Cellular respiration vs. photosynthesis

Health & Medicine, Cellular Respiration

Cellular Respiration vs. Photosynthesis To obtain energy needed for life, organisms depend on the processes of cellular respiration and photosynthesis. Though they share the same function of changing energy from one form to another, there are many differences between cellular respiration and photosynthesis in regard to the input and output molecules, energetics, cellular location, and ecological importance. The chemical equations of cellular respiration and photosynthesis are opposites. The reactants of one equation are the products of the other. In cellular respiration, glucose ($C_6H_{12}O_6$) and 6 oxygen molecules produce $6CO_2$, $6H_2O$ and releases energy. In photosynthesis, $6CO_2$, $6H_2O$ and energy from sunlight produce glucose and 6 oxygen molecules. In cellular respiration and photosynthesis, the reactants flow through pathways to become products in very different ways. Respiration is catabolic, breaking glucose down, while photosynthesis is an anabolic reaction, building glucose. When respiration breaks glucose down, energy is released in small increments. The released energy is used to synthesize ATP, NADH, and $FADH_2$. The NADH and $FADH_2$ go through oxidative phosphorylation to produce ATP and H_2O. Photosynthesis uses light reactions to provide energy to build glucose. Inside the thylakoids, where the light reactions take place, there are two types of photosystems, II and I. Photosystem II utilizes light energy to break apart H_2O molecules into $\frac{1}{2}O_2$, 2 hydrogen ions and 2 electrons. The oxygen and hydrogen ions enter the thylakoid space while the electrons move down an electron transport chain and synthesize ATP. The electrons then enter Photosystem I, where they are again stimulated by light and used to reduce NADP+ into NADPH. These ATP and NADPH are used during the Calvin Cycle

to change CO2 to sugars in many complex steps. The energy flows in both cellular respiration and photosynthesis through different parts of organelles. In cellular respiration, glycolysis takes place in the cytosol of a cell. In the next step, the pyruvate is turned into Acetyl CoA when it passes into the mitochondria. From there, the acetic acid becomes CO2 and the released energy is used to create FADH2, NADH, and ATP in the mitochondrial matrix. In the intermembrane space and inner membrane, oxidative phosphorylation occurs, creating ATP and H2O. In photosynthesis, the light reactions occur in the thylakoid and thylakoid membrane. The next part of photosynthesis, the Calvin Cycle, or dark reactions, occur in the stroma of the thylakoid. Photosynthesis and cellular respiration are small processes that have huge ramifications. Photosynthesis allows plants and other autotrophs to produce their own energy to survive, while also releasing oxygen. Heterotrophs and autotrophs alike use the oxygen and sugars created during photosynthesis for energy in the process of respiration. In autotrophs, photosynthesis paves the way for respiration to change the newly formed glucose to usable energy. In heterotrophs, only respiration is used because the heterotrophs consume autotrophs to obtain glucose. Both processes are fundamental to sustaining all forms of life.