

The urinary system and the kidneys

Revision notes · The urinary system, how the nephron filters blood, ADH, urea, and treatments for kidney failure.

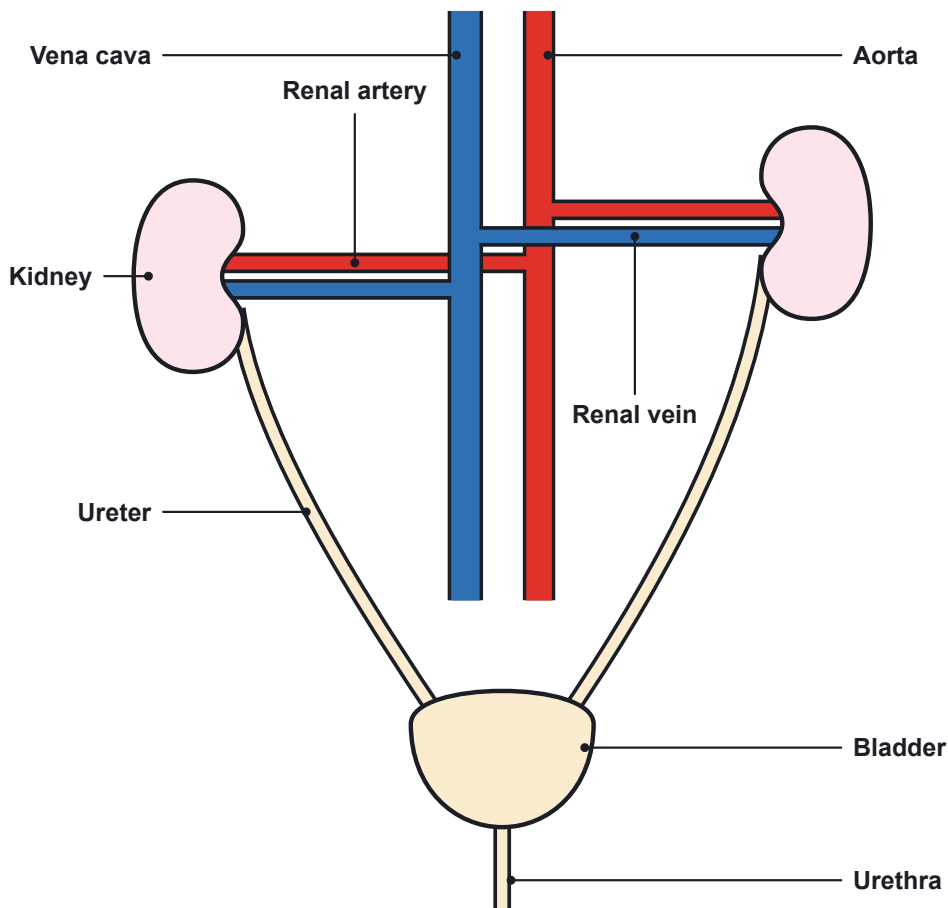
For Edexcel GCSE Biology 1BI0 and Combined Science 1SC0. **Triple only** is not in Combined Science. **Higher tier** is only on the Higher paper.

The urinary system and the kidneys **Spec 7.18B-7.22B** **Triple only**

The urinary system **Spec 7.18B**

The **urinary system** removes waste from the blood and gets rid of it as **urine**.

Part	Function
Kidneys	Filter the blood and make urine
Renal artery	Brings blood to the kidney
Renal vein	Takes blood away from the kidney
Ureters	Tubes that carry urine from the kidneys to the bladder
Bladder	Stores urine
Urethra	Tube that carries urine out of the body



The **urinary system**. The renal artery brings blood to each kidney and the renal vein takes it away.

Urea Spec 7.22B

The body cannot store excess amino acids. They are broken down in the **liver**, and **urea** is produced. Urea is a waste substance. It is carried in the blood to the kidneys and removed in the urine.

Exam tip: Write 'urea is made in the liver from excess amino acids'. It is made from amino acids, not from glucose or fat.

