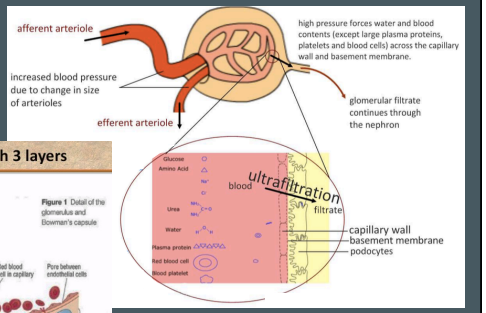
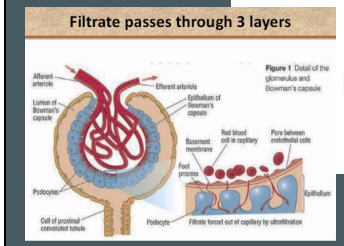
V. The Ultrastructure of the Glomerulus

A. The ultrastructure of the glomerulus and Bowman's capsule facilitate ultrafiltration-

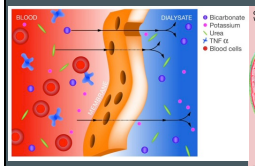


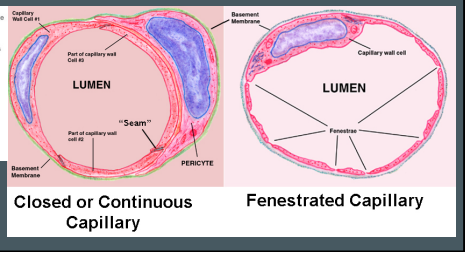


i-Biology; defenderauto.info

V. The Ultrastructure of the Glomerulus

1. The capillary wall is fenestrated (it contains pores) allowing fluid to move through it
2. The basement membrane only allows smaller molecules to be filtered
3. Filtration slits between foot projections of podocyte cells act as a filter allowing only smaller molecules to be filtered.





Doctorc.com; Clanekpr

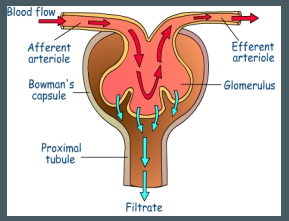
Closed or Continuous Capillary

Fenestrated Capillary

V. The Ultrastructure of the Glomerulus

Explain the process of ultrafiltration (8 marks)

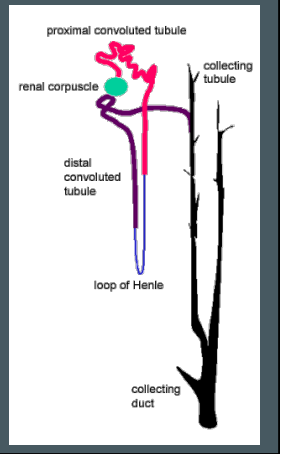
- Occurs in the Bowman's/renal capsule/ the kidney cortex
- The (entering) afferent arteriole has a larger diameter than the (leaving) efferent arteriole createing high pressure in the capsule
- Some smaller molecules are forced out of the glomerulus/blood into the capsule through basement membrane and the fenestrations/pores in the capillary wall
- Filtration slits between foot projections of podocyte cells also act as a filter
- Molecules in the filtrate include water, urea, glucose, amino acids, salts
- Plasma proteins, platelets, and cells are too large so remain in the blood
- Glomerular filtrate is then transported through the nephron



IGCSE Biology

VI. The Role of the Proximal Convoluted Tubule

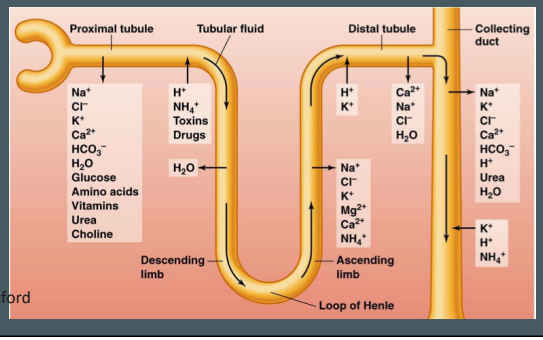
A. The proximal convoluted tubule selectively reabsorbs useful substances by active transport-
   1. Selective reabsorption of useful substances from the proximal convoluted tubule (PCT)
   2. The PCT extends from the Bowman's capsule to the loop of Henlé
   3. The PTC where most selective reabsorption occurs.



