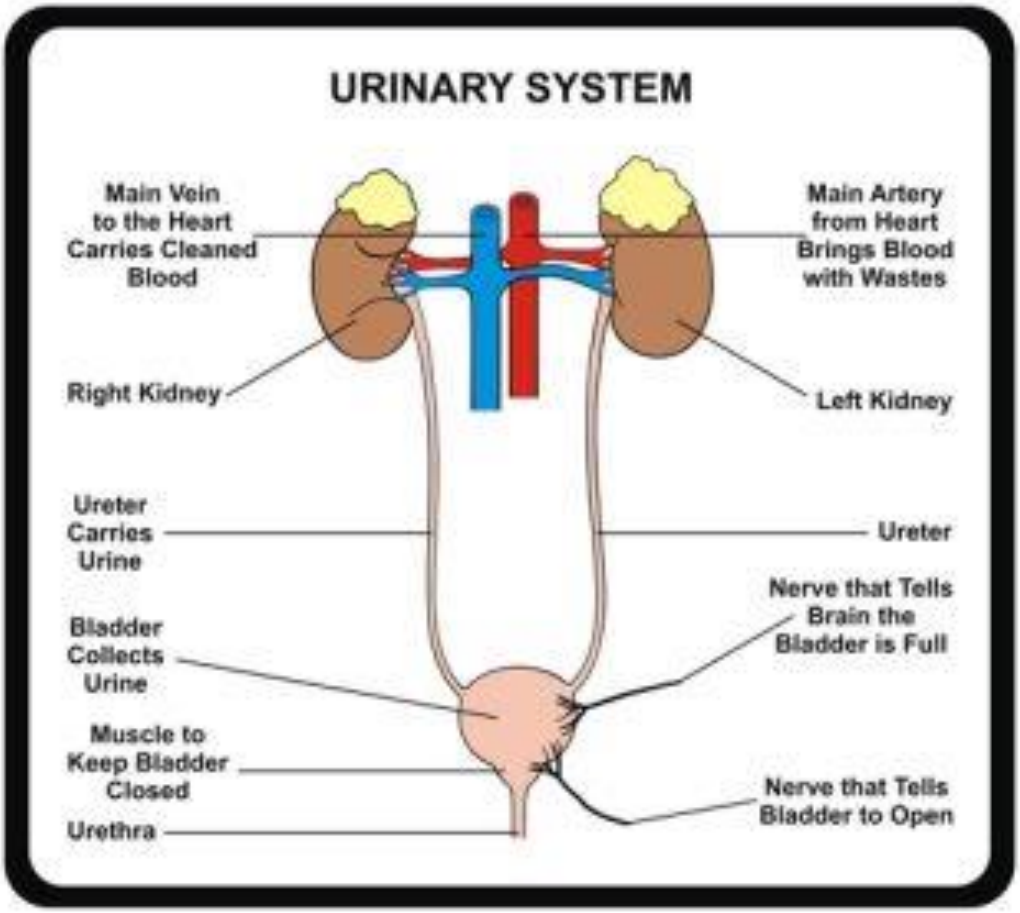
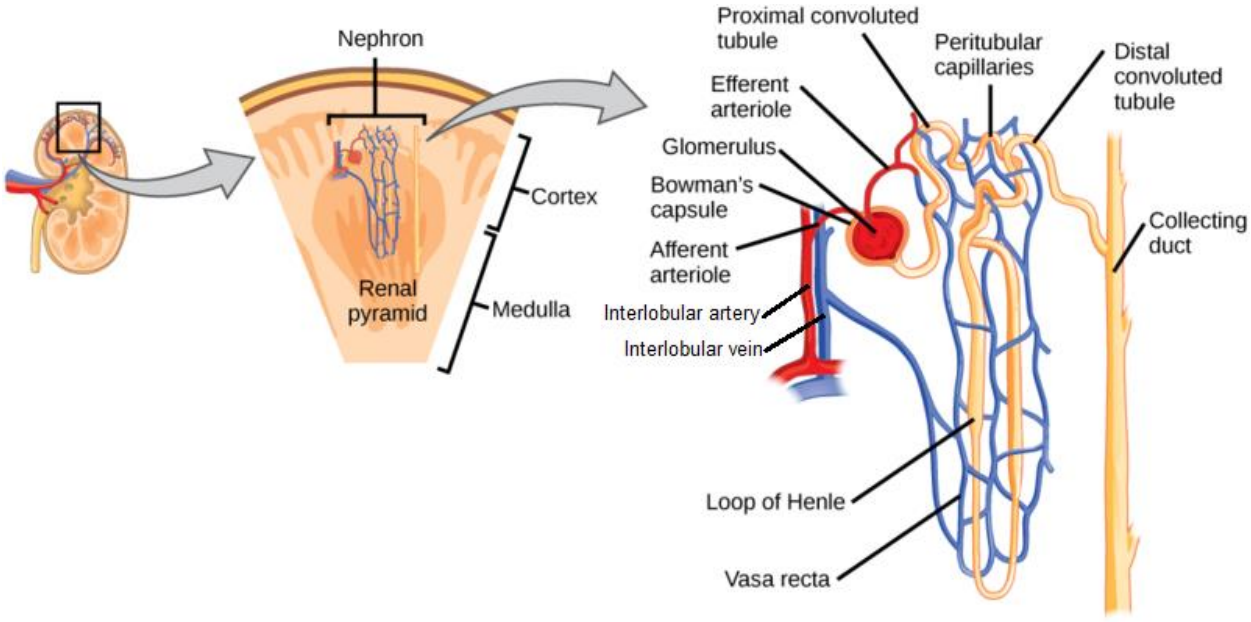
LO: Define excretion and explain the importance of removing nitrogenous and other compounds from the body

