Photosynthesis and cellular respiration essay

Health & Medicine, Cellular Respiration

Cellular respiration and photosynthesis are critical in the continued cycle of energy to sustain life as we define it. Both have several stages in which the creation of energy occurs, and have varied relationships with organelles located within the eukaryotic cell. The processes are the key in how life has evolved and become as diverse as we know it. Although cellular respiration and photosynthesis have different processes, they are interdependent upon each other, while exhibiting complementary cycles.

Cellular respiration by itself refers to the process of drawing energy from food and organic molecules for use. This is done by several reactions that are dependent upon each other. Similar to breathing, whereas as humans inhale oxygen, and exhale carbon dioxide, the process of cellular respiration is the exchange of oxygen to help break down the fuel which is defined as an aerobic process. This process is done by cells exchanging gases with its surroundings in order to create adenosine triphosphate (commonly references as ADT), which ultimately is used by the cells as a source of energy. This process is done through several reactions and is thus an example of a metabolic pathway. In a significantly simplified expression, in cellular respiration chemical energy that comes from fuel molecules is converted into ADP. ADP is then joined with a phosphate, which then converts into ATP, the energy currency of cells. When ATP is consumed or spent by the cells, it releases another phosphate, when will then join with ADP again, to renew the cycle. This entire cycle can be identified by three main stages: glycolysis, the citric acid cycle, and the electron transport.

The metabolic pathway that forms within the cytosol is defined as Glycolysis. During this state, one of the molecules of glucose divides into two molecules of pyruvate, which is occurs within the cytoplasmic fluid. To do this a glucose molecule breaks in half to create two three-carbon molecules by using ATP molecules. The newly split carbon molecules then provide electrons to NAD+ to form NADH, and simultaneously creating four additional ATP molecules. Afterwards the pyruvic acid will then lose a carbon molecule, changing into Acetic acid and beginning the citric acid cycle, in which the glucose is further broken down to CO2, an unneeded product, essentially waste. Afterwards, the enzymes used in this process dissolve within the mitochondria, in effect recycling on a molecular level. NADH is generated as the fuel oxidizes. Following that, CoA is created as each of the remaining acetic acid molecules attach to molecules named " coenzyme A" and then are delivered to the first reaction of the citric acid cycle. It is at this point that the CoA is removed and then recycled to re-attach to another acetic molecule all over again. While in this cycle, the acetic acid combines with additional carbon molecules to become citric acid. Each time one of these molecules starts the cycle as fuel two additional co2 molecules are " Wasted". This process is done once for each glucose molecule. The third stage in this process is the electron transport. During this phase, electrons obtained by the reactions completed in the first two stages travel down transport chains to oxygen. Within the inner membrane of the mitochondria is where the proteins and molecules that are the essence of this chain are located. This transport process is where the majority of the energy released creates ATP. A small amount of ATP is also created during the first two stages as well. ATP is the key to this entire process, as certain amounts of it are created in every step, and simultaneous also spent in each step as well. This creates a self-sustaining cellular cycle of energy production and use.

Photosynthesis is similar to cellular respiration, in that it is a process of obtaining energy. However, while cellular respiration is completed through animals (and some plants) by converting food and organic molecules to energy, photosynthesis is the process of converting energy from light sources, namely the sun, into chemical energy for plants, algae, and some bacteria’s. Photosynthesis is a process that occurs within organelles called chloroplasts. These organelles are able to absorb light, and are located inside of leaves. Within the leaf are tiny pores defined as stomata, in which carbon dioxide can enter, and oxygen can exit, the reverse process that in which most animals breathe. Just like animals, the process of photosynthesis needs water, although rather than ingested, water is absorbed through the plants roots and carried up to the leaves. The stomata is perhaps the most critical piece to this process, as this is where CO2 enters and can be stored, and where water and O2 exit.

Almost a reverse of what cellular respiration exhibits; photosynthesis combines carbon dioxide molecules and water obtained from its roots, and captures light energy to start the chemical process in which it creates energy and its byproducts. Its “ waste” byproducts include that of glucose, and oxygen gas which exits from the leaves. These “ wastes” are what cellular respiration needs to function, thus completing the life cycle almost perfectly. During photosynthesis light energy is chemically changed to bond with carbohydrate molecules that then get converted into ATP molecules and the energy within the ATP molecules is able to then be spent to allow the process to repeat continually and simultaneously within the cells. This entire process is done in two stages, the light reactions, and the Calvin cycle.

In the first step, the light reactions phase, solar energy is absorbed in the membranes of chlorophyll and chemically changed into ATP and the electron carries NADPH. Water is divided after the electrons are removed from NADP+ which creates NADPH, and oxygen is “ wasted” in a gaseous form. After this is completed, the Calvin cycle begins. During the Calvin cycle phase, the results of the light reactions give the cells the energy to create fuel or sugar from the carbon dioxide. Using ATP it is able to synthesize sugar and the enzymes responsible which get absorbed within the stoma inside the chloroplast. Every time this cycle is complete, sugar is produced, as well as NADP+, and some ADP with an additional phosphate group, these in turn combine with H2O and start the light reactions phase, starting the cycle anew.

Both cellular respiration and photosynthesis rely on key organelles within the eukaryotic cell in order to complete these tasks. There are some differences in the way living creatures and plants and fungi go about obtaining energy, and thus use certain organelles located within the eukaryotic cell. For example, although the mitochondria is where pyruvates enter to begin the cellular respiration process for obtaining energy, it can easily be perceived that plants have no need to possess such an organelle, as their conversion from light to energy is done through photosynthesis with chlorophyll.

Although most living creatures are unable to go through the chemical process of photosynthesis, plants exhibit both processes at the same time.

There are several important points that these processes deal with in order to maintain the balance of life within our ecosystem. The processes of photosynthesis and cellular respiration are extremely interconnected as they both provide energy that is used by plants, and recycle each other's " waste" for use. With a massively broad simplification example, humans inhale oxygen to keep their cells alive, and through cellular respiration, exhale what is " wasted" carbon dioxide. Plants on the other hand absorb carbon dioxide, and through both its process of photosynthesis converting light into energy chemically and during the process of cellular respiration, " waste" oxygen which is then recycled by other plants and humans to begin the process anew. This complementary reaction is what globally helps sustain life on many different levels.

As learned through the efforts contributed by Darwin however, cells will evolve based on the needs to the environment in order to survive. The majority of plants are able to go about the process of photosynthesis and draw CO_2 directly from the air, however, is some extremely hot and dry climates, or even cold climates, different methods increase the plants chance for survival, and allow it the ability to continue to produce oxygen for life to exist. Before the Calvin cycle can start, some plants, so categorized for their process, have different methods of dealing with carbon. C4 plants keep their stomata closed depending on the weather conditions, and have additional enzymes to help continually incorporate carbon into their processes continually. CAM plants already extremely used to dry areas only allow their stomata to open at certain times of the day, typically at night to absorb Co2, and are able to processes the Calvin cycle throughout the rest of the times the stomata is closed. Both of these examples show how plants have fully adapted to an environment which would otherwise be disruptive to the chemical reactions plants go through to create energy and oxygen. Natural selection has ensured that they are able to still make food and provide the benefit of food and air to other living creatures.

Both cellular respiration and photosynthesis have similar goals and cycles with different chemical results. Complementing each other, they allow carbon based life forms the necessary energy required to function, and with the “ waste” produced from both processes, enable a greenhouse effect in which one can benefit from the other continuously.