



CALIFORNIA SCIENCE & ENGINEERING FAIR 2019 PROJECT SUMMARY

Name(s) Yee Kit Chan; Jaimie Yu	Project Number S1801
Project Title MSG and Cell Growth	
<p style="text-align: center;">Abstract</p> <p>Objectives We think that too much of anything is not good; not specifically MSG. In our project, we aim to prove that any substance in excess will affect microtubule depolymerization by looking at the cell growth of apical meristems in plants with different concentrations of MSG and other substances.</p> <p>Methods We designed the experiment in the following steps: First, pour agar plates to grow Wisconsin Fast Plants. Next, prepare different concentrations of MSG and NaCl for watering. Thirdly, plant Wisconsin Fast Plants in pots and watered with different concentrations of MSG and NaCl. Then, incubate fungi plates with different concentrations of MSG and NaCl in the agar plate. Finally, measure plant heights and the size of the fungi colonies watered by different concentrations of MSG, NaCl, vitamins or sugar and recorded the data every 3 days to find a trend. We used the plant heights and sizes of the fungi colonies as an indicator for cell growth.</p> <p>Results The higher the concentration, the shorter the plant is and therefore the less the cell growth. For example, both the plant watered with the highest (10ml) concentration of MSG and the plant watered with the highest (10ml) concentration of NaCl showed no growth.</p> <p>Conclusions Doing this experiment showed that any substance in excess, such as salt, will affect microtubule depolymerization and therefore cell growth; not just MSG. While high concentrations of MSG did deter growth in the apical meristems of the Fast Plants, so did high concentrations of NaCl. There is no proof that MSG is the sole culprit for microtubule depolymerization. Therefore, our hypothesis was supported. It is a common myth that MSG is especially harmful. However, based on the results of our experiment, I would argue that another common food additive, salt, is just as harmful.</p>	
Summary Statement The project tested different concentrations of MSG and other substances to show that any substance in excess will have a negative effect on cell growth.	
Help Received Heng Yuan Shr	



CALIFORNIA SCIENCE & ENGINEERING FAIR 2019 PROJECT SUMMARY

Name(s) Isabelle Do	Project Number S1802
Project Title The Effect of Nuclear-Cytoplasmic Partitioning of AAR2 and HYL1 on microRNA Biogenesis and Plant Development	
<p style="text-align: center;">Abstract</p> <p>Objectives This experiment is part of a larger study dedicated to finding the exact location of microRNA (miRNA) biogenesis in plant cells. As the location of microRNA biogenesis has not yet been found, nor could be found in the time period this experiment has taken place, this is meant to observe and analyze the effect of nuclear-cytoplasmic partitioning of splicing protein AAR2 and double-stranded RNA-binding protein HYPONASTIC LEAVES1 (HYL1) has on miRNA biogenesis and plant growth, specifically in Arabidopsis plants and cells. It is believed that the subcellular location of AAR2 may be negligible, though it is mainly found in the chloroplast, to the overall biogenesis and plant development process and if HYL1 is sent to the cytoplasm via nuclear export signal, it is postulated to be located in the nucleus, it would disrupt the above processes. One thing that is believed is that if changing the subcellular locations of AAR2 and HYL1 can affect their interactions and functions as proteins, then changing the subcellular locations would also affect the microRNA biogenesis and plant development process. Within several months of experimentation, all the data gathered has led to the conclusion that the partitioning of AAR2 does not seem to affect plant growth, therefore not affect miRNA biogenesis, and the placing the HYL1 protein in the cytosol leads to more consistent development and growth. As the study continues, more data will be able to definitively locate the site of miRNA biogenesis in Arabidopsis cells.</p> <p>Methods Soil, Fertilizer, Agar gel, Electrophoresis gel and analysis. microscope, autoclave, pipettes, a variety of chemicals, incubator, pcr machine</p> <p>Results Signal Type Intensity Protein Number/Type Amount with Significant Growth NLS 2 HYL1 17 1:6 with little to no underdeveloped sprouts</p>	
Summary Statement How changing the location of AAR2 and HYL1 in the cell can affect miRNA density, miRNA biogenesis, and overall plant development.	
Help Received Dr. Xuemei Chen allowed me to work in her laboratory and use her equipment. Dr. Lusheng Fan taught me the procedures required and the correct scientific methods required to complete my project.	



