# BIOLOGY – ENERGY, ENZYMES, CELLULAR RESPIRATION, PHOTOSYNTHESIS, AND METABOLIC PATHWAYS PRACTICE TEST (SAMPLE)

## STUDY GUIDE

## SAMPLE STUDY GUIDE WITH LIMITED QUESTIONS

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# Introduction

Preparing for a certification exam can feel overwhelming, but with the right tools, it becomes an opportunity to build confidence, sharpen your skills, and move one step closer to your goals. At Examzify, we believe that effective exam preparation isn't just about memorization, it's about understanding the material, identifying knowledge gaps, and building the test-taking strategies that lead to success.

This guide was designed to help you do exactly that.

Whether you're preparing for a licensing exam, professional certification, or entry-level qualification, this book offers structured practice to reinforce key concepts. You'll find a wide range of multiple-choice questions, each followed by clear explanations to help you understand not just the right answer, but why it's correct.

The content in this guide is based on real-world exam objectives and aligned with the types of questions and topics commonly found on official tests. It's ideal for learners who want to:

- Practice answering questions under realistic conditions,
- Improve accuracy and speed,
- Review explanations to strengthen weak areas, and
- Approach the exam with greater confidence.

We recommend using this book not as a stand-alone study tool, but alongside other resources like flashcards, textbooks, or hands-on training. For best results, we recommend working through each question, reflecting on the explanation provided, and revisiting the topics that challenge you most.

Remember: successful test preparation isn't about getting every question right the first time, it's about learning from your mistakes and improving over time. Stay focused, trust the process, and know that every page you turn brings you closer to success.

Let's begin.

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# How to Use This Guide

This guide is designed to help you study more effectively and approach your exam with confidence. Whether you're reviewing for the first time or doing a final refresh, here's how to get the most out of your Examzify study guide:

### 1. Start with a Diagnostic Review

Skim through the questions to get a sense of what you know and what you need to focus on. Your goal is to identify knowledge gaps early.

### 2. Study in Short, Focused Sessions

Break your study time into manageable blocks (e.g. 30 – 45 minutes). Review a handful of questions, reflect on the explanations.

### 3. Learn from the Explanations

After answering a question, always read the explanation, even if you got it right. It reinforces key points, corrects misunderstandings, and teaches subtle distinctions between similar answers.

### 4. Track Your Progress

Use bookmarks or notes (if reading digitally) to mark difficult questions. Revisit these regularly and track improvements over time.

### 5. Simulate the Real Exam

Once you're comfortable, try taking a full set of questions without pausing. Set a timer and simulate test-day conditions to build confidence and time management skills.

### 6. Repeat and Review

Don't just study once, repetition builds retention. Re-attempt questions after a few days and revisit explanations to reinforce learning. Pair this guide with other Examzify tools like flashcards, and digital practice tests to strengthen your preparation across formats.

There's no single right way to study, but consistent, thoughtful effort always wins. Use this guide flexibly, adapt the tips above to fit your pace and learning style. You've got this!

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# Questions

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**1. Signal transduction pathways involve intracellular events stimulated by an extracellular signal.**

A. They occur only in prokaryotes.

B. They involve intracellular events stimulated by an extracellular signal.

C. They do not involve second messengers.

D. They are limited to changes in membrane potential with no kinase activity.

**2. What is the link between electron transport and ATP synthesis?**

A. The direct transfer of electrons to ADP forms ATP.

B. Wireless energy is used to convert ADP to ATP.

C. The link is a proton gradient created by the movement of electrons.

D. The energy from ATP is used to pump protons to generate more electrons.

**3. In the gut epithelium, where is the greatest amount of cell growth expected?**

A. Crypts

B. Villi

C. Luminal surface

D. Submucosa

**4. Which statement best describes the ATP yield from fermentation compared with respiration?**

A. Fermentation yields less ATP than respiration and does not use the electron transport chain.

B. Fermentation yields more ATP than aerobic respiration.

C. Fermentation requires oxygen to proceed.

D. Fermentation directly produces $CO_2$ as a final electron acceptor.

**5. In chloroplasts, how does the thylakoid lumen become acidic?**

A. Protons are pumped from the stroma into the thylakoid lumen.

B. Protons are pumped from the lumen into the stroma.

C. Protons are generated by ATP hydrolysis in the lumen.

D. Protons diffuse out of the chloroplast.

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**6. Which statement about spontaneous reactions is true?**

A. Spontaneous reactions require energy input to proceed

B. Spontaneous reactions cannot occur without catalysts

C. Spontaneous reactions always release energy as they proceed

D. Spontaneous reactions have positive ΔG

**7. Loss of the Netrin-1 receptor can disrupt signaling regulating which cellular outcomes?**

A. Endocrine signaling

B. Autocrine signaling

C. Juxtacrine signaling

D. Cell growth and apoptosis

**8. How does glycolysis produce ATP?**

A. Substrate-level phosphorylation

B. Oxidative phosphorylation

C. Electron transport

D. Photophosphorylation

**9. What is activation energy?**

A. The energy required to initiate a chemical reaction

B. The energy released during the reaction

C. The energy stored in the products

D. The energy absorbed from the environment

**10. Which enzyme complex utilizes the proton gradient to synthesize ATP?**

A. Cytochrome c oxidase.

B. ATP synthase.

C. Hexokinase.

D. Pyruvate dehydrogenase.

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# Answers

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1. C
2. C
3. A
4. A
5. A
6. C
7. D
8. A
9. A
10. B