University of Leeds

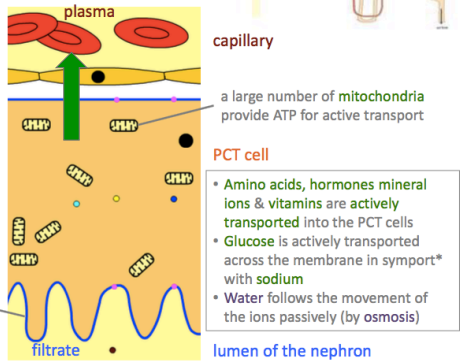
VI. The Role of the Proximal Convoluted Tubule

a. All glucose, amino acids, vitamins and hormones are reabsorbed here
b. Approximately 80% of the mineral ions and water are also reabsorbed



Oxford

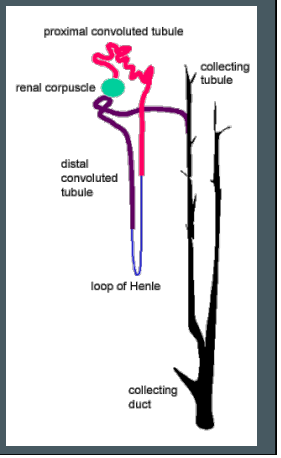
VI. The Role of the Proximal Convoluted Tubule



*symport is a type of cotransport here a molecule of glucose and sodium are moved together in the same direction.

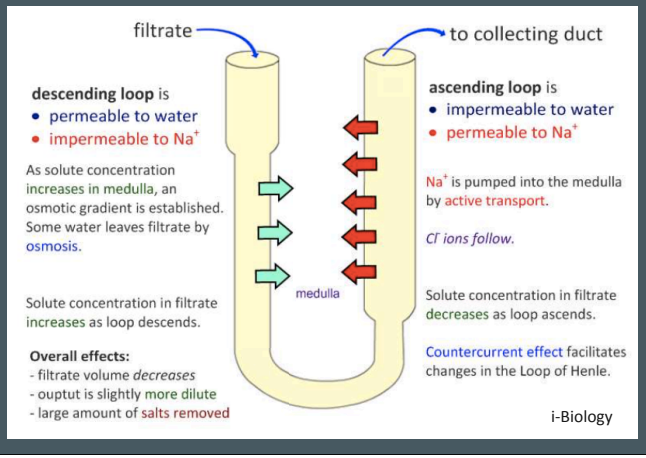
VII. The Role of the Loop of Henlé

A. The loop of Henlé maintains hypertonic conditions in the medulla-
   1. Osmoregulation is the control of water and solute concentrations in the body fluids (e.g. the blood plasma).
   2. The job of the loop of Henlé is to generate a high concentration of solutes (low concentration of water) in the tissue fluid of the medulla compared to the filtrate in the nephron.
      a. This aids the reabsorption of water in the collecting duct.
      b. Thus the output of urine is more dilute than the input.



University of Leeds

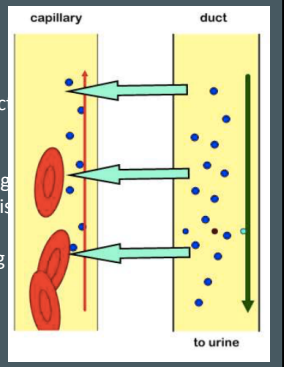
VII. The Role of the Loop of Henlé



i-Biology

VIII. Function of ADH

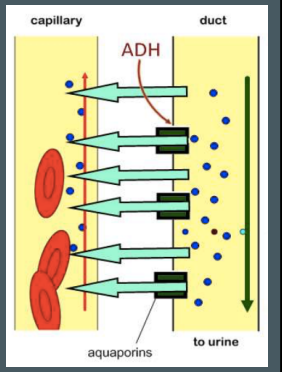
A. ADH controls reabsorption of water in the collecting duct-
   1. The collecting duct balances the water concentration of the blood through hormonal control.
      a. Filtrate enters the collecting duct from the distal convoluted tubule.
      b. Water moves from the collecting duct to the capillaries by osmosis.
      c. Water and filtrate flow in opposite directions, maintaining concentration gradient, a counter-current system.



