



**CALIFORNIA SCIENCE & ENGINEERING FAIR  
2018 PROJECT SUMMARY**

<b>Name(s)</b> <b>Annika Lynn Abbott</b>	<b>Project Number</b> <b>S1201</b>
<b>Project Title</b> <b>The Effect of Proximity to Roadway on Water Quality</b>	
<p style="text-align: center;"><b>Abstract</b></p> <p><b>Objectives/Goals</b> Determine how proximity to a roadway affects the water quality of bodies of water by measuring water quality at various different sites.</p> <p><b>Methods/Materials</b> Bought and used Tetra brand water quality test strips that test the pH, nitrite, and nitrate levels of water and six 4 ounce glass jars. Water samples from several sites around each water body were collected and then their water quality was tested using the test strips.</p> <p><b>Results</b> Water quality (as measured by pH, nitrite, and nitrate levels) worsened the closer a water body was to a roadway. pH was lower and nitrite and nitrate levels were higher (all of which are signs of bad water quality) the closer a water body was to a roadway.</p> <p><b>Conclusions/Discussion</b> This experiment concluded that water quality worsens the closer a body of water is to a roadway due to vehicle emissions and roadway runoff that contaminate the water with various different toxins. The information found in this experiment is important as water is necessary for life and if water is contaminated by pollution, it can have detrimental effects on aquatic life, wildlife, and humans.</p>	
<b>Summary Statement</b> I tested the water quality of various bodies of water to determine how proximity to a roadway affects water quality.	
<b>Help Received</b> I designed and performed the experiment myself. My science teacher reviewed my experiment and lab report.	



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<b>Name(s)</b> Avery Almendariz; Bridget Quain	<b>Project Number</b> <b>S1202</b>
<b>Project Title</b> <b>Rock 'N Roll</b>	
<b>Abstract</b> <b>Objectives/Goals</b> We wanted to discover if there is a correlation between water concentration and liquefaction. <b>Methods/Materials</b> We used a shake table, water, sand, bucket, and a rock. To begin our experiment, we put a specific water concentration with four cups of sand. We then placed a rock and measured their height. We then set it on the shake table at 200 rpms for one minute and recorded how far the rock sunk. We repeated this ten times for each water concentration. <b>Results</b> At 25% water concentration the average amount of liquefaction was 5 mm. At 50% the average was 29.35 mm. The rock at 50% water concentration sunk 24.35 mm more on average than at 25%. This shows the direct correlation between an increase in water concentration and an increase in liquefaction. <b>Conclusions/Discussion</b> Our results supported our hypothesis. Our experiment notifies the population of one of the important factors in the occurrence of liquefaction. This is a serious problem in California due to its susceptibility to earthquakes.	
<b>Summary Statement</b> In this experiment we discovered the relationship between water concentration and liquefaction.	
<b>Help Received</b> None. We designed and carried out the procedure by ourselves.	



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2018 PROJECT SUMMARY**

<b>Name(s)</b> <b>Sebastian Antony; Gerson Cruz</b>	<b>Project Number</b> <b>S1203</b>
<b>Project Title</b> <b>The Effects of Grazing Species on Native Plants</b>	
<b>Abstract</b> <b>Objectives/Goals</b> The purpose of our experiment is to find a link between animals grazing on a plot of land and the biodiversity of native plants on that plot. Non-native/invasive plant species are endangering native plant species in the Wind Wolves area. If we can reduce the amount of invasive plants by having animals graze on that area then we can fix the environment at wind wolves. <b>Methods/Materials</b> We measured out a five meter radius circle with a tape measure. Then we identified and tallied each species. Repeats were included. Then we measured biodiversity with the Simpson's index. <b>Results</b> Our results indicated that grazing species have a positive effect on native plant species. But the grazing species has had a negative effect on the total biodiversity as a whole. <b>Conclusions/Discussion</b> The importance is that this would allow for a return of native plant species and positively affect other endangered species of the environment. This would also help get rid of invasive plants which burn easily and are one of the main causes of wildfires.	
<b>Summary Statement</b> We measure the effect that grazing has had on plant biodiversity and see how that has affected native and invasive plant species.	
<b>Help Received</b> We received help from a plant biologist at Windwolves Preserve named Brooke Wainwright.	



