CALIFORNIA STATE SCIENCE FAIR
2016 PROJECT SUMMARY

Name(s)	Project Number
Alvin Kristoff E. Agatep	**S1101**

Project Title

An Analysis of the Effect of Effluent on the Water Quality of the Santa Ana River

Abstract

Objectives/Goals

The purpose of this project was to determine the water quality of the Santa Ana River as a result of the effluent flowing through the water treatment plant located next to the river in Riverside. Much knowledge of the actual quality of the water would be derive through a series of tests from water quality test kits.

Methods/Materials

Water test kits, water bottles, water scoop contraption, journal, and writing utensils. Water test kits of the various quality factors varied from portable spectrophotometers, titration apparatuses, and simple measuring devices. 3 tests were conducted at the 4 predetermined sites over a course of three months beginning from the end of November to the beginning of February. Sites were determined based on the influence of effluent on the water's quality.

Results

Water from test sites 1-4 had relatively similar levels for temperature, chloride concentration, total dissolved solids, alkalinity, dissolved oxygen, hardness, carbon dioxide, and salinity. Notable results were that oh pH, nitrate, and phosphate. Where water was located in site 3 (effluent mix) and site 4 (river water; no mix), the water seemed to be just a tad bit basic with pH values between 7.09 and 7.46. Nitrate levels were significantly low in sites 1 and 2(effluent water), where levels in these sites were from 2.8 ppm and below. Sites 3 and 4 had values from 7 ppm up to 8.2 ppm. Finally, phosphate levels in site 1 (effluent water) had higher levels of phosphate (2.5 ppm) compared to the other sites, with their values being lower than 2 ppm.

Conclusions/Discussion

With high levels of alkalinity, hardness and TDS levels coming from all sites , it was fully determined that the water from the Santa Ana River was not drinkable. This was reassured by levels indicated by the EPA, which demonstrated that the levels found from these tests highly surpassed the safe consumption rates. Although exposure to these high levels does not affect one's physicality, through experimentation and was concluded that with the the very low concentrations of nitrate and high concentrations of phosphate, the water was indeed safe to partake in recreational purposes.

Summary Statement

Through a series of water tests, I have found that the water in the Santa Ana River affected by the effluent was not drinkable but safe to recreationally swim in.

Help Received

I was given help by my advisor and chemistry teacher, Michelle Hampton, who provided me with all the water test kits.

Name(s)

Diana Agdashian

Project Number

S1102

Project Title

Potable Water Analysis

Abstract

Objectives/Goals
Analysis of the contaminants present in potable domestic water sources.

Methods/Materials
Tested domestic water sources for contamination by using LaMotte testing kits. Water samples from a variety of cities and LaMotte testing kits for the following: Phosphate, nitrate, copper, zinc, iron, lead, pH, cyanide, chloride.

Results
While some contamination levels exceeded the safety limit, the majority were under the limit and were safe for consumption. The experiment provided a concise measure of the level of toxicities present in the water.

Conclusions/Discussion
The repeated trials revealed some toxicities however most were measured to be under the hazardous limit. The experiment provided an in depth look at the level of contaminants in domestic water sources and exposed a small correlation between income level and contamination level.

Summary Statement

I conducted an analysis of the contaminants present in potable domestic water sources.

Help Received

My science teachers, John Shirajian and Richard Yu, and my brother David Agdashian reviewed my experiment and explained concepts.

Name(s)	Project Number
Mireya Amparano	**S1103**

Project Title

Decomposition of Foam Cup Alternatives

Abstract

Objectives/Goals

The purpose was to observe and measure the decomposition of natural alternatives to polystyrene products. The plastics were made with starches or flours with natural ingredients to create an environmentally friendly product. I hypothesized the corn starch alternative would have the greatest decomposition since it would create a softer and flexible product ideal for decomposition.

Methods/Materials

The natural alternatives were created with 15mL glycerin,120mL water, 10mL of vinegar, 6 grams of baking soda and 15 grams of one of the five starches or flours. The ingredients tested were corn starch, wheat flour, rice flour, potato starch and tapioca starch. All of the ingredients were mixed and heated to create a clear solution poured onto wax paper and dried in the sun for 3 days. Each of the five plastics were made three times and labeled. The mass as well as qualitative observations were collected before placed in the compost bin. The compost bin was built with alternating layers of carbon-based and nitrogen-based materials with soil for decomposition. All plastics were placed in the compost bin and were observed and measured every 3 days for a 27 day period.

