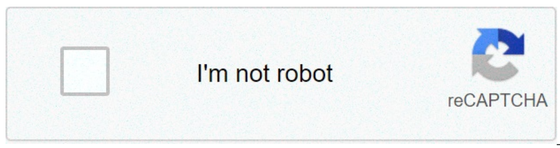


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# The diagram shows a mitochondrion

You need to know how photosynthesis and cellular respiration are related (that the products of one are the reactants of the other). You need to know the reactants, products and basic functions of photosynthesis, aerobic, and anaerobic respiration. You need to understand how ATP is connected with energy transfers within the cell. You need to know that photosynthesis stores energy while cellular respiration releases energy. The diagram below shows the relationship between photosynthesis and cellular respiration and the organelles in which they occur. Which statement describes how photosynthesis and cellular respiration are interrelated? A. Oxygen is produced during cellular respiration and stored during photosynthesis. B. Carbon dioxide and water released by cellular respiration are used in photosynthesis. C. Photosynthesis releases the energy that is stored during the process of cellular respiration. D. Glucose is used during cellular respiration to produce food that is broken down during photosynthesis. CLICK HERE FOR ANSWER Which gas is removed from the atmosphere during photosynthesis? A. hydrogen B. oxygen C. nitrogen D. carbon dioxide CLICK HERE FOR ANSWER A weightlifter is using heavy weights in short bursts for a competition. Because his muscle cells are not able to take in enough oxygen to make very much ATP the weightlifter begins to get fatigue in his muscles. Which of the following processes is most likely going on in the muscles of the weightlifter as he competes in his event? A. As the cells run out of oxygen they switch to anaerobic respiration, which allows the cell to make small amounts of ATP in the absence of oxygen. B. As the cells run out of oxygen, they die off gradually and the weightlifter's muscles have fewer contracting muscle cells. C. The cells will never run out of oxygen if the weightlifter is breathing. D. As the cells run out of oxygen, they will continue to make the same amount of ATP, since oxygen is not required to make ATP. CLICK HERE FOR ANSWER What function does ATP carry out in living things? A. aids in protein folding and coiling B. used to capture and transfer energy C. identifies DNA start sequences for transcription D. helps maintain the fluidity of cell membranes CLICK HERE FOR ANSWER How are cellular respiration and photosynthesis related, in terms of energy? A. The energy captured in photosynthesis is used to power cellular respiration. B. The energy transformed in cellular respiration is used to power photosynthesis. C. Photosynthesis and respiration perform the same task in terms of energy transformation. D. Energy is not involved in either photosynthesis or cellular respiration. CLICK HERE FOR ANSWER Two different species of bacteria are examined. Scientists find that species X always produces CO2 and H2O during cellular respiration. Species Y always produces ethyl alcohol and CO2. Which conclusion can be made from these observations? A. Only species Y is aerobic. B. Only species Y is anaerobic. C. Both species X and Y are aerobic. D. Both species X and Y are anaerobic. CLICK HERE FOR ANSWER In which way are photosynthesis and cellular respiration different? A. Cellular respiration stores ATP, while photosynthesis releases ATP. B. Cellular respiration produces oxygen, while photosynthesis uses oxygen. C. Photosynthesis releases energy, while cellular respiration stores energy. D. Photosynthesis used carbon dioxide, while cellular respiration produces carbon dioxide. CLICK HERE FOR ANSWER A diagram representing the relationship between photosynthesis and cellular respiration is shown below. The numbered boxes in the diagram represent which of the following? A. 1 - water; 2 - nitrogen B. 1 - nitrogen; 2 - oxygen C. 1 - oxygen; 2 - carbon dioxide D. 1 - carbon dioxide; 2 - water CLICK HERE FOR ANSWER ATP & Cellular Respiration Photosynthesis Khan Academy - Cellular Respiration Khan Academy - Photosynthesis General Biology - Chapter 4, pg. 98 Honors Biology - Chapter 8, pg. 190, Chapter 9, pg. 210 8.1.1 State that oxidation involves the loss of electrons from an element, whereas reduction involves a gain of electrons and that oxidation frequently involves gaining oxygen or losing hydrogen, whereas reduction frequently involves losing oxygen or gaining hydrogenRedox (reduction-oxidation) reactions are chemical reactions that involve the transfer of electrons (gain or loss) between speciesMnemonics for redox reactions include:OIL RIG: Oxidation Is Loss (of electrons), Reduction Is Gain (of electrons)ELMO: Electron