

Excretory System

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Homeostasis

Balancing internal conditions in specific boundaries in a stable way is referred to as **homeostasis**.

CO₂ – excreted through respiratory system

Water – excreted through lungs during expiration in the form of vapor, through the skin in the form of sweat, through the large intestine in the form of feces and through the kidney in the form of urine.

Sweat – contains water, salt and urea.

Is urea the reason for smell from sweat!?

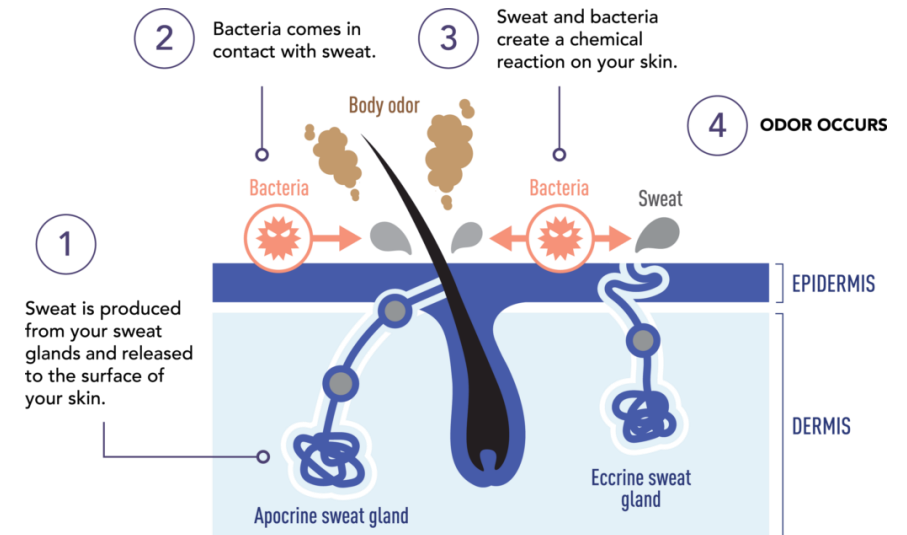
Role of Bacteria:

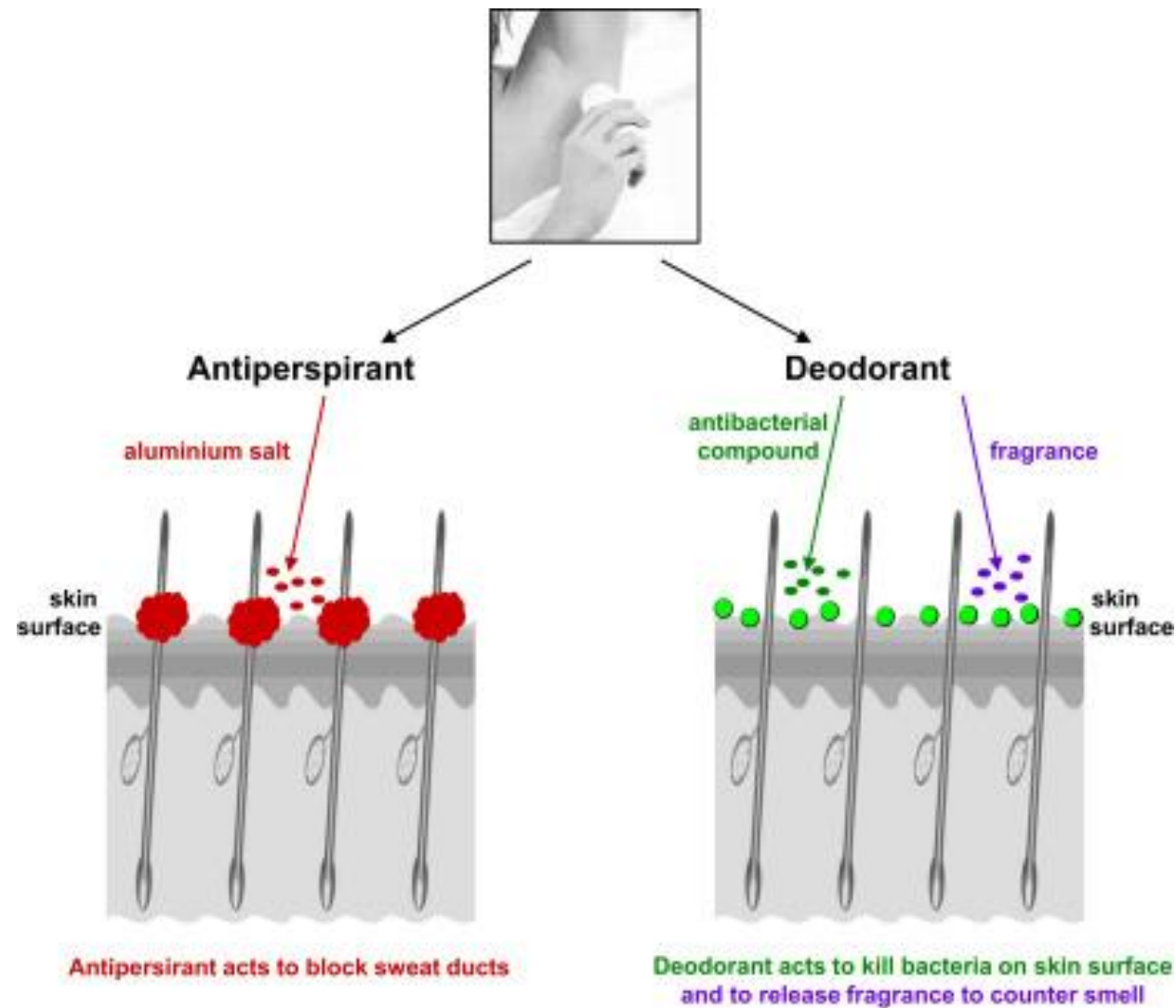
The odor arises when skin bacteria (**e.g., Staphylococcus and Corynebacterium**) metabolize components of apocrine sweat. These bacteria break down proteins and lipids into **volatile organic compounds (VOCs)**, such as:

Short-chain fatty acids (e.g., isovaleric acid, which smells cheesy).