Definition:
Excretion is the process by which metabolic waste products are removed from the body of an organism.

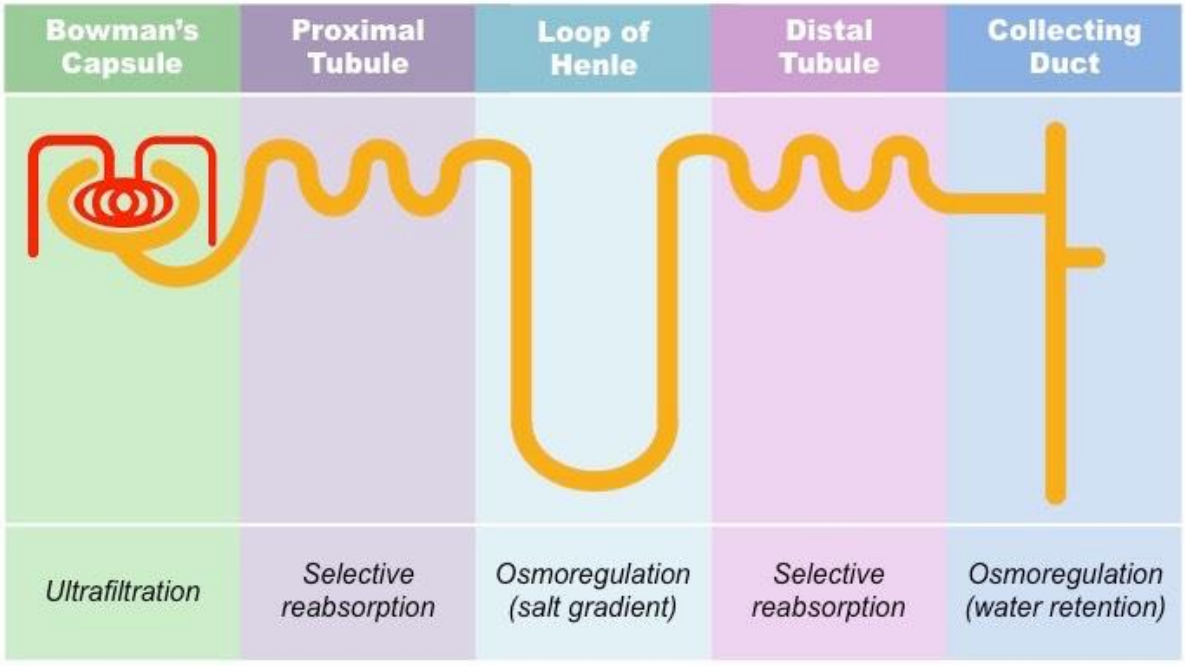
Importance:
Metabolic (anabolism + catabolism = metabolism) reactions (chemical reactions) produce metabolic waste products. Metabolic waste products are toxic and poisonous if they accumulate in excess in the body.