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2018 PROJECT SUMMARY**

<b>Name(s)</b> Amaya M. Bechler	<b>Project Number</b> <b>S1204</b>
<b>Project Title</b> <b>How Does Tidal Wetland Restoration in the Humboldt Bay Area Affect Bird Diversity and Occurrence?</b>	
<b>Abstract</b> <b>Objectives/Goals</b> Northern California's Humboldt Bay tidal marshlands represent a sensitive environment damaged by extensive urbanization, diking, and other human practices. The objective of this project was to analyze how different approaches to restoration of tidal sloughs around the bay affected the occurrence birds which utilize that habitat. <b>Methods/Materials</b> Five different locations around the bay which represented varying levels of restoration were chosen and surveyed with an observation-based protocol, which involved travelling a distance of 0.5 kilometers while recording all species observed. Behaviors and locations were noted when applicable to increase accuracy of data. <b>Results</b> Results were complex but overall the most varied wetland habitat containing both mudflats and tidal sloughs attracted the most diversity in birds. Drier land created by diking attracted many insectivorous species but did not provide suitable habitat for wetland species. Where previous salt marsh environment had undergone construction and urbanization, very few native species were present, and were replaced by invasive Eurasian species. <b>Conclusions/Discussion</b> These results indicate what types of restoration may be most effective at restoring suitable habitat for bird species in the Humboldt Bay region. Reintroduction of tidal sloughs as well as salt marsh to previously drained land provides for the most diversity in native bird species. Damage to wetland environments in the forms of cattle-grazing and urbanization lowers diversity and negatively impact marshland bird species. This study could provide insight into how restoration of coastal Californian wetland can be targeted to benefit endangered avian species.	
<b>Summary Statement</b> This project studied what occurrence of bird species can indicate about damage and restoration of tidal wetlands.	
<b>Help Received</b> I received help from a member of the U.S. Fish and Wildlife when drawing conclusions about which species to prioritize, and was advised throughout the process by my natural history teacher. Otherwise I conducted this project independently.	



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<b>Name(s)</b> Scott Cao	<b>Project Number</b> <b>S1205</b>
<b>Project Title</b> <b>Volatile Climate of the Miocene: A Glimpse into Our Future?</b>	
<b>Abstract</b> <b>Objectives/Goals</b> Determination of how CO <sub>2</sub> levels (the greenhouse effect) and organic carbon burial (the Monterey hypothesis) affected the climate of the Miocene <b>Methods/Materials</b> Sediments from the Miocene (23-5 Ma) were studied ODP site 1490 and ODP site 1482. 5 samples of Trilobatus Trilobus between the size fraction 212-250 micrometers were picked from the sediment from each section of the core, cleaned, and analyzed through a mass spectrometer for Delta C-13. 400 micrograms of T. Trilobus were also picked from the sediment from each section of the core, cleaned, and analyzed through another mass spectrometer for magnesium and calcium <b>Results</b> Temperatures of the Miocene were highest ~17-15 Ma, a time period called the Mid-Miocene climatic optimum, and then decreased into the late Miocene before stabilizing during the late Miocene. This data was compared to global CO <sub>2</sub> records obtained from previous experiments. Delta C-13 values increased ~18 Ma, and this data was compared to the change in temperatures during the Mid-Miocene. <b>Conclusions/Discussion</b> Global CO <sub>2</sub> levels were highest during the Mid-Miocene climatic optimum, and then decreased when temperatures decreased heading into the late Miocene, supporting the greenhouse effect. However, CO <sub>2</sub> levels decreased during the late Miocene, but temperatures stayed relatively constant at both sites, showing a deviation from the greenhouse effect. The Monterey Hypothesis states that the high delta C-13 caused the decrease in temperatures during the Mid-late Miocene, but Delta C-13 values increased ~18 Ma and temperatures did not start decreasing until ~15 Ma, indicating a lag time, which contradicts the Monterey Hypothesis	
<b>Summary Statement</b> I reconstructed the climate of the Miocene to determine how and why it changed	
<b>Help Received</b> I crushed, sieved, and picked all samples using the lab equipment from University of California Santa Cruz. My mentor Dr. Tali Babila cleaned the samples and ran the mass spectrometer	