Sulfur-containing compounds (e.g., thioalcohols, contributing to onion-like odors).

Urine – contains water, salt and urea.





The excretory system in humans consists of **kidneys, ureter, urinary bladder** and **urethra**.

Liver converts ammonia to urea!
Ammonia is highly toxic!

NH_3 – ammonia

$\text{CO}(\text{NH}_2)_2$ – Urea

$\text{C}_5\text{H}_4\text{N}_4\text{O}_3$ – Uric acid

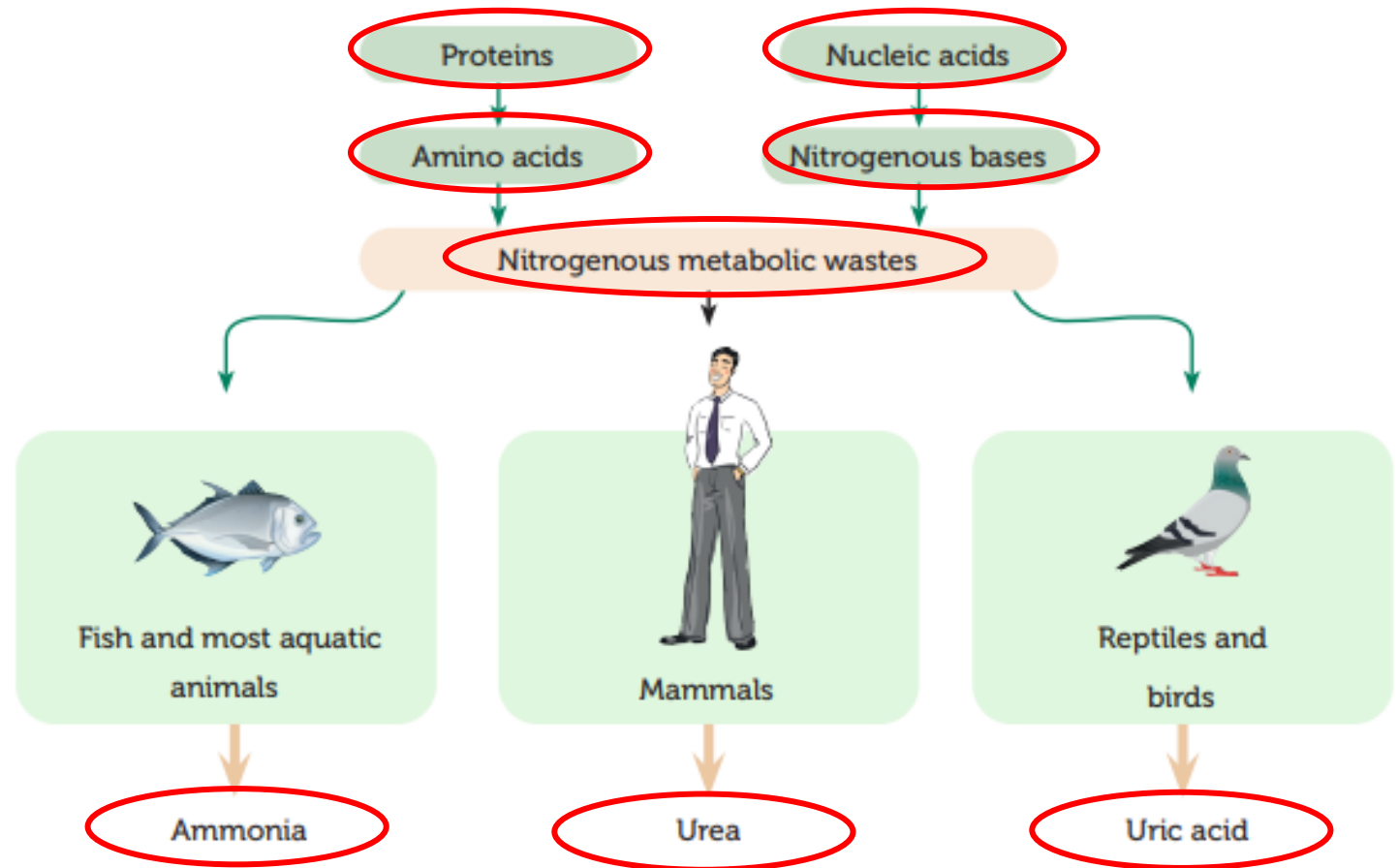
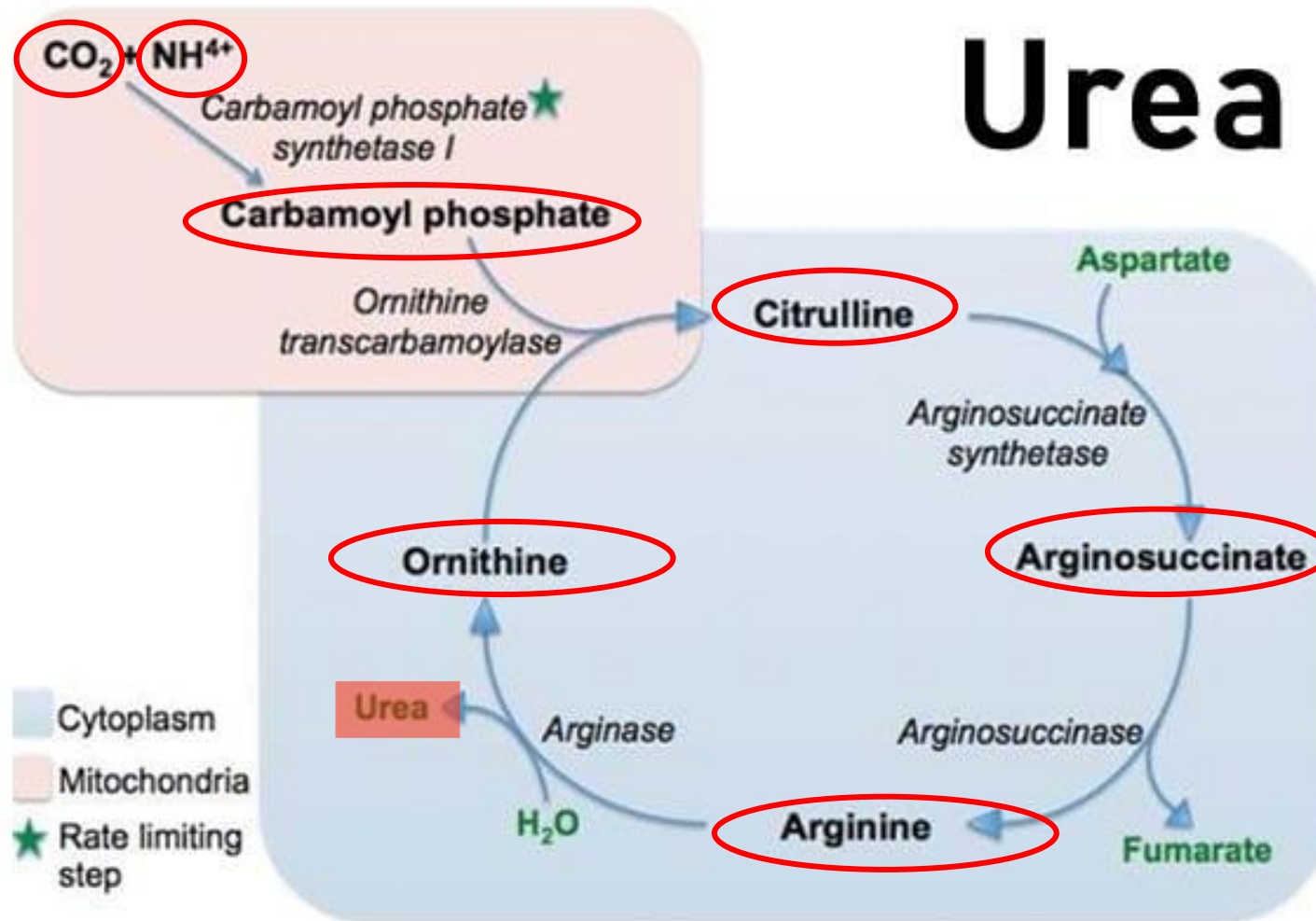