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# Explanations

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**1. Signal transduction pathways involve intracellular events stimulated by an extracellular signal.**

A. They occur only in prokaryotes.

B. They involve intracellular events stimulated by an extracellular signal.

C. They do not involve second messengers.

D. They are limited to changes in membrane potential with no kinase activity.

*Signal transduction pathways translate an external signal into intracellular actions. When a signal molecule binds a receptor, the message is passed inside the cell often via second messengers such as cyclic AMP, Ca2+, IP3, and DAG. These small molecules amplify the signal and help activate downstream targets, like protein kinases, which then modify other proteins to change cellular behavior. This is why second messengers are a hallmark of many signaling cascades. The idea that these pathways do not involve second messengers doesn't fit the pattern of how these signals typically work. In addition to second messengers, signaling often involves kinase cascades and can lead to changes in gene expression or metabolism. It's also not limited to prokaryotes or to changes in membrane potential; kinase activity and second messengers are common features across many eukaryotic signaling pathways.*

**2. What is the link between electron transport and ATP synthesis?**

A. The direct transfer of electrons to ADP forms ATP.

B. Wireless energy is used to convert ADP to ATP.

C. The link is a proton gradient created by the movement of electrons.

D. The energy from ATP is used to pump protons to generate more electrons.

*The link between electron transport and ATP synthesis is chemiosmotic coupling: as electrons move through the electron transport chain, their energy is used to pump protons across the inner mitochondrial membrane, creating a proton gradient (proton motive force). This stored energy drives protons back through ATP synthase, turning ADP and inorganic phosphate into ATP. So ATP production is powered by the electrochemical gradient generated by electron transport, not by a direct transfer of electrons to ADP, and not by some wireless transfer or by ATP pushing protons.*

**3. In the gut epithelium, where is the greatest amount of cell growth expected?**

A. Crypts

B. Villi

C. Luminal surface

D. Submucosa

*In the gut lining, the highest rate of cell production happens in the crypts of Lieberkühn. These crypts house the stem cells and a rapid transit-amplifying cell population that continuously divides. As these cells divide, their progeny migrate upward along the crypt–villus axis, then differentiate into mature absorptive and secretory cells as they reach the villus. By the time they reach the tip of the villus, they are shed and renewed, keeping the epithelium constantly replenished. The luminal surface mostly contains differentiated cells with little division, and the submucosa is a supportive connective tissue layer—not a proliferative zone. Thus, the crypts are the primary site of epithelial growth.*

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**4. Which statement best describes the ATP yield from fermentation compared with respiration?**

A. Fermentation yields less ATP than respiration and does not use the electron transport chain.

B. Fermentation yields more ATP than aerobic respiration.

C. Fermentation requires oxygen to proceed.

D. Fermentation directly produces $CO_2$ as a final electron acceptor.

*Fermentation yields far less ATP than respiration because it relies only on glycolysis and does not use oxidative phosphorylation via the electron transport chain. In glycolysis, you start with one glucose and net 2 ATP. Without an electron transport chain to harvest more energy, the electrons from NADH are returned to NAD+ by transferring them to the end product of fermentation (pyruvate or a related molecule). This regeneration of NAD+ lets glycolysis continue in the absence of oxygen, but it doesn't drive additional ATP production beyond the initial 2 ATP from glycolysis. In contrast, aerobic respiration uses glycolysis plus pyruvate processing, the citric acid cycle, and the electron transport chain, pulling much more energy out of each glucose molecule—roughly 30–32 ATP in many cells. So the statement that fermentation yields less ATP than respiration and does not use the electron transport chain best captures the key difference. The other ideas aren't accurate for fermentation in general: it doesn't require oxygen to proceed, and while $CO_2$ can be produced in some fermentation pathways (for example, during alcoholic fermentation), $CO_2$ is not the final electron acceptor in fermentation.*

**5. In chloroplasts, how does the thylakoid lumen become acidic?**

A. Protons are pumped from the stroma into the thylakoid lumen.

B. Protons are pumped from the lumen into the stroma.

C. Protons are generated by ATP hydrolysis in the lumen.

D. Protons diffuse out of the chloroplast.

*The thylakoid lumen becomes acidic because protons are pumped from the stroma into the lumen as electrons are transported through the photosynthetic electron transport chain. As light drives the flow of electrons, the cytochrome b6f complex pumps $H^+$ from the stroma into the lumen, and water splitting at photosystem II also releases protons into the lumen. This accumulation of $H^+$ lowers the lumen's pH, creating a proton gradient that stores energy used by ATP synthase to make ATP. If protons were pumped the other way, or if protons were simply generated by ATP hydrolysis in the lumen, or if they diffused out, the gradient would not form. The key is moving protons into the lumen to build the proton motive force.*