**CALIFORNIA SCIENCE & ENGINEERING FAIR
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Name(s) Olivia Elliott; Camryn Palmer	Project Number S1803
Project Title Does Gibberellic Acid Affect Pea Plant Growth?	
<p style="text-align: center;">Abstract</p> <p>Objectives The objective of this project is to find the most suitable quantity of gibberellic acid to create the most growth in snow pea plants.</p> <p>Methods Gibberellic acid (powder form), digital scale, snow pea plant seeds, distilled water, isopropyl alcohol, graduated cylinder, eyedropper, and ruler. Administer incremental drops of gibberellic acid to the assigned plants daily and measure plant growth weekly.</p> <p>Results Overall, five drops of gibberellic acid results in the most growth after 3 weeks. This indicates that five drops increases pea plant growth the most.</p> <p>Conclusions The results of this experiment indicate that as you increase the amount of gibberellic acid, the growth rate increases. This project aids in the discovery of the most useful amount of gibberellic acid for plant growth.</p>	
Summary Statement We showed how different quantities of gibberellic acid increased snow pea plant growth.	
Help Received We designed and performed the experiment ourselves.	



CALIFORNIA SCIENCE & ENGINEERING FAIR 2019 PROJECT SUMMARY

Name(s) David He	Project Number S1804
Project Title Effect of Genetic Modification of DMR6 in Solanum lycopersicum	
<p style="text-align: center;">Abstract</p> <p>Objectives The objective of this study is to determine the effects of modification of DMR6 in tomato fitness and abiotic stress response.</p> <p>Methods Plant trays, dsRNA, qPCR kit, soil, tomato seeds dsRNA interference was utilized to silence the DMR-6 gene in a group of 3-day-old Solanum lycopersicum seedlings, while another group was used as a control. Both were split into five groups at 18 days. Two groups were grown as normal, while one group received three times more water, one group received no water, and one group was subjected to 4 degrees Celsius. Height, leaf color, and leaf quantity were measured every three days until 18 days, after which they were measured every 12 hours. qPCR was utilized to quantify dsRNA efficacy.</p> <p>Results Results show significantly higher plant heights for groups 1, 2, and 5, with significantly higher leaf quantities in group 2 ($P < 0.05$). The average heights and average amount of plant leaves in the experimental groups were both lower than in the control groups for every condition except at low temperature, which exhibited precisely the opposite results. In addition, the groups placed under stresses showed more visible circadian rhythms, while the treated plants showed more visible circadian rhythms than wild-type plants under the same condition with the exception of group 4, whose treated plants showed less visible circadian rhythms.</p> <p>Conclusions This study reflects undiscovered effects of the DMR6 gene in plants, not just for regulating height, but leaf growth, circadian rhythms, cold resistance, and possibly chlorophyll production. More importantly, however, this is an integral step in determination of effects of genetic modification on plant fitness. With sufficient data like this, it may even be possible to predict these effects and compare them in order to work towards an optimal solution for crop yield.</p>	
Summary Statement I found that genetic modification of DMR6 in tomato plants generally caused lower plant height and leaf quantities, along with increased strength of circadian rhythms.	
Help Received Professor Jose Pruneda Paz of UCSD gave resources for qPCR and allowed lab space to perform it, guiding me through the procedure. However, my project was completely independent from his research, and the rest of the project was my idea.	



**CALIFORNIA SCIENCE & ENGINEERING FAIR
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Name(s) Royal Huey	Project Number S1805
Project Title The Effects of Simulated Microgravity on the Root Development of Seedlings	
<p style="text-align: center;">Abstract</p> <p>Objectives The goal of this project is to examine the effects of simulated microgravity by using a rotating container that simulates perpetual falling on Raphanus raphanistrum (Champion variety) seeds, especially an assessment of health using the root to stem ratio. The health of the plant would be directly corralative to the viability of sustainable plant based food sources in space.</p> <p>Methods ROTATING MECHANISM: Using an Arduino microcontroller, stepper motor, alligator clips, and power supply, a device was created that would rotate a 3D printed "platform" at ten rotations per minute, such that the outer edge of a 9 cm petri dish would be traveling at a slow falling speed. This method is modeled after the 2D clinostat used as ground controls at Kennedy Space Center. The 3D printing was done with help from an student-led club on campus.</p> <p>MAINTENANCE AND DATA COLLECTION: Place seeds in a 9 cm plastic petri dish which has been lined with a moist paper towel. After seven days, compare the radish seeds' germination time, direction of growth, and root development in each of the control and experimental conditions: vertical rotation, unmoving vertical, and unmoving horizontal. After removal from the dish, compare cell morphologies and types of seedlings in each of the control groups and experimental groups at 400x magnification using a light microscope.</p> <p>RATIONALE: Root and stem growth are often two measures of "plant health". Roots grow in order to access nutrients and water, and movement toward these things are considered healthy. Stem development is a sign that the plant is completing chemical conversions necessary for growth and storage of starches. Examining the root to stem length ratio mitigates the assessment of plant health solely based on water or light availability.</p> <p>Results</p>	
Summary Statement What the effects of simulated microgravity have on primarily root development, but also overall plant health and growth patterns.	
Help Received Most help came from my high school AP biology teacher, Ms. Claudio but minor help with coding came from Jonathan Kolbeck (George Washington University).	