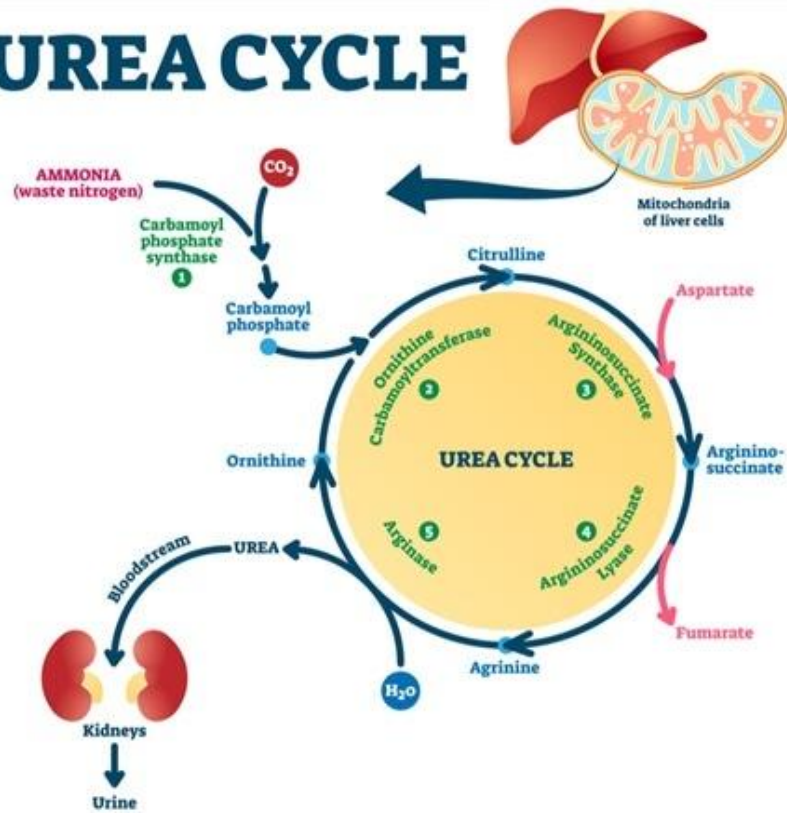
Figure 1: Comparison of nitrogenous wastes in various organisms

Urea Cycle

Enzymes & Steps



UREA CYCLE



Urea is transported to kidneys

Once produced in the liver, urea enters the bloodstream and is transported throughout the body. It is water-soluble and can easily circulate in the blood plasma.

How kidneys work

<https://www.youtube.com/watch?v=pv5-GwJ90ZM>

Kidneys

The kidneys perform many crucial functions, including:

- maintaining overall fluid balance.
- regulating and filtering minerals from the blood.
- filtering waste materials from food, medications, and toxic substances.
- creating hormones that help produce red blood cells, promote bone health, and regulate blood pressure.

