Unit 4.1 Cells to systems

context

All living things are made up of cells. Not all cells are the same, however. Some are skin cells and some are liver cells. Others are blood cells, cheek cells, muscle cells, sperm cells, egg cells, brain cells… Each part of your body has cells that are specialised to carry out a specific job.

Specialised cells

Groups of similar cells make up **tissue**. Skin tissue is made from skin cells, liver tissue is made from liver cells and heart tissue is made from heart cells. Tissue groups together to form organs. Kidney tissue makes up the kidneys, brain tissue makes up the brain and heart tissue makes up the heart.

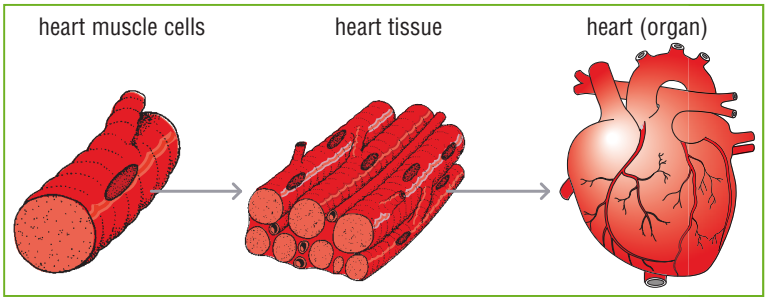

Fig 4.1.1 Cells make up tissue and tissue makes up organs.

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Body systems

A group of organs working together to do a particular job in the body is called a **body system**. For example, the skeletal system is a relatively lightweight structure that holds the body upright and protects the body's internal organs. The skull, for example, protects the brain and the spinal column protects the spinal cord. Another body system, the muscular system, attaches to it. Together they provide us with the ability to move.

Typical body systems include the nervous system, and the male and female reproductive systems.

Aerobic respiration

Cells need energy to stay alive and to carry out their specialised jobs. If cells die then the tissue made from them also dies. Organs and body systems soon fail and the body dies. To make the energy they need, cells need a constant supply of oxygen (O_2) and glucose ($C_6H_{12}O_6$). Glucose is a type of sugar and is one of the main products of digestion—the processing of food in the digestive system.

