YOUR MENTOR GURU

CSIR NET Life Sciences & Biotechnology — Unit 7

System Physiology – Animal

Study & revision companion | Topic explanations, core facts, and active-recall questions

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How to use this guide

Read each topic, explain the key mechanism in your own words, then answer the self-check prompts without looking at the notes. Use your detailed textbook or class notes for full derivations and additional examples.

Topic overview

1. 1. Blood, Circulation and Hemostasis
2. 2. Respiration and Gas Exchange
3. 3. Kidney and Osmoregulation
4. 4. Nervous System and Synapses
5. 5. Muscle Contraction
6. 6. Endocrine Regulation
7. 7. Digestion, Reproduction and Immunophysiology

1. Blood, Circulation and Hemostasis

Hemoglobin shows cooperative O_2 binding; increased CO_2, H^+ and temperature generally favor O_2 release.

Cardiac output = heart rate × stroke volume; mean arterial pressure depends on cardiac output and vascular resistance.

Platelet adhesion, activation and aggregation form a primary plug; coagulation produces fibrin for stabilization.

Thrombin converts fibrinogen to fibrin; plasmin mediates fibrinolysis.

Blood contains red cells, white cells and platelets. Hemoglobin carries oxygen; platelet activation and coagulation produce a stable clot.

When solving a question, distinguish the underlying mechanism from its observable outcome. Compare the normal situation with the altered condition, and check whether the evidence supports a direct effect or only an association. The central distinction to retain is: a left shift of the hemoglobin oxygen curve indicates increased affinity.

Self-check: Explain the mechanism or relationship above; identify one common misconception; predict the effect of changing a key variable.

2. Respiration and Gas Exchange

Ventilation moves air, while perfusion moves blood; V/Q mismatch impairs gas exchange.

O_2 transport is mainly hemoglobin-bound; CO_2 is transported largely as bicarbonate in blood.

Alveolar diffusion depends on surface area, barrier thickness and partial-pressure gradients.

Central chemoreceptor responses are strongly influenced by CO_2-linked changes in CSF pH.

The cardiac cycle includes filling and ejection; ECG reflects cardiac electrical activity.

When solving a question, distinguish the underlying mechanism from its observable outcome. Compare the normal situation with the altered condition, and check whether the evidence supports a direct effect or only an association. The central distinction to retain is: cardiac output = heart rate × stroke volume.

Self-check: Explain the mechanism or relationship above; identify one common misconception; predict the effect of changing a key variable.

3. Kidney and Osmoregulation

Glomerular filtration produces ultrafiltrate; tubular reabsorption and secretion modify it.

GFR is estimated using creatinine-based equations clinically; clearance of an ideal freely filtered, neither secreted nor reabsorbed marker equals GFR.

ADH increases collecting-duct water permeability through aquaporin-2 trafficking.

Aldosterone increases Na^+ reabsorption and K^+ secretion in distal nephron segments.

Gas exchange follows partial-pressure gradients; hemoglobin carries O_2 and most CO_2 travels as bicarbonate.

When solving a question, distinguish the underlying mechanism from its observable outcome. Compare the normal situation with the altered condition, and check whether the evidence supports a direct effect or only an association. The central distinction to retain is: higher CO_2 and lower pH usually promote oxygen

unloading.

Self-check: Explain the mechanism or relationship above; identify one common misconception; predict the effect of changing a key variable.

4. Nervous System and Synapses

Resting membrane potential is influenced strongly by K^+ permeability and ionic gradients.

Voltage-gated Na^+ channels initiate the action-potential upstroke; K^+ conductances contribute to repolarization.

At chemical synapses, Ca^{2+} influx triggers vesicle fusion and neurotransmitter release.

Myelin increases conduction speed through saltatory propagation between nodes of Ranvier.

Voltage-gated Na^+ and K^+ channels generate action potentials; Ca^{2+} triggers transmitter release at chemical synapses.

When solving a question, distinguish the underlying mechanism from its observable outcome. Compare the normal situation with the altered condition, and check whether the evidence supports a direct effect or only an association. The central distinction to retain is: action potentials are all-or-none.

