Essay 2- Energy Transfers which take place inside living organisms

One of the most important molecules for living organisms is ATP. ATP is our immediate energy source, made from Adenine, a ribose sugar and 3 phosphate groups. We use ATP as a cell can't get its energy directly from glucose, so during respiration the energy released from glucose is used to make ATP. Once made, ATP diffuses into the part of the cell that needs energy. The energy in ATP is stored in high energy bonds between the phosphate groups and is released in a hydrolysis reaction. ATP is broken down into ADP and an inorganic phosphate, as the phosphate bond is broken energy is released, ATP hydrolase catalyses the hydrolysis reaction. During ATP hydrolysis the energy released can be used directly, and the inorganic phosphate is used for phosphorylation, which often makes the compound more reactive. ATP is re-synthesised in a condensation reaction, during respiration and photosynthesis, and is catalysed by ATP synthase.

An energy transfer used in the body is for muscle contraction. This process involves ATP. In the sarcoplasm calcium ions activate the enzyme ATP hydrolase, which hydrolyses ATP into ADP and an inorganic phosphate to provide energy for muscle contraction. The energy released from ATP causes the myosin head to bend and pulls the actin filament along in a kind of rowing action. Another ATP molecule provides energy to break the actin-myosin cross bridge, so the myosin head detaches from the actin filament after it has moved. The myosin head reattaches to s different binding site further along the actin filament, forming a new cross-bridge allowing the cycle to continue. During Muscle contraction ATP is used up extremely quickly, so must be constantly generated in three main ways. One of these ways is the ATP-PCr system. ATP is made by adding a phosphate group taken from PCr. The ATP-PCr system generates ATP very quickly and is alactic. The other two ways ATP is constantly produced involves respiration.

There are two types of respiration; aerobic which requires oxygen and anaerobic which occurs in environments where oxygen is extremely limited. Both produce ATP, although anaerobic respiration produces significantly less ATP than aerobic respiration. The stage that occurs in both types of respiration is glycolysis. During glycolysis, glucose is phosphorylated using a phosphate from a molecule of ATP, creating gone molecule of glucose phosphate and one molecule of ADP. ATP is then used to add another phosphate, forming hexose bisphosphate, which is split into two molecules of triose phosphate. The triose phosphate is then oxidised forming two molecules of pyruvate, NAD is reduced and there is a net gain of two ATP molecules. Another process within aerobic respiration that produces a lot of ATP is oxidative phosphorylation. In oxidative phosphorylation hydrogen atoms are released from reduced NAD and FAD and are split into protons and electrons. As the electrons move don the electron transport chain they lose energy at each carrier. The energy is used to pump protons from the mitochondrial matrix into the intermembrane space, this leads to the concentration of protons being higher in the intermembrane space than in the mitochondrial matrix, forming an electrochemical gradient. Protons move down the electrochemical gradient, across the inner mitochondrial membrane and into the mitochondrial matrix by ATP synthase, this movement drives the synthesis of ATP. At the end of the chain, oxygen acts as the final electron acceptor and water is formed. In oxidative phosphorylation energy is transferred down the electron transport chain.

Similar to respiration, energy transfers take place in photosynthesis in plants. Photosynthesis is split into two parts, the light dependent reaction and the light independent reaction. Both parts include

energy transfer. In phosphorylation, light energy is absorbed by PSII, exciting the electrons in chlorophyll, the electrons move to a higher energy level, the electrons are released and move down the electron transport chain to PSI. The electrons that move down the chain must be replaced so light energy split water into protons, electrons, and oxygen. Like in oxidative phosphorylation as electrons move down the chain they lose energy. The energy is used to transport protons into the thylakoid, producing a higher concentration of protons in the thylakoid than stroma. Protons move down the concentration gradient via ATP synthase, the energy from this is used to combine ADP and an inorganic phosphate. Reduce NAD is also formed as light energy is absorbed by PSI which excites the electrons to an even higher energy level. The electrons are transferred to NADP along with a proton from the stroma. The ATP produced is then used in the Calvin cycle, also known and the light independent reaction.

Finally, energy is transferred through ecosystems when organisms eat other organisms. Producers start off the food chain and are defined as organisms that make their own food. For example, plants make their own food through photosynthesis. During photosynthesis, plants use the energy to produce glucose and other sugars. Some of the sugars are used for respiration, the rest of the glucose is made to use other biological molecules like cellulose, these biological molecules make up the plants biomass (the chemical energy stored in the plant). It is the biomass that transfers energy to other organisms. Energy transfer in living organisms can be controlled through farming practices, for example, farmers can restrict movement of livestock so that less energy is used for respiration, they are also kept in warm pens, so less energy is wasted generating body heat.

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