

## Excretion:

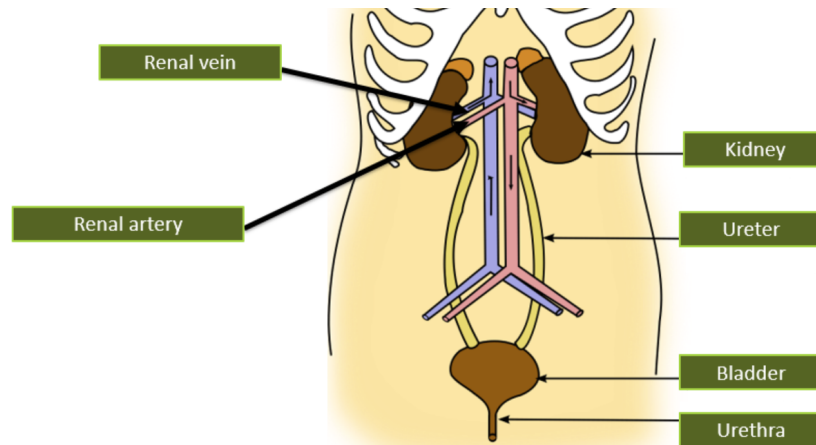
- Excretion - Removal of Metabolic waste (any waste made from a chemical reaction) from the body.
- Excretion organs include:
  - Kidneys - Removal of urea, water, and ions from blood as urine.
  - Skin - removal of water and salt by sweating.
  - Lungs - removal of carbon dioxide and water vapor from blood during expiration.

## Proteins and Urea:

- Proteins contain nitrogen - an excess of it can be toxic and must be excreted (which means amino acids cannot be stored in the body)
- Excess amino acids are converted to urea.
- Amino acids from proteins are first broken down into carbohydrates and urea in the liver.
  - Deamination: breaking down nitrogenous compounds, mostly amino acids.
- The urea then passes through the blood to the kidneys.

## Liver:

- Controls the amount of glucose in the blood with help of insulin.
- Breaks down old red blood cells
- Breaks down alcohol, drugs, and hormones (known as detoxification)
- Prolonged use of Alcohol/drugs (paracetamol) lead to liver failure.
- Liver makes bile stored in the gallbladder, which is broken down and added to faeces.



## Kidney Structure:

- Cortex - the outer layer packed full of filters called nephrons that filter blood.
- Medulla - the middle layer which has tubes carrying filtered wastes to the center of the kidney, and contains Loop of Henle.
- Pelvis - area where the collecting ducts come together and connect to the ureter.
- Ureter - transports the urine to the bladder.

## **Nephron structure:**

- Each kidney contains over a million tubules/nephrons.
- Convolted tubules - where reabsorption of useful substances happens, including Glucose, most water, and some salts.
  - Proximal - all glucose reabsorbed + some water and minerals.
  - Distal - reabsorption of excess water and mineral ions.
- Bowman's Capsule - where filtration takes place, the filtrate contains usable and waste products.
- Collecting Duct - collects the urine from nephrons and transports it to the pelvis.

## **Kidneys:**

- Kidneys can fail - long term association with diabetes and blood pressure.
- Waste clogs up in blood quickly - needs a dialysis machine which does the same job as the kidneys.
- We generally only need one kidney to function.

## **Urinary System Process:**

- Unfiltered blood enters the kidney at high pressure from the renal artery (afferent arterioles with high pressure)
- Blood enters a ball of capillaries called Glomerulus.
- Blood is filtered and exits the kidney from the renal vein.
- The capillaries sit in a filter called the Bowman's capsule/renal capsule.
- Small molecules leave the capillaries (proteins and RBC are too large) and enter the capsule (including glucose, amino acids, salts, urea, water) - Ultrafiltration
- The filtered blood moves down the nephron. (glomerular filtrate)
- In the proximal convoluted tubule, cells reabsorb the useful substances - all sugars are reabsorbed, as well as some water and mineral ions. (selective reabsorption)
- The remaining urea and water continues to the Loop of Henle, where some water is reabsorbed. (Osmoregulation) - a salt gradient draws water out.
- Then the filtrate goes through the distal convoluted tubule, where excess water and mineral ions are reabsorbed. (selective reabsorption)
- The filtrate then goes down the collecting duct where water is regulated (osmoregulation) and passed through the pyramid to go to the pelvis.
- The urine formed passes through the ureter and is stored in the bladder.
- It is held there by sphincters until the bladder is full, and removed through the urethra.
  - First sphincter opens automatically when the bladder is full.
  - The second opens voluntarily.

### **Excess Water:**

- The body is always trying to maintain normal levels (Homeostasis)
- Water content in the blood and body must be kept constant.
- If not regulated, cells will take up the water through osmosis, swell up, rupture.

### **Osmoregulation:**

- The body controls the water content of blood using the kidney.
- Special cells in the hypothalamus of the brain detect the concentration of water in blood.
- They then cause the pituitary gland to release hormone called ADH (antidiuretic hormone)
- This then travels to the kidney through the blood where it makes the walls of the collecting duct more permeable to water, therefore more water is reabsorbed into the blood.
- This makes urine more concentrated with urea.
- This is a form of negative feedback - adjusting and balancing levels to equilibrium. (almost always balanced water levels)

### **Water Levels Decrease:**

- The hypothalamus detects the decrease in water concentration and signals the Pituitary Gland to release more ADH that travels to the collecting duct.
- The collecting duct becomes more permeable, and more water is reabsorbed back into the blood from the collecting duct.
- The urine becomes more concentrated with urea, and decreases in volume.
- This returns water levels back to normal.

### **Water Levels Increase:**

- The hypothalamus detects the increase in water concentration and signals the Pituitary gland to release less ADH that travels to the collecting duct.
- The collecting duct becomes less permeable, and less water is reabsorbed back into the blood from the collecting duct.
- The urine becomes less concentrated (more dilute) and increases in volume.
- The water levels return to normal.

### **After Kidney Filtration:**

- Conc. of Glucose - stays the same.
- Conc. of Ions - slightly decreases.
- Conc. of Urea - Fully Depleted.