EXCRETORY PRODUCTS AND THEIR ELIMINATION

- The process of elimination of waste materials from the body is called excretion.

  EXCRETORY ORGANS-Ammonia, urea and uric acid are the major forms of nitrogenous wastes

- Ammonia is the most toxic form &requires large amount of water for its elimination,
- Uric acid is the least toxic, can be removed with a minimum loss of water.
- **1.Ammonotelism.-*E***xcreting nitrogenous wastes in the form of ammonia**.**
- Eg:-Many bony fishes, aquatic amphibians and aquatic insects
- **Ureotelism**-Mammals, many terrestrial amphibians and marine fishes mainly excrete urea and are called **Ureotelic animals**.
- Ammonia produced by metabolism is converted into urea in the liver of ureotelic animals and released into the blood which is filtered and excreted out by the kidneys.
- **Ureotelism**-Reptiles, birds, land snails and insects excrete nitrogenous wastes as **uric acid** in the form of **pellet** or **paste** with a minimum loss of water and are called **ureotelic animals.**

EXCRETORY ORGANS	ANIMAL GROUP
Protonephridia or flame cells	Platyhelminthes (Flatworms, e.g., Planaria), rotifers, some annelids and the cephalochordate – Amphioxus.
Nephridia	Earthworms and other annelids.
Malpighian tubules	Most of the insects (Eg: cockroaches)
Antennal glands or green glands	Crustaceans like Prawns.
kidney	Fishes / Amphibians / Reptiles / Birds / Mammals

Organs of the Human Excretory System

1. **Lungs-excrete carbon dioxide**

2. **Liver-produces urea and bile**

3. **Kidney-filter blood and remove urea and other wastes**

Consists of ---Kidney , Ureter, urinary , Urethra

Structure of Kidney

Cortex -Outer zone

Medulla -Inner zone

Hilum - notch at concave side

Renal pelvis -Funnel shaped space at the inner side of the hilum

Medullary pyramid - Conical masses of the medulla

Calyx-space into which Medullary pyramids opens

Colums of Bertini-extention of cortex between medullary pyramids

- The nephron or renal tubule is the functional unit of the kidney
- Each human kidney has about one million nephrons
- Urine is manufactured by the nephrons

Structure of Nephrone

1.Bowmans capsule

2.Proximal convoluted tubule(PCT)

3.Henle's loop

a.Ascending limb

b, Descending limb

4.Distal convoluted tubule

5.Collecting duct

Bowmans capsule

- Double walled cup shaped structure

Glomerulus - tuft of capillaries inside the bowmans capsule

Afferent arteriole - Fine branch of Renal artery

Efferent artery - Capillaries that carried out the blood from glomerulas

Blood flows, **afferent arteriole** ⟶ **glomerulus** ⟶ **efferent arteriole**

Malpighian body or renal corpuscle -Bowmans capsule + glomerulus

Peritubular capillaries-efferent arteriole forms a capillary network around the renal tubule

Vasa recta- a vessel of peritubular capillary run parallel to the Henle's loop

Juxta glomerular apparatus-(JGA)-a special region formed by dct and afferent arteriole at the location of their contact

It secretes a hormone-**renin**

Two types of nephrones

1, **Cortical nephrones**- Loop of Henle is very short

Extends only very little to medulla

Vasa recta is absent or highly reduced

2,Juxtamedullary nephrones- Loop of Henle is very long and runs deep into medulla(in desert animals henles loop is very long)

URINE FORMATION

Includes 3 steps

1,Glomerular filtration

2.Reabsorption

3.Secretion

Glomerular Filtration

- About 1100-1200ml of blood is filtered by kidney
- The blood from afferent arteriole enters into narrow tubules of glomerulus at a high pressure
- This pressure causes the filtration

Much of the components of blood except proteins and blood cells filtered. So this process is called ultrafiltration

Filtration membrane-3 membranes

1, Capillary endothelium

2, Basement membrane

3, Epithelium of Bowman's capsule-Epithelium consists of podocytes(cells with proceses)-leaving minute pore called slit pores or filtration slits

Filtration occurs through these pores

The amount of the filtrate per minute is called **Glomerular Filtration Rate**
average-125ml/minute
180 litres/day.
When JFR decreases JGA activated and secrete Renin
It stimulate blood flow and increase GFR

- 99% of the total filtrate is reabsorbed by renal tubules

- Glucose, amino acids and salts are reabsorbed by active transport
- Water is reabsorbed by osmosis