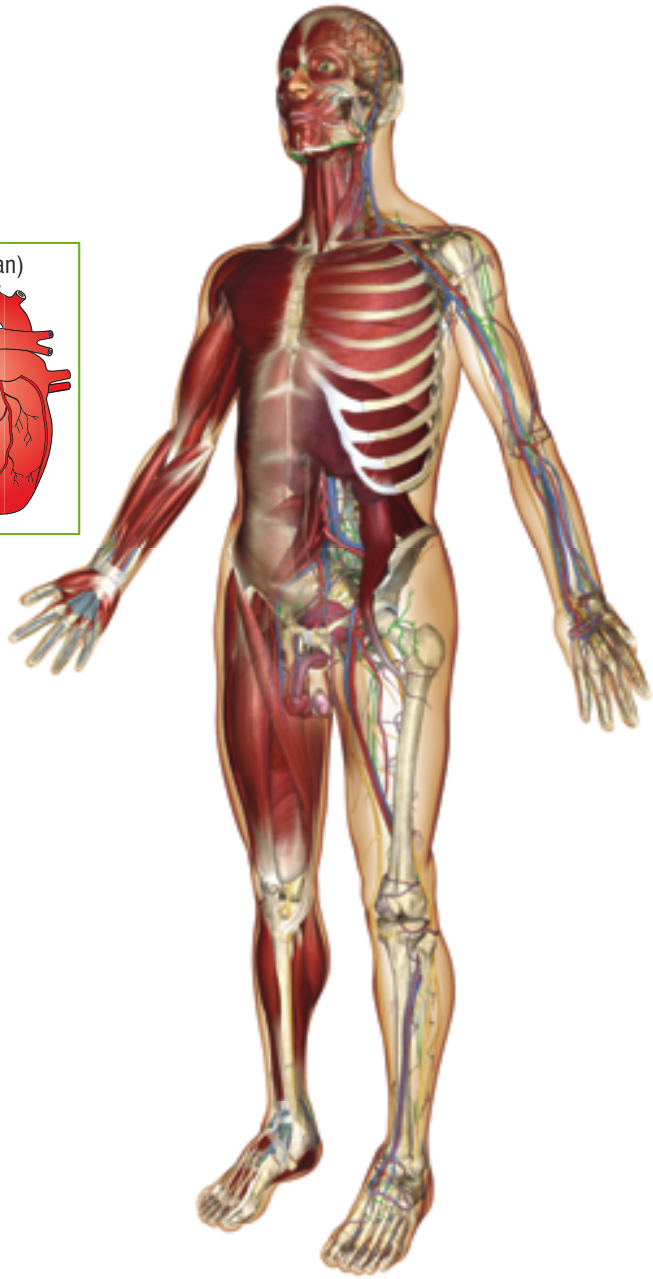


Fig 4.1.2 The human body is made from many different systems.

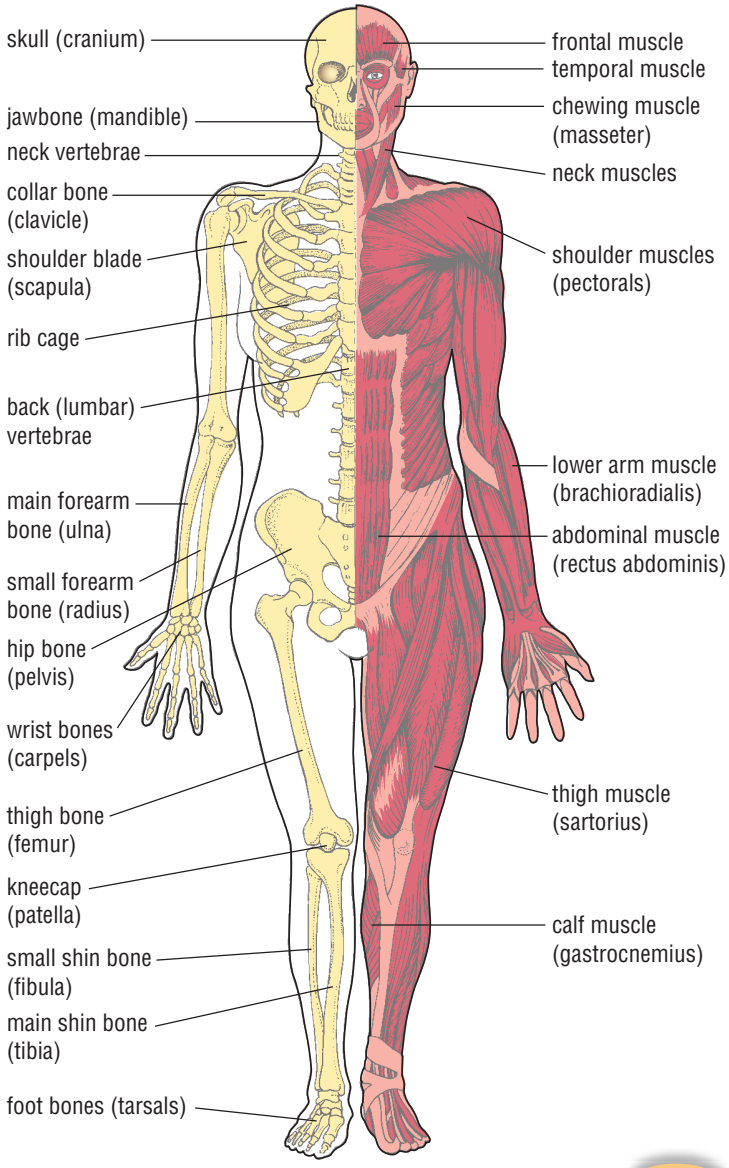
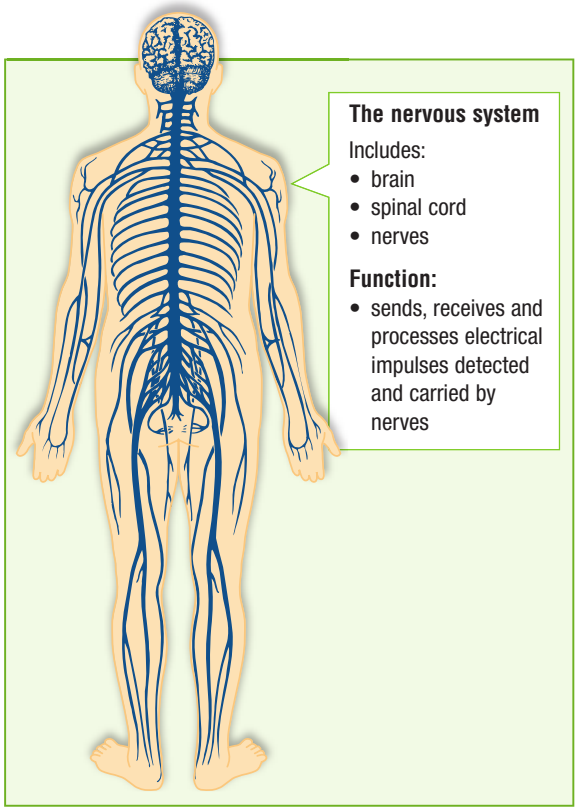