LO: Outline the function of the nephron with reference to ultra-filtration and selective reabsorption in the production of urine

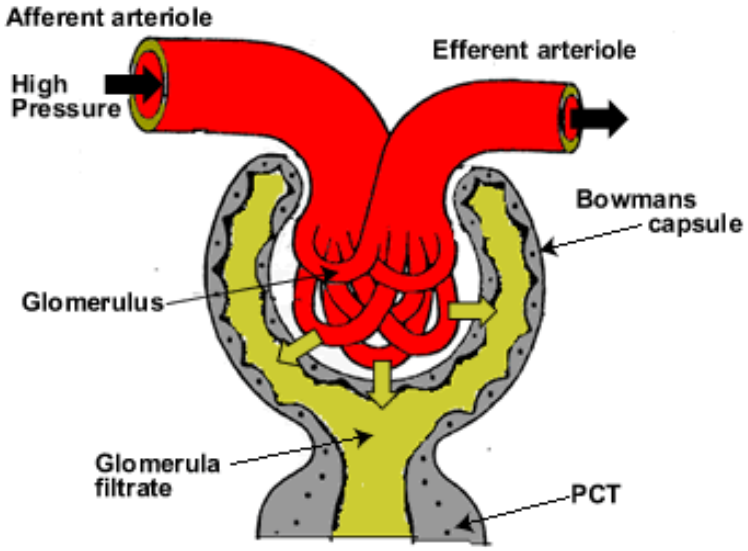




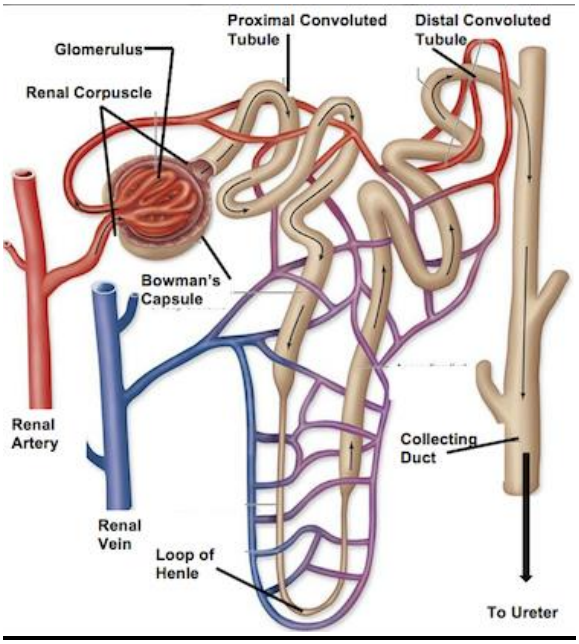
Function of nephron:
Removal of metabolic waste products from blood through the processes of ultra-filtration and selective reabsorption, to form urine.



Ultra-filtration:



