.
5. Flying in a light aircraft (which does not have a pressurised cabin) when suffering from a heavy cold could cause damage to the ear. Explain how this could occur.
6. Suggest why some receptors are concentrated in one place (e.g. light, smell and taste receptors) while others are distributed all over the body surface (e.g. touch and pressure receptors).