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<b>Name(s)</b> <b>Ji Won Chae</b>	<b>Project Number</b> <b>S1206</b>
<b>Project Title</b> <b>The Effects of Ocean Currents on the Distribution of Particle Matter</b>	
<b>Abstract</b> <b>Objectives/Goals</b> This science fair project studies the movement of particles in relation to ocean current patterns. The purpose of this project was to determine whether the materials and compounds used in the process of offshore drilling reach shore ecosystems, through experimental small-scale applications of large-scale processes. It was hypothesized that that contaminants would likely settle near the ocean floor, and be transported by rising deep water currents towards the shore. <b>Methods/Materials</b> Sites with public access were chosen for their convenience as well as the direct impact on human life. Immediately after the sampling procedure had ended, ocean currents were recorded. The samples were delivered to a laboratory. The samples were analyzed through ICP-MS. In addition, arsenic, barium, bromine, cadmium, chromium, iron, strontium, and zinc were chosen for analysis. Arsenic and cadmium are heavy metals. Chromium, iron and zinc are metals that are beneficial in trace amounts. Bromine is present in brine and seawater due to its properties as an ion. Strontium is abundant in the crust and can form salts. Barium can form precipitates. <b>Results</b> The hypothesis that the highest levels of contamination would be observed in the region subjected to the greatest amount of outward directed surface ocean currents was proven as the trends in the data indicate the sample sites that experienced outward surface level ocean currents. The overall trend in the data favors the outward currents with elevated quantities of contaminants, distinctly higher than the nine other beaches. <b>Conclusions/Discussion</b> The hypothesis was supported by data collected. Beaches which had experienced outgoing surface-level ocean currents were correlated to higher levels of contaminant content within the water. Difficulties isolating this experiment from contamination limit the bounds of the research. Despite these limits, the overall conclusion is unaffected. Iterations may incorporate sediment and sea water may be tested separately in order to refine the results of the experiment and to isolate specific characteristics of metal contamination. A greater emphasis on the effects on life may be worthwhile. By understanding how drilling by-products are spread by oceanic currents, we can predict and trace the path of contaminants in the case of potential error, minimizing damage and impacts upon the environment.	
<b>Summary Statement</b> My project examined the relationship between ocean currents and natural patterns with the spread of particulate matter as manifesting in possible contamination from offshore drilling platforms.	
<b>Help Received</b> Exova Lab provided the ICP-MS data analysis service.	



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<b>Name(s)</b> Yoonji A. Kwon	<b>Project Number</b> <b>S1207</b>
<b>Project Title</b> <b>The Effects of Different Micro-Environments and Activities on Personal Exposure to Black Carbon</b>	
<p style="text-align: center;"><b>Abstract</b></p> <p><b>Objectives/Goals</b> To attribute trends in black carbon, or BC, concentrations in personal exposure to micro-environments of certain conditions as accurately and reliably as possible, and to better predict BC concentrations based on micro-environments. Include wind, rain, indoors vs outdoors, proximity to vehicles and traffic, riding vs waiting for vehicles, indoor ventilation, and micro-environments of restaurants and other areas of cooking.</p> <p><b>Methods/Materials</b> MicroAeth AE51 for Black Carbon from AethLab and Microsoft Excel. Set up and turn on the air pollution monitor according to provided operation manual. Change white quartz fiber filters in monitor daily. Filters provided by AethLab with monitor. Carry monitor in bag during travel or activities. Log changes in micro-environments change and any abnormal conditions. At end of every sampling, download data from monitor onto a computer as a spreadsheet using software provided with the monitor.</p> <p><b>Results</b> Summer peaks in BC were at Athabasca Glacier in and near a large vehicle with a diesel engine, at restaurants in Canada, OR, and WA, and during a wildfire in OR. Winter Fresno peaks were in restaurants, at a public park close to the road, in traffic at I-5 freeway inside a car, near midnight on New Year's Eve, and when cooking and riding cars to and from school. BC was exceedingly low at school. Hourly PM2.5 from RAAN for Central Fresno and Clovis was similar to hourly BC from ambient fixed site and to hourly personal exposure BC. Hourly PM2.5 and BC personal exposures all dropped sharply on a windy day and in period of intermittent rain. For all regression graphs and correlations of hourly PM2.5, BC personal exposures, and BC ambient exposures, p values were less than 0.001.</p> <p><b>Conclusions/Discussion</b> Peaks suggest that proximity to the road, traffic or commute by car, cooking in restaurants and at home, wildfires, and fireworks on New Year's increase BC in personal exposure. My study provides evidence to further support previous studies of PM in that wind, rain, ventilation, and closed windows decrease personal exposure. Regression plots and calculated correlation constants and p values showed strong correlation between PM2.5, BC outside, and BC in personal exposure. Strengthened correlations and causations between micro-environments and BC make predictions of BC more reliable so that actions to reduce BC and its negative effects can be more effective.</p>	
<b>Summary Statement</b> By measuring the BC personal exposure, I attributed conditions of micro-environments to BC personal exposures and ambient concentrations.	
<b>Help Received</b> I received help from my father, who is a professor at the University of the State of California, Fresno. He helped me condense my data when I was making my graphs, and he helped me gain access to and learn how to use the MicroAeth monitors used in my project.	