i-Biology

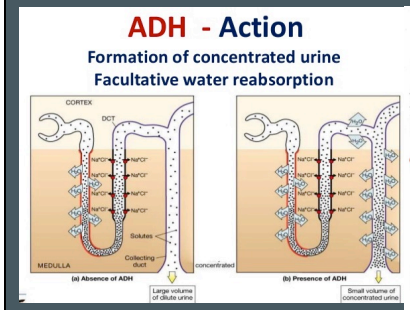
VIII. Function of ADH

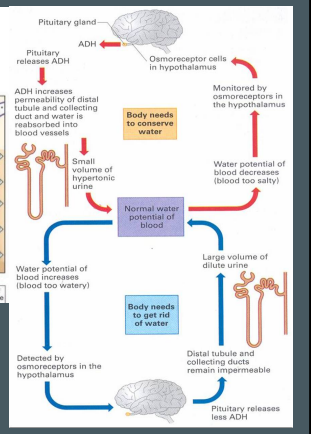
2. If a person is dehydrated, ADH (hormone) acts on the walls of the collecting duct, opening aquaporins (channels) making the collecting duct more permeable to water.
   a. More water is transferred into the blood.
   b. Urine output decreases and becomes more hypertonic (high solute concentration).



i-Biology

VIII. Function of ADH





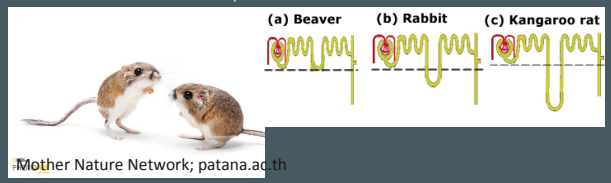
Osmoregulation is an example of negative feedback control using hormone. Water content of blood is monitored by the hypothalamus and regulated by the pituitary gland.

NephroTube; PMG Biology

IX. Some Animals have Relatively Long Loops of Henlé

A. The length of the loop of Henlé is positively correlated with the need for water conservation in animals-

- *The kangaroo rat's (Dipodomys nitratoides) loop of Henlé is much longer than that of other rodents. This in part explains the kangaroo rat's amazing ability to survive in deserts.*
- *The kangaroo rat's kidneys are especially efficient and produce only small quantities of highly concentrated urine. They have very long loops of Henlé which builds a higher ion concentration in the medulla. Therefore allowing more water to be reabsorbed in the collecting duct.*
- *Kangaroo rats can concentrate urea to 3,500 mmol/L, whereas humans can only concentrate urea to 400 mmol/L.*



Mother Nature Network; patana.ac.th

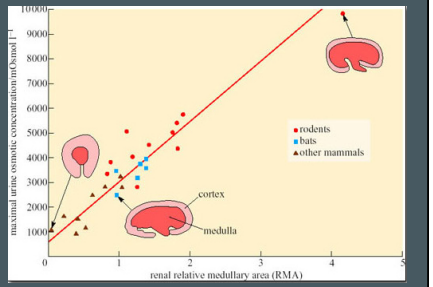
IX. Some Animals have Relatively Long Loops of Henlé

B. Length of the loop of Henlé and water conservation
   1. The ion concentration in the medulla builds as the loop of Henlé descends.
   2. A longer loop of Henlé in implies a larger medulla (compared to the kidney size) than in animals with a shorter loop of Henlé.

This shows the relationship between relatively medullary area in the mammalian kidney and the maximal urine concentration that can be produced.

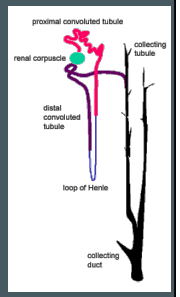
The higher the ion concentration the more water can be reabsorbed in the collecting duct making the urine more concentrated.

Withers, P.C.



Explain osmoregulation in the kidney (8 marks).

- Osmoregulation takes place in the Loop of Henlé and collecting duct/medulla
- Loop of Henlé
  - Descending limb is permeable to water but not to Na^+
  - Ascending limb is permeable to Na^+ but not to water
  - Na^+ is pumped out of the ascending limb into the medulla
  - This creates an osmotic potential between nephron and medulla
  - Some water leaves descending loop by osmosis
  - Output is reduced volume and salt concentration
- Collecting Duct
  - Filtrate enters collecting duct from distal convoluted tubule
  - Countercurrent flow of blood in capillaries and filtrate in duct maintains concentration gradient
  - Osmosis of water into blood
  - Dehydration detected by hypothalamus, leads to release of ADH by the pituitary
  - ADH opens aquaporins in walls of duct and increases transfer of water into blood, creates hypertonic urine
  - Excess water in blood leads to breakdown of aquaporins, creates hypotonic urine.



University of Leeds