Structure of the kidneys

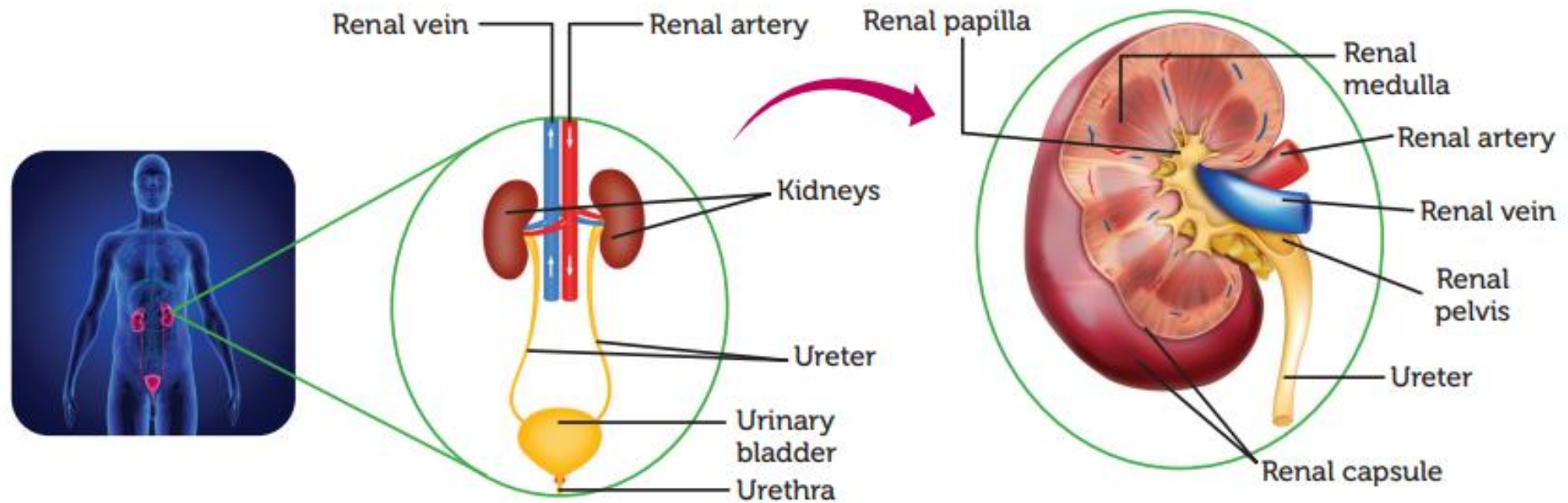


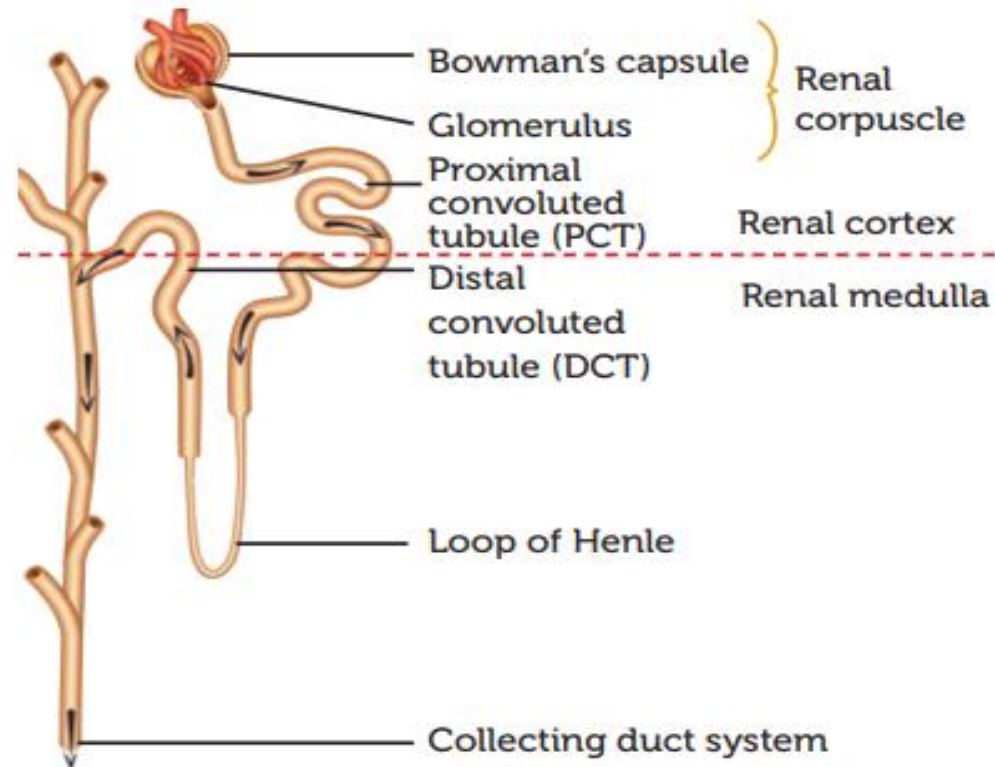
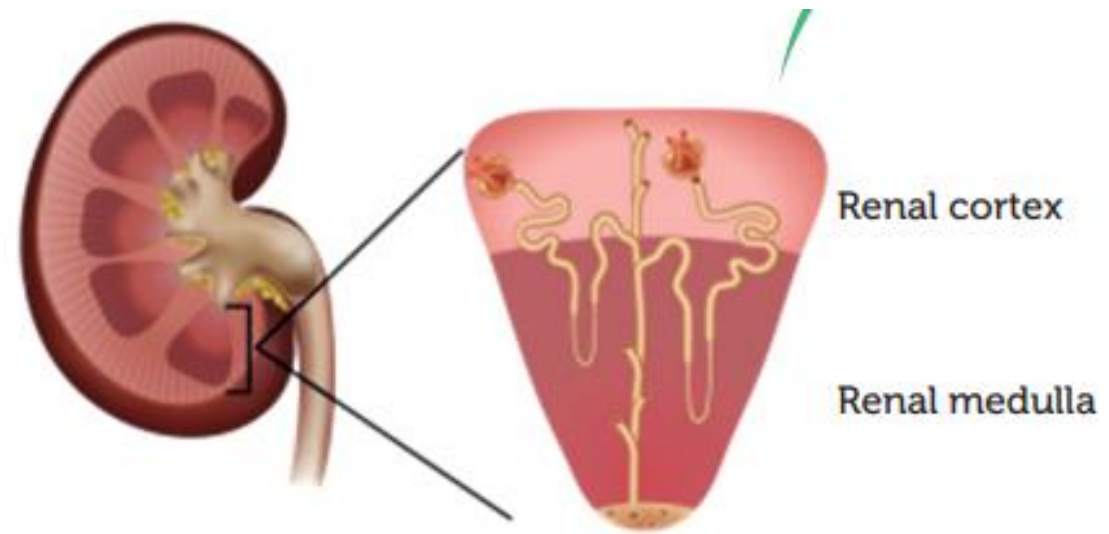
Figure 3: Human urinary system

