# CALIFORNIA STATE SCIENCE FAIR
## 2009 PROJECT SUMMARY

**Name(s)**
Ronit B. Abramson

**Project Number**
**S1701**

**Project Title**
# Cell Wall Formation from Marine Diatom Protoplasts: Implications for Novel Transformation and Nanotechnology Techniques

**Abstract**

**Objectives/Goals**
Biosilification, or the biological processes responsible for silica deposition, is of growing interest in many fields of study from marine biology to nanotechnology. Since diatoms can so readily make three-dimensional intricate structures that exceed current synthetic methods, investigation of diatom cell wall development offers applications in microengineering, photonics, and nanotechnology. Diatoms also have shown potential as a source of lipids for biodiesel. However, diatom research is impeded because access to the cellular DNA is obstructed by the silica cell wall. The purpose of this research is to (1) study the biological processes of frustule development from the protoplasts of the marine diatom Nitzschia alba and (2) establish procedure for protoplast growth and regeneration. This information regarding structure formation may be used to aid development of more efficient biomimetric designs in future research.

**Methods/Materials**
In this study, the marine apochloratic diatom Nitzschia alba was induced to grow without a cell wall using a silica-starved media, L+2%, consisting of 0.5% bacto-yeast extract, 1% bactotryptone, and 2% sodium chloride. Rapid agitation was necessary to induce frustule divergence. The resulting protoplasts were then harvested and transferred to an artificial seawater media with PDMPO, a silica fluorescence stain. The cell wall regeneration was observed for pattern and growth comparison after 24 and 48 hour time periods using an epifluorescence microscope.

**Results**
A successful procedure was developed to induce protoplast growth in the diatom species Nitzschia alba and these protoplasts were shown to be viable cells. The cell wall was regenerated into wild-type morphology form and shown to reproduce through multiple successive generations (viewed via silica staining) from the protoplast form.

**Conclusions/Discussion**
It was determined that viability was maintained through the protoplast procedure as evidenced by the complete regeneration of the cell wall with wild-type morphology through multiple generations. Further investigation is required to establish genes responsible for independent steps of cell wall formation but the implications suggest the potential for an alternative gene transformation technique and pave the way for further studies of diatom cell wall development.

**Summary Statement**
This study developed a procedure for growing the diatom species Nitzschia alba without its cell wall and proved that the resulting protoplasts are viable and regenerate their cell walls in the wild-type morphology.

**Help Received**
Used lab equipment at Scripps Institution of Oceanography under supervision of Dr. Mark Hildebrand (but research conducted independently)

# CALIFORNIA STATE SCIENCE FAIR
# 2009 PROJECT SUMMARY

**Name(s)**

**Shilpa P. Argade**

**Project Number**

**S1702**

**Project Title**

## Correlating Genetic Signatures with Surface Sugar Expression in Vibrio vulnificus

**Abstract**

**Objectives/Goals**

Vibrio vulnificus is a gram-negative bacterium found in warm coastal waters. Infections caused by V. vulnificus have a high mortality rate (up to 55%), and most die within 48 hours of hospital admission.

Sialic acids (Sias) are a diverse family of 9-carbon sugars found on the outermost ends of glycan chains in mammals. Some pathogenic bacteria express Sias on their cell surfaces as part of complex polysaccharide structures, such as the capsular polysaccharide (CPS). These Sia-decorated polysaccharides allow the bacteria to evade detection by the immune system. V. vulnificus has been shown to express a CPS. In the Sia biosynthetic pathway, NeuB is the gene responsible in the biosynthesis of Neu5Ac, the most common form of Sia. NeuA encodes the enzyme needed to activate Sia (Neu5Ac to CMP-Neu5Ac).

Based on available genome sequences of two different strains (CMCP6 and YJ016), I hypothesized that V. vulnificus will express Sias or closely related structures that may be directly related to virulence. There may be a correlation between the clinical or environmental status of V. vulnificus isolates and the level of Sia expression, where virulent strains have high levels and environmental strains have low levels of Sia.

**Methods/Materials**

Nineteen strains of V. vulnificus were selected from a larger library of isolates for which sequence data of the Sia biosynthetic genes had been characterized. These nineteen strains along with five controls were analyzed for their relative Sia content using DMB-HPLC. 2-Keto-3-deoxyoctulosonic Acid (Kdo) was used as an internal control in order to normalize Sia values. The Sia/Kdo ratio was then calculated to determine the relative Sia expression by each strain.