Results

The wheat flour plastic obtained the highest average of decomposition of 50.5% through the time period. The lowest averages were the tapioca starch with 32.24% decomposition and potato starch with 30.8% decomposition. The percentages show how much and fast each plastic decomposed in the time period.

Conclusions/Discussion

The results refuted my hypothesis since corn starch resulted in a thick and inflexible plastic that had the third highest decomposition but the potato starch plastic was supported in the lowest decomposition. The wheat flour overall resulted in the fastest product decomposed than the other ingredients. The knowledge of the decomposition of the alternatives of foam cups may lead to a possible way to create an environmentally friendly product.

Summary Statement

The decomposition of alternatives to plastic made with flours and starches was observed and resulted in the wheat flour being the quickest.

Help Received

I created the plastics but received help in building the compost bin from father. My environmental teacher helped in project ideas and methods.

Name(s)

Angie Castro; Jessica Manlapeg Schager

Project Number

S1104

Project Title

Wetlands and Water Quality

Abstract

Objectives/Goals

The purpose of our project was to determine if water in wetlands differs from its source depending on the aquatic flora and fauna.

Methods/Materials

Two synthetic wetlands were tested for chlorine, alkalinity, nitrate, nitrite, ammonia, hardness, pH, turbidity, and temperature using a water sampling kit. The source of the two wetland pools was tested for the same aspects to see how the water quality changed.

Results

Our results show from the two pools, the water quality overall improved more in the pool with plants and fish. In contrast, the barren pool had higher levels of chlorine, pH, turbidity, and nitrite making it stray from ideal water conditions.

Conclusions/Discussion

Our conclusion is that plants and fish in wetlands help improve the water quality of the source flowing into the pool. This supported our hypothesis which was that the pool with aquatic life would be an ideal environment.

Summary Statement

Our project focuses on how aquatic fauna and flora may be evidence of healthy water quality in riparian pools.

Help Received

None. The experiment was preformed by ourselves.

Name(s)	**Project Number**
Natalie Chau	**S1105**

Project Title

How Do Chemically Treated Seeds Affect the Quality of Soil in Comparison to Untreated Seeds?

Abstract

Objectives/Goals
To determine the effects of chemically treated seeds on the quality of the soil, using the characteristics of moisture, acidity, and quantity of nitrogen, phosphorus, and potassium nutrients as comparison

Methods/Materials
Used soil, eight pots, and chemically treated tomato/corn seeds, non-chemically treated tomato/corn seeds, water. I used two varieties of plants (corn/tomato) because these tomato is a C3 plants and corn is a C4 plant, which have different photosynthesis processes from each other. For independent variables, I used a beaker to measure an exact amount of water and a balance to measure an equal amount of soil in each pot. The soil properties tested for comparison are the following: NPK soil test kit to test nitrogen/phosphorus/potassium levels of the soil, pH meter to measure acidity of soil, moisture meter

Results
There was no common trend amongst the factors tested (NPK, moisture, pH) between the corn and tomato plant. Therefore, each soil quality factor are independent of each other and should be accounted for individually.

Conclusions/Discussion
In order to improve this experiment, it would be useful to quantify the exact amount of nutrients and amount of water in the soil some way, rather than using relative calculations found with the NPK test kit. It would also be helpful to normalize the pH in relation to size as well.

Summary Statement

I compared the soil quality of chemically treated and untreated seeds and found both correlations and differences between the C3(Tomato plants) and C4(Corn Plants).

Help Received

I designed, built, and performed the experiments myself. However, Stanford students helped review my procedure and calculations.

Name(s)	Project Number
Hunter C. Crawford-Shelmadine	**S1106**

Project Title

Lumbriculus variegatus and Man-Made Hazards: What Is the Tipping Point?

Abstract

Objectives/Goals

The purpose of this experiment is to test how exposure to pesticide, fertilizer, oxybenzone sunscreen, zinc oxide reef safe sunscreen, or acidity at different concentrations effect the blood flow rate of Lumbriculus variegatus and then to repeat the experiment using different combinations of these man-made stressors to better understand how exposure to multiple stressors changes the results.

Methods/Materials

Build custom slide to contain worm for viewing. Mix concentrations (control .05 .1 .5 1 2.5 5%) for each stressor (above). Place worm in solution for 15 minutes. Remove worm. Count blood flow contractions (bpm) for 60 sec w/40x microscope. You need an assistant to time. Record data and repeat for each solution. Record qualitative observations.