Nephrons

The basic structural and functional units of the kidney are nephrons. Each kidney holds approximately one million nephrons. Nephrons can filter 180 litres of blood in a day. Roughly 1.5 litres of this is excreted from the body as urine.

A nephron is comprised of three parts. These are;

- Glomerulus (a network of capillaries)
- Bowman's capsule
- Renal tubules (proximal convoluted tubules, loop of Henle, distal convoluted tubule, and collecting duct system)



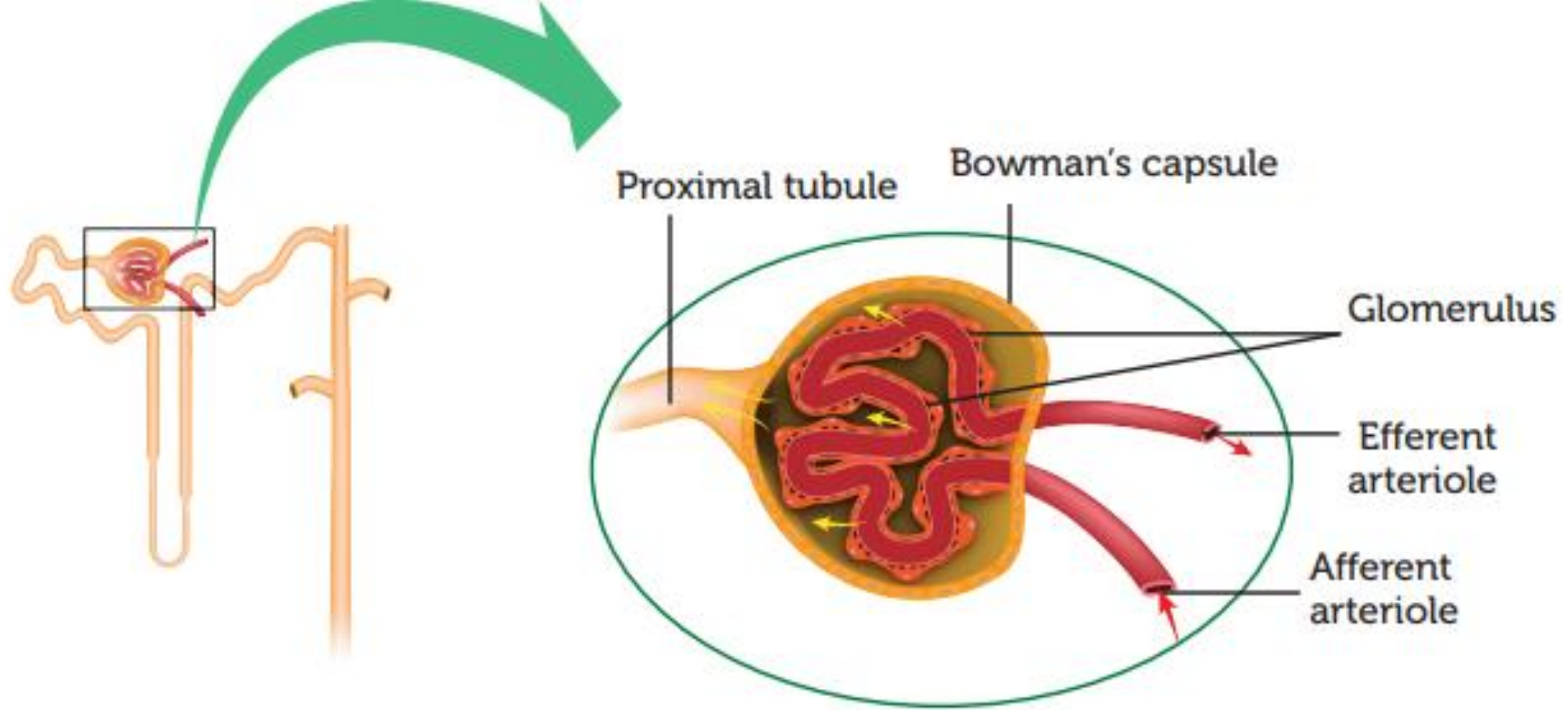


Figure 5: Filtration in renal corpuscle

The **afferent arterioles** that enter **Bowman's capsule** branch out into glomerulus, a network of capillaries. These capillaries then unite and leave Bowman's capsule as **efferent arterioles**.

