Endocrine Physiology

Introduction to Endocrine Principles

There are **TWO** major groups of hormones

Peptide and protein hormones

Amine hormones

Peptide and protein hormones act through cell membrane receptors

Peptide and protein hormones act through generation of **second messengers**

Steroid hormones and Lypophyllic hormones

Mechanism of action of Steroid hormones

Synthesis, Storage, and Release of Hormones

Types of Endocrine glands and cells

Control of Endocrine Systems

AXIS: One endocrine gland acting on another endocrine gland

The vertebrate pituitary gland

hormonal and neural mechanisms that modulate the action of the HPA (Hypot-pituit-adrenal) AXIS

The mammalian stress response phases

The mammalian stress response and blood losses

Endocrine control of salt and Water Balance

The renin–angiotensin–aldosterone system

Muscle and Movement

The organization of skeletal muscles

Excitation–contraction coupling

Whole Skeletal Muscles contractions

Muscle Energetic

The molecular bases of movement

The organization of skeletal muscles

The Contractile proteins

Muscle contraction produced by sliding filaments (sliding-filament theory)

Molecular interactions that underlie muscle contraction

Regulation of contraction by Ca^{2+} and regulatory proteins

Excitation–contraction coupling

Whole Skeletal Muscles: Isometric and isotonic contractions

Summation and tetanus

The relationship between length and tension produced by skeletal muscle

Work done by a muscle during contraction

MUSCLE ENERGETICS: The production and use of ATP

The mechanisms of meeting the ATP costs running

Neural control of skeletal muscle

Respiration

Properties and Transport of gases

External respiration and Ventilation

Breathing in Vertebrates and Invertebrates

Internal or cellular respiration

Properties of gases: the total pressure exerted by a mixture of gases

Temperature and salinity decrease gas solubility in solutions

Transport of Gases

convective gas transport

Gas transport occurs by alternating convection and diffusion

The oxygen cascade

The physical properties of air and water affect respiration

External respiration and Ventilation

EXTERNAL RESPIRATION: Generalized features of animal gas exchange

different types of respiratory structures

Oxygen transfer from the environmental medium to the blood

Vertebrate Breathing

Total area and thickness of the gas-exchange membrane in the gills or lungs

Respiration and Water balance in terrestrial organisms

Role of skin on O_2 and CO_2 exchange

The branchial breathing system in teleost fish

Breathing in teleost fish, Regulation of Breathing in fish

Breathing organs of amphibians and reptiles

The airways in mammals

Dynamic lung volumes in healthy young adult men

Mechanisms of gas transport in final branches of mammalian lungs during inhalation

the lungs and air sacs of birds

Airflow in the lungs and air sacs of birds

insect breathing tracheal system

Circulation

Transport of oxygen and carbon dioxide in body fluids

Circulation and Hearts

Circulation in vertebrates and invertebrates

Respiratory pigments Increase the amount of oxygen carried by blood

Respiratory pigments undergo reversible combination with O2

Typical **oxygen equilibrium curves** for human arterial blood

Oxygen delivery by human blood at rest and during vigorous exercise

The diversity of blood oxygen equilibrium curves and their ecological meaning

The **Bohr effect**: decrease in pH or increase on CO_2 decrease affinity for O_2

Carbon dioxide equilibrium curves

Processes of CO_2 uptake by the blood in a systemic blood capillary of a vertebrate

The extent of CO_2 transport depends on **blood buffers**

Circulation

The heart as a pump

The conducting system and the process of conduction in the mammalian heart (MYOGENIC)

Parasympathetic and sympathetic control of circulation rates

Blood pressure and blood flow

Vascular system structure and function

Blood flow in the human systemic vasculature

Closed circulatory system

Pulmonary circuit properties and function

Open circulatory system of insect and crustacean

Water and Salt Physiology

Body fluids

Introduction to water-salt physiology

There are three major types of body fluids

Osmotic regulation: maintenance of a steady osmotic pressure.

Ionic regulation : maintenance of steady concentrations of ions.

Volume regulation: maintenance of steady volume of water.

Importance of ions and water in physiology

Water-Salt in natural aquatic environments

Terrestrial environments: humidity, evaporation and Saturation water vapor pressure

Factor important in evaporation

Osmotic, ionic and volume regulation and conformity

Organs of osmoregulation of blood : kidneys, gills, gland salts

The **U**rine/**P**lasma radio

How Organisms **gain** water

Metabolic water

The fundamental principles of cell-volume regulation, role of organic molecules

Osmotic pressures of sea, fresh water and terrestrial organisms. How are they maintained?

Water and Salt Physiology

Animals in Fresh water

Animals in the ocean

Animals that face changes in salinity

Animals on terrestrial habitats

Water-Salt in natural aquatic environments

Water-Salt regulation in freshwater animals

ADAPTATIONS: **Active ion transport uptake** across gill epithelium of a freshwater fish

Water–salt relations in freshwater fish

Water-Salt regulation in **Marine** Invertebrates

Water–salt relations in marine teleost fish

NaCl secretion by a chloride cell of a marine teleost fish

Birds in ocean environments: salt glands of a herring gull

Water–salt relations in a marine shark

UREA and Trimethylamine oxide (TMAO)

Animals from brackish water

Acclimation to changed salinity

Terrestrial environments

Terrestrial organisms lose water by evaporation

Humidic and Xeric animals

Low integumentary permeability to water reduces evaporative water loss

Respiratory evaporative loss depends on the function of the breathing organs

The temperature of air exhaled from the nostrils

evaporative loss and size.

Excretory water loss depends on the **concentrating ability** of excretory organs

Water-turnover rates of free-living terrestrial vertebrates as a function of body size

Amphibians occupy xeric habitats despite their humidic nature: ADAPTATIONS

Insects are excellent water managers, WHY?

Xeric vertebrates are well adapted to prevent water losses.

Excretion

Basic mechanisms of Kidney function

Urine formation in Amphibians

Urine formation in Mammals

Urine formation in Insects

Nitrogen balance

Kidneys

Basic mechanisms of Kidney function

Formation of primary urine by ULTRAFILTRATION OR active solute secretion

Urine formation in amphibians during diuresis and antidiuresis

The action of an antidiuretic hormone (ADH)

Aquaporin

Urine formation in **mammals**

ANATOMY explains PHYSIOLOGY

Evolutionary development of renal papilla in mammals native to different habitats

Maximum urine concentration **correlates** with the relative thickness of the medulla

Countercurrent multiplication is the key to produce concentrated urine

Osmotic pressure increases with depth in the medulla

The **single effect**

Countercurrent multiplication in the loop of Henle

Major molecular mechanisms of NaCl reabsorption and associated processes

Role of Malpighian tubules and hindgut of an insect in excretion

nitrogenous compounds excreted by animals