Loss Means OxidationLEO goes GER: Loss of Electrons is Oxidation, Gain of Electrons is ReductionIn metabolic reactions, a species that has been reduced has the ability to reduce other species (this is the predominant role of hydrogen carriers)The differences between oxidation and reduction can be summarised by the following table: 8.1.2 Outline the process of glycolysis, including phosphorylation, lysis, oxidation and ATP formationGlycolysis is the first stage of cell respiration and involves the breakdown of glucose into two molecules of pyruvateIt is an anaerobic reaction (does not require the presence of oxygen) and occurs in the cytoplasmThere are four main parts in glycolysis (not including intermediary steps):1. Phosphorylation: A hexose sugar is phosphorylated by two ATP to become hexose biphosphate2. Lysis: The hexose biphosphate splits into two triose phosphates (3C sugars)3. Oxidation: Hydrogen removed from the triose phosphates via oxidation (NAD is reduced to NADH + H+)4. ATP Formation: Four ATP molecules are released as the triose phosphates are converted into pyruvate Overall: One molecule of glucose results in 2 pyruvate, 2 (NADH + H+) and 2 ATP (net gain)8.1.3 Draw and label a diagram showing the structure of a mitochondrion as seen in electron micrographs 2D Representation 3D Representation Electron Micrograph8.1.4 Explain aerobic respiration, including the link reaction, the Krebs cycle, the role of NADH + H+, the electron transport chain and the role of oxygenAerobic respiration takes place in the mitochondria, using the pyruvate produced via glycolysisIt produces large amounts of ATP in the presence of oxygen via three main processes:The Link ReactionPyruvate is transported from the cytosol to the mitochondrial matrix in a reaction that produces (one) NADH + H+ via oxidationThe pyuvate loses a carbon (as CO2) and the remaining two carbons are complexed with coenzyme A (CoA) to form acetyl CoAThe Krebs CycleIn the matrix, acetyl CoA combines with a 4C compound to form a 6C compoundOver a series of reactions the 6C compound is broken back down into the original 4C compoundThese reactions result in the formation of 2 CO2 molecules, 1 ATP molecule and multiple hydrogen carriers, specifically 3 (NADH + H+) and 1 FADH2 The Electron Transport ChainThe hydrogen carriers (NADH + H+ and FADH2) provide electrons to the electron transport chain on the inner mitochondrial membraneAs the electrons cycle through the chain they lose energy, which is used to translocate H+ ions to the intermembrane space (creating a gradient)The hydrogen ions return to the matrix through the transmembrane enzyme ATP synthase, producing multiple ATP molecules (via chemiosmosis)Oxygen acts as a final electron acceptor for the electron transport chain, allowing further electrons to enter the chainOxygen combines the electrons with H+ ions to form water moleculesThe electron transport chain produces the majority of the ATP molecules produced via aerobic respiration (~32 out of 36 ATP molecules)Overview of Aerobic Respiration8.1.5 Explain oxidative phosphorylation in terms of chemiosmosisOxidative phosphorylation describes the production of ATP from oxidised hydrogen carriers (as opposed to substrate level phosphorylation)When electrons are donated to the electron transport chain, they lose energy as they are passed between successive carrier moleculesThis energy is used to translocate H+ ions from the matrix to the intermembrane space against the concentration gradientThe build up of H+ ions creates an electrochemical gradient, or proton motive force (PMF)The protons return to the matrix via a transmembran enzyme called ATP synthaseAs they return they release energy which is used to produce ATP (from ADP and Pi)This process is called chemiosmosis and occurs in the cristaeThe H+ ions and electrons are combined with oxygen to form water, allowing the process to be repeated anewOverview of Chemiosmosis 8.1.6 Explain the relationship between the structure of the mitochondria and its functionInner membrane: Folded into cristae to increase surface area for electron transport chainIntermembrane space: Small space between inner and outer membranes for accumulation of protons (increases PMF)Matrix: Contains appropriate enzymes and a suitable pH for the Krebs cycle to occurOuter membrane: Contains appropriate transport proteins for shuttling pyruvate into the mitochondria Page ID12718 Contributed by BoundlessGeneral Microbiology at Boundless Mitochondria are organelles that are responsible for making adenosine triphosphate (ATP), the cell’s main energy-carrying molecule. Learning ObjectivesExplain the role