Filtration

The principle of filtration is forcing of the fluids and the substances (here, blood) dissolved in it through a membrane by pressure (here, the blood pressure).

Amino acids, glucose, small proteins, nitrogenous wastes, water, vitamins and ions easily pass into the capsular space or the lumen of the Bowman's capsule.

Certain harmful substances like urea, pigments, ammonium salts, creatinine, uric acid and potassium ions also, filter out to become a part of the filtrate.

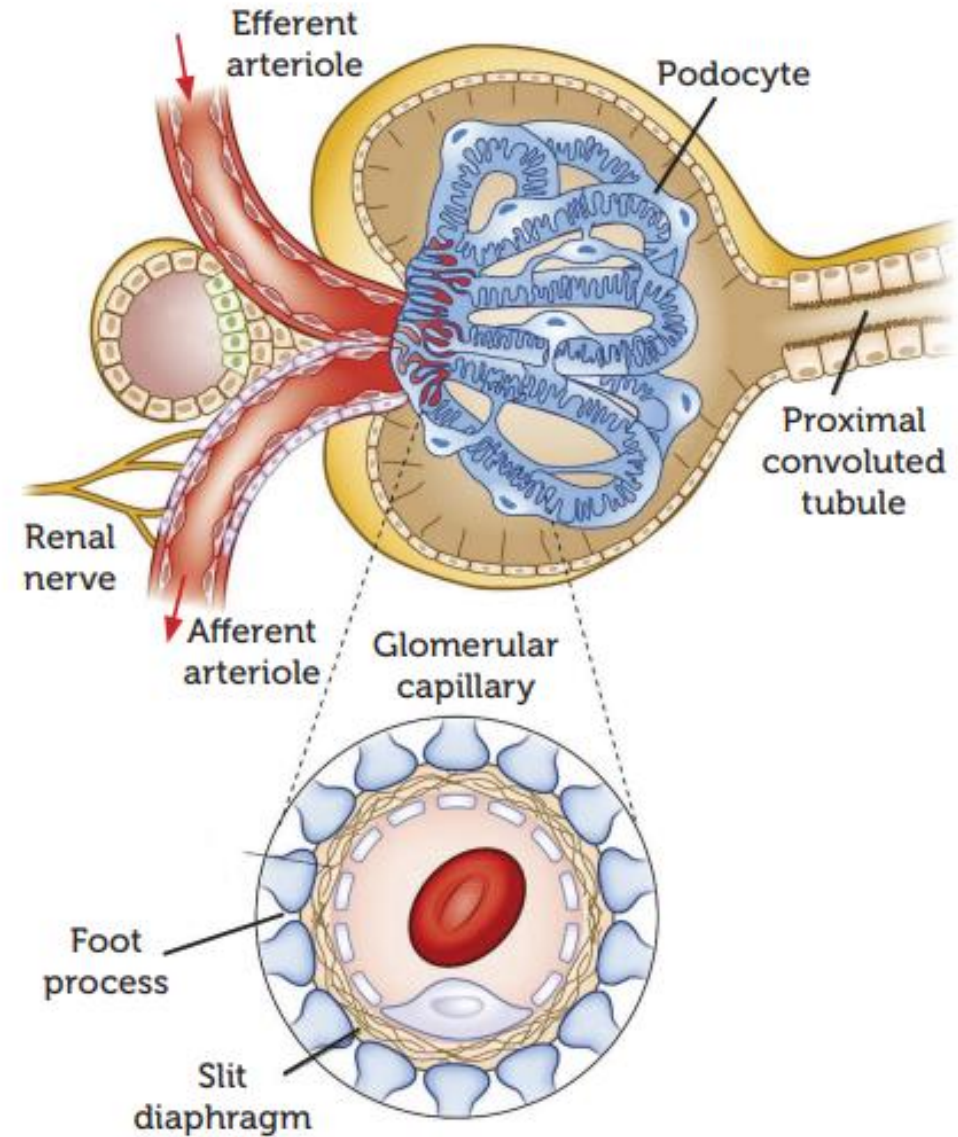


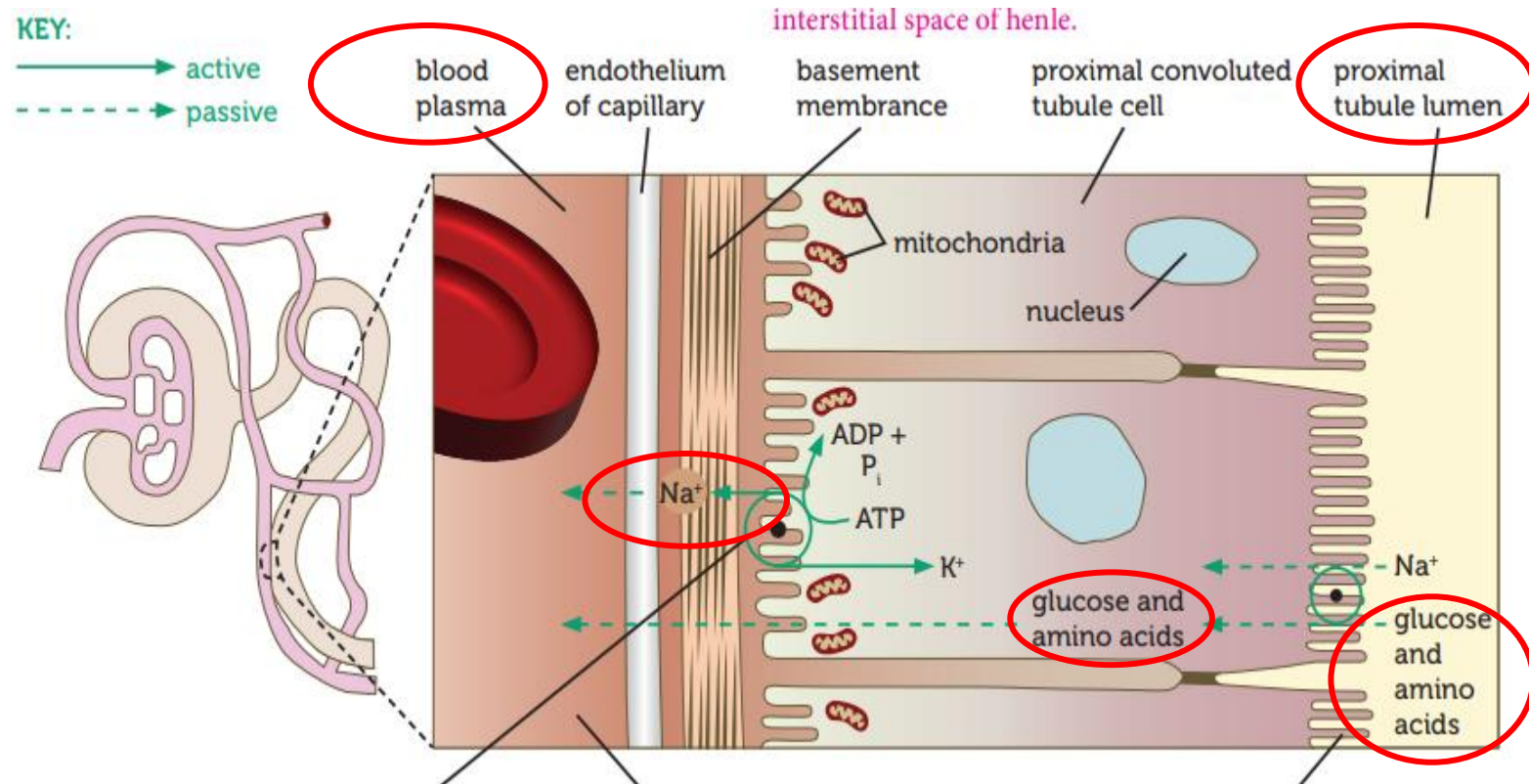