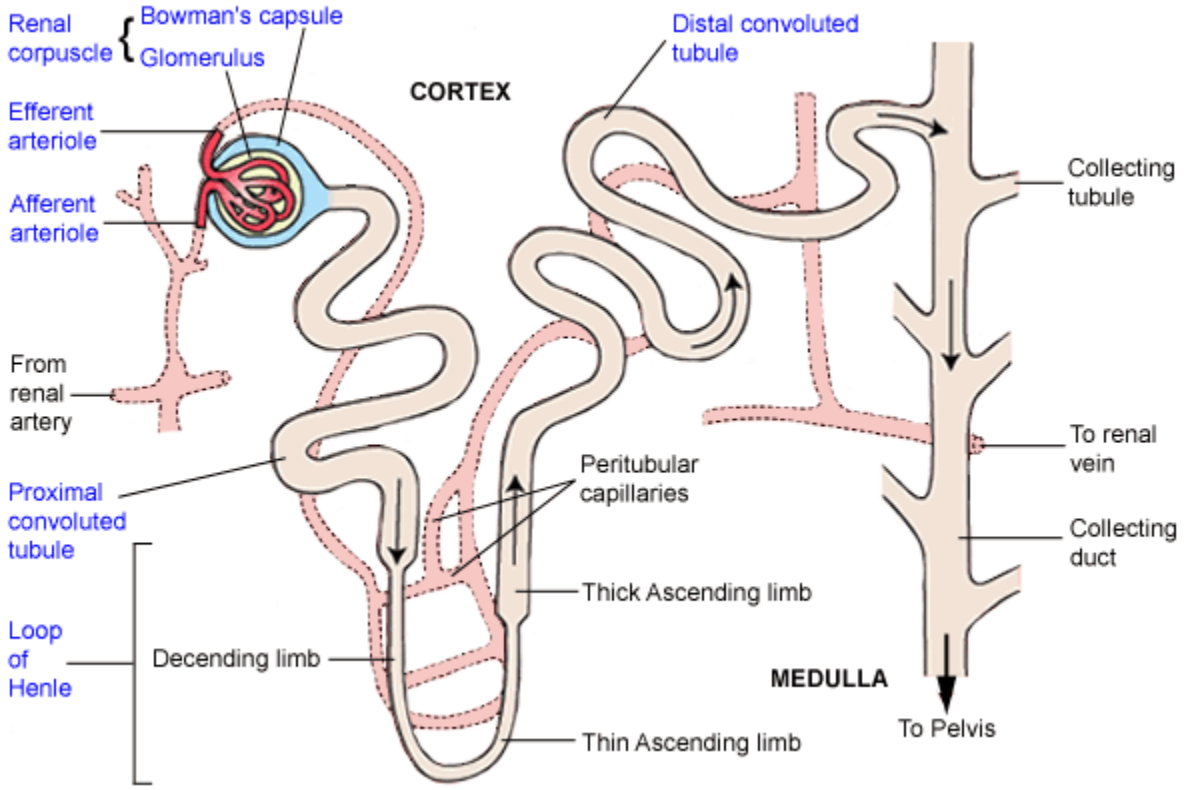
1. Most of the blood plasma is forced out of the glomerular blood capillaries into the Bowman's capsule.
2. This is due to the high hydrostatic pressure in the glomerulus. The high blood pressure is present because the afferent arteriole bringing blood into the glomerulus is wider than the efferent arteriole, which carries blood away.
3. A partially permeable membrane called the basement membrane wraps around the glomerular blood capillaries. The membrane allows only small molecules such as glucose, amino acids, urea, water, mineral salts, etc through.
4. Large molecules like proteins, red blood cells, platelets cannot pass through.



Selective reabsorption:

1. As the glomerular filtrate from ultrafiltration passes through the nephron, useful materials such as glucose, amino acids, mineral salts are taken back into the bloodstream by selective reabsorption at the proximal convoluted tubule.
2. All glucose and amino acids molecules will be selectively reabsorbed into the blood capillaries by diffusion and active transport in a healthy individual.
3. Most of the water molecules are reabsorbed by osmosis.

LO: Outline the role of anti-diuretic hormone (ADH) in osmoregulation



Anti-diuretic hormone stimulates the reabsorption of water at the collecting duct of the nephron.

Loss of water (Eg; excessive sweating/salty diet):