**6. Which statement about spontaneous reactions is true?**

A. Spontaneous reactions require energy input to proceed

B. Spontaneous reactions cannot occur without catalysts

C. Spontaneous reactions always release energy as they proceed

D. Spontaneous reactions have positive $\Delta G$

*Spontaneity is about Gibbs free energy. A process is spontaneous when $\Delta G$ is negative, meaning it can proceed without continuous input of energy from outside and the system releases free energy as it moves to a more stable state. That release of free energy is what allows the reaction to do work on the surroundings, even if heat flow isn't the driving factor. Catalysts aren't required for spontaneity; they only speed things up by lowering activation energy. A positive $\Delta G$ would mean the process is non-spontaneous under those conditions and would need external energy to proceed. So the statement that spontaneous reactions always release energy as they proceed aligns with the idea of negative $\Delta G$ and energy being released, rather than requiring energy input.*

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## 7. Loss of the Netrin-1 receptor can disrupt signaling regulating which cellular outcomes?

A. Endocrine signaling

B. Autocrine signaling

C. Juxtacrine signaling

D. Cell growth and apoptosis

*Netrin-1 receptor signaling governs cell fate by directing survival and growth decisions through dependence receptor pathways. When netrin-1 binds its receptors (such as DCC or UNC5), it promotes cell survival and can influence growth. Losing the receptor removes these survival cues, shifting outcomes toward altered growth and apoptosis. The other signaling modalities—endocrine (hormones traveling through the blood), autocrine (self-targeting signals), and juxtacrine (direct cell-to-cell contact)—describe how signals move between cells, not the downstream fate decisions controlled by netrin-1 receptor signaling. So disruption most directly affects cell growth and apoptosis.*

## 8. How does glycolysis produce ATP?

A. Substrate-level phosphorylation

B. Oxidative phosphorylation

C. Electron transport

D. Photophosphorylation

*Glycolysis generates ATP through substrate-level phosphorylation, a direct transfer of a high-energy phosphate from an intermediate of glycolysis to ADP to form ATP. In glycolysis, this happens in two steps: first, the conversion of 1,3-bisphosphoglycerate to 3-phosphoglycerate transfers a phosphate to ADP to make ATP; then, phosphoenolpyruvate donates its phosphate to ADP via pyruvate kinase, making another ATP molecule. This mechanism relies on high-energy phosphate groups carried by glycolytic intermediates, not on a membrane-bound proton gradient. Oxidative phosphorylation uses electron transport chains and a proton motive force to drive ATP synthesis and occurs in mitochondria, while photophosphorylation happens in chloroplasts during photosynthesis. Glycolysis can proceed without oxygen, but its ATP yield comes specifically from substrate-level phosphorylation rather than oxidative phosphorylation.*

## 9. What is activation energy?

A. The energy required to initiate a chemical reaction

B. The energy released during the reaction

C. The energy stored in the products

D. The energy absorbed from the environment

*Activation energy is the energy barrier that must be overcome to start a chemical reaction. It represents the minimum energy needed for reactants to reach a high-energy transition state where bonds are broken and new bonds form. This barrier is not the energy released or absorbed by the overall reaction—that's the enthalpy change—and it's not the energy stored in the products. Instead, it's the energy that must be supplied from the surroundings (or supplied by a catalyst, which provides a lower-energy pathway) to get the reaction going. Temperature can raise the number of molecules with enough energy to overcome this barrier, increasing the reaction rate, while a catalyst lowers the barrier without changing the overall energy change of the reaction.*

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**10. Which enzyme complex utilizes the proton gradient to synthesize ATP?**

A. Cytochrome c oxidase.

B. ATP synthase.

C. Hexokinase.

D. Pyruvate dehydrogenase.

*The main concept tested is how a proton gradient powers ATP synthesis, a process known as chemiosmosis. In cellular respiration, the electron transport chain pumps protons across the inner mitochondrial membrane, creating a proton-motive force. Protons flow back through the ATP synthase enzyme, and this flow drives the rotation of its F0 part, which enables the F1 part to synthesize ATP from ADP and inorganic phosphate. That enzyme complex, ATP synthase, is the one that converts the proton gradient into ATP. Cytochrome c oxidase is part of the electron transport chain and helps pump protons, but it doesn't make ATP directly. Hexokinase initiates glycolysis by phosphorylating glucose, and pyruvate dehydrogenase converts pyruvate to acetyl-CoA, linking glycolysis to the citric acid cycle without synthesizing ATP from a proton gradient. So the enzyme that uses the proton gradient to synthesize ATP is ATP synthase.*

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# Next Steps

Congratulations on reaching the final section of this guide. You've taken a meaningful step toward passing your certification exam and advancing your career.

As you continue preparing, remember that consistent practice, review, and self-reflection are key to success. Make time to revisit difficult topics, simulate exam conditions, and track your progress along the way.

If you need help, have suggestions, or want to share feedback, we'd love to hear from you. Reach out to our team at hello@examzify.com.

Or visit your dedicated course page for more study tools and resources:

https://bioenergyenzymescellrespiration.examzify.com

We wish you the very best on your exam journey. You've got this!

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