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<b>Name(s)</b> <b>Paloma Lobos; Sergio Serrano</b>	<b>Project Number</b> <b>S1208</b>
<b>Project Title</b> <b>Impact of Student Class Size on Indoor Air Quality</b>	
<p style="text-align: center;"><b>Abstract</b></p> <p><b>Objectives/Goals</b> The objective of this experiment is to determine if there is a correlation between the levels of pollutants in the air and the class size.</p> <p><b>Methods/Materials</b> In this experiment, an air quality monitor will be placed into multiple classrooms in order to identify the amount of pollutants in the air. After seven days, the data will be collected through an app.</p> <p><b>Results</b> Volatile Organic Compounds are higher in tile floored classrooms, Carbon dioxide is the highest in tile and portable classroom, and particulate matter is highest in carpet floored classrooms and tile floor classroom.</p> <p><b>Conclusions/Discussion</b> The information gathered explained that the air quality in the classrooms at Ridgeview high school have less pollutants when there are no students in the classroom.</p>	
<b>Summary Statement</b> We measured We measured the levels of pollution in three different floored classroom in order to make a correlation between class size and indoor pollutants.	
<b>Help Received</b> Our science teacher, Mike Braiser, helped us acquire an indoor air quality monitor for out experiment.	



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<b>Name(s)</b> <b>Tai L. Michaels</b>	<b>Project Number</b> <b>S1209</b>
<b>Project Title</b> <b>Effects of Short Fire Return Intervals on Chaparral Ecosystems</b>	
<p style="text-align: center;"><b>Abstract</b></p> <p><b>Objectives/Goals</b> Fire return intervals (FRIs) are a key environmental factor in chaparral ecosystems. With increasing drought and anthropogenic fire ignition particularly in the past decades, dangers with short FRIs are increasing. I examine the impacts of short FRIs on diversity, coverage, and flammability several decades afterwards. 10 pairs of nearby quadrats with differing FRIs were selected and transects were taken recording presence of individual species in either canopy or understory. I found significant decreases in shrub canopy coverage and net canopy coverage in short FRI sites. Short FRIs also increased the spread potentials of fires while decreasing the intensities of fires. These changes suggest that short FRIs form a positive feedback loop increasing flammability which then increases the probability of further short FRIs. The decreased intensity may cause greater invasive species dominance and could further increase fire risk. These findings suggest that fire management should place a greater premium on controlling fires in areas with recent burns or previous short FRIs in order to reduce future fire risk and further ecological degradation. Implementation of these practices could help reduce risk to property and lives from fires and the landslides, floods, and air pollution that follow.</p> <p><b>Methods/Materials</b> Used fire maps to identify nearby pairs of sites with differing intervals between fires. Sampled sites recording canopy and understory species presence at points along transects. Calculated cover by growth form, diversity, and flammability (FFT model from USFS).</p> <p><b>Results</b> Diversity and canopy cover (particularly shrubs) decreased with short FRI sites. Fire spread potentials rose while flame available fuel decreased in short FRI sites. Changes in cover for other growth forms and understory plants were not significant.</p> <p><b>Conclusions/Discussion</b> This study implies that the decreased canopy cover caused by short FRIs increases the flammability of an ecosystem. The decreased available fuel suggests lower intensity fires which may benefit invasive species. These results support the hypothesis that short FRIs increase risk of further fires in a positive feedback loop.</p>	
<b>Summary Statement</b> In studying the effects of short intervals between fires (FRIs) in chaparral ecosystems, I find that they damage the canopy, reduce fire intensity, and lead to greater flammability increasing the likelihood of more short FRIs in the future.	
<b>Help Received</b> I received advice from Dr. Valliere on narrowing in on a research question.	



