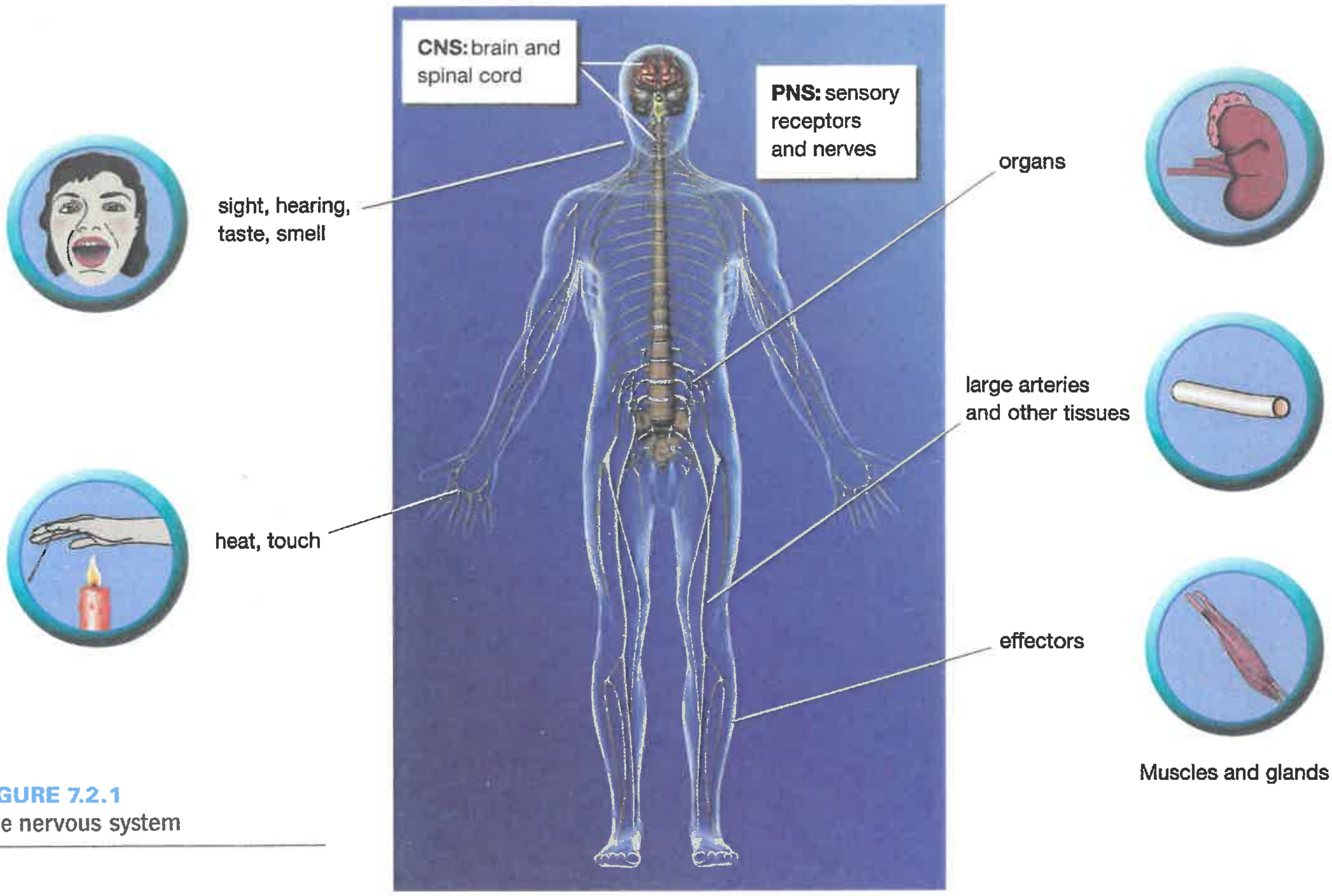

FIGURE 7.2.1
The nervous system

Nerve cells

The nervous system is made up of trillions of nerve cells called neurons. **Neurons** are specialised cells that transmit electrical messages from one part of your body to another at very high speed. These electrical messages are called **nerve impulses** and they can travel in only one direction.

A neuron has all of the usual features of any animal cell including a nucleus, cell membrane and cytoplasm. As you can see in Figure 7.2.2, a neuron also has many other specialised parts including dendrites, an axon and axon terminals.