Fig 4.1.3 The skeletal and muscular systems



The nervous system

Includes:
- brain
- spinal cord
- nerves

Function:
- sends, receives and processes electrical impulses detected and carried by nerves

Fig 4.1.4 The nervous system

Male includes:
- penis
- testes
- scrotum
- prostate
- vas deferens

Function:
- produces sperm cells
- produces semen
- allows sperm to be delivered into a female to fertilise the egg

Female includes:
- vagina
- uterus (womb)
- ovaries
- fallopian tubes

Function:
- produces egg cells
- allows sperm to be delivered to the egg to fertilise it
- includes the uterus, where the baby develops

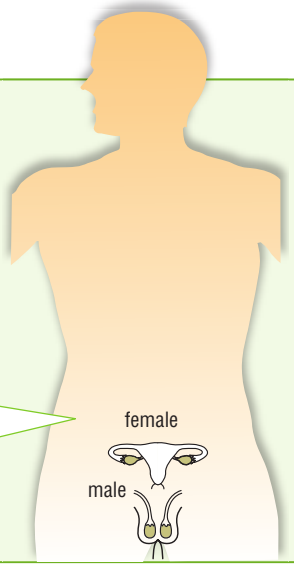


Fig 4.1.5 The reproductive system

Science Clip

Sore muscles

Normally the cells get all the energy they need from aerobic respiration. However, when the body is exercising hard, the cells often do not get enough oxygen to provide the increased energy they now need. This is when cells begin anaerobic respiration, a reaction that still provides energy but needs no oxygen. One of its products is lactic acid. Muscle soreness after exercise is normally blamed on a build-up of lactic acid in the muscles, although recent research indicates that it might be due to tiny tears in the muscles instead.

The cells carry out a chemical reaction called **aerobic respiration**. This reaction can be written as a word equation:

glucose + oxygen ⟶ carbon dioxide + water + energy

Chemists usually write the equation for aerobic respiration as a balanced chemical equation:

$$C_6H_{12}O_6 + 6O_2 \longrightarrow 6CO_2 + 6H_2O + \text{energy}$$

The products of aerobic respiration are carbon dioxide (CO_2), water (H_2O) and the energy the cells need.

Staying alive

Four body systems are vital in keeping cells alive:

- the **digestive system**—supplies the blood with glucose and other nutrients that the cells need
- the **circulatory system**—blood supplies everything the cells need (including glucose and oxygen) and gets rid of whatever waste the cells produce (e.g. carbon dioxide and water)
- the **respiratory system**—supplies the blood with oxygen and removes carbon dioxide from it
- the **urinary system**—reactions in the cells produce wastes that will poison them if allowed to build up. Although the circulatory system removes these wastes from the cells, the blood itself will soon be poisoned unless they are filtered out and removed from the body. This is the role of the kidneys and the urinary system.