**Results**

The results show that the 7 strains that had a NeuA gene similar to CMCP6 had high Sia expression (an average of 85.59) suggesting that there is a function of the CMCP6 gene that is necessary in order to express Sias at high levels. In striking contrast ($p$-value $< .01$), the 8 strains that had YJ016-like NeuA genes expressed low levels of Sias (an average of 0.26).

**Conclusions/Discussion**

This project has demonstrated a direct correlation between a CMCP6-like NeuA gene, and high Sia expression. It is known that Sias play an important role in host-pathogen interactions. Thus, drugs that block the biosynthesis of Sias in Vibrio vulnificus may be an effective treatment for this highly virulent infection.

**Summary Statement**

I found a correlation between the presence of a certain gene in Vibrio vulnificus and the expression of Sialic Acid, which could potentially tell scientists how virulent a strain is.

**Help Received**

Dr. Amanda Lewis supervised my research; Used lab equpment at UCSD in Dr. VIctor Nizet's Lab.

# CALIFORNIA STATE SCIENCE FAIR
## 2009 PROJECT SUMMARY

**Name(s)**
Kyle Jones; Ali Lanewala; Tisa Barrios Wilson

**Project Number**
**S1703**

**Project Title**
# Algae Oxygen Production in the Salton Sea

**Abstract**

**Objectives/Goals**
This experiment's objective was to test the different levels of phosphorus on the oxygen production of algae in order to determine if it is a major contributor to the lack of oxygen in the Salton Sea.

**Methods/Materials**
Materials:
Four, 5 Gallon buckets to hold the water and algae. One Triple beam balance to weigh the algae prior to placement in the buckets. Twenty-Five grams of each Miracle grow 24% phosphorus Fertilizer, Miracle Grow 18% phosphorus Fertilizer, and Vigora 4.0% phosphorus Fertilizer to put in different buckets with the water and algae.

**Results**
The Vigora 4.0% phosphorus Fertilizer had the least effect on the oxygen production of algae.

**Conclusions/Discussion**
We concluded that the 4.0% phosphate solution has the least effect on the oxygen levels as was predicted by this experiment's hypothesis, while the higher concentrations had a much larger effect, causing an expedited loss of oxygen.

**Summary Statement**
To determine if the phosphorus in the agricultural run off has an effect on the oxygen production in the Salton Sea

**Help Received**
Jeff Jones drove us to the Salton Sea. The Salton Sea authority gave us an initial tour.

# CALIFORNIA STATE SCIENCE FAIR
## 2009 PROJECT SUMMARY

**Name(s)**
Chingiz R. Bigalimov

**Project Number**
**S1704**

**Project Title**
## Can Fresh Garlic Prevent Fungi Growth?

**Abstract**

**Objectives/Goals**
The purpose of my experiment is to test if freshly squeezed garlic could prevent the fungi growth as it has been claimed in some scientific research.
Hypothesis: If I add Garlic to a fungi solution (Saccharomyces Cereviae), then the fungus will grow slower or stop growing at all.

**Methods/Materials**
#Freshly squeezed garlic 10 gm; Saccharomyces cereviae; Sugar; Pipettes; Scale; 20 x 10ml Graduated Test Tubes (10 tubes per control group and 10 tubes per experimental group); 1 x 20 ml Graduated Test Tube; Digital Camera; Equipment to measure the release of CO2: basin filled with water,test tube on ring stand clamp fixed on the edge of the basin, 20 ml graduated testing cylinder to gather and measure the released gas, plastic tubing (approximately 1 foot long)

**Results**
Measurement of CO2 Released (ml)
Tube # Control Group Treatment Group
Tube 1 2 3
Tube 2 3 1
Tube 3 3 2
Tube 4 2 1
Tube 5 3 2
Tube 6 2 2
Tube 7 3 1
Tube 8 2 2
Tube 9 2 2
Tube 10 3 2
Mean 2.5 1.8
Standard Deviation 52.70% 63.25%; Variation 0.28 0.40; T-Test (1 tail, type 1) 0.022.
Hypothesis Testing: We see that the mean of the treatment group is lower than the mean of the control group. To test if the difference is statistically significant, I applied one-tail T-test, which takes into account not only the difference between the means of the two samples, but also the difference of their variability. My hypothesis is that at 5 % significance level (á=0.05) the mean of the treatment group is lower than the mean of the control group, that is why I used one-tailed test. I claim that the difference is

**Summary Statement**
The purpose of my experiment is to test if freshly squeezed garlic could prevent the fungi growth as it has been claimed in some scientific research.

