

AP BIOLOGY CHEAT SHEET

Unit 3: Cellular Energetics

Quick Overview

- **Focus:** enzymes, energy coupling, ATP production, cellular respiration, and photosynthesis.
- **Exam lens:** connect inputs and outputs, track energy transformations, and understand regulation.

Enzymes: The Basics

- **Biological catalysts** — speed up reactions by lowering activation energy.
- **Active site:** substrate binds specifically.
- **Induced fit model:** enzyme changes shape slightly when binding.
- **Factors affecting activity:** temperature, pH, substrate concentration.
- **Inhibition:**
 - Competitive:** inhibitor binds active site.
 - Noncompetitive:** inhibitor binds elsewhere, changes shape.
- **Cofactors/coenzymes may be required.**

Mnemonic: "Lock and key, but flexible."

ATP and Energy Coupling

- **ATP = adenosine triphosphate** → energy currency.
- **Energy stored in phosphate bonds.**
- **Hydrolysis** ($ATP \rightarrow ADP + Pi$) releases energy for cellular work.
- **Energy coupling:** exergonic reaction powers an endergonic one.

Membrane Structure

- **Goal:** Convert glucose into ATP.
- **Glycolysis (cytoplasm):**
 - Glucose → 2 pyruvate, 2 ATP (net), 2 NADH.
 - Anaerobic or aerobic.
- **Link Reaction (mitochondrial matrix):**
 - Pyruvate → Acetyl-CoA + CO₂ + NADH.
- **Krebs Cycle (matrix):**
 - Acetyl-CoA oxidized.
 - Produces NADH, FADH₂, 2 ATP, CO₂.
- **Electron Transport Chain (inner mitochondrial membrane):**
 - NADH & FADH₂ donate e⁻.
 - Oxygen = final electron acceptor → forms water.
 - Chemiosmosis (proton gradient) drives **ATP synthase** → ~34 ATP.
- **Total Yield:** ~36–38 ATP per glucose.

Mini formula box

- **ATP Hydrolysis:** $ATP \rightarrow ADP + Pi + energy$
- **Cell Respiration:** $C_6H_{12}O_6 + 6 O_2 \rightarrow 6 CO_2 + 6 H_2O + \sim 36 ATP$
- **Photosynthesis:** $6 CO_2 + 6 H_2O + light \rightarrow C_6H_{12}O_6 + 6 O_2$

Anaerobic Respiration / Fermentation

- **Occurs when O₂ absent.**
- **Lactic acid fermentation:** pyruvate → lactate (animals).
- **Alcohol fermentation:** pyruvate → ethanol + CO₂ (yeast).
- **Less efficient, only 2 ATP from glycolysis.**

Photosynthesis (Chloroplasts)

Goal: Convert light energy → chemical energy.

1) Light Reactions (thylakoid membranes):

- Photosystems II & I capture light.
- Water split → O₂ released.
- ATP & NADPH produced.

2) Calvin Cycle (stroma):

- Uses ATP + NADPH to fix CO₂.
- Produces G3P → glucose.

Equation:

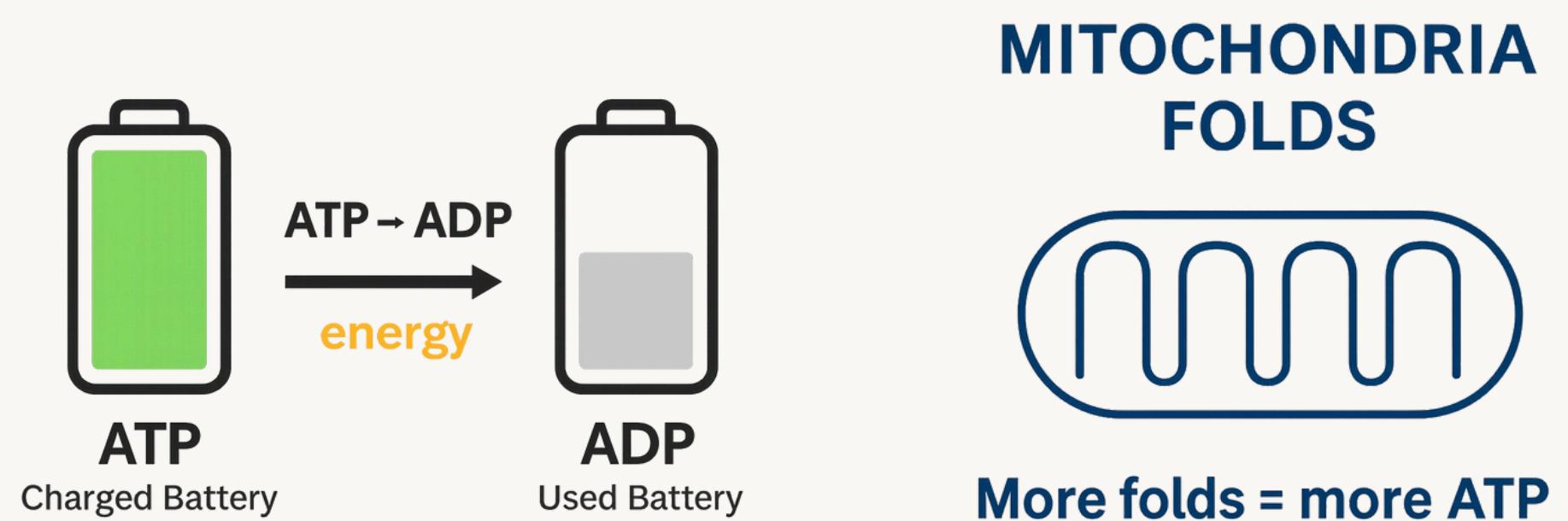


Mnemonic: "Light makes ATP & NADPH; Calvin builds sugar."

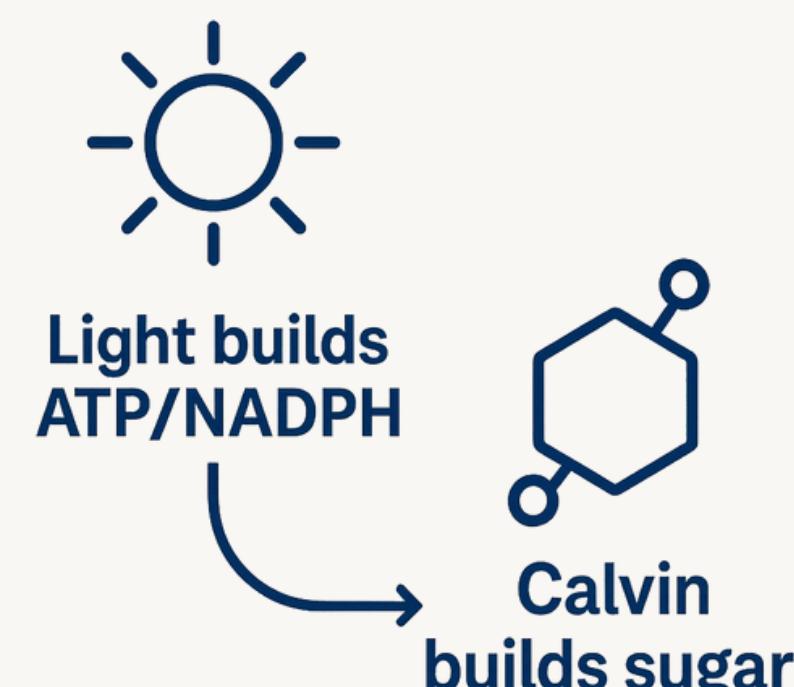
Common exam pitfalls

- Forgetting enzymes lower activation energy but don't change ΔG.
- Mixing up competitive vs noncompetitive inhibition.
- Thinking fermentation makes ATP (it only regenerates NAD⁺ so glycolysis can continue).
- Forgetting O₂ is the final electron acceptor in the ETC.
- Confusing ATP production locations: glycolysis (cytoplasm), Krebs + ETC (mitochondria), light reactions (thylakoid).

Visual Mnemonics



PHOTOSYNTHESIS



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