CALIFORNIA SCIENCE & ENGINEERING FAIR 2019 PROJECT SUMMARY

Name(s) Emily Huitt	Project Number S1806
Project Title California Avocados Harvested in the Golden State: Investigating Root Rot and Combating Phytophthora cinnamomi	
<p style="text-align: center;">Abstract</p> <p>Objectives In 2017, I observed that California avocado farmers lost over \$50 million in crop damage due to root rot caused by Phytophthora Cinnamomi. I own a small grove of avocado trees that were dying with this disease which were confirmed by my local agriculture lab testing. I wanted to see if I could combat Phytophthora Cinnamomi with an eco-friendly treatment that stops the growth of root rot instead of using the harsh popular phosphorus acid treatments. This pathogen infects the roots of avocado trees, resulting in death of the entire tree. My goals were to disrupt the pathogen s life cycle by forcing it into dormancy prematurely by using soil amendments. Secondly to thermally inactivate the spores by elevating soil temperature using a solarized bed. Then promoting new root growth by using endomycorrhizal fungi to expand the hyphae root hairs to absorb nutrients.</p> <p>Methods I mixed soil amendment treatment of eggshells, coffee grounds, poultry manure, endomycorrhizal fungi and wood chips and spread it around 18 of my 36 avocado trees. I left 18 as a control group to see how the trees normally progress. Gypsum and eggshells provide calcium to improve soil porosity and cause spores to encyst prematurely. Poultry manure for nitrogen and coffee grounds help maintain a favorable pH. I installed black plastic tarps over my soil amendments to create my solarization beds, creating a greenhouse effect to increase soil temperature which thermally inactivates the Phytophthora Cinnamomi spores.</p> <p>Results I found that the Gypsum I put out supplied needed calcium that the trees needed. When I tested the soil samples from the trees that had been treated they came back negative for Phytophthora Cinnamomi. When I conducted the leaf analysis I saw a calcium build up from 1.6% in 2016 to 2.3% in 2017 which is good for fruit production. Avocado feeder roots are 25 centimeters below the tree and this allowed me to use a surface probe thermometer to measure the temperature variations.</p> <p>Conclusions I noticed that the root rot started to go away and that the leaves were starting to return back to the trees. There were new shoots that started to appear the second year that I did this project. When I added Endomycorrhizal Fungi around the roots I saw that the hyphae root hairs were longer bringing in more water and nutrients which makes the tree and its fruit bigger. In both 2016 and 2017 I saw that there was a 1000+ avocado gain between the 18 trees that were treated and the 18 that were not. When I had the soil samples tested again they were confirmed to be negative of Phytophthora Cinnamomi.</p>	
Summary Statement My project shows an eco-friendly and comprehensive method to control and rid the recurrence of Phytophthora Cinnamomi that will kill my trees if left untreated.	
Help Received My mom helped me to conduct this experiment as she is a farmer and has a great amount of knowledge about farming trees.	



**CALIFORNIA SCIENCE & ENGINEERING FAIR
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Name(s) Siya Iyer	Project Number S1807
Project Title Improving Algal Biofuel Production with Nanotechnology	
<p style="text-align: center;">Abstract</p> <p>Objectives The objective of this study was to find different tools to improve algae's light utilization and production of oil.</p> <p>Methods Algae was grown in flasks, with added titanium dioxide nanoparticles and nitrogen. A light meter was used daily to measure the amount of light each culture absorbs. The mass was measured by pouring the culture through a coffee filter and leaving it to dry. Oil was then extracted by grinding it into a paste then mixing and pressing it to record the amount of oil collected.</p> <p>Results The algae grown under the condition of the titanium dioxide nanoparticle was compared to nitrogen enhanced algae and algae grown under normal conditions. The algae performed best with 10 mg of added nano-titanium dioxide.</p> <p>Conclusions The algae grown under the conditions of 10 mg of nano-titanium dioxide performed the best as it produced the most oil. The titanium dioxide nanoparticle is photoreactive and acts as a catalyst to stimulate algal growth. This greatly improved the algae's light utilization and production of oil, making a more efficient alternative biofuel.</p>	
Summary Statement I created an efficient way using nanotechnology to improve algae's light utilization and production of oil.	
Help Received None. I designed and performed the experiment myself.	