The **cell body** contains the nucleus, which is the control centre of the cell. The **dendrites** branch out from the cell body and receive messages from other nerve cells, which are then sent on to the cell body. The **axon** or nerve fibre sends nerve impulses in only one direction—away from the cell body. The axon terminals pass the message on to the next neuron.

There are different types of neurons. Each type of neuron has a different function within the nervous system (Figure 7.2.3).

- **motor neurons**—carry messages from the CNS to effectors. **Effectors** are muscles or glands (tissues that secrete hormones) that translate the messages into actions.
- **connector neurons**—transmit messages between neurons in the CNS.
- **sensory neurons**—have specialised receptors, which are sensitive to stimuli such as heat or light. They carry messages to the brain and spinal cord from cells in the sense organs (such as your eyes, ears, tongue and skin).

The messages sent along the neuron are electrical. If all the neurons in your body touched one another, then stimulating one nerve ending would be like turning on one switch in your house and having all the lights and appliances come on. Your body needs to control which nerves 'fire' at a certain time.

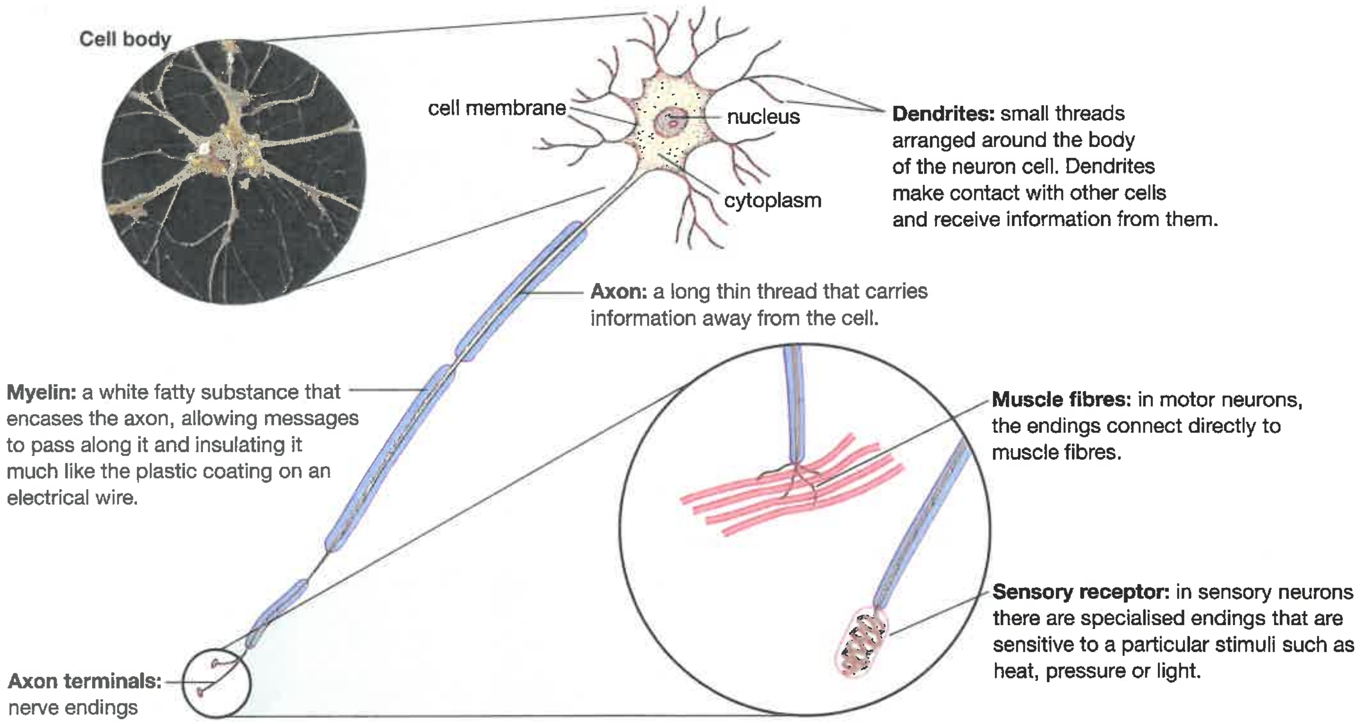

FIGURE 7.2.2 These are some of the specialised endings a typical neuron can have.

