YAKEEN NEET 2.0

2026

EXCRETORY PRODUCTS AND ITS ELIMINATION

ZOOLOGY | Lecture – 5

By- SAMAPTI MAM

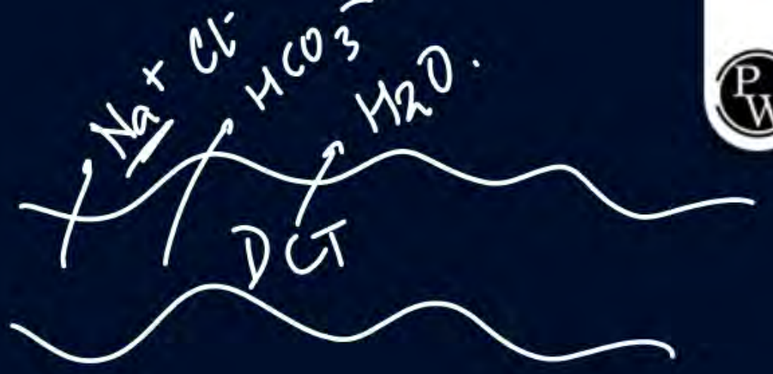
Topics to be covered

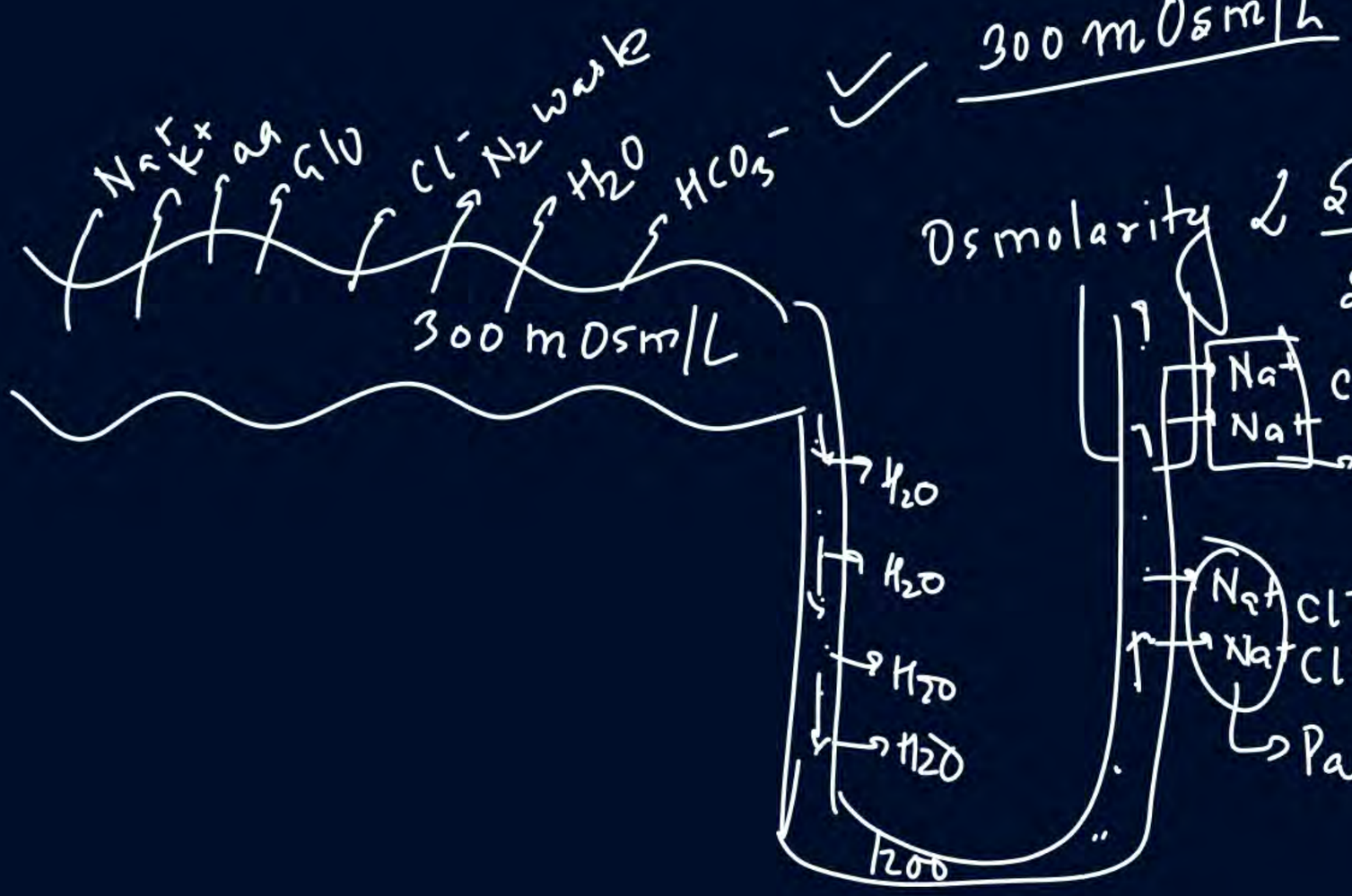
13. 08. 2025

1. Tubular secretion, counter current mechanism, micturition
2.
3.
4.

MY TELEGRAM

3 amazing experiments



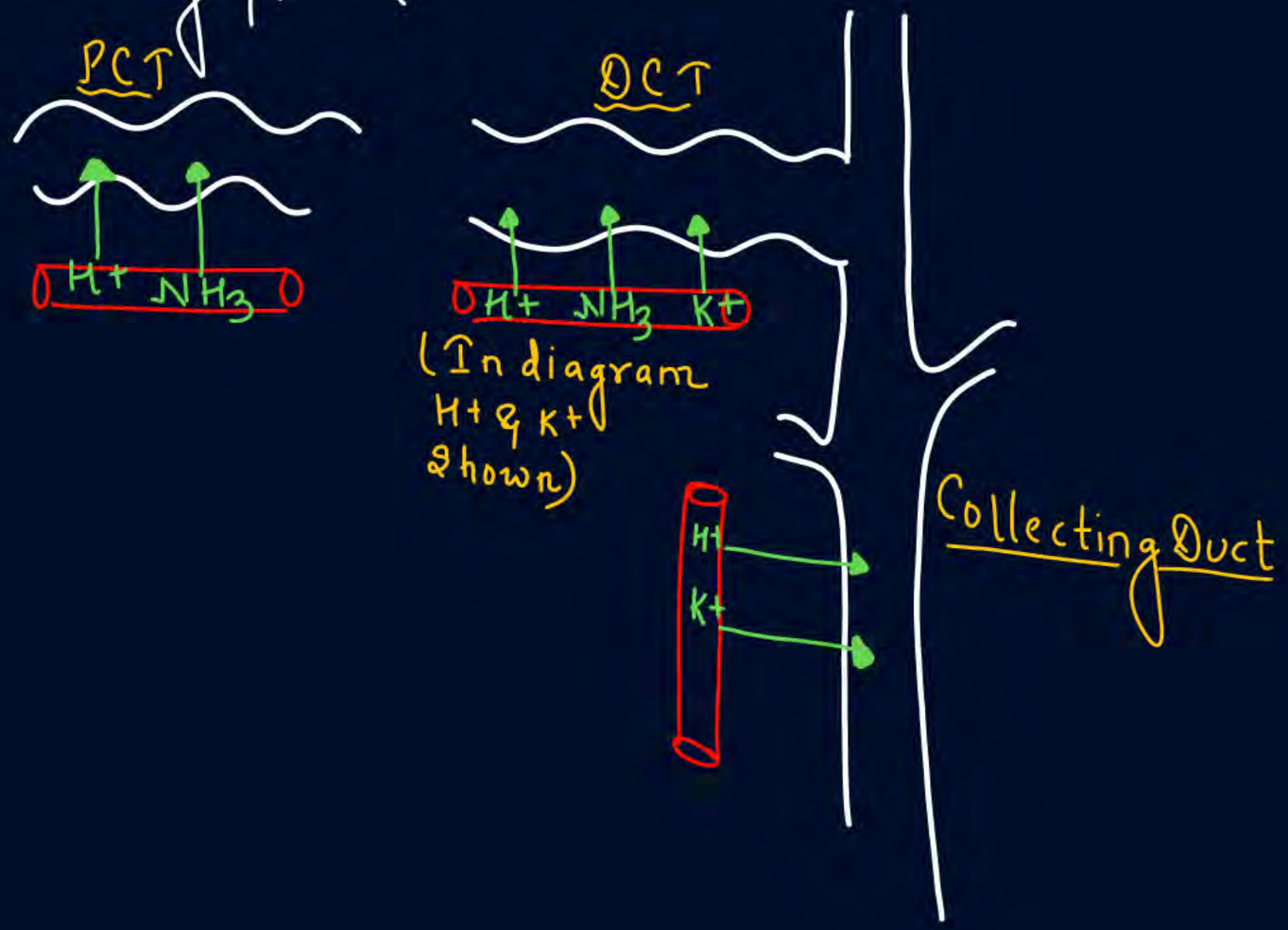


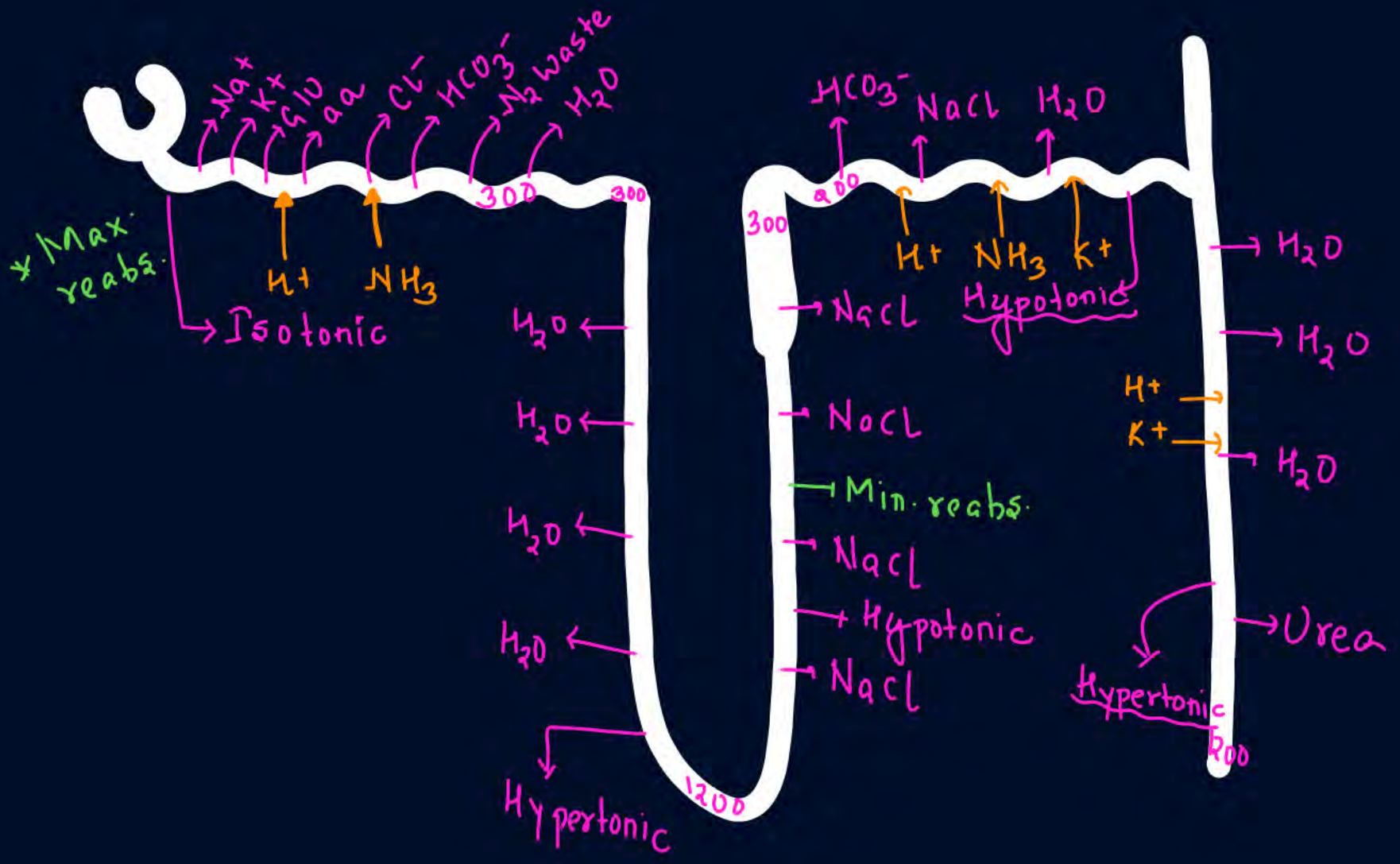
Osmolarity ∝ Solute ↑
Solvent ↑

ADH/
Vasopressin

(3) Tubular Secretion:

- Selective process: Maintain Acid-Base balance (pH) & ionic balance in body fluids.




Na+
K+
Cl⁻
aa
Cl⁻
HCO3⁻
N2 waste
H2O
300
300
* Max. reabs.
H+
NH3
Isotonic
H2O
H2O
H2O
H2O
Hypertonic
1200
HCO3⁻
NaCl
H2O
200
300
H+
NH3
K+
NaCl
Hypotonic
NaCl
Min. reabs.
NaCl
Hypotonic
NaCl
H2O
H2O
H+
K+
H2O
Urea
Hypertonic
800

The amount of the filtrate formed by the kidneys per minute is called **glomerular filtration rate** (GFR). GFR in a healthy individual is approximately 125 ml/minute, i.e., 180 litres per day !

The kidneys have built-in mechanisms for the regulation of glomerular filtration rate. One such efficient mechanism is carried out by juxta glomerular apparatus (JGA). JGA is a special sensitive region formed by