AP Biology 2019-2020

Unit 3: Cellular Energetics Study Guide

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| Learning Objective | AP LO # | “I can” Statement |
| 3.1 | 3.4a-c | I can describe the role of energy in living organisms.1. Living systems require a constant input of energy
2. Laws of thermodynamics
3. Energy is required to maintain order and power cellular processes
4. Loss of energy flow or order results in death
5. Reaction coupling- Cellular processes that release energy may be coupled with processes that require energy
6. Energy-related pathways in biological systems are sequential to allow for controlled transfer of energy.
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| 3.2 | 3.1a-b3.2 | I can describe the properties of enzymes and explain how enzymes affect the rate of biological reactions.1. Active site that is specific to substrates in shape and charge
2. Activation energy
3. Denaturation
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| 3.3 | 3.3a-d | I can explain how the cellular environment affects enzyme activity.1. Effects of temperature and pH
2. Concept and application of the pH equation pH=-log[H+]
3. Effects of substrate and product concentration
4. Competitive and noncompetitive inhibitors
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| 3.4 |  | I can adequately (for this point in the course) design and carry out a laboratory experiment, including graphing of data and data analysis. |
| 3.5 | 3.6a-b | Cellular Respiration (overall)-I can describe the overall process that allows organisms to use energy stored in biological molecules in order to power cellular functions and know that respiration and fermentation are characteristic of all forms of life.1. CR in eukaryotes involves a series of enzyme-catalyzed reactions
2. Convert the energy stored in biological macromolecules into chemical energy in ATP
3. ETC and chemiosmosis occurs on mitochondrial membrane of eukaryotes and cell membrane of aerobic prokaryotes
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| 3.6 | 3.6c-h | Cellular Respiration (details)- I can explain each of the following portions of aerobic respiration, including what molecules are involved and the location of each in the cell or mitochondrion. See specific LOs below for each.1. Glycolysis
2. Pyruvate oxidation (transition step)
3. Krebs cycle (Citric Acid Cycle)
4. Electron transport chain
5. Oxidative phosphorylation (by chemiosmosis)
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| 3.7 | 3.6d-e | Glycolysis and Pyruvate Oxidation-I can explain the processes of glycolysis and pyruvate oxidation, including reactants and product, and where they occur in the cell or mitochondrion. |
| 3.8 | 3.6f | Krebs Cycle (Citric Acid Cycle)-I can explain the overall Krebs cycle (citric acid cycle) including the electron carriers that are produced (NADH FADH2) and where it occurs in the mitochondrion. |
| 3.9 | 3.6g-h | Oxidative Phosphorylation (ETC and chemiosmosis)-I can explain how the electron transport chain in cellular respiration creates an electrochemical gradient of protons (H+) using the electrons extracted in glycolysis and the Krebs cycle and how this gradient is used to produce ATP through oxidative phosphorylation by ATP Synthase.1. Role of NADH and FADH2
2. Role of sequence of electron acceptors/carriers in the inner mitochondrial membrane
3. Creation of electrochemical gradient of H+ ions (protons)
4. Flow of protons through ATP Synthase drives the production of ATP
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| 3.10 | 3.6i | Fermentation-I can explain how fermentation (anaerobic respiration) allows glycolysis to continue in the absence of oxygen.1. Fermentation replenishes the electron carriers needed for glycolysis
2. Produces 2 ATP molecules overall
3. Alcohol and lactic acid are waste products of different forms of fermentation
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| 3.11 | 3.6j | I understand that the conversion of ATP to ADP releases energy to drive cellular work. |
| 3.12 |  | I can explain oxidation-reduction (REDOX) reactions and identify which products have been oxidized or reduced as well as the importance of these reactions in metabolic pathways. |
| 3.13 | 3.5a | Photosynthesis (overall)- I can describe the overall process of photosynthesis and understand that it first evolved in prokaryotes.1. Capture energy from the sun and produces sugars
2. PS first evolved in prokaryotes
3. Prokaryotic photosynthesis was responsible for oxygenating the atmosphere
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| 3.14 | 3.5b-g | Photosynthesis (details)- I can explain how cells capture energy from light and transfer it to biological molecules for storage and use.1. Structure of the chloroplast
2. Light-dependent vs light-independent reactions
3. Photosystems I and II- location and role of chlorophylls (boosting electrons), role of ATP and NADPH
4. Electron transport chain- transfer of electrons established an electrochemical gradient of protons (hydrogen ions), NADP+ as terminal electron acceptor
5. Role of ATP synthase
6. Calvin cycle- occurs in stroma of the chloroplast, ATP and NADPH from light reactions powers the production of carbohydrates from CO2
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| 3.15 | 3.6c | I understand that electron transport chains occur in all living organisms and can explain the differences among where they occur and the electron carriers used.1. Cellular respiration- NADH and FADH2, oxygen is terminal electron acceptor
2. Cellular respiration- decoupling oxidative phosphorylation (chemiosmosis) from the ETC produces heat that can be used by endotherms to regulate body temp
3. Photosynthesis- NADP+ is terminal electron acceptor
4. Prokaryotes use the plasma membrane for the ETC and chemiosmosis
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