Figure 6: Structure of the renal corpuscle

Reabsorption

The kidneys in humans produce around 160L-170L of ultrafiltrate on a daily basis. **The proximal tubule results in the electrolyte, fluid, and homeostasis of nutrients by reabsorbing approximately 60%-70% of the Na^+ , Cl^- and water, a large portion of NaHCO_3 , and almost of all the ultrafiltrate nutrients.** As only certain substances are reabsorbed, the process is called **selective reabsorption**.

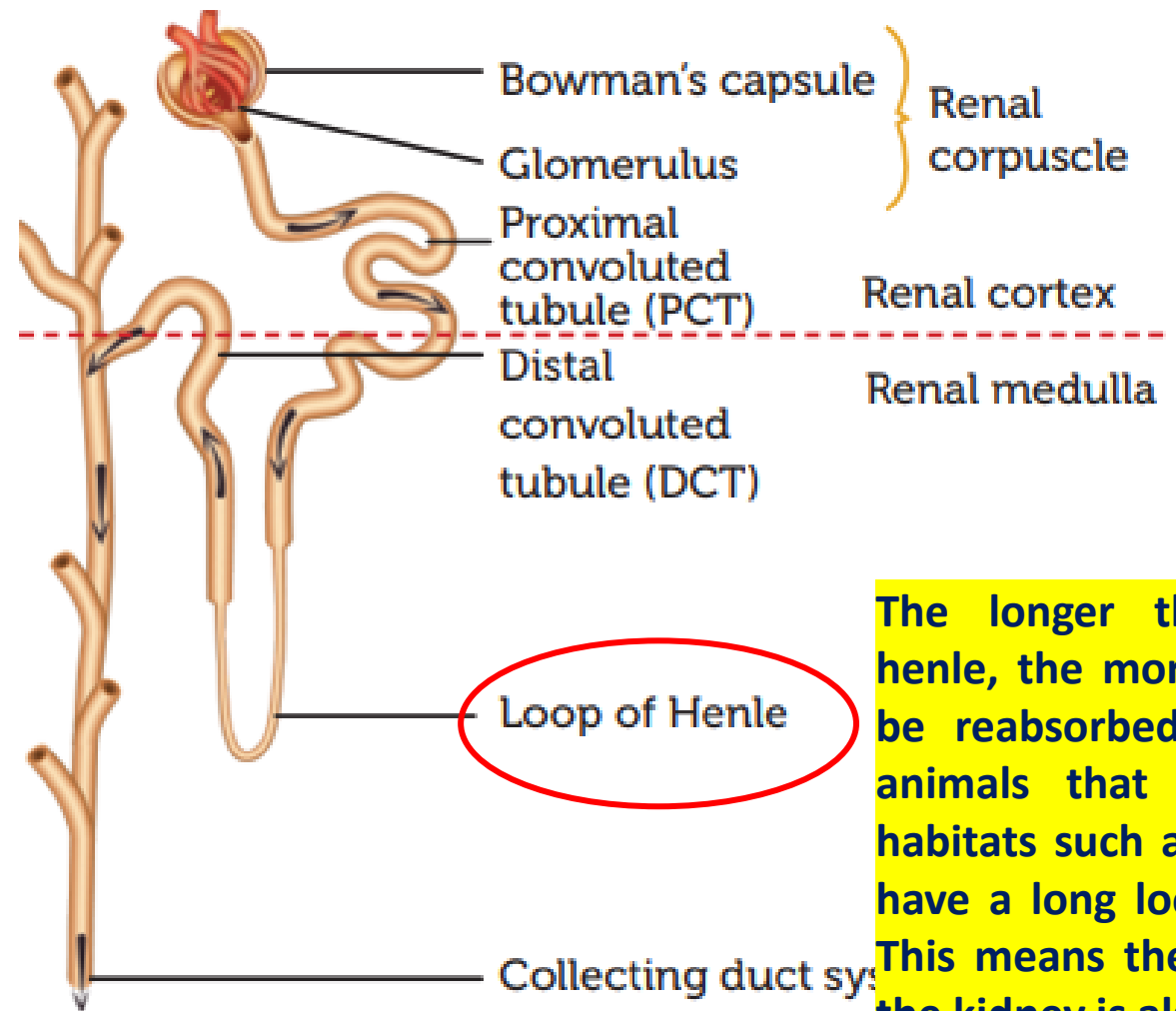
Which molecules are reabsorbed?