cellular modifications in the distal convoluted tubule and the afferent arteriole at the location of their contact. A fall in GFR can activate the JG cells to release renin which can stimulate the glomerular blood flow and thereby the GFR back to normal.

A comparison of the volume of the filtrate formed per day (180 litres per day) with that of the urine released (1.5 litres), suggest that nearly 99 per cent of the filtrate has to be reabsorbed by the renal tubules. This process is called **reabsorption**. The tubular epithelial cells in different segments of nephron perform this either by active or passive mechanisms. For example, substances like glucose, amino acids, Na^+, etc., in the filtrate are reabsorbed actively whereas the nitrogenous wastes are absorbed by passive transport. Reabsorption of water also occurs passively in the initial segments of the nephron (Figure 16.5).

During urine formation, the tubular cells secrete substances like H^+, K^+ and ammonia into the filtrate. Tubular secretion is also an important step in urine formation as it helps in the maintenance of ionic and acid base balance of body fluids.

16.3 Function of the Tubules

Proximal Convoluted Tubule (PCT): PCT is lined by simple cuboidal brush border epithelium which increases the surface area for reabsorption. Nearly all of the essential nutrients, and 70-80 per cent of electrolytes and water are reabsorbed by this segment. PCT also helps to maintain the pH and ionic balance of the body fluids by selective secretion of hydrogen ions and ammonia into the filtrate and by absorption of HCO_3^- from it.

Henle's Loop: Reabsorption is minimum in its ascending limb. However, this region plays a significant role in the maintenance of high osmolarity of medullary interstitial fluid. The descending limb of loop of Henle is permeable to water but almost impermeable to electrolytes. This concentrates the filtrate as it moves down. The ascending limb is impermeable to water but allows transport of electrolytes actively or passively. Therefore, as the concentrated filtrate pass upward, it gets diluted due to the passage of electrolytes to the medullary fluid.

Distal Convoluted Tubule (DCT): Conditional reabsorption of Na^+ and water takes place in this segment. DCT is also capable of reabsorption of HCO_3^- and selective secretion of hydrogen and potassium ions and NH_3 to maintain the pH and sodium-potassium balance in blood.