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<b>Name(s)</b> <b>Austin L. Nash</b>	<b>Project Number</b> <b>S1210</b>
<b>Project Title</b> <b>Mammalian Behavioral Ecology in Southern California Habitat Fragments</b>	
<p style="text-align: center;"><b>Abstract</b></p> <p><b>Objectives/Goals</b> This study examined the impact of human and domestic dog presence on the species richness and movement of mammals in habitat fragments within a suburban matrix and possible human-wildlife conflict that could occur.</p> <p><b>Methods/Materials</b> Eight game cameras were installed in two habitat fragments in the Palos Verdes Peninsula, one canyon with human and domestic dog presence and one control canyon without. Cameras were placed at natural constrictions along the two main travel corridors in the canyons, trails and creek beds. The camera installations were then monitored for 200 days from 5-3-17 to 11-18-17. Species richness for each canyon, movement location and time patterns, and the percentage of overall captures each species represented were analyzed.</p> <p><b>Results</b> The control canyon had a higher species richness (9 vs. 6) and accounted for 93% of wildlife captures. Nocturnal activity was preferred for both canyons, but <i>Procyon lotor</i> and <i>Canis latrans</i>, in the control canyon showed a greater variability in time of activity than their conspecifics in the canyon with human presence. <i>C. latrans</i> captures showed no difference in frequency between canyons, while the other 8 mammal species captured on video showed a strong preference for the control canyon. Mesopredators <i>P. lotor</i> and <i>F. catus</i> accounted for 68% of wildlife captures while <i>C. latrans</i> and <i>V. vulpes</i> accounted for only 1.8% of said captures. 82% of wildlife captures and 0.59% of domestic captures occurred at night.</p> <p><b>Conclusions/Discussion</b> Therefore, human-wildlife conflict will likely be minimal in these fragments and human presence reduces mammal species diversity and movement in habitat fragments.</p>	
<b>Summary Statement</b> This project showed that human presence in habitat fragments reduced species richness and that human-wildlife conflict is of a low probability and a significant mesopredator release has occurred in the fragments studied.	
<b>Help Received</b> I conducted the entire project by myself. I rented game cameras from California State University Long Beach and purchased all other equipment myself.	



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<b>Name(s)</b> <b>Nina A. Patel</b>	<b>Project Number</b> <b>S1211</b>
<b>Project Title</b> <b>Parasite Contamination of Soil from Community Gardens and Playgrounds Associated with Free-roaming Cats</b>	
<p style="text-align: center;"><b>Abstract</b></p> <p><b>Objectives/Goals</b> The purpose of our research was to evaluate the public health threat of seven free-roaming cat colonies located in the greater San Francisco Bay Area. This goal was achieved by measuring the abundance of free-roaming cats near playgrounds and community gardens within the area and assessing whether or not the soil is contaminated with <i>T. gondii</i> using lab techniques.</p> <p><b>Methods/Materials</b> We collected soil samples from each site and used a sugar flotation technique to recover any potential oocysts present and the samples were posteriorly processed for DNA extraction. We also collected data on colony size, number of feeding stations, and number of latrines to examine if these factors could be associated with presence and distribution of <i>T. gondii</i>. Samples were analyzed using Polymerase Chain Reaction (PCR) and Gel Electrophoresis to determine presence of <i>T. gondii</i>.</p> <p>There were various materials necessary including numerous reagents and buffers for the lab procedures. A large and small centrifuge was also necessary. All of the necessary solutions to conduct the research were acquired through a mentor at UCSC Santa Cruz.</p> <p><b>Results</b> Our testing revealed no positive samples of <i>T. gondii</i>. Because our results were inconclusive and we did not find any <i>T. gondii</i>, we can not make any connections to prevalence factors and our hypothesis can not be confirmed or rejected.</p> <p><b>Conclusions/Discussion</b> Our testing revealed no positive samples of <i>T. gondii</i>. Because our results were inconclusive and we did not find any <i>T. gondii</i>, we can not make any connections to prevalence factors. These results, however, show that there is a low risk factor for becoming infected near the sites we collected samples from. Because this parasite can cause deformities in babies if the mothers become infected with the parasite during pregnancy, this shows that the community gardens and parks involved in this study are relatively safe for pregnant women and children.</p>	
<b>Summary Statement</b> I evaluated the public health threat of free-roaming cats in regard to the parasite <i>Toxoplasma Gondii</i> and found that the areas of study were relatively safe of the parasite.	
<b>Help Received</b> All of the research was performed at UCSC under the guidance of Luz de Wit who helped advise throughout the process.	



