

Project Proposal
Bio 3B
Saddleback College
Spring 2009

Proposal Title: The Effect of Altitude on Chlorophyll Concentrations and Stomate Counts in *Salvia apiana*

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Investigator Background: Anthony Avanzino and Dolly Rojo are Biology 3B students under Dr. Tony Huntley. Both are second year students at Saddleback College with a completion of the 1A program. Each has completed a project of similar caliber and understands the principles of scientific inquiry.

Project Summary

An ecosystem is often characterized and diversified by the organisms that make it up and contribute to its stability. Plants play a major role in this cycle of life and offer a great example of one of the more complex components to nature's order: photosynthesis. This process can be loosely described as a balanced intermingling of light and respiratory energy (Warburg 1958), and is synthesized by the basis of this inquiry: chlorophyll.

Investigators are interested in the effects of elevation on chlorophyll concentrations, not only to understand the adaptive qualities of Earth's organisms, but to better understand why there may exist a high and low critical point for life as it correlates to elevation. In a similar study, performed by Covington (1975), samples taken at lower elevation were found to contain higher chlorophyll concentrations than those taken at the higher elevations. Although trees were greener and had a larger canopy spread at higher elevations, the outer mesophyll and external tissues of these samples were found to be more or less dead. Current investigators expect similar results, potentially attributed from the increased UV intensity at higher elevations and the variance in stomata diffusion (Naumburg et al, 2001). Chlorophyll concentrations are expected to be higher closer to sea level primarily due to an adaptive adjustment to a smaller, less invasive proportion of sunlight and higher concentration of carbon dioxide.

The diffusion of CO₂ and water through the stomata of a plant is an essential aspect to the plant's survival and success of its complex internal system (Ting and Loomis, 1963). This is of great ecological importance to the environment and its constituents primarily as a chemical converter and valuable source of energy. These driving forces make up and contribute to a fluctuation in the pressure of Earth's lesser and greater atmosphere. Though partial pressures stay fairly constant throughout the various atmospheric layers (Humphreys 1913), CO₂ mixing ratios decrease with elevation and temperature (Bischof et al, 1980), thus altering the concentration/gradient diffusion rates. These variations in CO₂ concentration could account for an unbalanced relation between the reaction of light and water, and the incorporation of CO₂ into the production of inorganic energy, i.e. Calvin cycle. Due to these environmental

constraints, stomate counts are expected to be higher, and thus, closer to each other at greater elevations.

Project Description

Investigators will hike up Santiago peak, Santa Ana Mountains, CA. (5,687 feet, 1,733 meters, above sea level) taking ten samples of *S. Apiana* at every 1000 ft. Group number is dependent upon the maximum elevation achieved and the quality of life at higher elevations. Samples will then be taken back to Saddleback College, Mission Viejo, CA. to be measured for chlorophyll concentration as they correlate to the elevation. Leaves will be cored and placed in 3 mL. of 80% acetone and refrigerated for 24-48 hours. Concentrations will be measured with a Beckman DU 700 spectrophotometer at specified wavelengths and according to the MacKinney (1941) equation. Stomate counts will be acquired using a Nikon Eclipse E2000 microscope. Leaves will be pressed to slides and superglue will be used as the surface mold. Variables including: water source, slope face, frequency of life, and light exposure will be taken into consideration with a preliminary hike and adjusted for as necessary.

Budget

All tools and machinery will be provided by Saddleback College, whereas specimens/samples will be selected/obtained from the Santa Ana Mountains.

References

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- Naumburg, Elke, Ellsworth, David S. and Katul, Gabriel G. 2001. Modeling Dynamic Understory Photosynthesis of Contrasting Species in Ambient and Elevated Carbon Dioxide. *Oecologia* 126(4): 487-499
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