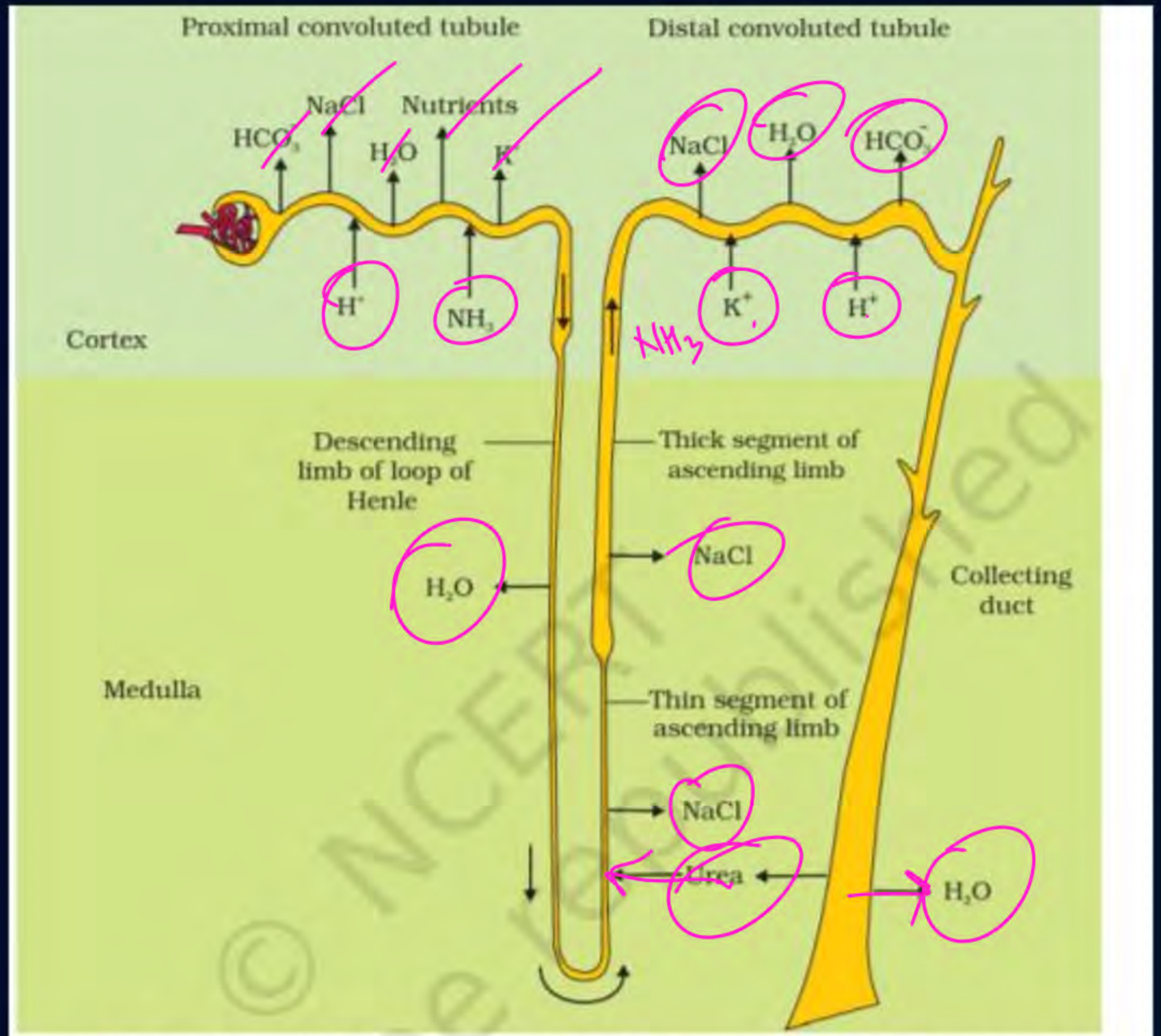


Figure 16.5 Reabsorption and secretion of major substances at different parts of the nephron (Arrows indicate direction of movement of materials.)

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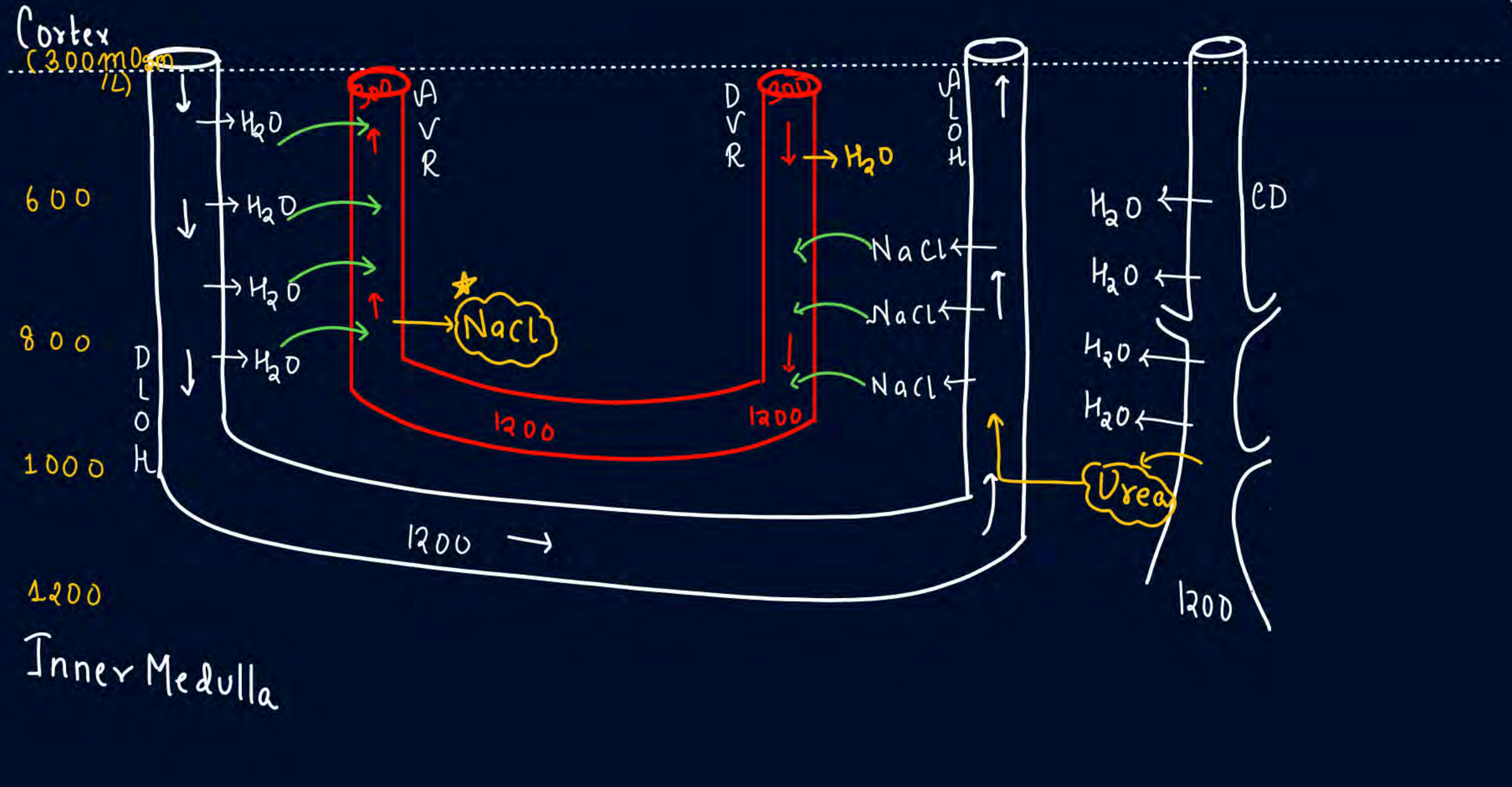
Collecting Duct: This long duct extends from the cortex of the kidney to the inner parts of the medulla. Large amounts of water could be reabsorbed from this region to produce a concentrated urine. This segment allows passage of small amounts of urea into the medullary interstitium to keep up the osmolarity. It also plays a role in the maintenance of pH and ionic balance of blood by the selective secretion of H^+ and K^+ ions (Figure 16.5).

