

Chapter 2: Homeostasis

Complete Sindh Textbook Board curriculum notes covering plant adaptations, human osmoregulation, kidney structure, and medical disorders.

Introduction to Homeostasis



Internal Environment

Maintenance of internal conditions like water quantity, solutes, and temperature within strict physiological limits.



Three Main Aspects

- **Osmoregulation:** Water & salt balance.
- **Thermoregulation:** Optimal enzyme temperature.
- **Excretion:** Elimination of metabolic wastes.



Feedback Mechanism

Detectors identify variance from set-point and trigger corrective responses via nervous or hormonal pathways.

Osmotic Adjustments in Plants

4 Ecological Groups

≡ Hydrophytes

Submerged in fresh water. Poorly developed roots, broad leaves with upper stomata for excess water removal (e.g., Water lily, Hydrilla).

🌿 Halophytes

Grow in salt marshes. Take up salts actively into vacuoles and store in salt glands to survive hypertonic external waters.

🌱 Mesophytes

Moderate water soils. Standard root systems and moderate leaves with regular stomatal regulation during daylight.

Xerophytes

Desert environments. Deep roots, thick waxy cuticles, spines instead of leaves, and succulent parenchymatous stems.

Urinary System of Man

Key Structural Components

- **Kidneys (Pair):** Reddish-brown, bean-shaped organs filtering blood. Hilus connects renal vessels & ureter.
- **Ureters (Pair):** Narrow muscular tubes transporting urine from renal pelvis to bladder.
- **Urinary Bladder:** Thin-walled muscular bag storing urine temporarily.
- **Urethra:** Tube conveying urine from bladder to external body opening.

Internal Kidney Regions

- **Renal Cortex:** Outer dark brown region protected by fibrous capsule.
- **Renal Medulla:** Inner lighter zone featuring 12–16 conical renal pyramids.
- **Renal Pelvis:** Funnel-shaped central collecting space leading into the ureter.
- **Nephrons:** 1+ million microscopic functional units per kidney.

Detailed Structure of Nephron

Malpighian Body

Composed of Bowman's capsule (cup-like structure) enclosing a dense capillary tuft called Glomerulus. Site of ultrafiltration.

Proximal Tubule

First coiled section in cortex. Responsible for selective reabsorption of glucose, amino acids, and essential mineral ions.

Loop of Henle

U-shaped hairpin loop extending into renal medulla. Facilitates significant water and salt reabsorption to concentrate urine.

Distal & Duct

Distal convoluted tubule leads to collecting duct where final water adjustment occurs before emptying into renal pelvis.

Mechanism of Urine Formation

3 Main Steps

STEP 01

Ultrafiltration

Blood entering glomerulus under high pressure forces plasma water, urea, salts, and glucose into Bowman's capsule non-selectively.

STEP 02

Selective Reabsorption

Useful substances (all glucose, amino acids, essential salts) and bulk water are reclaimed back into peritubular capillaries.

STEP 03

Tubular Secretion

Remaining metabolic wastes (creatinine, excess ions) are actively secreted into the tubule to maintain proper blood pH and purity.

Osmoregulation & ADH Hormone

💧 High Blood Concentration (Dehydration)

- Water potential of blood decreases.
- Hypothalamus stimulates pituitary gland to release more **ADH**.
- Collecting ducts become highly permeable, reabsorbing more water.
- Produces small volume of **concentrated urine**.

☁️ Excess Water Intake (Dilute Blood)

- Water potential of blood increases.
- Pituitary gland secretes less **ADH**.
- Collecting ducts reabsorb less water into capillaries.
- Produces large volume of **dilute urine**.

Kidney Stones & Renal Failure

Kidney Stones (Calculi)

Solid crystal masses of calcium oxalate, calcium carbonate, or uric acid precipitating in renal pelvis.

Treatment: Lithotripsy (ultrasonic shock waves) or surgical removal.

Kidney Failure

Complete or partial cessation of nephron filtration causing toxic accumulation of urea and solute imbalance.

Fatal if untreated. Requires renal transplant or artificial machine filtration.

Hemodialysis

Artificial machine filtering patient blood across a semi-permeable membrane against dialyzer fluid.

Schedule: 2–3 sessions weekly, 3–5 hours each.

KARACHI EDU COACHING CENTER

Chapter Review & Key Takeaways

Homeostasis ensures survival by stabilizing internal temperature, water balance, and waste elimination through coordinated feedback loops and renal filtration.

Ready for Quiz & Board Examination Practice