

Exploration of the Effect of Light Intensity, Action Spectrum, and
Absorption Spectrum on Photosynthetic Processes

Madison McVey

October 25, 2016

Biology 111-541

TA: Marko Baloh

Abstract:

In exercise 7, Photosynthesis, students determined the relationship between cellular respiration and photosynthesis. This was done by conducting experiments that affected the light intensity, action spectrum, and absorption spectrum and observing the effect it had on the processes of photosynthesis. Students completed these experiments in groups of eight and simultaneously conducted the different experiments. Removing the gasses from spinach leaves and observing the results when exposed to different colored lights tested the effect of the action spectrum on photosynthesis. The effect of the absorption spectrum was noted when four pigments from chlorophyll were analyzed at various wavelengths using a spectrophotometer. The effect of light intensity on photosynthesis was observed by analyzing the reaction rate of tubes filled with a chloroplast solution exposed to various amounts of light. In general, it was found that photosynthesis occurs most effectively when exposed to blue light, results can best be analyzed at 400-500 nm, and both the absorbance value and rate of the reaction decreased, as the intensity of light increased.

Introduction:

Out of all the biological processes, photosynthesis is arguably the most important. For starters, all organisms depend on plants in some way, so it ultimately is the basis of the entire food web. As if food wasn't important enough to survive, all animals and humans depend on oxygen to survive. Without a constant cycle of photosynthesis, the supply of oxygen, and ultimately life, would diminish (NGA).

Photosynthesis is a 100% efficient process that removes the carbon dioxide in the air and replaces it with carbohydrates and oxygen (Harris-Haller 2014).

Photosynthesis is represented by the chemical reaction of $6 \text{CO}_2 + 6 \text{H}_2\text{O} + 686 \text{ kilocalories} \rightarrow \text{C}_6\text{H}_{12}\text{O}_6 + 6 \text{O}_2$. As outlined in the equation, carbon dioxide and water react with 686 kilocalories of light energy to form a molecule of glucose and six molecules of oxygen (Harris-Haller 2014). This reaction is driven by two main stages, one being photochemical, which is responsible for releasing the oxygen molecules, and the other biochemical, responsible for fixing carbon into sugars (Harris-Haller 2014). The carbon dioxide used as a reactant in the photosynthesis reaction is a by-product of cellular respiration, which is responsible for driving cellular metabolism. Cellular respiration is a process that is utilized by all eukaryotic organisms, including those that are also photosynthetic (Harris-Haller 2014). This lab will attempt to confirm the relationship between photosynthesis and cellular respiration through experimental data.

For the three experiments conducted in this lab, there were three separate hypotheses and null hypotheses. For the light intensity experiment, the null hypothesis was that the amount of light each tube was exposed to would not effect the rate of reaction and all would perform at an equal rate. The hypothesis was that the tube wrapped in foil and kept in a dark space would have the fastest rate of reaction and highest absorbance value. The hypothesis created for the absorption spectrum lab hypothesized that the lowest absorbance of the pigments would be recorded at the lowest wavelength, whereas the null hypothesis was the varying wavelengths would have no effect on the absorbance levels of the four pigments.