Counter-Current mechanism:

- Mechaniam to Concentrate the Urine.
- Counter: OPPOSITE
  Current: Flow

i) B/w filterate in both LOH
ii) B/w Blood in Ascending & Descending Vasa Recta
iii) Filterate in DLOH & Blood in Ascending VR
Filterate in ALOH & Blood in Descending VR


Cortex
(300 mOsm/L)
600
800
1000
1200
Inner Medulla
DLOH
H_2O
H_2O
H_2O
H_2O
300
AVR
NaCl
1200
DVR
300
H_2O
1200
ALOH
NaCl
NaCl
NaCl
CD
H_2O
H_2O
H_2O
H_2O
Urea
1200
1200

Some imp. Points:

→ Close proximity b/w LOH & VR & counter current b/w them helps in maintaining high 'OSMOLARITY' of interstium (medullary).

→ High Osmolarity is maintained by → NaCl, → Urea

→ H_2O reabsorb from DLOH ⟶ enters AVR ⟶ Returns NaCl to the interstitium

→ NaCl reabsorb from ALOH ⟶ enter DVR ⟶ Release small of H_2O in interstitium

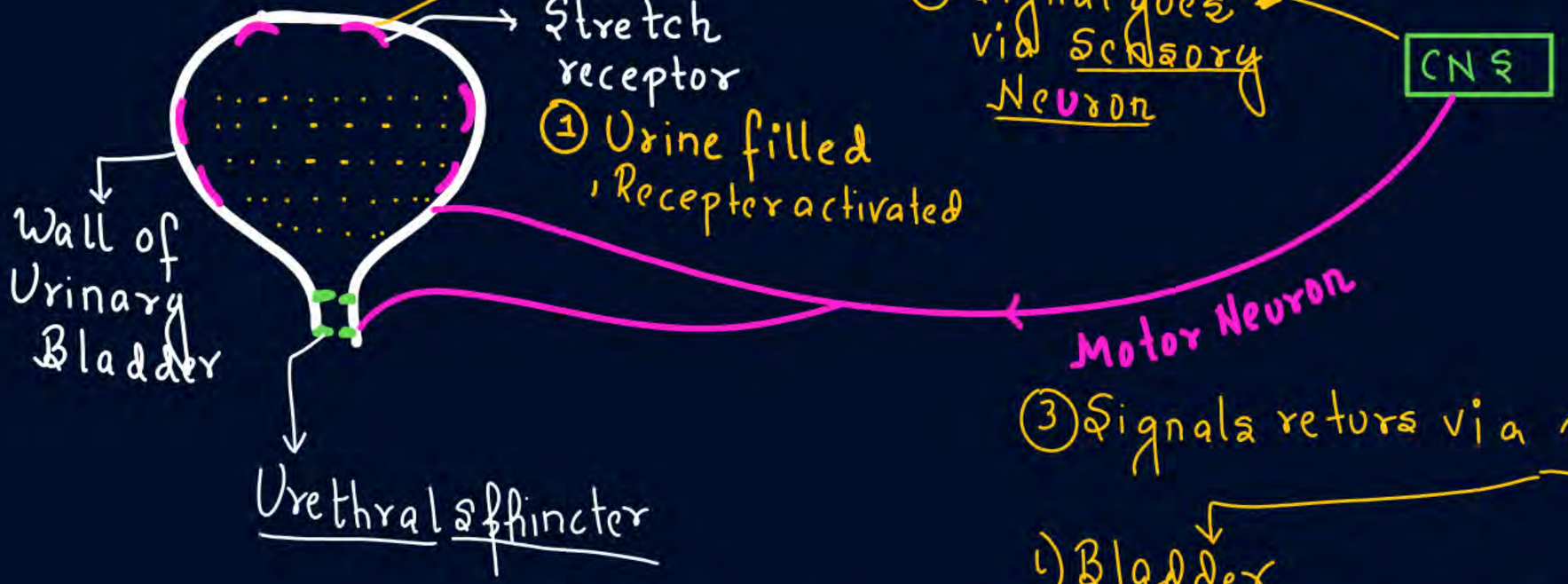
→ Urea reabsorbed from CD → some retained in Interstitium (↑ Osmolarity)
→ some goes/enters into ALOH (thin)

→ ↑ osmolarity in medullary interstitium: Helps in CONCENTRATING URINE.