When the nerve impulse reaches the axon terminals at the end of an axon, a chemical called a **neurotransmitter** is released into the space between the neurons. This space is called a **synapse** (Figure 7.2.4 on page 282). The neurotransmitter carries the message from the axon of one neuron to the dendrite of the next neuron. The dendrite receives the chemical message and sends off an electrical signal.

About 50 different neurotransmitters carry electrical impulses across these gaps. These neurotransmitters control which nerves fire and when.

In your body, the neurons are bundled together to form nerves, as shown in Figure 7.2.5 on page 282. Neurons are covered with an insulating layer called a **myelin sheath**. The myelin sheath electrically insulates the neurons from each other and increases the speed of the nerve impulse.

The parts of the CNS that contain neurons covered in myelin are called white matter. The parts that contain mainly cell bodies are called grey matter. The outer parts of the brain are made up mainly of grey matter.

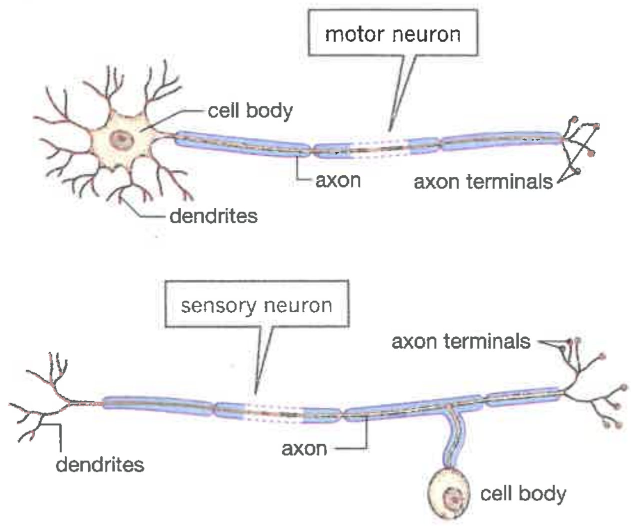

FIGURE 7.2.3 Two types of neuron

SciFile

What a nerve!

The longest neuron in your body extends from your big toe to the middle part of your spine and is about a metre long. A giraffe's longest nerve is in its neck and is up to 5 metres long!

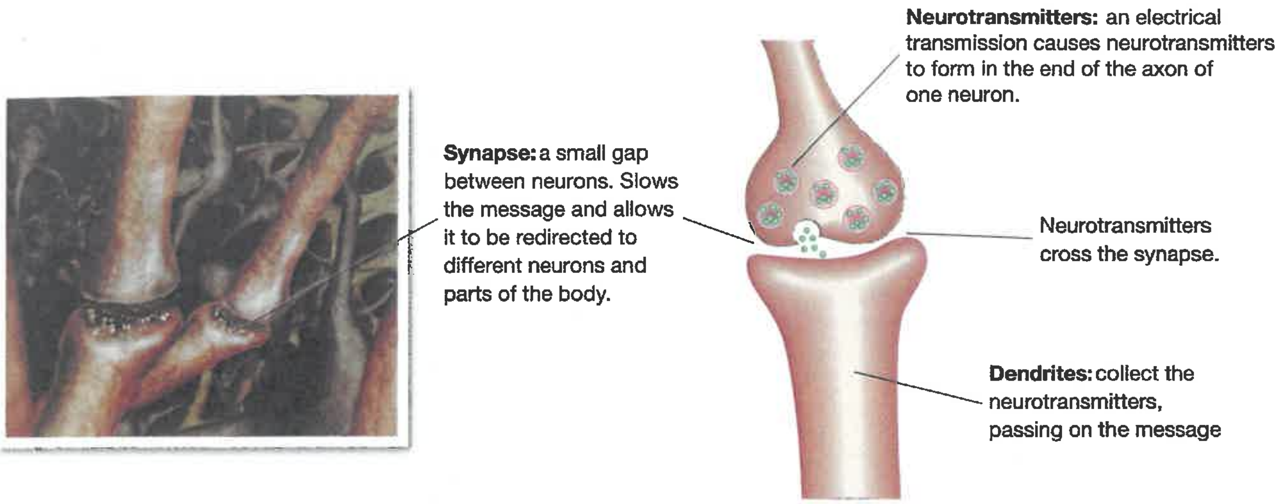

FIGURE 7.2.4 At the synapse, the electrical signal of the nerve is converted into a chemical signal called a neurotransmitter, which carries the signal across the gap. The chemical signal is then converted back to an electrical signal.

