

Excretion

Revision notes · Excretory products of the lungs, kidneys and skin, and how the kidney filters blood, reabsorbs useful substances and controls water with ADH.

For Pearson Edexcel International GCSE Biology 4BI1 and Science (Double Award) 4SD0. **Biology only** is not in the Double Award and is only examined on Paper 2.

Excretion **Spec 2.71-2.79B**

Excretion: lungs, kidneys and skin **Spec 2.71**

Excretion The removal from the body of the waste products of metabolism.

Cells make waste products as they carry out chemical reactions. Some of these are poisonous or harmful if they build up, so they must be removed. Three organs carry out **excretion** in humans: the lungs, the kidneys and the skin.

Organs of excretion and their excretory products

Organ	Excretory products
Lungs	Carbon dioxide (and water vapour), lost when we breathe out
Kidneys	Urea, with excess water and ions, lost in urine
Skin	Water, salts (ions) and urea, lost in sweat

Carbon dioxide is a waste product of respiration. **Urea** is a nitrogen-containing waste product. The blood carries both to the organs that remove them.

Common mistake: Faeces are not excretory products. They are undigested food that has never been part of the cells' chemistry, so removing them is egestion, not excretion.

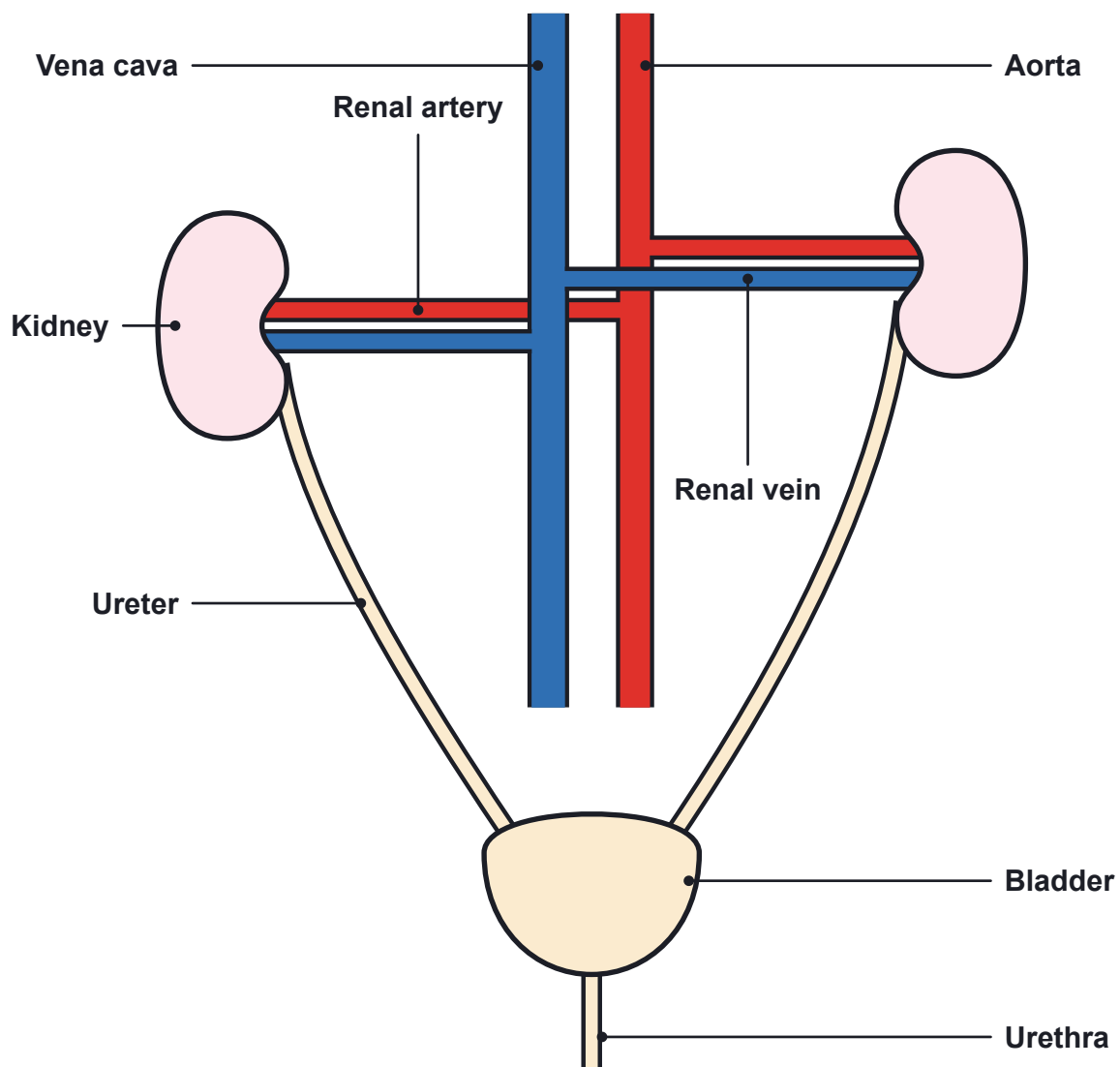
Exam tip: Always match the product to the organ: carbon dioxide from the lungs, urea from the kidneys. Sweat also contains urea, but its main job is cooling.