→ by reabsorption of Large amt. of H_2O via Collecting Duct (4 times)

300 → 1200

Micturition: Process of Urination



Urine Composition:

→ 1 - 1.5 L / day.

→ pH = 6.0 (slightly acidic)

→ Color: Slightly yellowish (Urochrome)
↳ derivative of Bile pigment

→ Urea: 25 to 30 g eliminated / day

Abnormal Components

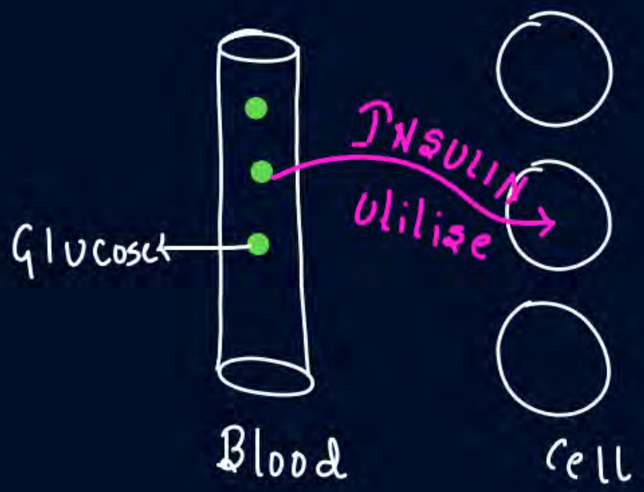
→ Glucose in Urine: Glycosuria
→ Ketone Bodies in Urine: Ketonuria
] Indicative of Diabetes mellitus

→ Protein in Urine: Albumunaria
→ Blood in " : Haematuria

Pus in Urine: Pyuria

Concept :

Insulin : Blood 'Glu' level ↓



* Cells use 'Glu' to produce Energy

→ No insulin

↓

No 'Glu' Utilisation by Cell

↓

Blood 'Glu' ↑ : 'Glu' out via Urine

* Cells: β-oxidation of fats to produce Energy

↓

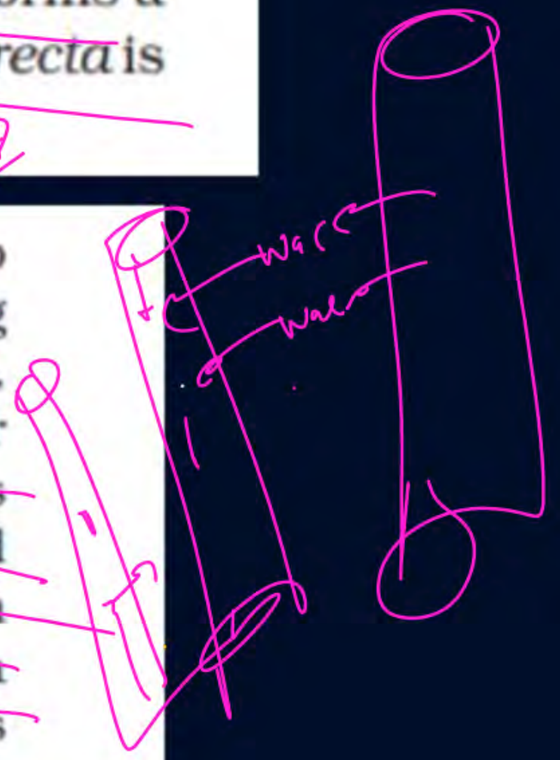
Ketone Bodies form

↓

KETONURIA.

16.4 Mechanism of Concentration of the Filtrate

Mammals have the ability to produce a concentrated urine. The Henle's loop and *vasa recta* play a significant role in this. The flow of filtrate in the two limbs of Henle's loop is in opposite directions and thus forms a counter current. The flow of blood through the two limbs of *vasa recta* is also in a counter current pattern. The proximity between the Henle's loop and *vasa recta*, as well as the counter current in them help in maintaining an increasing osmolarity towards the inner medullary interstitium, i.e., from 300 mOsmolL^{-1} in the cortex to about 1200 mOsmolL^{-1} in the inner medulla. This gradient is mainly caused by NaCl and urea. NaCl is transported by the ascending limb of Henle's loop which is exchanged with the descending limb of *vasa recta*. NaCl is returned to the interstitium by the ascending portion of *vasa recta*. Similarly, small amounts of urea enter the thin segment of the ascending limb of Henle's loop which is transported back to the interstitium by the collecting tubule. The above described transport of substances facilitated by the special arrangement of Henle's loop and *vasa recta* is called the **counter current mechanism** (Figure. 16.6). This mechanism helps to maintain a concentration gradient