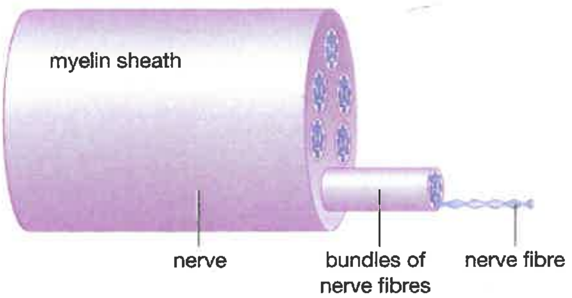

FIGURE 7.2.5 A nerve is made up of a large number or neurons, each of which is surrounded by a myelin sheath.

AB 7.3

The brain

Compared with other animals, humans have a very large brain for their body size. The human brain contains about 100 billion neurons, and has an average volume of 1200–1400 mL. The brain controls and regulates body functions. Without it, you cannot survive.

Medical imaging techniques can look inside a living brain. For example, MRI (magnetic resonance imaging) uses strong magnetic fields to distinguish different types of body tissue. MRI is useful in diagnosing brain tumours and finding areas of brain injury.

Sometimes other parts of the brain take over the function of the damaged parts, but there are situations where brain damage is permanent. fMRI (functional magnetic resonance imaging) measures and maps brain activity though changes in blood flow. fMRI is useful to determine the effects of a stroke or disease, or to guide brain treatment.

The cerebrum

When you think of what a human brain looks like, you are probably thinking of the **cerebrum**. You can see it in Figure 7.2.6. It occupies more than 80% of the brain and contains over 10 billion neurons. Its folded surface makes surface area three times greater than if the brain's surface was smooth.

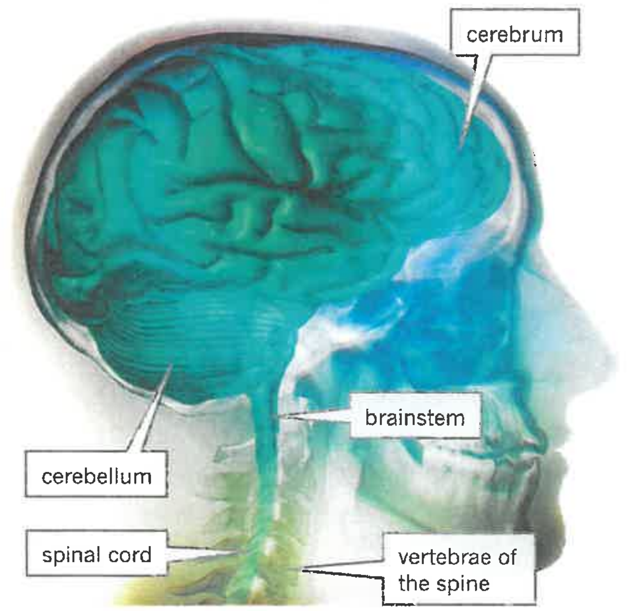

FIGURE 7.2.6 Computer-enhanced X-ray showing the external structure of a human brain.

It is in the cerebrum that the higher intellectual functions of humans take place. The cerebrum controls your conscious thoughts and the intentional (voluntary) movement of every body part. For example, if you scratch your nose then it is the cerebrum controlling your movement. The cerebrum also receives sensory messages from all body parts. For example, physical pain, the sound you hear and the light you see are all processed by the cerebrum.

The cerebrum is made up of two parts, called the right and left cerebral hemispheres. When you are performing an intended and voluntary action such as walking or hitting a ball, the right hemisphere controls the left side of your body and the left hemisphere controls the right side of your body (Figure 7.2.7). Each half of the brain can work independently, but you use both cerebral hemispheres for most activities. One side usually dominates in a particular task. For example, in most people the left side has more control over language and logical thinking, such as mathematical ability. The right side is the more creative and emotional side. Musical and artistic abilities depend on the right side of the brain.

