TOPIC 11.3: OSMOREGULATION

Stages of Excretion

Nephrons are the functional units of the kidneys
- Are situated in the cortex but descend into the medulla

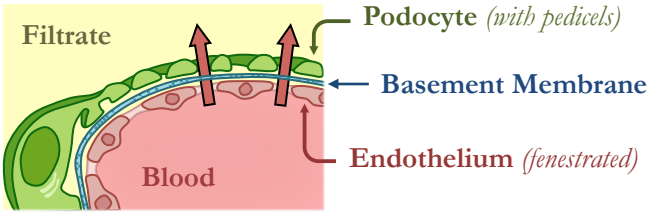
Nephrons mediate excretion via three main stages:
- **Ultrafiltration** – filters out all cells and proteins
- **Selective reabsorption** – retains nutrients / solutes
- **Osmoregulation** – controls water retention

Ultrafiltration

Ultrafiltration occurs at the Bowman's capsule / glomerulus
- Separates cells and proteins from blood to form filtrate

Structure of the Bowman's Capsule

- Glomerular capillaries are fenestrated (have pores), which allows blood to freely exit the glomerulus
- The capsule is lined with podocytes that have extensions (called pedicels) that the blood can freely pass between
- The **only** filtration barrier is the basement membrane that lies between the glomerulus and the capsule



Hydrostatic Pressure (ULTRAfiltration)

- Blood is forced into a Bowman's capsule at high pressure
- Wide afferent arterioles (entry) lead into narrow efferent arterioles (exit), increasing the pressure in the capsule
- Also, the extensive narrow branching of the arterioles increases glomerular surface area available for filtration

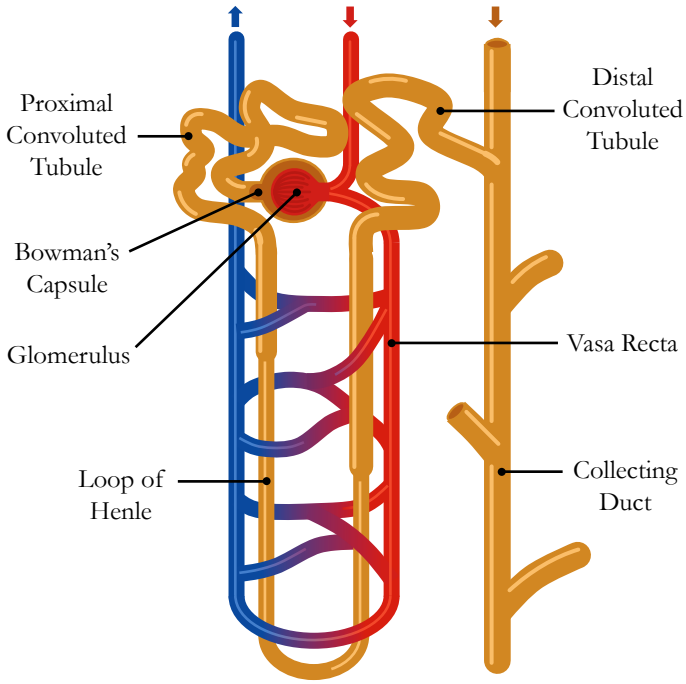
Selective Reabsorption

Selective reabsorption occurs in the convoluted tubules
- Involves the reuptake of usable substances from filtrate

Materials are **actively** transported across the tubule's apical membrane before diffusing across the basolateral membrane
- Tubules are lined with microvilli to increase surface area

Materials reabsorbed by the convoluted tubules include:
- Glucose and amino acids (via symport with sodium ions)
- Mineral ions and vitamins (via protein pumps)
- Water (follows ions and solutes via osmosis)

Nephron



Osmoregulation

Osmoregulation is the control of water balance in the body
- Involves the loop of Henle and collecting ducts

Establishing a Salt Gradient

- The loop of Henle creates a salt gradient in the medulla
- The descending limb is permeable to water but not salt
- The ascending limb is permeable to salts but not water
- This means that as the loop descends into the medulla, the interstitial fluid becomes increasingly hypertonic

Antidiuretic Hormone (ADH)

- As the collecting duct passes through the medulla, the salt gradient draws water **out** of the duct (into blood)
- The amount of water drawn from the ducts is controlled by ADH (released from the posterior pituitary gland)
- ADH produces water channels (aquaporins) to faciliate water reabsorption by the collecting duct
- Levels are high when dehydrated and low when hydrated

Water Conservation

Maintaining water balance is critical to survival *(homeostasis)*
- Dehydration causes blood pressure to drop *(⬆ heart rate)*
- Overhydration causes cells to swell *(leads to organ damage)*

Desert animals will have longer loops of Henle to maximise water conservation *(⬆ salt gradient = ⬆ water reabsorption)*