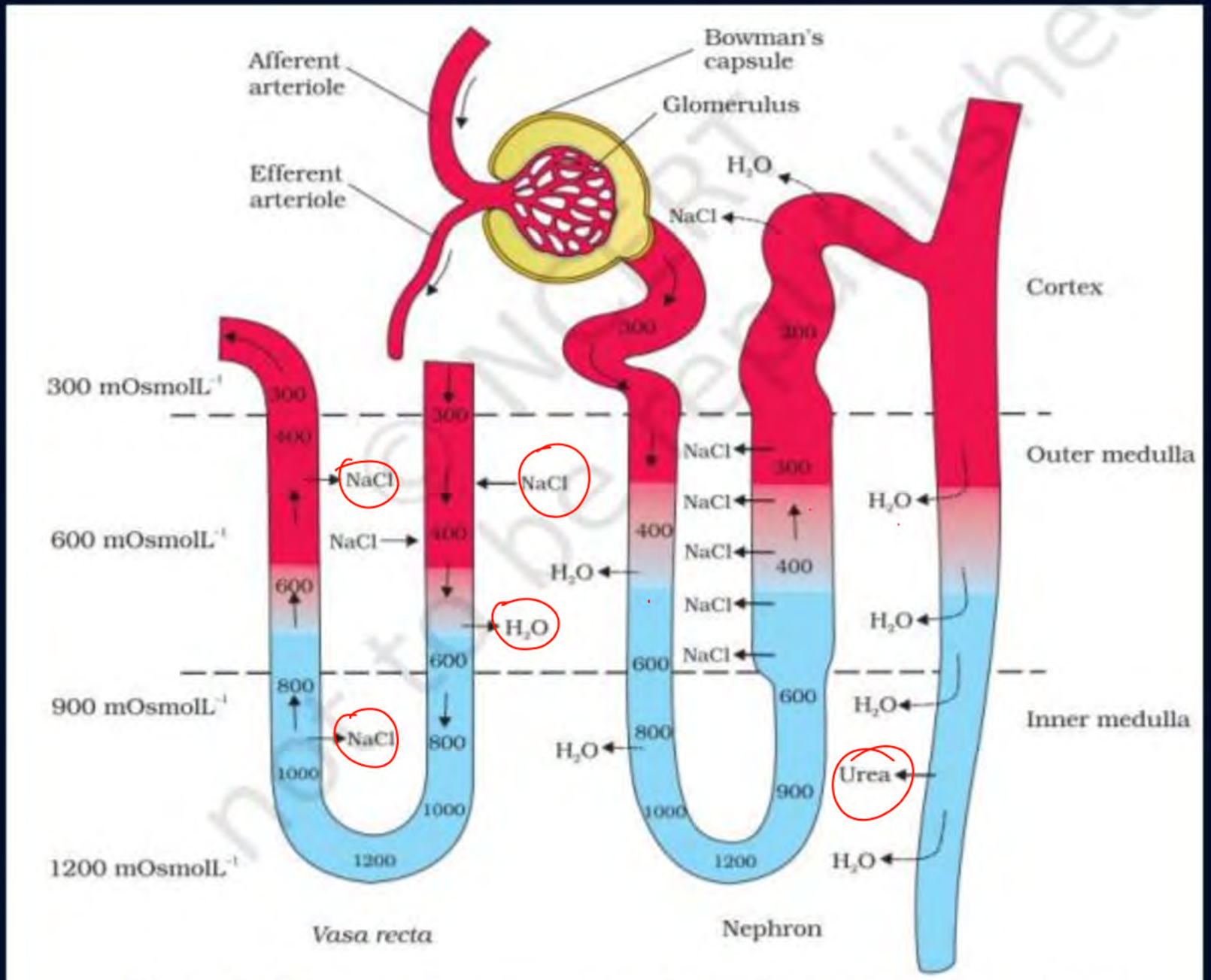
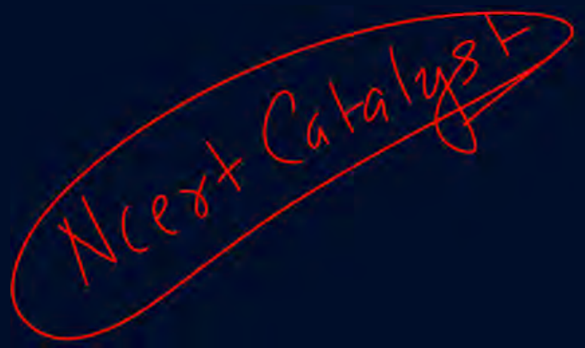


Figure 16.6 Diagrammatic representation of a nephron and *vasa recta* showing counter current mechanisms

16.6 Micturition

Urine formed by the nephrons is ultimately carried to the urinary bladder where it is stored till a voluntary signal is given by the central nervous system (CNS). This signal is initiated by the stretching of the urinary bladder as it gets filled with urine. In response, the stretch receptors on the walls of the bladder send signals to the CNS. The CNS passes on motor messages

to initiate the contraction of smooth muscles of the bladder and simultaneous relaxation of the urethral sphincter causing the release of urine. The process of release of urine is called micturition and the neural mechanisms causing it is called the micturition reflex. An adult human excretes, on an average, 1 to 1.5 litres of urine per day. The urine formed is a light yellow coloured watery fluid which is slightly acidic (pH-6.0) and has a characterestic odour. On an average, 25-30 gm of urea is excreted out per day. Various conditions can affect the characteristics of urine. Analysis of urine helps in clinical diagnosis of many metabolic discorders as well as malfunctioning of the kidney. For example, presence of glucose (Glycosuria) and ketone bodies (Ketonuria) in urine are indicative of diabetes mellitus.


Next Catalyst

QUESTION

Assertion (A): The Henle's loop and *vasa recta* play a insignificant role in concentration of urine.

Reason (R): The vasa recta and Henle's loop facilitate the counter-current mechanism.

1. Both Assertion (A) and Reason (R) are true, and Reason (R) is a correct explanation of Assertion (A).

2. Both Assertion (A) and Reason (R) are true, but Reason (R) is not a correct explanation of Assertion (A).

3. Assertion (A) is true, but Reason (R) is false.

4. Assertion (A) is false, but Reason (R) is true.

QUESTION

Assertion (A): In terms of composition, the glomerular filtrate is similar to protein-free plasma.

Reason (R): The endothelium of glomerular blood vessels and the epithelium of Bowman's capsule are permeable to plasma protein.

1. Both Assertion (A) and Reason (R) are true, and Reason (R) is a correct explanation of Assertion (A).

2. Both Assertion (A) and Reason (R) are true, but Reason (R) is not a correct explanation of Assertion (A).

3. Assertion (A) is true, but Reason (R) is false.

4. Assertion (A) is false, but Reason (R) is true.

QUESTION

Assertion (A): Kidneys play a role in the maintenance of pH and ionic balance of the blood.