**CALIFORNIA SCIENCE & ENGINEERING FAIR
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Name(s) Jorja Moes; Anjali Slyker	Project Number S1808
Project Title Silver Nanoparticles on Freshwater Aquatic Java Plant Growth	
<p style="text-align: center;">Abstract</p> <p>Objectives This experiment was performed in order to determine the positive and/or negative effects different concentrations of silver nanoparticles have on the growth of freshwater plants.</p> <p>Methods 3 Black Forest Asian Java Fern Potted Live Water Aquatic Aquarium Plants, 3 large clear 2.5 quart plastic containers, 1800 mL of distilled water, 1800 mL of silver nanoparticle solution that we made, various rocks (for a plant base), and a ruler. Every 5 days, measured leaf growth of 3 aquatic Java plants in 3 silver nanoparticle concentrations(0%, 50%, 100%).</p> <p>Results The 0% silver nanoparticle concentration resulted in a decrease of 25%. The 50% silver nanoparticle concentration resulted in a decrease of 5%. The 100% silver nanoparticle concentration resulted in a decrease of 7%. The measurements collected after approximately 5 weeks suggest that the silver nanoparticles did take part in a decrease in growth, however do provide a more substantial environment for the java plant rather than distilled water alone.</p> <p>Conclusions The mixture of distilled water and the silver nanoparticle solution resulted in the least amount of leaf length decrease, suggesting that the silver nanoparticles do help in the health of the plant along with the presence of water.</p>	
Summary Statement We proved that silver nanoparticles can elevate the growth of aquatic plants more so than distilled water alone.	
Help Received Our chemistry teacher assisted us in providing materials needed to make silver nanoparticles, as well as her classroom/lab to make them in.	



CALIFORNIA SCIENCE & ENGINEERING FAIR 2019 PROJECT SUMMARY

Name(s) Wynn Phaychanpheng; Audrey Sogata	Project Number S1809
Project Title Jasmonic Acid Regulation of Abiotic Stresses in Brassica rapa and Arabidopsis thaliana	
<p style="text-align: center;">Abstract</p> <p>Objectives To test if jasmonic acid is a feasible solution to combatting drought and salinity stresses in two types of plants, Brassica rapa and A. thaliana.</p> <p>Methods Planted 50 Brassica rapa and 50 A. thaliana seeds and sustained them using a self-watering deli cup system and 24/7 light source. To salt stress the plants, we created a solution using NaCl and CaCl, and tested 6EC and 12EC concentrations. To drought stress, we limited water reserve weekly(5 and 3mL). Jasmonic acid (JA)solution was created by mixing 200mL of water to 42 uL 90% JA 10% ethanol solution, and then applied periodically. Each plant species had a control, JA control, 6EC control, 6EC JA, 12EC control, 5ml dry stress control, 5ml dry stress JA, 3ml dry stress control, and 3ml dry stress JA group.</p> <p>Results JA control for Brassica rapa had the highest average growth rate for every aspect of the plant except flowers. Its dominance was especially profound in leaves and buds (24.5% and 37.5% respectively). Superiority of the JA control was also reflected in A. thaliana; this plant group had an average rate of growth increase of 54.86% for stalk height, and a 222.14% increase in buds! For the stressed groups, only a slight increase in growth rate for some areas was observed; e.g. an increase of 25.36% in stalk height for 12EC Salinity JA compared to 17.29% for 12EC Control, and reduced growth in others; e.g. 74.29% increase in leaf count in 6EC Control yet only a 37.71% growth in the JA group. However, we noticed the stressed plants treated with JA were more vibrant and sturdier relative to the other flaccid salt-stressed plants. JA also allowed drought-stressed plants to survive longer and appear healthier than the control.</p> <p>Conclusions We hypothesized the plants treated with 6EC of salinity and JA would be the most successful plant group; however, this was not supported as the most successful group was JA control, which had the overall highest average rates of growth for both Brassica rapa and A. thaliana. Additionally, JA did aid in improving stress tolerance, creating sturdier and greener crop and quickening stressed plants development so lofty fruit production could occur before stress accumulated to an unmanageable level. Thus, JA is a viable solution for combatting stresses in agriculture without harming produce. Farmers globally can use JA as a means for growing crops in drought-prone or increasingly prevalent salty regions.</p>	
Summary Statement We tested the effects of jasmonic acid on salinity and drought stressed Brassica rapa and A. thaliana and discovered a method to increase stress tolerance and overall development in crops.	
Help Received We consulted with Mr. Brandon Young and used his laboratory at Murrieta Genomics to conduct an extension to the experiment.	