The kidney and the urinary system **Spec 2.72B, 2.73B** **Biology only**

The kidneys do two jobs. **Excretion**: they remove urea from the blood. **Osmoregulation**: they control the water content and the ion content of the blood. Both jobs happen as the kidneys make **urine**.

- Excretion: urea is filtered out of the blood and is not taken back, so it leaves the body in urine.
- Osmoregulation: the kidney changes how much water (and how many ions) it reabsorbs back into the blood, so only the excess is lost in urine.

Parts of the urinary system	
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.

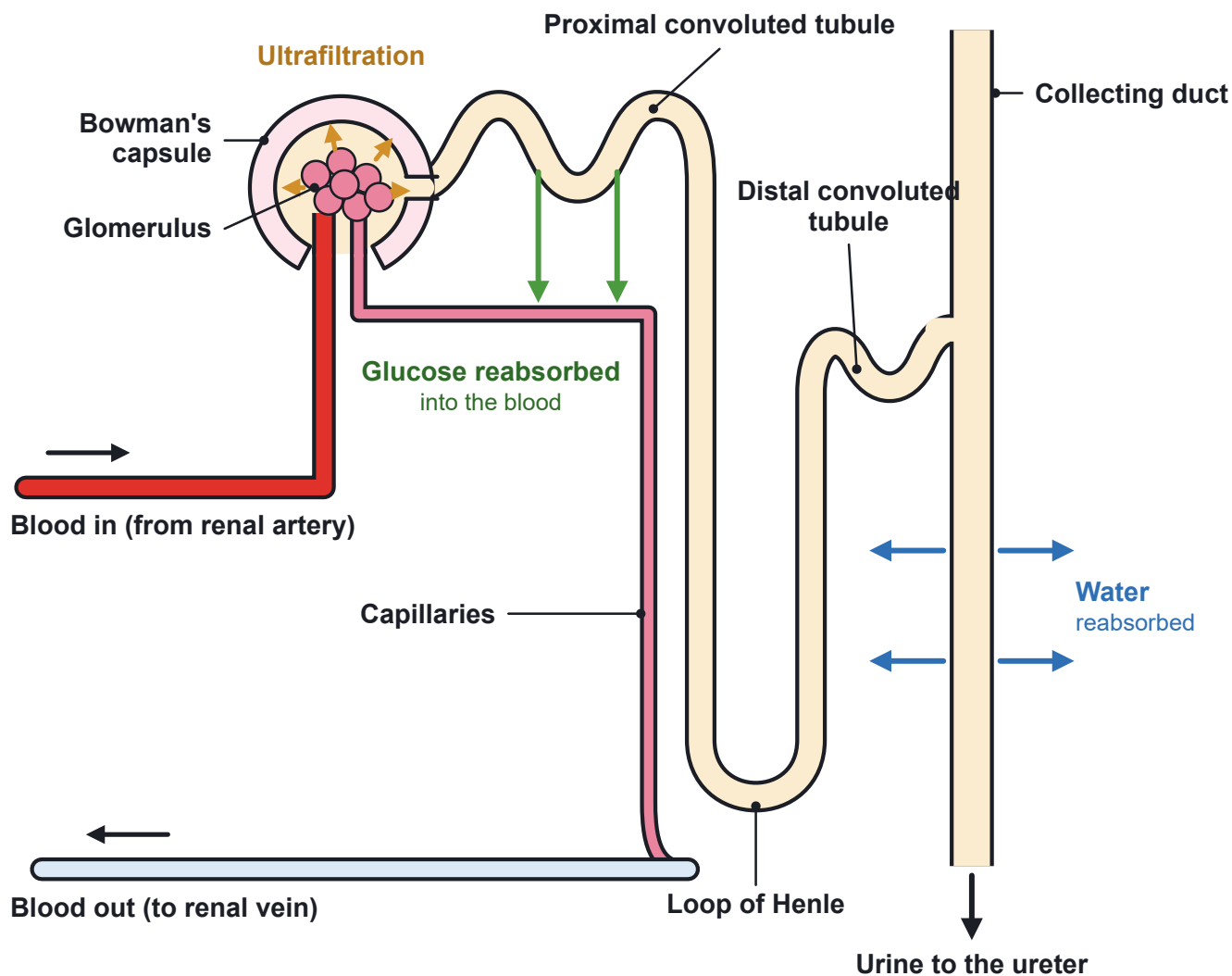
Common mistake: The ureter carries urine from the kidney to the bladder. The urethra carries urine from the bladder out of the body. Do not swap them.

