# EXCRETION

#### Excretion in humans

Excretion is the removal of the following substances:

- toxic materials
- waste products of metabolism
- excess substances from organisms

Excess amino acids are deaminated in the liver to form glycogen and **urea**. The urea is removed from the tissues by the blood and **expelled by the kidneys**.

**Deamination**: is the removal of the nitrogen-containing part of amino acids to form urea.

- Urine is taken from the kidneys to the **bladder** by the **ureters**.
- Urethra is the tube that carries urine out of the body.

The need for excretion:

- Some of the compounds made in reactions in the body are potentially toxic if their concentrations build up.
- CO2 dissolves in fluids such as tissue fluid and blood plasma to form carbonic acid. This increase in acidity can affect the actions of enzymes and can be fatal.
- Ammonia is made in the liver when excess amino acid are broken down. However, ammonia is very alkaline and toxic. It is converted to urea which is much less poisonous, making it a safe way of excreting excess nitrogen.

#### Structure of the kidneys:



- The kidney tissue consists of many capillaries and tiny tubes, called **renal tubules**, held together with connective tissue.
- The **cortex** is the dark, outer region.
- The **medulla** is the lighter, inner zone.
- A renal artery carries blood to the kidney and a renal vein carries it away.
- The ureter carries urine from the kidney to the bladder.
- Where the ureter joins the kidney there is a space called the **pelvis**.
- The renal artery divides up into a great many arterioles and capillaries, mostly in the cortex.
- Each arteriole leads to a **glomerulus**. This is a capillary repeatedly divided and coiled, making a knot of vessels.
- Each glomerulus is almost entirely surrounded by a cup-shaped organ called a **renal capsule**, which leads to a coiled **renal tubule**.
- This tubule, after a series of coils and loops, joins a **collecting duct**, which passes through the medulla to open into the pelvis.
- A **nephron** is a single glomerulus with its renal capsule, renal tubule and blood capillaries.

## Function of the kidneys:

- The blood pressure in a glomerulus causes part of the blood plasma to leak through the capillary walls.
- The red blood cells and the plasma proteins are too big to pass out of the capillary, so the fluid that does filter through is plasma without the protein.
- The fluid thus consists mainly of water with dissolved salts, glucose, urea and uric acid.
- The process by which the fluid is filtered out of the body by the glomerulus is called **ultrafiltration**.
- The filtrate from the glomerulus collects in the renal capsule and trickles down the renal tubule.
- As it does so, the capillaries that surround the tubule absorb back into the blood these substances which the body needs.
- First, all the glucose is reabsorbed, with much of the water.
- Then some of the salts are taken back to keep the correct concentration in the blood.
- The process of absorbing back the substances needed by the body is called **selective reabsorption**.
- The molecules which are not selectively reabsorbed continue along the nephron tubule as urine .

The dialysis machine (artificial kidney):



Dialysis is a treatment that filters and purifies the blood using a machine

### **Dialysis fluid contains:**

- a glucose concentration similar to a normal level in the blood
- a concentration of ions similar to that found in normal blood plasma
- no urea

As the dialysis fluid has no urea in it, there is a large concentration gradient – meaning that urea moves across the partially permeable membrane, from the blood to the dialysis fluid, by diffusion.

As the dialysis fluid contains a glucose concentration equal to a normal blood sugar level, this prevents the net movement of glucose across the membrane as no concentration gradient exists.

As the dialysis fluid contains an ion concentration similar to the ideal blood plasma concentration, movement of ions across the membrane only occurs where there is an imbalance.

	Advantages	Disadvantages
Kidney transplants	<ul> <li>Patients can lead a more normal life without having to watch what they eat and drink</li> <li>Cheaper for the NHS overall</li> </ul>	<ul> <li>Must take immune-suppressant drugs which increase the risk of infection</li> <li>Require a suitable donor with a good tissue match</li> <li>Shortage of organ donors</li> <li>Kidney only lasts 8-9 years on average</li> <li>Operation carries risks and is expensive</li> </ul>
Kidney dialysis	<ul> <li>Available to all kidney patients (no shortage)</li> <li>No need for immune- suppressant drugs</li> </ul>	<ul> <li>Patient must limit their salt and protein intake between dialysis sessions</li> <li>Expensive for the NHS</li> <li>Regular dialysis sessions – impacts on the patient's lifestyle</li> </ul>