

Introduction to Animal Physiology

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The study of how animal bodies work, from cells to whole organisms.

1. What Is Animal Physiology?

- **Definition:** The branch of biology that examines the mechanical, physical, and biochemical functions of animals.
 - **Scope:**
 - Cellular processes (e.g., metabolism, signaling)
 - Organ system operation (e.g., circulation, respiration)
 - Integration of systems to maintain homeostasis
 - **Goal:** Explain how structure (anatomy) enables function and how animals adapt to internal and external challenges.
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2. Core Concepts

Concept	Description	Example
Homeostasis	Maintenance of stable internal conditions despite external changes.	Regulation of body temperature in mammals.
Feedback Loops	Mechanisms that adjust physiological variables; can be negative (stabilizing) or positive (amplifying).	Insulin?glucose regulation (negative feedback).
Metabolism	All chemical reactions that provide energy and build cellular components.	Aerobic respiration of glucose in muscle cells.
Allometry	Relationship between body size and physiological traits.	Larger animals have slower heart rates per gram of tissue.
Adaptation	Physiological traits that improve survival in a specific environment.	Counter?current heat exchange in bird legs.

3. Major Organ Systems & Their Primary Functions

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System	Primary Functions	Key Physiological Processes
Nervous	Rapid communication, integration of sensory information, coordination of behavior.	Action potentials, synaptic transmission.
Endocrine	Hormone production, long-term regulation of metabolism, growth, reproduction.	Hormone synthesis, receptor binding.
Circulatory	Transport of gases, nutrients, wastes; temperature regulation.	Cardiac output, blood pressure control.
Respiratory	Gas exchange (O ₂ uptake, CO ₂ removal).	Ventilation, diffusion across alveolar membranes.
Digestive	Breakdown of food, absorption of nutrients, waste elimination.	Enzymatic hydrolysis, peristalsis.
Excretory (Urinary)	Removal of metabolic waste, osmoregulation, acid-base balance.	Glomerular filtration, tubular reabsorption.
Musculoskeletal	Movement, support, protection of internal organs.	Muscle contraction, bone remodeling.
Immune	Defense against pathogens, tissue repair.	Innate and adaptive immune responses.
Reproductive	Production of gametes, nurturing offspring (in viviparous species).	Hormonal control of gametogenesis, gestation.

4. Cellular Foundations

1. Cell Membrane Transport

- *Passive*: diffusion, osmosis, facilitated diffusion.
- *Active*: primary (ATP-driven pumps), secondary (co-transport).

2. Signal Transduction

- Receptor binding → second messengers (cAMP, Ca²⁺) → cellular response.

3. Energy Production

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- Glycolysis → pyruvate → (a) anaerobic fermentation, (b) aerobic respiration (Krebs cycle, oxidative phosphorylation).

4. Protein Synthesis & Turnover

- Transcription → translation → post-translational modifications; ubiquitin-proteasome degradation.
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5. Homeostatic Regulation – Example: Body Temperature

| Step | Mechanism | Outcome | |-----