Results

PESTICIDE: The presence of pesticide in any .01% combination was lethal but not individually. In a .05% solution, pesticide & oxybenzone sunscreen was lethal, pesticide & fertilizer had a statistically significant reduction in bpm.
FERTILIZER: The addition of fertilizer when mixed with pesticides resulted in a lethal combination, but when mixed with oxybenzone sunscreen did not have a consistent impact to the bpm.
ACIDITY: Lowering to pH6 only had a minor measurable impact when added to the pesticide and fertilizer mixture. There was a statistically significant drop in bpm in the 0.05% concentration.
ZINC OXIDE REEF SAFE SUNSCREEN: The addition of this sunscreen did not have a positive or negative impact on the Lumbriculus variegatus in any combination.
OXYBENZONE SUNSCREEN: The presence of oxybenzone in the water trapped the worms in a thick film which increased BPM whereas virtually all other stressors decreased BPM.
OTHER RESULTS: exposure to fertilizer & pesticide (ind) turned their red colorful insides to gray. After 15 hours of exposure to each stressor, all were alive in .05% & .1% zinc and fertilizer but 100% dead in other solutions.

Conclusions/Discussion

My hypothesis states that when I measure the effect of a single man-made stressor on Lumbriculus variegatus and compare those results to when they are exposed to multiple man-made stressors, the multiple man-made stressors will have a greater impact on the Lumbriculus variegatus. My hypothesis is partially correct. Only certain combinations of man-made stressors had a statistically significant greater impact on the Lumbriculus variegatus than did the stressor(s) have by itself.

Summary Statement

My experiment shows that certain man-made stressors (toxins/chemicals) in combination do have a greater impact (often lethal) on aquatic life than when exposed to the man-made stressor by itself.

Help Received

My science teacher, Mr. Raffa, provide input & feedback on experimental design and was a great support throughout the project.

Name(s)	Project Number
Philip M. Felizarta	**S1107**

Project Title

A Climate Model for Predicting Global Mean Temperature Anomalies

Abstract

Objectives/Goals
The objective of this study is to confirm the correlation between CO2 concentration and average global temperature and to create a simple climate model that can accurately predict annual global mean temperature anomalies.

Methods/Materials
Berkeley Earth was the source of data for actual annual global mean temperature anomalies from 1955 to 1999. The climate model was designed by incorporating CO2, volcano and solar forcing with the ENSO cycle. Mean annual atmospheric CO2 concentrations were obtained from the 5th Assessment Report of the Intergovernmental Panel on Climate Change (IPCC). Yearly mean sunspot numbers were accessed from the National Geophysical Data Center. The list of the largest volcanic eruptions and historical ENSO Index values were obtained from the National Weather Service/NOAA. The computed values were compared to the actual temperature anomalies to determine accuracy. The 1955-1999 model was used to predict the temperature anomalies from 2000 to 2015 and from 2016 to 2100 with different climate change mitigation scenarios.

Results
The CO2 forcing is the only factor to closely parallel the overall increasing trend of the actual temperature anomalies. However, the combined effects of the natural forcings nearly match the fluctuations of the temperature anomalies.
The forecast for 2000-2015 in terms of the sunspot number, ONI and CO2 emission were accurate when compared to the actual data. It also predicted an apparent slowdown in the warming trend from 2000 to 2014.
According to the model, the mean global temperature will increase by 5°C (9°F) in 2100 with absence of climate change mitigation; it will increase by 4°C (7°F) with existing mitigation and 2°C (3.6°F) with substantial mitigation.

Conclusions/Discussion
Natural forces including sun, volcanoes and the El Nino Southern Oscillation (ENSO) have strong short term effects on global temperature. However, the long warming trend is driven predominantly by atmospheric CO2 concentration. The apparent slowdown in global warming from 2000 to 2014 can be explained by the cyclical pattern of the ENSO.

Summary Statement

A climate model incorporating carbon dioxide and natural forces can accurately predict annual global mean temperature anomalies.

Help Received

Name(s)	Project Number
Julianna Manseau; Ameila Ussat	**S1108**

Project Title

The Effects of Vegetation and Urbanization on Bird Abundance

Abstract

Objectives/Goals

We monitor the bird species of San Lorenzo Valley High School in order to compare the diversity and abundance of birds in garden and urban settings. We categorize our sites as garden or urban based on the amount of foliage in each plot. Our null hypothesis is that the bird abundance will not be affected by vegetation level of the plot.