CALIFORNIA SCIENCE & ENGINEERING FAIR 2019 PROJECT SUMMARY

Name(s) Alina Pollner	Project Number S1810
Project Title Bioengineering Plant Genomes to Increase Crop Production via CRISPR-Cas9	
<p style="text-align: center;">Abstract</p> <p>Objectives Since plants are the major source of food for our planet, a comprehensive understanding of factors affecting their growth and development is critical. This project employed classical molecular approaches together with new genome editing tools based on CRISPR-Cas9 technologies to investigate the role of a subset of transcriptional regulatory genes, Mini Zinc Fingers (MZF), in the model system <i>Arabidopsis thaliana</i>. In the hope of finding keys to increased fruit production, MZF1 and MZF2 genes were targeted using a CRISPR-Cas9 strategy to generate loss-of-function mutants, and demonstrate the first steps of a Super-Mendelian inheritance model that will allow efficient propagation of beneficial mutations.</p> <p>Methods Bacterial transformations through <i>Escherichia coli</i> and <i>Agrobacterium tumefaciens</i> allowed the creation of two gRNA CRISPR-Cas9 constructs, which targeted MZF1 and, separately, MZF2. These constructs were then inserted into the <i>A. thaliana</i> genome, plants were grown, and transgenics identified. The mutant plants were genotyped and phenotypic observations were drawn.</p> <p>Results Plants with knocked-out MZF1 expression alone produced an average of 87% more fruit than wild type and had 78% longer stem length ($p < 0.001$ for both). MZF2 knockout plants did not have statistically significantly more fruit per stem or longer stem length. A double knockout of MZF1 and MZF2 produced plants with an average 294% more fruit compared to wild type ($p < 0.001$). The single knockouts are the first steps in a new Super-Mendelian inheritance model mediated by Cas9, ensuring that when engineered plants breed with wild type plants, both copies of mutant alleles are inherited by future progeny.</p> <p>Conclusions Plants with both MZF1 and MZF2 knocked out produce the greatest increase in fruit production as compared to wild type. Results also confirm that MZF1 plays a greater role than MZF2 in the inhibition of Zinc Finger transcription factors. This project provides the framework for an implementation of a Super-Mendelian inheritance model, ensuring propagation of the beneficial mutation, thereby potentially allowing increased crop production in the field. The use of these beneficial mutations in the agricultural field could potentially have a global impact on increasing overall food production.</p>	
Summary Statement Editing the genome of <i>A. thaliana</i> via CRISPR-Cas9 led to a significant increase in fruit production with potential applications toward solving world hunger.	
Help Received I am very grateful to the Yanofsky Lab at UCSD under the mentorship of Prof. Yanofsky and Dr. Juan-Jose Ripoll. All work shown was done by the student (designing of gRNAs, PCRs, bacterial transformation, phenotypic conclusions, etc.).	



