



MASSACHUSETTS CLEAN TECHNOLOGY AWARDS

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Region V: Southeastern MA

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“ The Photosynthetic Process of C3, C4, and CAM plants, and Their Effects on Greenhouse Gases ”

I was born November 18, 1991, and moved to Massachusetts from Florida when I was three. I have always been very successful in school and was in the Gifted and Talented program all through elementary and middle school. I love math and science; theoretical physics and astronomy have been my passion ever since seventh grade.

When I was able to join the science fair in the 9th grade I considered my options carefully and decided to combine Biology and Astronomy in a project called Terra-Forming Mars. In this project I studied which type of plant, a flowering or cactus plant, would reduce carbon dioxide levels the most in a Martian environment to produce oxygen in an atmosphere. I reached the regional level with this project, but did not go onto the state fair. Then this year, with the issue of Global Warming growing in our awareness, I decided to take on a project related to this important problem; I wanted to do my part and find out how to reverse greenhouse gas effects.

My project is dedicated to studying how plants with different photosynthetic processes are able to reduce carbon dioxide levels, and hopefully can be used to slow down the process of Global Warming. I want to do my part in helping the environment and natural beauty which man-kind has ravaged. I achieved second place at the science fair and will be attending the Massachusetts State Fair at M.I.T. the first weekend in May. I am very excited about this.

I hope to further succeed in the science fair. In the future, I am unsure what I would like to study. I wish to get into a science field, preferably Astro-Physics or even Environmental Engineering. I hope that receiving awards such as this and participating in events like the Science fair will help me to achieve these goals.

MY PROJECT:

The world today has a major problem with Global Warming. One of the main causes of this problem is the constant build-up of greenhouses gases, mainly carbon dioxide. Plants could potentially be the



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answer to this epidemic. Photosynthesis is the process in which plants take in carbon dioxide and water [H₂O], and then using sunlight as an energy source, convert it to sugars, which are in turn converted into more complex carbohydrates [compounds which are mainly carbon and hydrogen] such as starches, fats, and cellulose. The excess oxygen is released as a byproduct,, and is in turn used by animals as an energy source.

Different plants have different types of Photosynthesis. The three different types are C₃, C₄, and CAM. [In C₃, the CO₂ taken in by the plant is directly processed; in a C₄ plant, the CO₂ is taken in by one enzyme, and then stored to be processed by a second enzyme system. A CAM plant is typically a desert plant, which only opens its "stoma" at night, in order to minimize water loss, and then stores the CO₂ in an acidic form to be processed during the day when the sun is out.] Determining which type of photosynthesis reduces carbon dioxide the most could give valuable insight into which plants would most effectively combat greenhouse gases.

In this experiment, one plant of each type of photosynthetic process was planted in a in an individual container. A vacuum was then created in each container and carbon dioxide was put in the container, creating a pure carbon dioxide atmosphere. A Vernier probe was used to measure the carbon dioxide, and the rates were recorded over the span of a week. The experiment was done twice, each with a week's worth of data.

The carbon dioxide levels were measured inside the containers once a day over the course of a week. In week one, the results were as follows: C₄ plants reduced carbon dioxide levels by 4743 ppm; C₃ plants reduced carbon dioxide levels by 2692 ppm; and CAM plants reduced carbon dioxide levels by 4055 ppm. During week two, the results were: C₄ plants reduced carbon dioxide by 3220 ppm; C₃ plants reduced carbon dioxide levels by 1869 ppm; and CAM reduced carbon dioxide levels by 2914 ppm. In both experiments, C₄ plants reduced Carbon Dioxide levels the most, indicating that use of plants with this photosynthetic process would be the most useful in restoring a good balance of CO₂ in the atmosphere.