of the mitochondria. Key Points Mitochondria contain their own ribosomes and DNA; combined with their double membrane, these features suggest that they might have once been free-living prokaryotes that were engulfed by a larger cell. Mitochondria have an important role in cellular respiration through the production of ATP, using chemical energy found in glucose and other nutrients. Mitochondria are also responsible for generating clusters of iron and sulfur, which are important cofactors of many enzymes. alpha-proteobacteria: A taxonomic class within the phylum Proteobacteria — the phototropic proteobacteria. adenosine triphosphate: a multifunctional nucleoside triphosphate used in cells as a coenzyme, often called the “molecular unit of energy currency” in intracellular energy transfer cofactor: an inorganic molecule that is necessary for an enzyme to function One of the major features distinguishing prokaryotes from eukaryotes is the presence of mitochondria. Mitochondria are double-membraned organelles that contain their own ribosomes and DNA. Each membrane is a phospholipid bilayer embedded with proteins. Eukaryotic cells may contain anywhere from one to several thousand mitochondria, depending on the cell’s level of energy consumption. Each mitochondrion measures 1 to 10 micrometers (or greater) in length and exists in the cell as an organelle that can be ovoid to worm-shaped to intricately branched. Most mitochondria are surrounded by two membranes, which would result when one membrane-bound organism was engulfed into a vacuole by another membrane-bound organism. The mitochondrial inner membrane is extensive and involves substantial infoldings called cristae that resemble the textured, outer surface of alpha-proteobacteria. The matrix and inner membrane are rich with the enzymes necessary for aerobic respiration. Figure \(\PageIndex{1}\): Mitochondrial structure: This electron micrograph shows a mitochondrion as viewed with a transmission electron microscope. This organelle has an outer membrane and an inner membrane. The inner membrane contains folds, called cristae, which increase its surface area. The space between the two membranes is called the intermembrane space, and the space inside the inner membrane is called the mitochondrial matrix. ATP synthesis takes place on the inner membrane. Mitochondria have their own (usually) circular DNA chromosome that is stabilized by attachments to the inner membrane and carries genes similar to genes expressed by alpha-proteobacteria. Mitochondria also have special ribosomes and transfer RNAs that resemble these components in prokaryotes. These features all support the hypothesis that mitochondria were once free-living prokaryotes. Mitochondria are often called the “powerhouses” or “energy factories” of a cell because they are responsible for making adenosine triphosphate (ATP), the cell’s main energy-carrying molecule. ATP represents the short-term stored energy of the cell. Cellular respiration is the process of making ATP using the chemical energy found in glucose and other nutrients. In mitochondria, this process uses oxygen and produces carbon dioxide as a waste product. In fact, the carbon dioxide that you exhale with every breath comes from the cellular reactions that produce carbon dioxide as a by-product. It is important to point out that muscle cells have a very high concentration of mitochondria that produce ATP. Your muscle cells need a lot of energy to keep your body moving. When your cells don’t get enough oxygen, they do not make a lot of ATP. Instead, the small amount of ATP they make in the absence of oxygen is accompanied by the production of lactic acid. In addition to the aerobic generation of ATP, mitochondria have several other metabolic functions. One of these functions is to generate clusters of iron and sulfur that are important cofactors of many enzymes. Such functions are often associated with the reduced mitochondrion-derived organelles of anaerobic eukaryotes. There are two hypotheses about the origin of mitochondria: endosymbiotic and autogenous, but the most accredited theory at present is endosymbiosis. The endosymbiotic hypothesis suggests mitochondria were originally prokaryotic cells, capable of implementing oxidative mechanisms. These prokaryotic cells may have been engulfed by a eukaryote and became endosymbionts living inside the eukaryote.

the diagram shows molecules that a mitochondrion. the diagram below shows a mitochondrion. the diagram shows the structure of a mitochondrion. the given diagram shows the sectional view of a mitochondrion

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