CALIFORNIA SCIENCE & ENGINEERING FAIR 2019 PROJECT SUMMARY

Name(s) Aylin Salahifar	Project Number S1811
Project Title Comparing the Physiological Responses of C3, C4, and CAM Plants in Changeable Climates Using a Smart Plant Tracker	
<p style="text-align: center;">Abstract</p> <p>Objectives The objective of my study was to use a Smart Plant Tracker to research how C3, C4, and CAM plants would cope with Global Warming in order to understand the impact of rising temperatures on our future food sources.</p> <p>Methods In the first test group (the control group) I simulated the current avg. summer temperatures in the US. I placed 1 Lolium (C3), 1 Panicum virgatum (C4), and 1 Crassula ovata (CAM) in a circular formation. I suspended 1 Bulb 18in. above the center of the circular formation of plants, distributing 85F of heat onto the plants. For the 2nd test group, I suspended a Bulb 12in. above another set of Lolium, Panicum virgatum, and Crassula ovata plants, distributing 90F onto the plants. For the 3rd test group, I did the same, however I suspended the bulb 6in. above the plants, distributing 95F. I labeled each of the smartplant trackers, devices that measured the light, moisture, fertilizer levels, and temperature of the plants, with either C3, C4, or CAM. I inserted the trackers into the soil of their respective plants for test group 1 and measured the response after one week. Each week I placed the trackers in a different test group (following a pattern) and gathered data for 2 months using an app that correlated to the smart trackers.</p> <p>Results During the study, the vitals of the C3 plants were drastically lower than those of the C4/CAM plants. The smartplant app connected to the trackers conveyed the data on a scale of 1 to 10 (1 being deficient and 10 being in excess). A score of 5 meant the plant was in good health. Throughout the study, the C3 plants were deficient in moisture and in excess in light and temperature, while the C4/CAM plants were much more stable, with scores closer to 5.</p> <p>Conclusions At the end of the study, I discovered that there is a strong correlation between a plant's photorespiration pathway and how it will cope with the higher temperatures of the future. The C3 plants were more equipped to cope with lower temperatures and more moist conditions, rather than hotter, sunnier environments they were exposed to. This is largely due to their lack of photosynthetic adaptations to reduce photorespiration. The C4/CAM plants were more adapted to live in the hot, dry conditions than the C3 plants, because they have a pathway to minimize photorespiration. The conclusion of this study can be applied to real-world agriculture. As our global temperatures increase, the data from this experiment indicates that we should invest resources in planting C4 crops and figure out how to implement the C4/CAM pathway into C3 plants.</p>	
Summary Statement By analyzing the physiological effects Global Warming will have on plants with varying adaptations to photorespiration, I discovered that C4/CAM plants are more able to cope with the future's rising temperatures than C3 plants.	
Help Received I received help from my science teacher Mr. Nat, who helped me understand the mechanics of the smartplant tracker. My parents also helped keep me on task.	



**CALIFORNIA SCIENCE & ENGINEERING FAIR
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Name(s) Jiyoun Roh	Project Number S1899
Project Title Preventing Eutrophication with an Organic Fertilizer Made of Dark Chocolate, Coffee Grounds, and Banana Peels	
Abstract Objectives Problem: Chemical fertilizers cause problems with water quality when they run off into water sources, which often lead to eutrophication, otherwise known as accelerated water enrichment. A rapid, massive growth of algal blooms can occur, which diminishes water quality and harmfully affects the aquatic community by decreasing the photosynthetic rate of plants (by lowering the oxygen content of water) and increasing water toxicity. This experiment focused on the initial hindrance of eutrophication, beginning with the usage of organic fertilizers--which have similar benefits as chemical fertilizers but are less harmful to the environment. Banana peels, coffee grounds, and dark chocolate contained the active ingredients potassium, nitrogen, and phosphorous. Questions: Can these items work as efficient organic fertilizers? And what is the most effective use of them--as powder, solid, or liquid? Hypothesis: If a liquefied mixture of banana peels, coffee grounds, and dark chocolate is used as an organic fertilizer for the <i>Lepidium sativum</i> (garden cress), then the photosynthetic rate of the plant will increase at a faster rate, as compared to the control, powder form, and the whole form. Methods Used banana peels, coffee grounds, and dark chocolate. Used a dehydrator to dry out these foods, then crush them (by blending), liquefy them (by blending with water), or cut them up into chunks to make the respective fertilizers. Fertilized the soil of pots with these fertilizers, sowed garden cress seeds into the soil, and then let grow under a grow light. Results Each trial showed that the plants that grew with the help of the liquid fertilizer consistently germinated more rapidly and grew significantly faster and higher than the other plants (maximum height difference between the liquid and control at the end of 21 days was 2.6 cm). Conclusions Hypothesis that liquid fertilizer would work best was proved correct. This experiment can be a foundation for other scientists to build upon to eventually prevent eutrophication.	
Summary Statement I tested three different forms of fertilizer--solid, liquid, and powder--on plants in order to determine which fertilizer worked best and in the long term, work in preventing eutrophication.	
Help Received I designed and performed the project by myself, with input from my research mentors Ms. Tuason, Ms. Coba, and Ms. Arunachalam.	