Unit 4.5 The urinary system

context

Your body produces solid, liquid and gaseous waste materials while doing its many jobs. If the body did not get rid of all these materials, they would poison it and make you very ill.

Fig 4.5.1 Your cells produce wastes. The urinary system filters out some of them.

Excretion

Any build-up of waste in the body can be harmful. Undigested solid waste, for example, needs to be eliminated from your digestive tract and is expelled through the anus as faeces.

Your body cells also produce wastes that must be got rid of for them to continue to function properly. **Excretion** is the removal of these wastes. This waste can be:

- **gaseous**—Your body cells obtain their energy by burning glucose in a process known as respiration. This reaction releases dissolved carbon dioxide (CO_2) and water (H_2O) into the bloodstream. Carbon dioxide then travels to the lungs. It changes from dissolved to gaseous form and is then breathed out. Some water vapour is also exhaled (i.e. breathed out).
- **liquid**—Urine is waste made of **urea**, assorted waste products and excess water. Urea is produced by the liver after protein has been digested in the cells. Protein is needed for growth and repair, but any excess is broken down into simpler substances, the main one being urea. Urea passes into the bloodstream, where it travels to the kidneys to be filtered out with excess water and other waste products.

The kidneys

Kidneys are red-brown, bean-shaped organs that filter an amazing 1.3 litres of blood every minute (about one-quarter of the blood pumped by the heart).

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Kidney cortex (renal cortex)
located here are tiny filtration units called nephrons. Each kidney contains over a million nephrons.

Kidney pelvis (renal pelvis)
the pale-cream core of the kidney. The pelvis acts as a funnel that drains urine from the medulla to the ureter and bladder.

Medulla
darker areas of the kidney. The medulla contains cone-shaped funnels that drain urine from the nephrons to the pelvis.

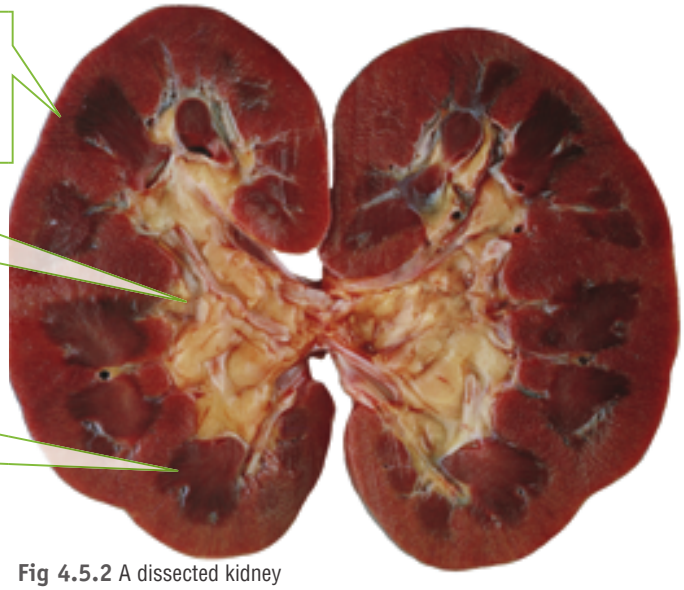

Fig 4.5.2 A dissected kidney

Science Clip

An 80 km long filter!

If the tiny tubes of all **nephrons** were stretched end-to-end, they would stretch an incredible 80 km!

Urine

Of every litre of blood processed, the kidneys filter out about one millilitre of waste liquid, or **urine**. Urine is produced at the rate of one drop per minute, or one to two litres per day. Urine consists of approximately:

- 95 per cent water
- five per cent urea
- small amounts of salts and other substances
- a small amount of bile (which gives urine its yellow colour).

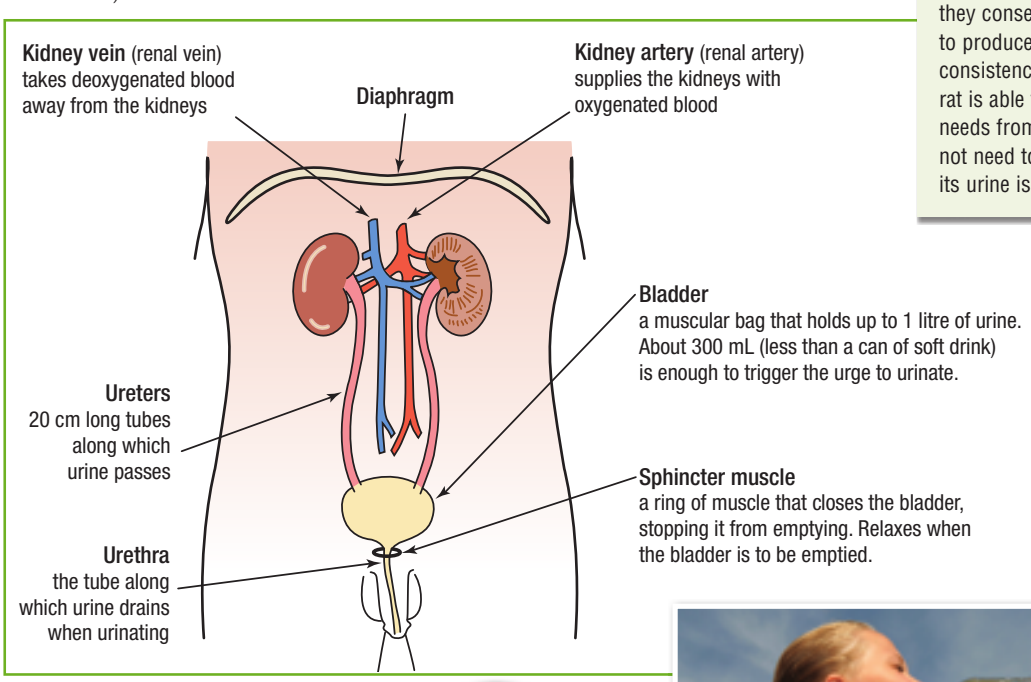

Fig 4.5.3 The urinary system

PP Drag-and-drop

Science Clip

A wee bit of information

About 47 per cent of a human's water output is in urine, 31 per cent in sweat, 16 per cent breathed out and six per cent in faeces.

Although camels need to drink water only occasionally, they drink in large quantities when they do. One way they conserve water between drinks is to produce sticky urine with the consistency of honey. The kangaroo rat is able to extract all the water it needs from the food it eats, and does not need to drink water. As a result, its urine is super-concentrated.

Fig 4.5.4 One way to reduce the risk of kidney stones is to drink at least one litre of water every day.

Kidney problems

Kidney stones

Sometimes concentrated substances in urine crystallise into small, solid particles called **kidney stones**. Kidneys stones form within the kidneys, ureters or bladder and can cause extreme pain. If they are small enough, kidney stones may pass out of the body in urine, but if they are too large, they may need to be shattered first. This is done in a procedure called a **lithotripsy**, during which a focused beam of ultrasound blasts them into pieces small enough to pass through the urinary tract.

Kidney failure

The body can function normally on a single kidney. If both kidneys fail, however, the situation becomes life threatening due to the build-up of poisonous wastes in the blood. The only options for survival are:

- **dialysis**—The blood is redirected into machines that filter it artificially. Dialysis must be performed regularly (e.g. three times per week for up to 8 hours each).
- **kidney transplant**—The donor kidney could come from a deceased or live donor. The transplant is most likely to be successful if it comes from a close relative.

Worksheet 4.7 The urinary system