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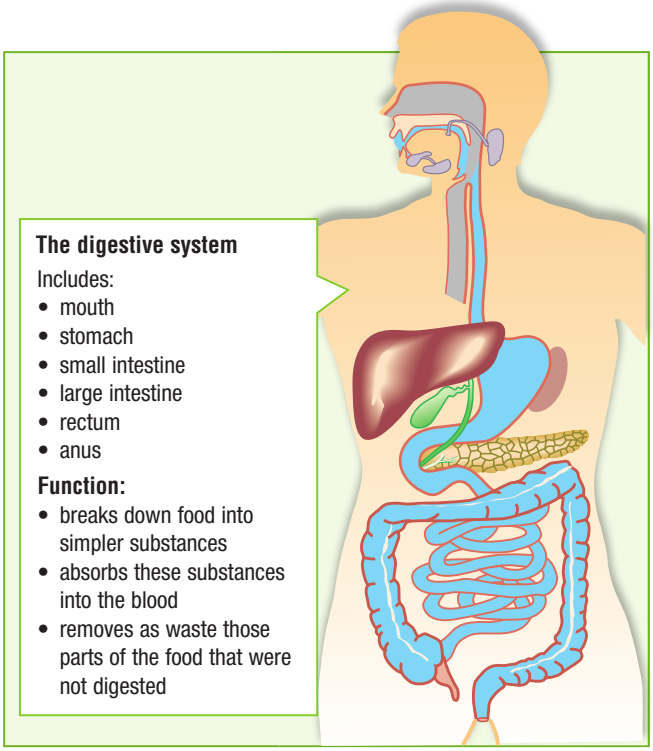