PCT- Reabsorption

- About 70% of the water and electrolite is reabsorbed
- Lined by simple cuboidal brush boarder epithelium
- Selective secretion of hydrogen ions, ammonia, and potassium ions.
- Helps in the ionic balance

The Loop of Henle – Reabsorption

- Descending limb- permeable to water and impermeable to electrolites
- Ascending limb- permeable to electrolites and impermeable to water
- Concentration increases as it moves downward, and get diluted as it moves upward
- Helps to produce hypertonic urine

Collecting duct- Reabsorption

- Large amount of water reabsorption (In ADH presence)
- Reabsorption of small amount of urea to keep up osmolarity
- Secretion of H+ ions,K+ions and NH3 to maintain ph

Counter current mechanism

A **current** that flows in an opposite direction to the flow of another **current**.

BLOOD FOLWS IN OPPOSITE DIRECTION in

1Ascending and descending limb of henle's loop

2. Ascending and descending limb of vasa recta

So they are in a counter current pattern

Steps

*Water reabsobed from Descending limb

*So osmolarity increases down wards

*Nacl is reabsorbed from ascending limb

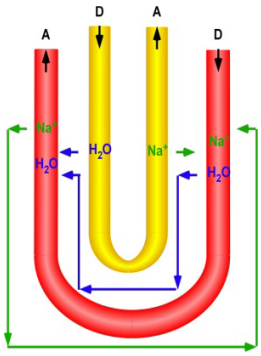
*So osmolarity decreases upwards

*Nacl now enters into the descending limb of vas recta

*Nacl transported to the ascending limb of vasa recta

*Nacl escape from the vasa recta into the interstitium.

*This helps to increase the osmolarity of interstitium so as to water reabsorption by osmosis



- **Regulation of kidney function 3 main mechanisms**
  1.Hormonal feed back By ADH
  2.By JGA
  3.By heart

1.Effect of ADH

Dehydration stimulates Osmoreceptors

Osmoreceptors stimulates hypothalamus

Hypothalamus releases ADH

ADH increases water reabsorption from later part of renal tubule

- Also constricts blood vessel to increase blood pressure
- urine volume increases
- ADH suppress the ADH release

2.By The juxtaglomerular apparatus (RAAS- Rennin Angiotensin Aldosteron Mechanism)

- Fall in BP Activates JGA
- Secrets rennin
- Converts Angiottensinogen to Angiotensin 1
- Then to Angiotensin II Its effects are 1.Constricts blood vessels 2 activates adrenal cortex to release Aldosterone
- Aldosterone couses reabsorption of Na+ and water

3.Effect of atrial natriuretic factor (ANF)

- Opposite to renin angiotensin mechanism
- * Increase in BP
- * stimulates right atrium of heart
- * atrium secretes ANF
- *ANF promotes Na^+ and water excretion
- * BP drops

Micturition

- Once urine enters the renal pelvis, ureters and finally in bladder, where it is stored.

- Micturition is the process of emptying the urinary bladder.
- Two processes are involved:
- Bladder filled with urine
- Walls streched
- Osmoreceptors on the wall stimulated, send signal to Brain
- Messages to contract muscles of bladder and relaxation of urethral sphincter
- Adult human excrete 1 to 1.5 litres of urine per day
  Excretes 25-30 grams of urea.
  Presence of glucose in urine-Glucosuria
  (indicative of diabetes mellitus)
  Presence of ketone bdies in urine -Ketonuria
  Excretion of large amount of diluted urine.-Diabetes insipidus

Role of other Organs in excretion

1. Lungs-excrete carbon dioxide
2. Liver- secretes bilirubin and biliverdin cholesterol etc-pass out along with digestive wastes

Sweat glands—helps to remove water, NaCl, urea, lactic acid etc.

Sebacious glands-helps to remove sterols, hydrocarbons,and waxes

Disorders

Uremia-Accumulation of urea in blood,Urea can be removed by hemodialysis

Dialysis - a method of removing waste substances from the blood when the kidneys are unable to do so.

- **Hemodialysis**. Blood from a artery is pumped into a dialysing unit after adding an anticoagulant like heparin.
- The unit contains a coiled cellophane tube surrounded by dialyzing fluid

- Dializing fluid contains same composition as that of plasma. But the nitrogenous wastes are absent
- As nitrogenous wastes are absent nitrogenous molecules flows from blood into dialysis fluid (based on concentration gradient).
- The cleared blood is pumped back to the body through a vein .