HARVESTING CHEMICAL ENERGY: CELLULAR RESPIRATION pdf

1: Chapter 9: Cellular Respiration: Harvesting Chemical Energy

Chapter 9 Cellular Respiration: Harvesting Chemical Energy Lecture Outline Overview: Life Is Work â€¢ To perform their many tasks, living cells require energy from outside sources.

As you can see the glucose molecule is completely oxidized to carbon dioxide and water. Of course, to accomplish the complete breakdown of glucose it is necessary to use numerous small steps. The glucose molecule contains an enormous amount of energy and it is simply not possible to release all the energy at once. Cellular respiration is composed of three components: The name of the pathway refers to the breakdown lysis of glucose. Glycolysis is the most ancient of all the metabolic pathways and is found in all organisms. It occurs in the cytoplasm of the cell. In the process of glycolysis the cell is able to break down one molecule of glucose to two molecules of pyruvate, Pyruvate contains less energy than glucose. During the metabolic steps of glycolysis energy is transferred from the molecular intermediates to energy carrying molecules. The point is that the amount of energy transferred only represents a minor fraction of what is available in glucose. Some bacterial species solely depend on the process as they do not contain the following two pathways. These pathways represent changes in organisms over evolutionary time making it possible to extract further energy from the pyruvate molecules. In bacteria the Krebs Cycle occurs in the cytoplasm while in eukaryotic cells it occurs in the matrix of the mitochondria. Consequently, the pyruvate molecules formed in the cytoplasm need to be transported into the mitochondria. The Krebs cycle is preceded by a preparatory step in which pyruvate a 3 carbon molecule is converted to Acetyl CoA a 2 carbon molecule. In the process energy is transferred to NADH. A carbon is released in the form of carbon dioxide CO2 Acetyl CoA enters a cyclic pathway by joining a four carbon molecule. As it is rearranged energy as well as carbons CO2 are released. Ultimately it will join a new Acetyl CoA once again as the cyclic pathway continues. All the carbons in the molecule are ultimately turned into carbon dioxide as the cycle keeps turning. As you can see glucose is completely oxidized to carbon dioxide! A relatively small amount of ATP has been produced. In contrast a large number of NADH has been formed. As you are well aware cellular processes depend on the presence of ATP. The dilemma at this point is that so far very little ATP has been produced, The challenge is to convert the energy trapped in the NADH molecules to a usable form, i. The ETC also takes place in the mitochondria. A series of proteins are present in the inner mitochondrial membrane the cristae. The electrons move through these proteins. Recall that membranes also serve as selective barriers in a cell. This is done in two steps: Such a gradient represents potential energy an analogy could be water on a hillside ii As the protons move back through the membrane the potential energy is used to make ATP molecules an analogy could be to allow the water on the hillside to fall and in the process capture the energy via a turbine. Building the Proton Gradient: In the first step the energy in the form of an electron is transferred from NADH to a protein in the inner mitochondrial membrane. The transferred electrons travel from protein to protein in the mitochondrial membrane. Ultimately the electron is transferred to an oxygen molecule the final electron acceptor which combines with protons to form water. As the electrons travel from protein to protein in the ETC they loose energy. This energy is mostly lost as heat but some of it is used to transport protons across the membrane. These protons are moved from the inside of the mitochondria matrix to the inter-membrane space between the outer and inner mitochondrial membrane. By this pumping action a proton gradient is built across the membrane. The inter-membrane space has a high concentration of protons while the matrix has a low concentration of protons. As you know based on your knowledge of diffusion these molecules strive towards returning across the membrane. Unfortunately or perhaps fortunately , the membrane does not allow these protons to cross the phospholipid bilayer. The membrane also contains numerous proteins fulfilling different cellular tasks. The protons can move across the membrane through the ATP synthase. Of course, the energy had its initial origin in the covalent bonds of a glucose molecule as it entered glycolysis. The newly formed ATP can now diffuse away from the mitochondria and perform cellular work in other parts of the cell. As it is used up it is split into ADP and P. The supply of ATP is continuously recycled. An Overview of Cellular Respiration.

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2: Harvesting Chemical Energy - Cellular Respiration

Cellular Respiration: a process able to extract a large amount of energy from food molecules. In eukaryotic cells oxygen is a required component. In eukaryotic cells oxygen is a required component. This metabolic process is the main reason that animals have elaborate gas exchange organs such as lungs, gills and other systems.

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1 Cellular Respiration: Harvesting Chemical Energy Chapter 9 â€¢ Objectives â€¢ Define oxidation and reduction, and, in general terms, explain how redox reactions are involved in energy.

4: Chapter 09 - Cellular Respiration: Harvesting Chemical Energy | CourseNotes

Cells harvest the chemical energy stored in organic molecules and use it to regenerate ATP, the molecule that drives most cellular work. Respiration has three key pathways: glycolysis, the citric acid cycle, and oxidative phosphorylation.

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