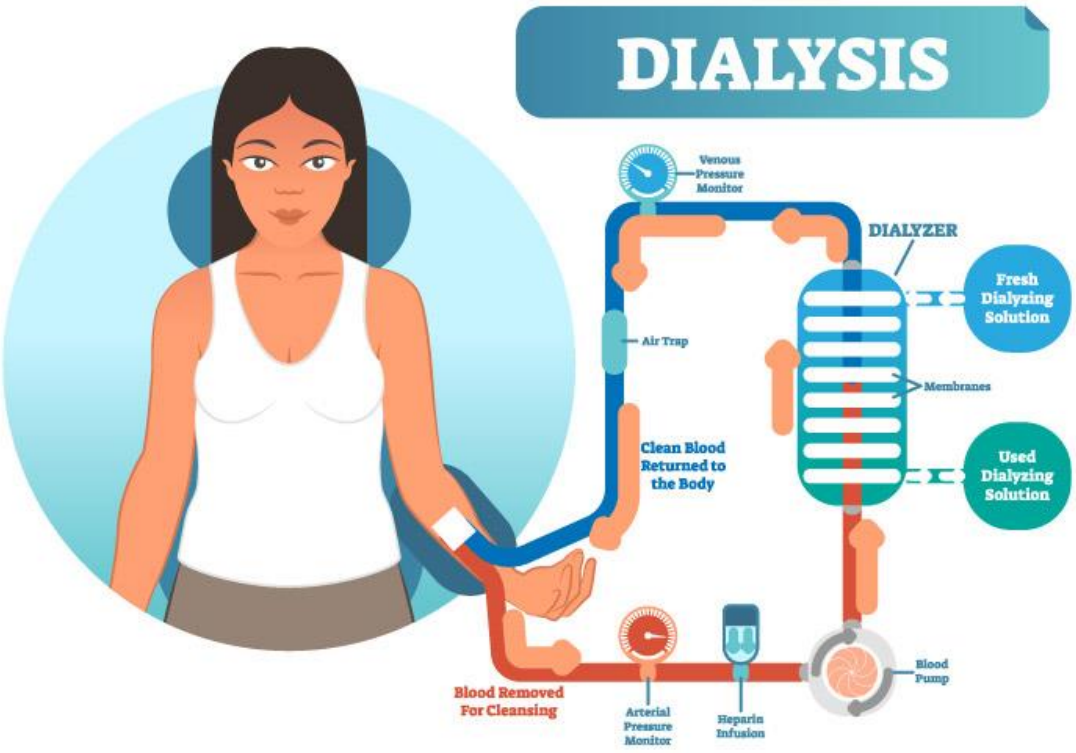
1. Water potential of blood plasma decreases below normal level.
2. Stimulates the hypothalamus to produce more anti-diuretic hormone (ADH).
3. Hypothalamus stimulates pituitary gland to release more ADH into the bloodstream.
4. Increases the permeability of cells of the wall of the collecting duct to water and collecting duct of the kidney tubules reabsorbs more water into the blood capillaries.

5. Lesser water loss in the urine, volume of urine produced is smaller and more concentrated.
6. Water potential of blood plasma increases back to normal.

Large intake of water:

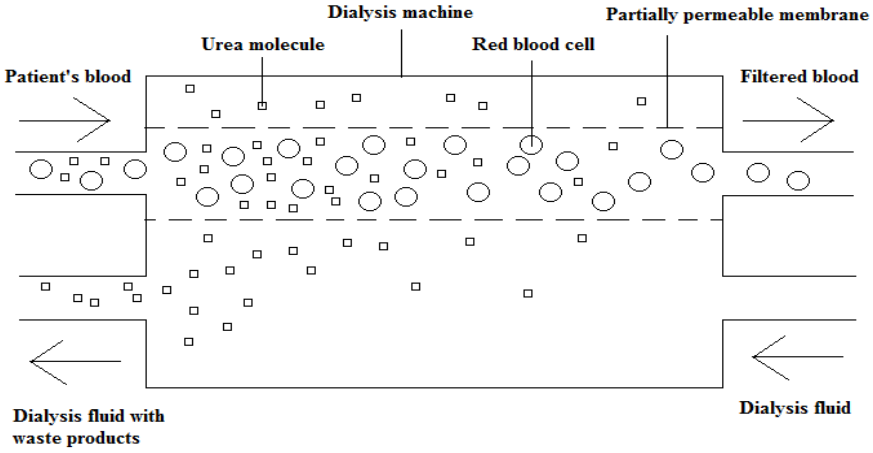
1. Water potential of blood plasma increases below normal level.
2. Stimulates the hypothalamus to produce less anti-diuretic hormone (ADH).
7. Hypothalamus stimulates pituitary gland to release less ADH into the bloodstream.
3. Decreases the permeability of cells of the wall of the collecting duct to water and collecting duct of the kidney tubules reabsorbs less water into the blood capillaries.
4. More water loss in the urine, volume of urine produced is larger and less concentrated.
5. Water potential of blood plasma decreases back to normal.

