

### The kidney

The kidney are excretory organs which are vital for survival

#### The functions of the kidney

Removal of urea                      Regulating the water potential of blood plasma

#### The structure of the kidney

Capsule                                  Layer of lipid surrounding the kidney that acts as a protective layer

Renal Cortex                          The outer region of the kidney

Renal Medulla                        The inner region of the kidney

Nephron                                The functional unit of the kidney  
located in between the renal cortex and the renal medulla  
the nephron is made of two sections...  
- the renal corpuscle  
- the renal tubules

Renal Corpuscle                      The renal corpuscle is made of the Glomerulus and the Bowman's Capsule

Renal Tubules                         The renal tubules are made up of proximal convoluted tubules, loops of Henle, and distal convoluted tubules

Pelvis                                    The pelvis removes any of the urine form the nephrons

Ureter                                    The ureter removes any urine from the pelvis to the bladder

Urethra                                 The urethra is a tube that removes urine from the bladder and expels it out of the body.

#### Processes that occur in the kidneys

#### Location

1- Ultrafiltration                      Renal corpuscle

2- Selective Reabsorbtion            Renal tubule

3- Water Reabsorbtion                Renal tubule

#### 1- ULTRAFILTRATION

#### 1- ULTRAFILTRATION (cont)

#### 1. SELECTIVE REABSORBTION

**Ultrafiltration** the process by which the blood is first filtered in the nephron for any small molecules leaving behind the erythrocytes and the large plasma proteins.

**Location** Ultrafiltration occurs in the glomerulus and the small molecules are filtered into the bowman's capsule which leads to the proximal convoluted tubule.

### Key Terms

**Glomerulus** network of capillaries where ultrafiltration occurs

**Bowman's capsule** Cup shaped structure that surrounds the glomerulus and is responsible for the initial stage of urine formation.

**Endothelium** the inner lining of the capillaries which are thin and permeable to allow the exchange of materials.

**Basement membrane** the basement membrane is made of collagen fibres and proteins that prevents the removal of large molecules from the capillary

**Podocytes** Lining of the bowman's capsule - they are specialised epithelial cells they contain pedicels

**Pedicels** finger like protections that are found on the podocytes that wrap around the capillary creating slits to stop the removal of any large molecules from the capillary

### Process

1. The unclean blood **enters** into the kidney by the **afferent arteriole** and **exits** the kidney through the **efferent arteriole**

2. The **afferent arteriole** has a **wide lumen** to maintain a **high hydrostatic pressure** from the artery - the hydrostatic pressure must be greater than the hydrostatic pressure in the Bowman's capsule so that it maintains a **hydrostatic pressure gradient**.

3. The **small molecules** are forced out of the capillary through the **endothelium** due to the **hydrostatic pressure gradient** - this is the **first filter**

4. The filtrate is then filtered through the **basement membrane** which prevents the removal of any large molecules - this is the **second filter**

5. The filtrate is then filtered through the **podocytes** that **line the Bowman's capsule** the filtrate is forced through the gaps between the podocytes have **pedicels**

6. The filtrate is now in the **bowman's capsule** with everything but the erythrocytes and the large plasma proteins and is now referred to as **glomerular filtrate**.

7. The glomerular filtrate moves then to the **proximal convoluted tubule**

**Selective Reabsorption** selective reabsorption is the process by which specific, necessary molecules are reabsorbed from the glomerular filtrate to the proximal convoluted tubule such as glucose and sodium ions (leaving the urea) to decrease the water potential in the PCT to reabsorb more water from the glomerular filtrate.

**Location** selective reabsorption occurs in the first section of the renal tubules - the molecules are absorbed from the proximal convoluted tubule in the capillary network surrounding the PCT

### Key Terms

**Na+** sodium ions

**Co-transport** the mechanism of active transport involving the simultaneous movement of two different substances across a biological membrane

### Process

1. **Na+** (sodium ions) is **actively transported** into the **tissue fluid** from the **cells** lining PCT tubule walls using a **sodium-potassium pump**

2. This **reduces the concentration** of **Na+** in the **cytoplasm** of the PCT cells



### 1. SELECTIVE REABSORPTION (cont)

3. The **Na<sup>+</sup>** molecules are then transported into the **PCT cells** from the **glomerular filtrate** with **glucose or amino acids** using **co-transporter proteins** by **facilitated diffusion**

4. As the **glucose and amino acid concentrations rise** in the **PCT cells** the glucose and amino acids **diffuse by facilitated diffusion** out the other side of the cell into the **tissue fluid** down their **concentration gradient**

5. The **substances** in the **tissue fluid** **diffuse** into the **blood** and are carried away to the rest of the body.

6. The **reabsorption of Na<sup>+</sup>, glucose and amino acids** **reduces the water potential in the cells** and the water potential **increases in the tubule fluid**

7. **Water** will enter into the **PCT cells** by **osmosis** down their **water potential gradient**.

#### Adaptation of cells lining the PCT

Many microvilli - adapted to increase the surface area for increased reabsorption of necessary molecules in filtrate such as glucose, amino acids and sodium ions

Co-transporter proteins - adapted to allow sodium ions, glucose and amino acids to perform facilitated diffusion

Many mitochondria - adapted to produce ATP for active transport of sodium ions into the blood stream from the PCT cells using sodium-potassium pumps.