The nephron and ultrafiltration Spec 2.74B, 2.75B Biology only

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

- **Bowman's capsule** and **glomerulus**: where blood is filtered.

- **Proximal convoluted tubule:** the first coiled part of the tubule, after the Bowman's capsule.
- **Loop of Henle:** the long loop that dips down and comes back up.
- **Distal convoluted tubule:** the second coiled part of the tubule.
- **Collecting duct:** the tube that several nephrons drain into, which carries urine towards the ureter.



A nephron. **Ultrafiltration** happens at the Bowman's capsule, **glucose is reabsorbed** at the proximal convoluted tubule and **water is reabsorbed** at the collecting duct.

Ultrafiltration

Blood in the glomerulus is at high pressure. This forces small molecules out of the blood and into the Bowman's capsule. This is **ultrafiltration**. The liquid that enters the capsule is the **glomerular filtrate**. Large molecules and cells are too big to pass through, so they stay in the blood.

Composition of the glomerular filtrate	
Substance	In the glomerular filtrate?
Water	Yes
Glucose	Yes
Urea	Yes
Ions	Yes
Proteins	No (too large)
Blood cells	No (too large)

Exam tip: Say that filtration is based on size: small molecules pass into the capsule and proteins and cells do not. Use the word ultrafiltration.

Selective reabsorption and urine Spec 2.76B, 2.77B, 2.79B Biology only

The glomerular filtrate contains useful substances as well as waste. The body cannot afford to lose them, so the useful substances are taken back into the blood. This is **selective reabsorption**.

Glucose: proximal convoluted tubule

All the glucose in the filtrate is reabsorbed into the blood at the **proximal convoluted tubule**. It is reabsorbed by **active transport**, which uses energy from respiration. Glucose is needed by cells as a fuel for respiration, so none must be lost in the urine. Normal urine contains no glucose.

Water: collecting duct

Water is reabsorbed back into the blood from the **collecting duct**. It moves out of the collecting duct by **osmosis**, into the more concentrated tissue around it, and then into the blood capillaries. The amount that is reabsorbed depends on the body's needs, and is controlled by ADH (next section). The more water that is reabsorbed, the less water is left in the urine.

What is in urine

What remains after reabsorption is **urine**. It contains **water, urea and ions**. It flows from the collecting duct to the ureter, then the bladder.

What happens to each substance in the nephron		
Substance	Filtered at the glomerulus?	In urine?
Water	Yes	Yes, the amount not reabsorbed
Glucose	Yes	No, all reabsorbed
Urea	Yes	Yes
Ions	Yes	Yes, the excess
Proteins and blood cells	No	No

Exam tip: For a mark on glucose, give the place (proximal convoluted tubule), the process (active transport) and the reason (needed for respiration).

ADH and the water content of the blood Spec 2.78B Biology only

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

How ADH regulates the water content of the blood

	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: More ADH means less urine, not more. ADH makes the collecting duct more permeable, so more water goes back into the blood.

Quick check

1. Name the excretory product of the lungs.
2. Name three substances lost from the skin in sweat.
3. **Biology only** Which part of the nephron does ultrafiltration take place in?
4. **Biology only** Where is glucose reabsorbed, and by what process?
5. **Biology only** What does ADH do to the collecting duct?

Quick check answers

Excretion

1. Carbon dioxide.
2. Water, salts (ions) and urea.
3. The Bowman's capsule (from the glomerulus).
4. The proximal convoluted tubule, by active transport.
5. It makes the collecting duct more permeable to water, so more water is reabsorbed.