LO: Outline the mechanism of dialysis in the case of kidney failure

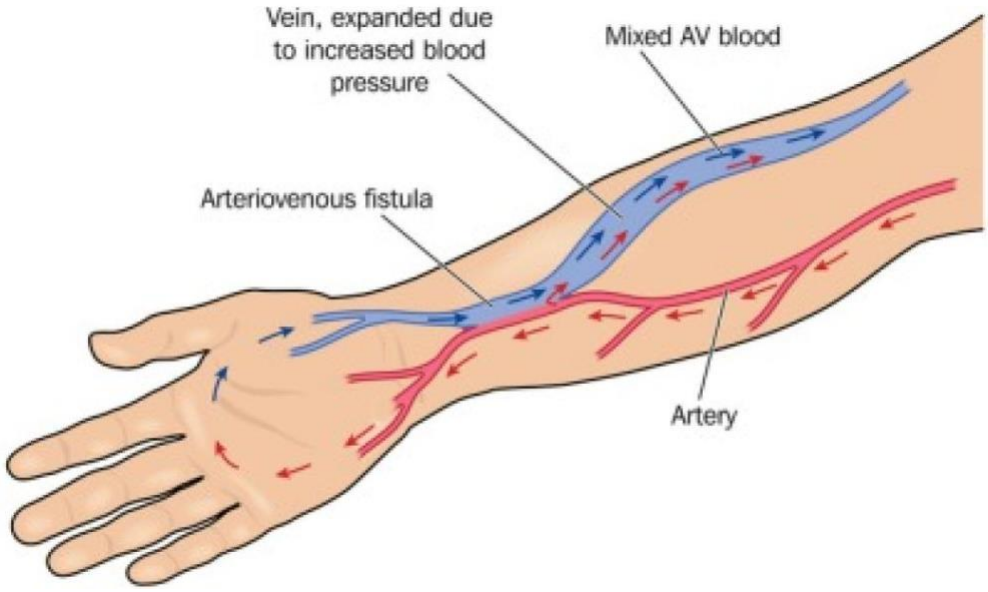


1. Blood is drawn from a vein in the patient's arm and pumped through a long, narrow and coiled tubing in the dialysis machine to increase surface area to volume ratio for faster diffusion of substances.
2. The partially permeable tubing is bathed in dialysis fluid. Big molecules like blood cells, platelets and plasma proteins stay in the tubing.
3. The dialysis fluid contains same concentrations of glucose, amino acids and other essential substances as blood to prevent diffusion of these substances out of blood.

4. No urea in the dialysis fluid to set up a concentration gradient for urea and other nitrogenous waste products to diffuse out of the tubing from blood into the dialysis fluid.
5. Dialysis fluid flows in the opposite direction of blood to maintain concentration gradient for diffusion of urea and other nitrogenous waste products out of the blood.



6. Filtered blood is returned to vein in patient's arm.
7. An AV (arteriovenous) fistula is used for dialysis.



Compare between dialysis and kidney function:

Similarities:
Both involves partially permeable membrane to allow small particles to filter through.
Both helps in the removal of metabolic waste products such as urea.

Differences:

Dialysis	Kidney
Involves diffusion only	Involves diffusion and active transport
Does not involve ultrafiltration and selective reabsorption.	Involves ultrafiltration and selective reabsorption.
Pressure provided by dialysis machine.	Pressure provided by the left ventricle of heart/narrower lumen efferent arteriole as compared to afferent arteriole.
Does not involve any hormones.	Involves anti-diuretic hormone (ADH) regulation
Dialysis fluid is needed.	Dialysis fluid not required. Only involve glomerular filtrate.
Cannot produce more concentrated/diluted urine	Can produce more concentrated/diluted urine
Involves concentration gradient for diffusion to occur	Use hydrostatic pressure during ultrafiltration to force out the filtrate