

KARACHI EDU COACHING CENTER • CLASS 9 BIOLOGY

Chapter 7: Bioenergetics

Comprehensive lecture notes on energy transformations, ATP as cellular currency, oxidation-reduction reactions, and cellular respiration.

Bioenergetics & Energy Flow



Definition of Bioenergetics

Study of energy relationships and energy transformations (conversions) in living organisms.



Role of Sunlight

Ultimate source of energy for Earth. Trapped by producers (plants) via photosynthesis and converted into chemical bonds.

Oxidation & Reduction (Redox)

Electron Loss

Oxidation Reactions

Defined as the loss of electrons (or loss of hydrogen atoms, or gain of oxygen atoms), releasing free energy.

Electron Gain

Reduction Reactions

Defined as the gain of electrons (or gain of hydrogen atoms, or loss of oxygen atoms), storing potential energy.

ATP Structure & Function

Molecular Components

Composed of adenine base, ribose sugar, and three phosphate groups.

High-Energy Bonds

Terminal phosphate bonds store ~7.3 kcal/mol of releasable energy.

ADP Conversion

Hydrolysis splits ATP into ADP and inorganic phosphate to power work.

Pigments & Chloroplasts



Chloroplast Structure

Double-membrane organelle containing thylakoids (grana) for light reactions and fluid stroma for dark reactions.



Photosynthetic Pigments

Chlorophyll a and b absorb blue/red wavelengths efficiently while accessory carotenoids capture supplementary light energy.

Light & Dark Reactions

Light-Dependent Phase

Occurs in grana. Photolysis splits water, releasing oxygen gas while generating high-energy ATP and NADPH molecules.

Calvin Cycle (Dark Phase)

Occurs in stroma. Fixes carbon dioxide using ATP and NADPH energy to synthesize glucose without requiring direct sunlight.

ENERGY RELEASE

Cellular Respiration Pathways

Glycolysis

Anaerobic breakdown of glucose into pyruvate in cytoplasm yielding 2 ATP.

Aerobic Respiration

Krebs cycle & electron transport chain in mitochondria yield 36–38 ATP.

Anaerobic / Fermentation

Produces lactic acid in animal muscles or ethanol and CO₂ in yeast cells.

Questions & Discussion

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