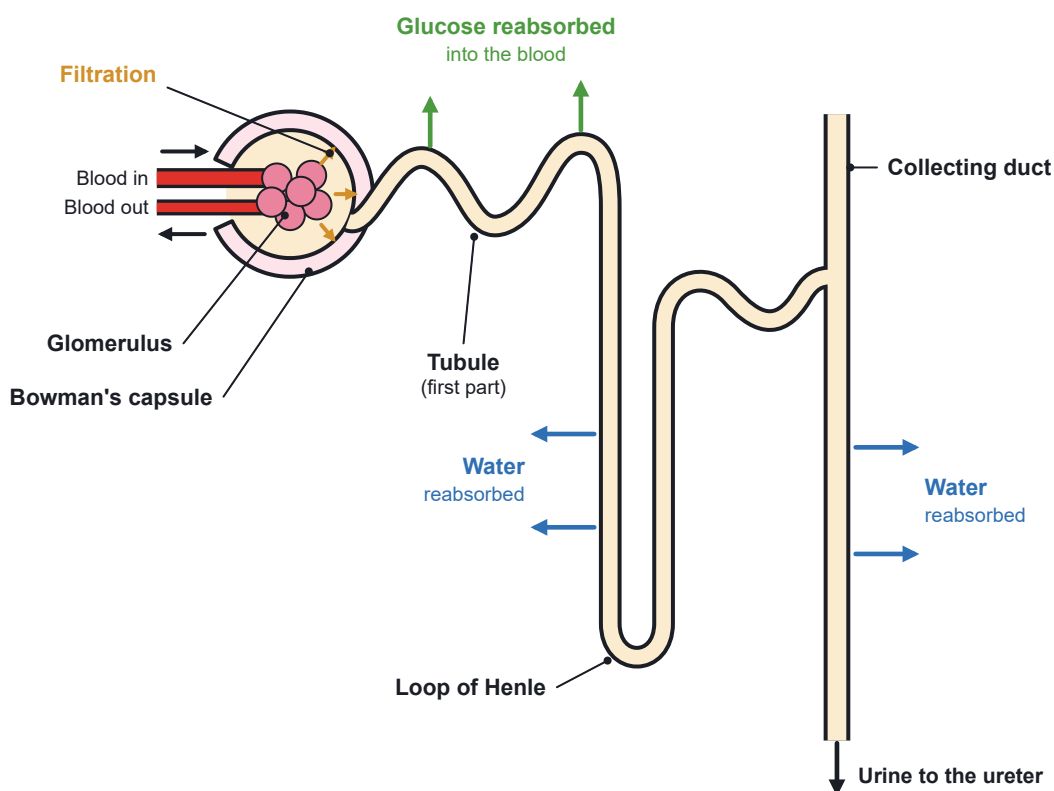
The nephron: filtering and reabsorption Spec 7.19B

Each kidney contains many tiny tubes called **nephrons**. The nephron filters the blood and forms urine. Blood enters a knot of capillaries, the **glomerulus**, which sits inside a cup-shaped **Bowman's capsule**.

1. **Filtration**: blood in the glomerulus is at high pressure. Small molecules such as water, glucose, urea and ions are forced out into the Bowman's capsule. Large molecules such as proteins, and blood cells, stay in the blood.
2. **Selective reabsorption of glucose**: in the first part of the tubule, all the glucose is reabsorbed back into the blood by active transport, which uses energy from respiration.
3. **Reabsorption of water**: as the filtrate passes along the loop of Henle and the collecting duct, water is reabsorbed back into the blood. How much depends on the body's needs.
4. What is left, which is urea, excess ions and water, is urine. It passes to the ureter.

Substance	Filtered at the glomerulus?	In urine?
Water	Yes	Yes, the amount that is not reabsorbed
Glucose	Yes	No, all reabsorbed
Urea	Yes	Yes
Proteins and blood cells	No	No

Exam tip: Link each part to its job: the glomerulus and Bowman's capsule filter, the tubule reabsorbs glucose, and the loop of Henle and collecting duct reabsorb water.



A **nephron**: filtration in the Bowman's capsule, **selective reabsorption** of glucose, then reabsorption of water.

ADH and the collecting duct Spec 7.20B

ADH is released by the pituitary gland. It controls how much water is reabsorbed in the kidney, which keeps the water content of the blood steady (osmoregulation). ADH changes the **permeability of the collecting duct**.

	Blood water content too low	Blood water content too high
ADH released	More	Less
Collecting duct	More permeable to water	Less permeable to water
Water reabsorbed into blood	More	Less
Urine	Small volume, concentrated	Large volume, dilute
Blood water content	Rises back to normal	Falls back to normal

Common mistake: ADH changes how permeable the collecting duct is to water. It does not change the amount of water the person drinks.

Treating kidney failure Spec 7.21B

If the kidneys fail, waste substances such as urea build up in the blood. There are two treatments: **kidney dialysis** and **organ donation** (a kidney transplant).

Kidney dialysis

1. The patient's blood flows through a dialysis machine, separated from dialysis fluid by a partially permeable membrane.
2. Urea and excess ions and water pass out of the blood into the dialysis fluid, which is changed to keep the concentration gradient.
3. The dialysis fluid has the same concentration of glucose and ions as healthy blood, so useful substances are not lost.
4. The cleaned blood is returned to the patient.

Kidney transplant

A healthy kidney from a donor is placed in the patient. The donor kidney must be a good tissue match, and the patient takes drugs so the immune system does not reject it.

	Dialysis	Transplant
Advantage	Available straight away	No regular treatment needed once it works
Disadvantage	Takes several hours, several times a week	Few donors, and the kidney may be rejected

Quick check

1. Which tube carries urine from the bladder out of the body?
2. Where is urea produced and from what?
3. What happens to glucose in the nephron?
4. What does ADH do to the collecting duct? (Higher)
5. Give one treatment for kidney failure.

Quick check answers

The urinary system and the kidneys

1. The urethra.
2. In the liver, from the breakdown of excess amino acids.
3. It is all reabsorbed into the blood.
4. It makes it more permeable to water, so more water is reabsorbed.
5. Kidney dialysis or a kidney transplant from a donor.