Reason (R): The descending limb of the loop of Henle selectively secretes hydrogen ions and ammonia into the filtrate.

1. Both Assertion (A) and Reason (R) are true, and Reason (R) is a correct explanation of Assertion (A).

2. Both Assertion (A) and Reason (R) are true, but Reason (R) is not a correct explanation of Assertion (A).

3. Assertion (A) is true, but Reason (R) is false.

4. Assertion (A) is false, but Reason (R) is true.

QUESTION

Statement 1 :PCT is the major site of reabsorption.
Statement 2: Nearly all of the essential nutrients, and 70-80 per cent of electrolytes and water are reabsorbed by PCT.

1. Statement I and Statement II both are correct.
2. Statement I is correct, but Statement II is incorrect.
3. Statement I is incorrect, but Statement II is correct.
4. Statement I and Statement II both are incorrect

QUESTION

Statement-I: Tubular secretion helps in the maintenance of ionic and acid base balance of body fluids.

Statement-II: Reabsorption is minimum in ascending limb of loop of Henle.

1. Statement I and Statement II both are correct.
2. Statement I is correct, but Statement II is incorrect.
3. Statement I is incorrect, but Statement II is correct.
4. Statement I and Statement II both are incorrect.

QUESTION

Statement-I: Glucose, amino acids, Na^+, etc., in the filtrate are reabsorbed passively.
Statement-II: The nitrogenous wastes are absorbed by active transport.

1. Statement I and Statement II both are correct.
2. Statement I is correct, but Statement II is incorrect.
3. Statement I is incorrect, but Statement II is correct.
4. Statement I and Statement II both are incorrect.

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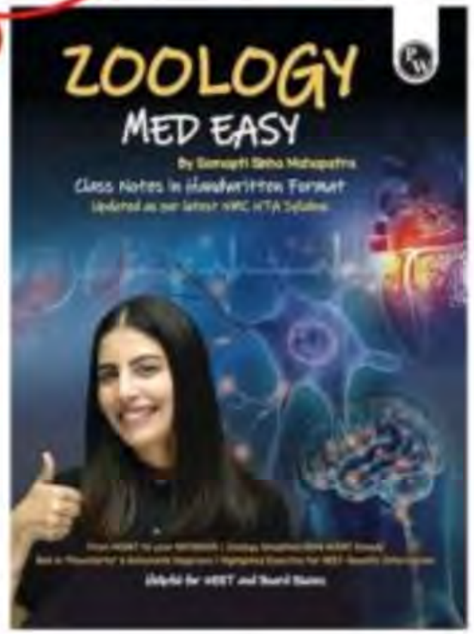

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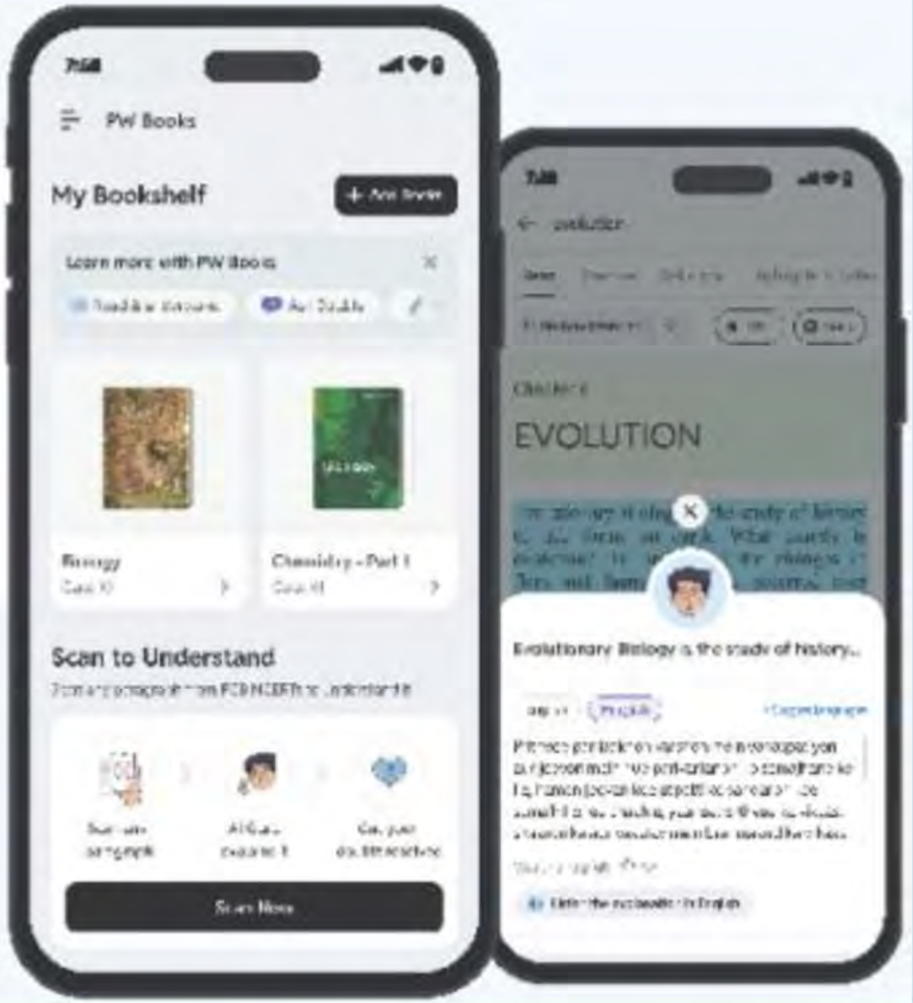

by PHYSICS WALLAH

Homework

- REVISE CLAASNOTES / ZOOLOGY MED EASY

THANK YOU