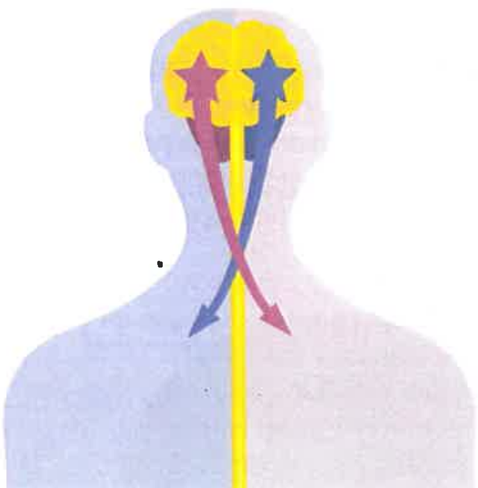

FIGURE 7.2.7 The right and left sides of the brain control the opposite sides of the body.

Figure 7.2.8 shows images of the brain created using both fMRI and PET (positron emission topography). Together these scans reveal the parts of the brain that are active during various activities. They show that the left-hand side of the brain is active during activities that involve language. They also show that different parts are active when listening, speaking, reading or just thinking about words.

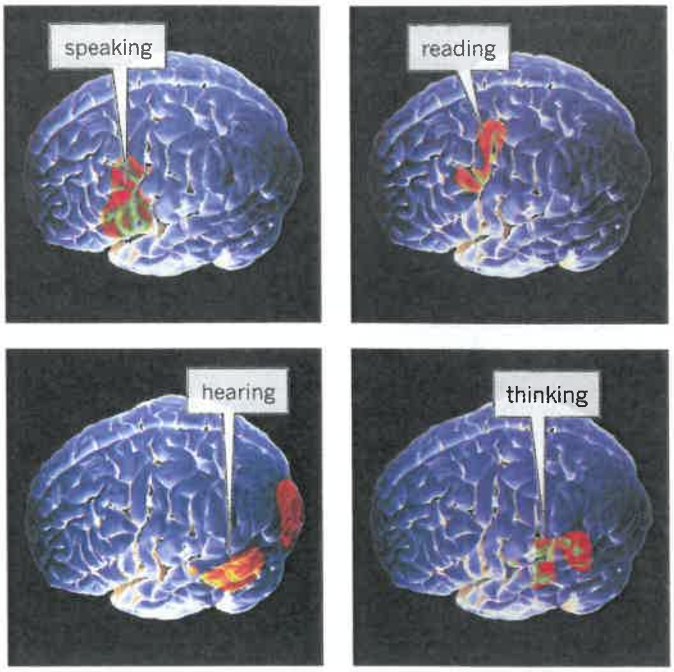

FIGURE 7.2.8 The red and green areas in these images show the areas of the brain that are active during various activities.

The cerebellum

At the base of the cerebrum is the **cerebellum**. The cerebellum is located where your skull curves inwards (Figure 7.2.9). The cerebellum is responsible for coordination and balance. Without it, walking would be impossible.

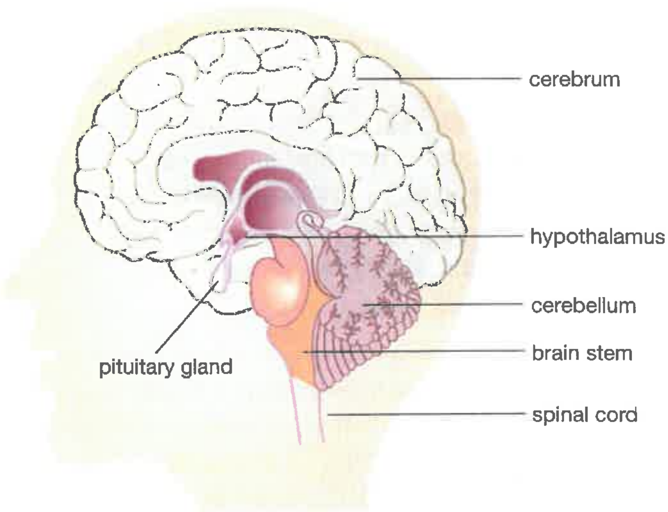

FIGURE 7.2.9 Vertical cross-section of the brain

Prac 1 p. 290
Prac 2 p. 291
Prac 3 p. 292

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