Methods/Materials

For our study at the high school, we designated six circular, fifty meter radius plots (three urban and three garden) separated by at least one hundred fifty meters to avoid duplicate bird counts. A bird is recorded in our data sheet, if the bird is heard, seen, or flushed from the plots. We also record abiotic factors at each plot, including temperature, wind speed, cloud cover and noise level.

Results

We have been monitoring since late October 2015, and our results do not indicate greater abundance of birds in garden plots. In consideration of the results, they do however indicate a strong correlation between bird abundance and distance from highway as well as bird abundance and distance from forest. This presents the new null hypothesis that there is no causation between bird abundance and distance from forest and bird abundance and distance from highway.

Conclusions/Discussion

As birds are key indicator species, this project informs us about the diversity of species and the environmental health of our campus. We hope that with further data this information found on bird abundance correlation with the forest and highway can be used with the information found on garden and urban areas affecting bird abundance to inform city planners on what types of vegetated areas are needed in rural areas, like the San Lorenzo Valley High School, in order to maintain a healthy bird abundance.

Summary Statement

In monitoring the birds at San Lorenzo Valley High School there have been correlations discovered between bird abundance and distance from highway as well as forest, and these abundances appear unaffected by if the plot is garden or urban.

Help Received

The school AP Environmental Science teacher explained how to set up the monitoring project, and has assisted with focusing the project on a specific bird topic. Additionally, she set us up with the mentors of Jeff Smith and Alex Rinkert. They have assisted in giving insight on poster set-up, what graphs to use,

Name(s)	Project Number
Evan A. Patel	**S1109**

Project Title

Intertidal Acidification: A Study on Local Adaptation

Abstract

Objectives/Goals

The implications of ocean acidification on marine organisms, specifically intertidal relationships, are vast. As the acidity of ocean waters increases, we find severe impacts on populations of marine animals. Calcifying organisms are especially affected as dropping pH levels hinder their ability to protect themselves. The purpose of this research is to determine the role of evolution in this changing environment and to examine phenotypic changes in mussel shells along the US West Coast to explore the evolutionary capacity of these marine intertidal organisms. We seek to determine the role of evolution in this changing environment.

Methods/Materials

Used equipment at UC Santa Cruz Joseph M. Long Marine Lab for experiment(High Resolution cameras, point micrometers, JMP Pro computer program for data analysis). Analyzed 432 mussel shells collected from US West Coast. Collected mussels from four sites with varying ocean pH levels. Used my own Macbook Pro computer.

Results

I found that there was significant deviation in physical traits of mussels found in lower pH waters in the north from the standard set by the three higher pH waters in the south. Through the analysis of these physical traits we were able to compile convincing evidence that local adaptation may be occurring in regions significantly impacted by ocean acidification.

Conclusions/Discussion

As ocean acidification moves to the forefront of global issues, it is important to examine the extent to which such a change will impact our world. The tolerance of organisms to adapt to acidifying conditions is crucial in forecasting the ramifications of climate change. This study helps deepen our understanding of climate change through evolution and determine how drastic a change it will bring to marine organisms.

Summary Statement

I examined the impact of ocean acidification on the California Mussel, M. Californianus, by analyzing shells and determined that there is a definite possibility that marine organisms are adapting to dropping ocean pH levels.

Help Received

I received help from my mentor, Gina Contolini, a graduate student at UC Santa Cruz. My parents played a huge role with support and transportation to the lab over the summer. My Honors Biology, Honors Physics, and AP Language and Composition teachers all helped review my paper I wrote on the research.

Name(s)	Project Number
Madeline J. Song	**S1110**

Project Title

El Betweeno: Morisita-Horn Index Correlates Rainfall Variability with Crop Yield

Abstract

Objectives/Goals

The 2015-2016 El Niño is predicted to be one of the strongest of its kind since it its devastating 1997-1998 occurrence. This project uses Morisita-Horn Index (Morisita's) as a novel approach to conducting spatial analysis of rainfall trends. This project has three goals: 1) create a computer program that conducts spatial analysis of color-coded rainfall maps, 2) apply Morisita-Horn index to processed maps in order to analyze year-to-year rainfall variability, and 3) use crop yield data along with Morisita's-derived rainfall variability to predict crop yield following the 2015-2016 El Niño.

Methods/Materials

Rainfall maps (United States, 2009, 2010, 2014, 2015) were downloaded from the National Weather Service's precipitation database and yearly crop yields were obtained from the United States Department of Agriculture Crop Summaries (2011, 2015). The Multi-Step Color Detection Computer Program was written for this project in order to process existing data (rainfall maps) into a user-friendly tool capable of utilizing Morisita's in spatial analysis. This multi-step computer program includes gridding, color detection/classification, and calibration.