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<b>Name(s)</b> <b>Visala R. Tallavarjula</b>	<b>Project Number</b> <b>S1212</b>
<b>Project Title</b> <b>Irrigation Water Usage Efficiency Improvement by Modification of Root Zone Soil Properties Using Carbon Sequestration</b>	
<p style="text-align: center;"><b>Abstract</b></p> <p><b>Objectives/Goals</b> Irrigation consumes more than 80% of the world's fresh water. The exploding global population and increasing food demands lead to water shortage. Improving the efficiency of irrigation will help to mitigate water stress. The purpose of this project is to study the effects of root zone soil modifications on soil water retention using a percolation control layer amended with charcoal.</p> <p><b>Methods/Materials</b> The design of experiments' study was conducted by varying Percolation Control Layer (PCL) thickness, percentage of charcoal amendment, and the grain size of charcoal added. Statistical analysis predicted that the water retention increases with increasing PCL thickness, increasing charcoal amendment percentage, and decreasing charcoal grain size. One reference bed with surface irrigation is compared to a) insert and top soil bed and b) insert, top soil bed and PCL layer at the root zone (with both coarse and fine grain charcoal amendment). Beds are watered as determined by container samples' weight loss and evapotranspiration calculation based on daily weather parameter data. Radish weights were compared from four beds. Scanning Electron Microscope images of coarse and fine grain charcoal samples were taken at 1000x magnification.</p> <p><b>Results</b> With 33% charcoal amendment, 4 cm PCL thickness, and two charcoal grain sizes, field tests were conducted with radish and green pea plants. The PCL with charcoal amendment showed 49% lower water consumption while also producing 50% higher radish yield. The yield improvements were statistically significant as shown by t-ratio of 2.26. SEM analysis showed coarse grain charcoal had higher surface roughness.</p> <p><b>Conclusions/Discussion</b> Charcoal amendment increased water retention at the root zone maximizing water usage by the plant transpiration. Optimized beds used less water while producing higher yield (radish weights and leaf size). Coarse grain charcoal's rough surface can lead to effective adsorption of nutrients, enhanced microbial activity and consequently better root health and plant growth. In addition, charcoal amendment results in carbon sequestration, which reduces greenhouse gas emission and ultimately can reverse climate change.</p>	
<b>Summary Statement</b> Using carbon sequestration (charcoal amendment) soil properties are modified to reduce irrigation water usage by 49%, while improving plant yield by 50%.	
<b>Help Received</b> Dr. Fred Barez helped me with data analysis methods. Mr. David Tuttle gave suggestions on bed preparation at the farm. Mr. Greg Rudd showed me how to prepare samples and take images using SEM.	



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<b>Name(s)</b> <b>Perrin J.G. Turney</b>	<b>Project Number</b> <b>S1213</b>
<b>Project Title</b> <b>Effects of Acidification on Freshwater Microorganisms: A 4 Year Study of Components of Climate Change on Microorganisms</b>	
<b>Objectives/Goals</b> This 4-year project determined the effects of climate change components on freshwater microorganisms at the Arcata Marsh: 2015: Salinity Tolerance, 2016: Increased agricultural/industrial pollutants, 2017: Temperature increase, 2018: Acidification.	
<b>Abstract</b> <b>Methods/Materials</b> Yeast, juice, carbon dioxide system, Arcata Marsh water, pH meter, microscope. Bubble carbon dioxide into tanks of Arcata Marsh water to establish 5.0 pH, 5.5 pH, and 6.0 pH. Observe and count Daphnia, Cyclops, amphipods, Coleps, Euglena, diatoms, Chlamydomonas, rotifers, and Hypotrichida daily for a month to identify mortality rates compared to the control: an unaltered tank of marsh water.	
<b>Results</b> In 5.0 pH, diatoms, Euglena, and Chlamydomonas increased exponentially. The 5.0 pH tanks became cloudy (bacteria) and mortality rates for non-algal microorganisms rose rapidly. In 5.5 pH, algal organisms increased in populations up to ten-fold. All other unicellular microorganisms significantly dropped in numbers over the span of a month. Amphipods remained relatively stable. In 6.0 pH, by the end of the month, all organisms, other than Daphnia and Cyclops (which decreased by 80%), increased similar to the control.	
<b>Conclusions/Discussion</b> As pH decreases, mortality rates for unicellular, non-algal organisms increases. Algal organisms mimic an algal bloom with the increased available carbon dioxide in the environment. The increase in algae increases the oxygen, thereby increasing the bacteria in the water which affects the equilibrium of the microorganisms in the system. Amphipods proved to be tolerant of acidification, although analysis of the structure of the exoskeletons would be an important study to determine if the lack of necessary minerals because of the increased carbonic acid led to weaker exoskeleton structure. In previous years, the microorganism mortality rates rose exponentially with chlorine pollutants, high concentrations of fertilizer, and salinity. Low concentrations of fertilizer pollutants had positive effects and higher temperatures increased Hypotrichida but proved detrimental to all other microorganisms in the study over a month. As the current trend of planetary warming continues and human populations increase, these freshwater ecosystems face real threats to their sustainability. Many components of this trend prove detrimental, and all of them, at the very least, change the dynamics of the organism populations.	
<b>Summary Statement</b> This project determined that freshwater microorganisms have varying sensitivities to the components of the current planetary warming trend including salinity, pollutants, increased temperatures, and acidification.	
<b>Help Received</b> A graduate student, Corianna Flannery, supplied advice about utilizing yeast and juice as a carbon dioxide source.	



