

CIE Biology GCSE
13: Excretion in humans
Notes

Waste products:

- **Urea** - urea is formed in the **liver** as a result of an **excess of amino acids**. Amino acids **cannot be stored** in the body, unlike glucose and other nutrients, thus excess amino acids that cannot be converted to proteins and used in the body are removed from the body in a process called **de-amination**. De-amination takes place in the liver and involves the **removal of the nitrogen-containing section** of the amino acids. This forms urea, which is then filtered from the blood by the **kidney** and **excreted from the body as urine**.
- **Carbon dioxide** - Carbon dioxide is a waste product produced in cells during **respiration**; carbon dioxide exits cells and is dissolved in the blood, where it is carried to the **lungs** to be excreted.
- **Excess water and salt** - Filtered from the blood by the **kidney** and excreted as urine.

The Kidney

The kidney's role is to **filter waste and excess substances** from the blood to be excreted from the body as **urine**. It is important for these substances to be filtered out of the blood, as a build-up of **toxins** could cause harm to the organism.

The volume of urine produced is dependent on the **water intake, temperature and exercise**: a **large amount of dilute urine** is formed when there is a large intake of water, a low temperature (water is not lost through sweating), and when a low amount of exercise is carried out.

The renal system:

Blood enters the kidney through the **renal artery** and exits through the **renal vein**.

- **Cortex** - the outer region of the kidney; the cortex contains nephrons.
- **Nephron** - the nephron is the functional unit of the kidney. It contains the glomerulus, which is where the blood is filtered and glucose, urea, water and salts are removed.
- **Tubule** - All glucose, most water and some salts are reabsorbed into the blood in the tubule (after being filtered out in the glomerulus). This prevents the loss of too much water. Urea is not reabsorbed, leading to a high concentration of urea in the urine.
- **Medulla** - the inner region of the kidney.
- **Ureter** - tubes that transport urine from the kidneys to the bladder, where it is stored before being excreted from the body.

Dialysis machines and kidney transplants:

When the kidneys are not working, the body cannot maintain the amounts of salts and glucose in the blood or remove urea. If the blood is not filtered correctly, **urea builds up in the body**, which is **toxic** and can eventually be fatal if a dialysis machine is not used or the kidney repaired or replaced.

During dialysis, blood is **taken from the arm** and travels through the dialysis machine. Inside, the blood flows past a solution called **dialysis fluid**, containing **glucose and ions**. The blood and fluid are separated by a **partially permeable membrane**, allowing **diffusion** between the blood and fluid. As the **fluid contains no urea**, there is a **high concentration gradient** and **urea exits the blood** into the dialysis fluid by diffusion. The levels of glucose and ions in the dialysis fluid are similar to that of the blood, thus there is usually **no net diffusion of ions or glucose** across the membrane, unless the blood is lacking in ions, in which case ions will diffuse into the blood from the dialysis fluid. **Clean blood** then exits the machine and **re-enters the patient's arm**.

Dialysis machines must be used regularly, however, to keep the blood clean. Patients typically undergo dialysis **3 times a week for hours at a time**, making it **difficult to work** and carry out a normal lifestyle as a large amount of time is spent travelling and undergoing dialysis. This **lowers quality of life**.

Kidney transplants are an alternative to constant dialysis. Although this comes with the risks associated with **major surgery**, as well as the **risk of rejection** to the organ, a successful kidney transplant can **raise the quality of life** of the patient and patients are not required to undergo hours of dialysis. Most humans are born with two kidneys, although they can survive with one, thus kidney transplants are from family members, as there is **less chance of rejection**.