**Help Received**

# CALIFORNIA STATE SCIENCE FAIR
## 2009 PROJECT SUMMARY

**Name(s)**
Michelle Chan; Viviane Nguyen

**Project Number**
**S1705**

**Project Title**
# Smack That Thing! Investigating the Transmission of E. coli to Apples through Houseflies

**Abstract**

**Objectives/Goals**
We have all experienced it. We have all seen a fly buzzing around the house, and reach for the fly swatter - almost by instinct. But how much harm is already done within those few seconds the fly manages to land on a surface? Considering ourselves as devoted fly-haters, we were inspired to conduct an experiment to see how much bacteria a fly can deposit on one of the few vulnerable and unprotected fruits - apples. We also wanted to emphasize the importance of washing fruits before eating and therefore incorporated that into our experiment: how can the transmission of the bacteria E. coli in houseflies be prevented through rinsing contaminated apples? After conducting research, we hypothesized that rinsing the apples in cold tap water for 20 seconds would reduce the bacteria count by 90%.

**Methods/Materials**
In order to test this claim, we bought houseflies and exposed them to E. Coli through their culture medium and recreated a stimulation of the flies landing on the apples' surface. The control group consisted of apples that were not exposed to the flies, the second group consisted of apples exposed to the flies, and the third group consisted of contaminated apples soaked in tap water for 20 seconds. We used an inoculating loop to transfer a sample of bacteria from each slice onto a Petri dish and then observed their colony growth every 24 hours for 48 hours.

**Results**
All in all, our hypothesis proved to be correct, with the Petri Dishes containing the apple slices that were not rinsed after fly exposure displaying the most growth and that count was reduced significantly after the cleanse by nearly 8 times. The percent increase from the control apples to the fly exposed apples was 94%. The percent decrease from the fly exposed apples to the washed apples was 87%, therefore proving our hypothesis to be correct.

**Conclusions/Discussion**
The results of our experiment reflect that rinsing our fruits does reduce the likelihood of an E. coli outbreak. These findings will raise awareness about the amount of bacteria a fly can deposit within seconds of landing and make people more conscientious when washing their fruits before consuming them. Although rinsing your fruits with cold water does drastically reduce to probability of ingesting E. Coli, it is not 100% reliable - so when in doubt, throw it out. Next time you see a fly buzzing around your food, grab a fly swatter and smack that thing!

**Summary Statement**
Our project investigates the role that houseflies play in transmitting E. coli to an apple and the affect that rinsing the apple has on its E. Coli count.

**Help Received**
Conducted experiment under supervision of teacher Angie Nguyen.

# CALIFORNIA STATE SCIENCE FAIR
# 2009 PROJECT SUMMARY

**Name(s)**

**Kelly Chesus; Joanna Coker**

**Project Number**

**S1706**

**Project Title**

## Phytoplankton Populations: Prospering or Perishing?

**Abstract**

**Objectives/Goals**

Through this project, we hope to determine the most favorable conditions for phytoplankton survival in the Santa Cruz Harbor. We believe these conditions to include higher temperatures, higher salinity, and lower turbidity (cloudiness).

**Methods/Materials**

Twice a month we collect a sample of phytoplankton from the Harbor using a three-foot mesh net and record the environmental factors of temperature, salinity, turbidity, and several others. We analyze the samples with a compound microscope to identify the individual species and determine abundance. We then graph our data in order to determine the relationship, if any, between species populations and the recorded factors.

**Results**

Our data has led us to believe that a lower turbidity and higher temperatures are beneficial factors contributing to phytoplankton growth.

**Conclusions/Discussion**

We believe that a lower turbidity increases phytoplankton growth because it allows sunlight to penetrate further into the water, thereby increasing photosynthesis and the phytoplankton's ability to reproduce. A higher temperature might do likewise because it would increase the rate of biological reactions within the phytoplankton, increasing their reproduction rate in a certain amount of time. From our data, we may be able to predict the occurrence of toxic phytoplankton blooms such as red tides. This project was made possible by: Gregg Langlois and the California Department of Health, Susan Coale of University of California Santa Cruz, and Jane Orbuch of San Lorenzo Valley High School.