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<b>Name(s)</b> <b>Srinivas Balagopal</b>	<b>Project Number</b> <b>S1299</b>
<b>Project Title</b> <b>The Effect of Nonlinearity on Recalibrating the AQI and Air Pollutant Forecasts for 3 Bay Area Urban Micro-climates</b>	
<p style="text-align: center;"><b>Abstract</b></p> <p><b>Objectives/Goals</b> The Bay Area Air Quality Management District (BAAQMD) uses ozone (O<sub>3</sub>) and particulate matter (PM<sub>2.5</sub>) readings to issue their daily Air Quality Index (AQI), eclipsing the impact of other criteria pollutants in urban microclimates. Current AQI forecasts also use linear and deterministic models that belie the impact of nonlinear pollutant interactions. Thus, my hypotheses are that (1) using nonlinear correlations and the Analytical Hierarchical Process (AHP) will result in an aggregated AQI accuracy of over 50% against the EPA's current AQI; (2) using nonlinear neural networks will produce accurate hourly pollutant forecasts. I obtained 3 years of hourly meteorological and pollutant data from BAAQMD for San Jose, San Francisco, and Oakland.</p> <p><b>Methods/Materials</b> I applied Spearman's Rho to derive monotonic coefficients between the met factors and pollutants, which I used to develop an AHP that derived a weighted AQI scale for each pollutant per microclimate in Excel. This AQI was tested for accuracy of pollutant impact against the control EPA AQI. I applied the coefficients to enrich BAAQMD data to construct pollutant/microclimate-specific LSTM networks in Python to forecast hourly pollutants. The forecast results were tested for accuracy against the control BAAQMD forecasts and against actual pollutant data.</p> <p><b>Results</b> The correlations showed that primary pollutants (CO, NO<sub>2</sub>, &amp; SO<sub>2</sub>) had greater impact on pollutant levels than met factors. My AHP-based AQI showed that 58.3% of EPA control AQIs reduce the impact of other pollutants, despite their having higher concentrations. My LSTM models increased the forecast accuracy by 57.3% for winter PM, 10% for summer O<sub>3</sub>, and 8% for fall O<sub>3</sub>, as compared to BAAQMD's control forecasts. Finally, annual forecasts were 96% accurate as tested against BAAQMD pollutant records.</p> <p><b>Conclusions/Discussion</b> 80% of global urban populations live in substandard air environments affected by anthropogenic primary emissions, compounded by topographical factors. My revised AQI provides an accurate pollutant representation for these microclimates that inform health impacts and empirically highlight the true sources of pollution. My nonlinear forecasts prove that dynamic urban environments are unsusceptible to linear and deterministic forecasting models and that using pollutant-centric nonlinear models provide accurate forecasts that allow individuals to plan their daily activities.</p>	
<b>Summary Statement</b> Using nonlinear correlations, I proved that primary air pollutants have a higher impact on urban microclimates than meteorological factors, which accurately represents aggregate air quality and allows for robust pollutant forecasting.	
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