

# 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 → 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 + CO<sub>2</sub> + NADH.
- **Krebs Cycle (matrix):**
  - Acetyl-CoA oxidized.
  - Produces NADH, FADH<sub>2</sub>, 2 ATP, CO<sub>2</sub>.
- **Electron Transport Chain (inner mitochondrial membrane):**
  - NADH & FADH<sub>2</sub> donate e<sup>-</sup>.
  - 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:**  $\text{ATP} \rightarrow \text{ADP} + \text{Pi} + \text{energy}$
- **Cell Respiration:**  $\text{C}_6\text{H}_{12}\text{O}_6 + 6 \text{O}_2 \rightarrow 6 \text{CO}_2 + 6 \text{H}_2\text{O} + \sim 36 \text{ATP}$
- **Photosynthesis:**  $6 \text{CO}_2 + 6 \text{H}_2\text{O} + \text{light} \rightarrow \text{C}_6\text{H}_{12}\text{O}_6 + 6 \text{O}_2$

### Anaerobic Respiration / Fermentation

- **Occurs when O<sub>2</sub> absent.**
- **Lactic acid fermentation:** pyruvate → lactate (animals).
- **Alcohol fermentation:** pyruvate → ethanol + CO<sub>2</sub> (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 → O<sub>2</sub> released.
- ATP & NADPH produced.

#### 2) Calvin Cycle (stroma):

- Uses ATP + NADPH to fix CO<sub>2</sub>.
- Produces G3P → glucose.

**Equation:**

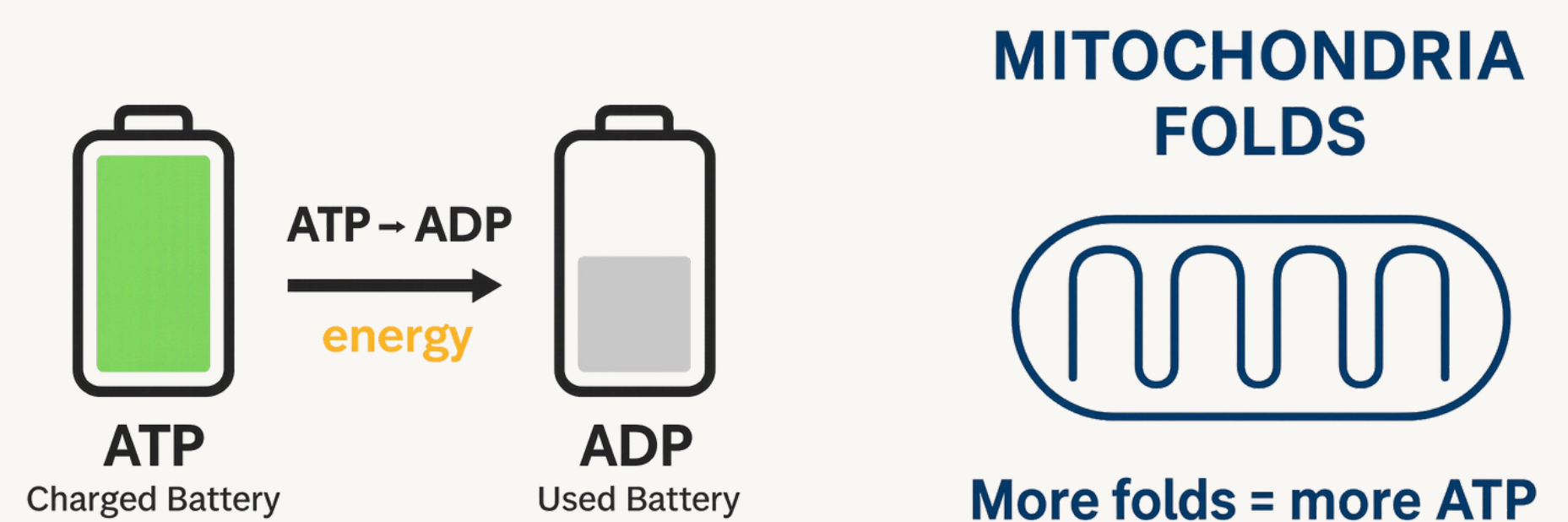


**Mnemonic:** “Light makes ATP & NADPH; Calvin builds sugar.”

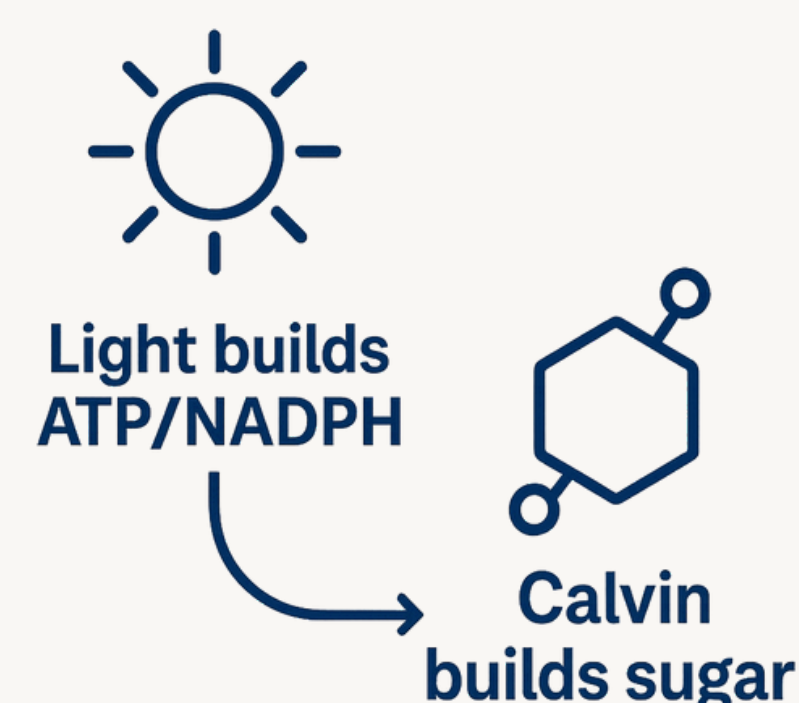
### Common exam pitfalls

- Forgetting enzymes lower activation energy but don’t change  $\Delta G$ .
- Mixing up competitive vs noncompetitive inhibition.
- Thinking fermentation makes ATP (it only regenerates NAD<sup>+</sup> so glycolysis can continue).
- Forgetting O<sub>2</sub> is the final electron acceptor in the ETC.
- Confusing ATP production locations: glycolysis (cytoplasm), Krebs + ETC (mitochondria), light reactions (thylakoid).

### Visual Mnemonics



### PHOTOSYNTHESIS



**Book a free consultation  
on our website now**

[www.northamericantutors.com](http://www.northamericantutors.com)