Fig 4.1.6 The digestive system

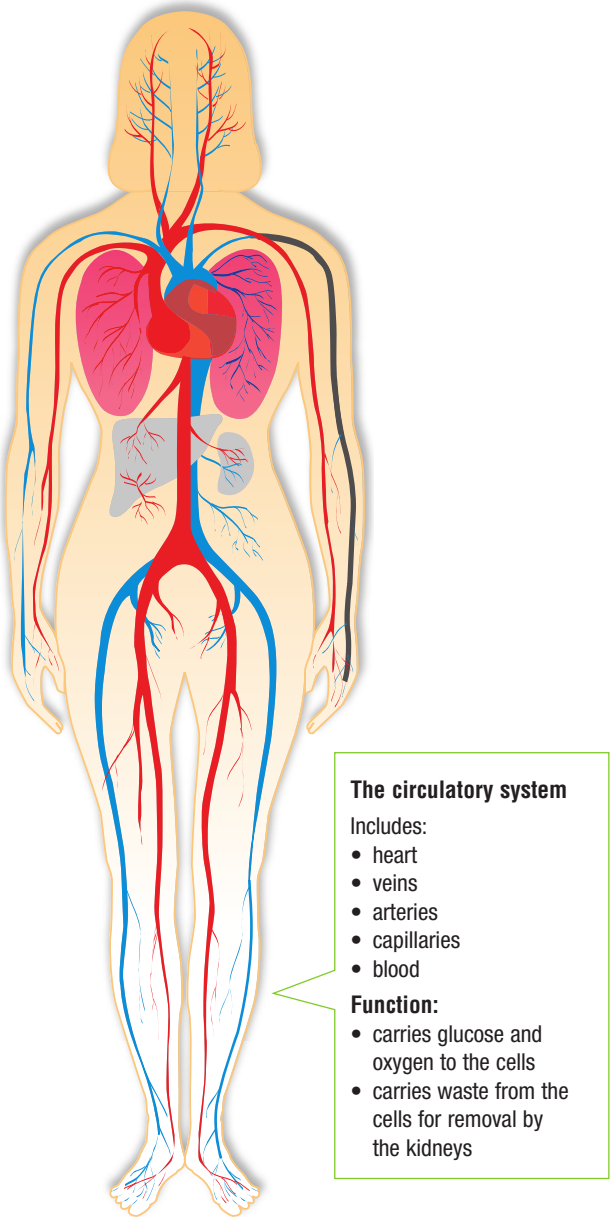

Fig 4.1.7 The circulatory system

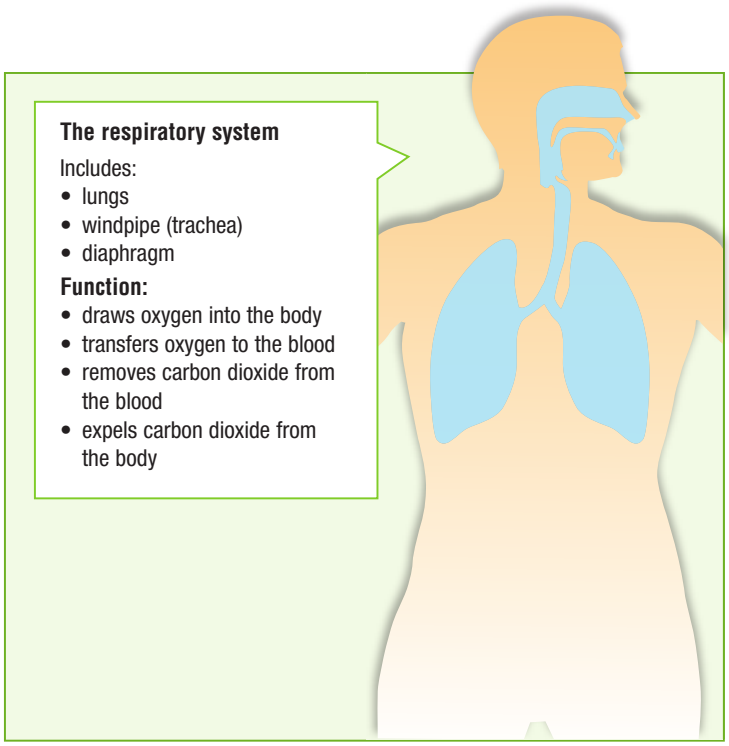

Fig 4.1.8 The respiratory system

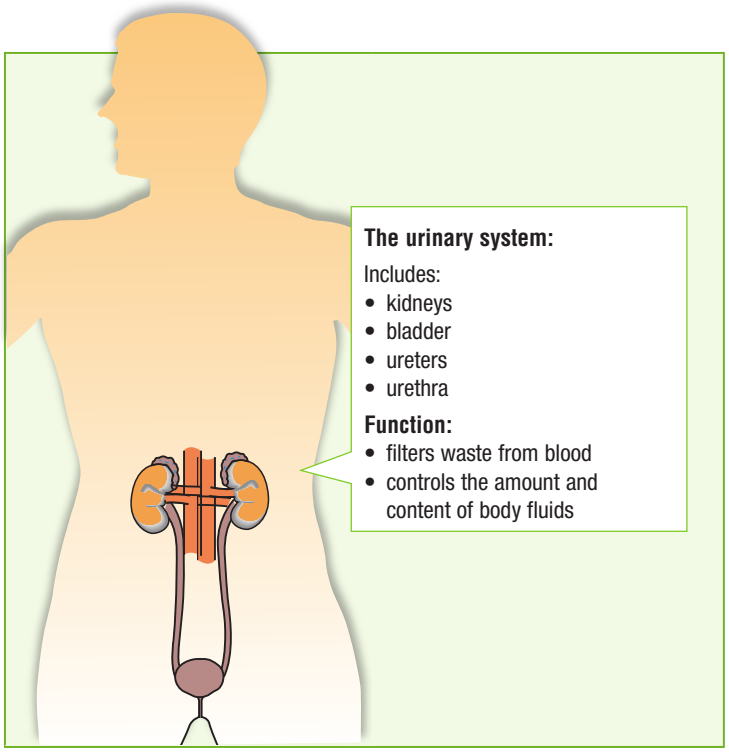

Fig 4.1.9 The urinary system

Science Clip

What is the speed of a sneeze?

Some scientists estimate the speed of a sneeze is around 150 kilometres per hour (42 metres per second), whereas others believe that the speed may be as fast as 85 per cent of the speed of sound or 1045 kilometres per hour! What *is* known is that about 40 000 droplets are produced by a single sneeze and that you can't sneeze while you're asleep.

Science Clip

What colour should urine be?

If you're well-hydrated and drinking enough water then your urine should be transparent and pale yellow (similar to apple juice) in colour. Clear urine indicates that you're over-hydrated, whereas dark yellow usually indicates that you're dehydrated and that you need to increase your water intake. Cloudy urine may indicate a bacterial infection. The smell of urine can be affected by the foods you eat. For example, eating asparagus adds a strong odour to human urine. This is due to the body's breakdown of asparagusic acid. Other foods that contribute to odour include curry, alcohol, coffee, turkey and onion.

Science Clip

Myth: Treat a jellyfish sting with urine

The tiny barbs on most jellyfish inject a base that can be neutralised with acid. That's why surf lifesaving clubs often have a bucket of vinegar ready—vinegar is an acid. Many people believe that a jellyfish sting can be treated with urine but urine is not acidic enough to neutralise the venom. Bluebottle jellyfish stings cannot be soothed with vinegar or urine because the chemical they inject is not a base.