- Glucose
- Amino acids, vitamins, inorganic ions.
- Some amount of water
- Some amount of urea.



The Loop of Henle

Henle's loop can be characterized by the U-shape, **whose main function is to perform the reabsorption of the water and Na^+Cl^- from the urine**, and connect the proximal and distal convoluted tubules.



The longer the loop of henle, the more water will be reabsorbed. Therefore, animals that live in dry habitats such as the desert have a long loop of Henle. This means the medulla of the kidney is also thicker

Distal Convolved Tubule and Collecting Duct System

These tubules continue to collect ions and water, by resulting in an increased concentration in urine.

The aim of all these steps, so filtration, reabsorption and secretion, is to produce urine at the end.

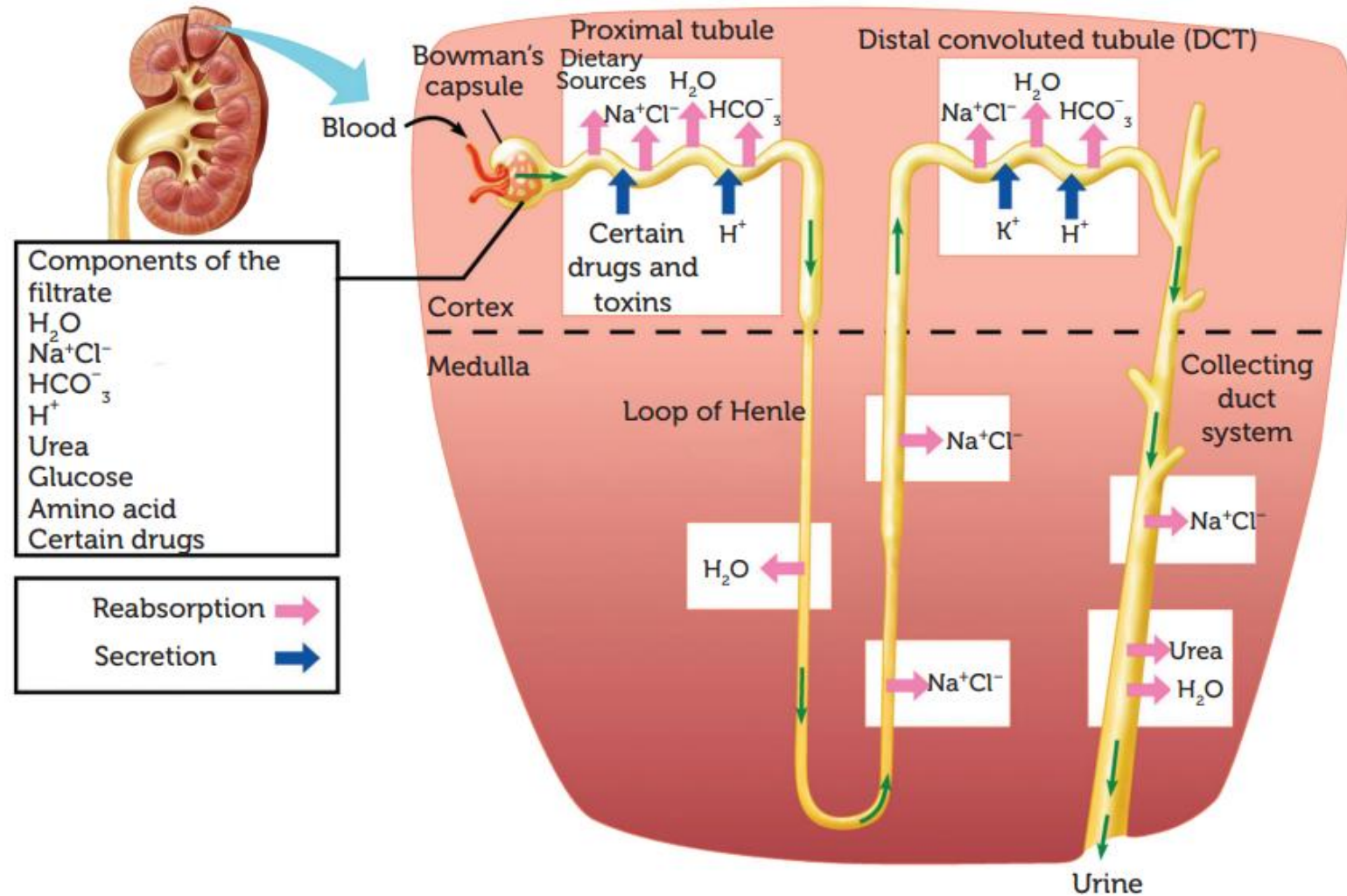


Figure 11: Reabsorption and secretion in the urinary duct