Results

4 gridded maps were generated and used for image analysis and color classification. 16 color algorithms were generated and tested for accuracy in image analysis of rainfall maps. 19 prediction ratios were generated to predict crop yields following the 2015-2016 El Niño storm.

Conclusions/Discussion

This project provides farmers and consumers with a user-friendly tool which they can use to plan and undertake timely interventions before potentially devastating changes in climate and food security. For many individuals across the world, climate volatility is a direct cause of food insecurity. This project unites mathematics, computer science, agricultural science, and climatology in hopes that collaboration between different fields can accelerate the global fight against world hunger.

Summary Statement

Morisita-Horn Index was applied to rainfall maps with use of computer image analysis software in order to analyze the effects of rainfall variability on crop yields in the years following the 2015-2016 El Niño.

Help Received

Name(s) Ashley Welch; Maxwell Zinkievich	Project Number **S1111**

Project Title

El Nino's Effects on San Lorenzo Valley's Atmospheric Inversions

Abstract

Objectives/Goals

The purpose of our project is to compare atmospheric inversion events in the San Lorenzo Valley during El Nino and non El Nino years, and to identify the differences in atmospheric stratification as well as particulate matter (PM 2.5) counts. We wanted to observe the atmospheric changes that the El Nino weather patterns would do to the formation and intensity of atmospheric inversions in the valley.

Methods/Materials

To accomplish this, we launched iMet radiosondes from San Lorenzo Valley High School, which is located in San Lorenzo Valley, carried by 200 gram weather balloons into the atmosphere. We then analyzed the data that we collected to see if an inversion was present, and then to see what the specific characteristics of that inversion were.

Results

After we had collected a substantial dataset, we compared the major characteristics of the inversions from an El Nino year, to a non El Nino year, using past datasets that were collected at the same local. For these two data sets, we were able to clearly see the differences in inversions between the years.

Then, we were able to access a BAM (Beta Attenuation Monitor) located on San Lorenzo Valley#s Tri-School campus to see the differences in PM 2.5 accumulation due to inversions over time.

Conclusions/Discussion

From the data sets that we have collected, both from the radiosonde launches, as well as from the BAM, we can say that the atmospheric effects of El Nino are that inversions occur less often and when they do, they do not have their normal intensities and because of this, trap smaller amounts of pollutants in the atmosphere.

Summary Statement

Our project compares the difference between atmospheric inversions occurring in an El Nino year to those occurring in a non El Nino year.

Help Received

Name(s)

Albert J. Zhai

Project Number

S1112

Project Title

A Web-based Global Plant Productivity Information System

Abstract

Objectives/Goals

The objectives of this project are to:
Deliver near-real-time global plant productivity information from NASA's OCO-2 satellite to average farmers and researchers.
Assist farmers in spotting early signs of plant stress and improving agricultural efficiency.
Improve understanding of plant productivity responses to weather and climate variabilities.

Methods/Materials

Solar-induced-fluorescence (SIF) is the near-infrared light re-emitted by plants during the process of photosynthesis. It has been found to represent the total productivity of a plant more accurately than the commonly used measure of the amount of chlorophyll present. The NASA OCO-2 satellite mission, launched in July 2014, provides global CO_2 and SIF measurements. However, the SIF measurements are not easily accessible to ordinary people and their interpretation requires prior knowledge. I wrote Python scripts to process 18 months of OCO-2 SIF data from September 2014 to February 2016 into gridded arrays. Then, I assembled them into a web-based data portal that I built myself via Python (for the handling routine) and JavaScript (for the user interface). A virtual globe was implemented to allow users to conveniently obtain the SIF values on any date and at any location on the Earth. In addition, the abnormality of SIF compared to historical means and its temporal variation are also displayed in the webpage.

Results

The data portal I created enables ordinary people to efficiently examine plant productivity trends around the world. Using my portal, I found that there are large plant activity differences between an El Niño year and a normal year in multiple areas. Also, they match the precipitation reponses to the El Niño in those areas.

Conclusions/Discussion

This web-based GPPIS is useful for informing farmers about crop health, guiding water and nutrient use, improving regional farming practice and enhancing agricultural productivity. In addition, it is useful for scientists to understand the factors that influence global plant productivity. It is a direct application of NASA satellite data and has immediate benefits for drought monitor and water resource management.

Summary Statement

I built a web-based data service to allow general users to monitor plant productivity all around the globe.

Help Received