Self-check: Explain the mechanism or relationship above; identify one common misconception; predict the effect of changing a key variable.

5. Muscle Contraction

Ca^{2+} binds troponin C in skeletal muscle, moving tropomyosin to permit actin–myosin interaction.

ATP binding detaches myosin from actin; ATP hydrolysis primes the myosin head.

Sarcomeres shorten as thin filaments slide past thick filaments; filament lengths do not shorten.

Smooth muscle contraction is regulated mainly through Ca^{2+}–calmodulin activation of MLCK.

Rods and cones transduce light; cochlear hair cells detect mechanical vibrations.

When solving a question, distinguish the underlying mechanism from its observable outcome. Compare the normal situation with the altered condition, and check whether the evidence supports a direct effect or only an association. The central distinction to retain is: light generally hyperpolarizes vertebrate photoreceptors.

Self-check: Explain the mechanism or relationship above; identify one common misconception; predict the effect of changing a key variable.

6. Endocrine Regulation

Peptide hormones usually act through cell-surface receptors; many steroid hormones regulate transcription through intracellular receptors.

Insulin promotes glucose uptake in muscle and adipose tissue via GLUT4 translocation and supports storage pathways.

Glucagon supports hepatic glucose output during fasting.

Hypothalamic–pituitary axes frequently use negative feedback from target-gland hormones.

Glomerular filtration, tubular reabsorption and secretion determine urine composition. ADH helps regulate water retention.

When solving a question, distinguish the underlying mechanism from its observable outcome. Compare the normal situation with the altered condition, and check whether the evidence supports a direct effect or only an association. The central distinction to retain is: clearance = urine concentration × urine flow / plasma concentration.

Self-check: Explain the mechanism or relationship above; identify one common misconception; predict the effect of changing a key variable.

7. Digestion, Reproduction and Immunophysiology

Gastric pepsin begins protein digestion; pancreatic enzymes and brush-border enzymes continue nutrient breakdown.

Bile salts emulsify lipids and aid micelle formation; pancreatic lipase releases fatty acids and monoacylglycerols.

LH surge triggers ovulation; FSH supports follicular development and Sertoli-cell functions.

Innate barriers, inflammation and adaptive lymphocytes coordinate defense against infection.

Digestive enzymes break down food; hormones coordinate metabolism and reproduction through feedback loops.

When solving a question, distinguish the underlying mechanism from its observable outcome. Compare the normal situation with the altered condition, and check whether the evidence supports a direct effect or only an association. The central distinction to retain is: the LH surge triggers ovulation in a typical menstrual cycle.

Self-check: Explain the mechanism or relationship above; identify one common misconception; predict the effect of changing a key variable.

Active-recall practice

1. Explain the essential principles of 1. Blood, Circulation and Hemostasis and give one experimental or real-world application.

2. Explain the essential principles of 2. Respiration and Gas Exchange and give one experimental or real-world application.

3. Explain the essential principles of 3. Kidney and Osmoregulation and give one experimental or real-world application.

4. Explain the essential principles of 4. Nervous System and Synapses and give one experimental or real-world application.

5. Explain the essential principles of 5. Muscle Contraction and give one experimental or real-world application.

6. Explain the essential principles of 6. Endocrine Regulation and give one experimental or real-world application.

7. Explain the essential principles of 7. Digestion, Reproduction and Immunophysiology and give one experimental or real-world application.

Final revision checklist

- 1. Blood, Circulation and Hemostasis
- 2. Respiration and Gas Exchange
- 3. Kidney and Osmoregulation
- 4. Nervous System and Synapses
- 5. Muscle Contraction
- 6. Endocrine Regulation
- 7. Digestion, Reproduction and Immunophysiology

Further study

Use the corresponding unit notes, topic-wise detailed lessons, MCQs, practice tests and full-length mock tests on yourmentorguru.com. This compact PDF is a revision companion, not a replacement for full syllabus textbooks.