**Summary Statement**

The goal of our project is to determine what specific environmental conditions are favorable to phytoplankton growth.

**Help Received**

Used microscopes and cameras at San Lorenzo Valley High School under the supervision of Jane Orbuch, teacher. Received some advice and reference samples from Gregg Langlois, employee of California Department of Health, and Susan Coale, researcher at University of California Santa Cruz.

# CALIFORNIA STATE SCIENCE FAIR
# 2009 PROJECT SUMMARY

**Name(s)**

Alex Co; Grant King

**Project Number**

**S1707**

**Project Title**

## How to Keep the Dentist Away

**Abstract**

**Objectives/Goals**

We hoped to determine the effects of various foods on the growth of oral bacteria, consisting primarily of Streptococcus Mutans, seeing which advanced their growth and which inhibited it providing a clear picture of bacterial nutrition and oral health.

**Methods/Materials**

In order to test oral bacterial growth, we began a starting culture with bacterial colonies from plaque. We put them into a flask full of liquid Luria broth which we then allowed to grow. After there was enough bacterial growth, we poured the culture in each Petri dish, added the chemical, and allowed it to grow in an incubator at 37C. After 24 hrs of growth, we measured the absorptance in a spectrophotometer. To make the results more accurate, we then subtracted the absorption of a blank with only Luria broth and the chemical added from the data we collected.

**Results**

The results were varied providing a picture of the diverse nutritional needs of the bacteria we tested. Acids and bases were agreed with our expectations, for the most part decreasing growth as we predicted. Carbohydrates, though, defied our beliefs: white sugar posted only moderate growth. Salts, too, decreased growth, iodized salt especially, due perhaps to the toxicity of iodine. Surprisingly, fats also led to a great decimation of population. This can be attributed to the complexity of triglycerides, especially saturated fats. These findings were echoed in proteins. Spices were more varied in their results, with only one posting a clear decrease: turmeric. Vitamins were a mixed bag as well. Vitamins A and C increased growth, B was neutral, and D and Calcium led to great death. Finally, we tested toothpaste as well. It led to zero growth at all three concentrations, validating its reputation. Our homemade toothpaste was not as successful, yielding moderate decreases at all three levels.

**Conclusions/Discussion**

As a result, we were able to see what foods were beneficial and detrimental for oral health as well as what nutrients Streptococcus primarily feeds on. We discovered Vitamins A and C, orange juice, etc. advanced bacterial growth, while some like proteins, fats and salts were damaging to the bacteria, and therefore advanced our health. Others were more neutral like cumin, black pepper, and Vitamin B having little effect. In conclusion, we were able to ascertain much information on Streptococcus' metabolism abilities.

**Summary Statement**

We tested the effects of different foods on oral bacteria and observed which chemicals impeded and encouraged bacterial growth, in order to determine the bacteria's metabolism and nutrional needs.

**Help Received**

Dr. Malhotra supervised all of our lab work as well as offered feedback on experimental ideas and processes; Dr. Osslund from Amgen and Dr. Jiang from Baxter provided us with Luria Broth; Mr. Hoag gave us equipment and taught us how to properly use it

# CALIFORNIA STATE SCIENCE FAIR
## 2009 PROJECT SUMMARY

**Name(s)**
Kira A. Cozzolino

**Project Number**
**S1708**

**Project Title**
# The Effect of Colloidal Silver Concentration on the Diameter of the Zone of Inhibition Produced on Escherichia coli

**Abstract**

**Objectives/Goals**
This experiment examined the question: #What is the effect of colloidal silver concentration on the size of the zone of inhibition produced on Petri dishes inoculated with Escherichia coli?# and was conducted to test how effectively different dilutions of colloidal silver inhibited bacterial growth. The hypothesis was: #If circles of filter paper dipped in colloidal silvers of varying concentrations are placed on Petri dishes that have been inoculated with the bacterium Escherichia coli, then the colloid with the highest concentration will produce the largest zone of inhibition.#

**Methods/Materials**
Seventeen pre-poured nutrient agar Petri dishes were inoculated with Escherichia coli. Each Petri dish was divided into quadrants, and sterilized filter paper disks infused with colloidal silver of either 50, 25, or 5 ppm were placed in the center of three quadrants of each Petri dish. The fourth quadrant contained a filter paper disk that had been sterilized and was not infused with any substance. After 48 hours incubation, the zones of inhibition around each filter paper disk were measured in millimeters, recorded, and compared.

**Results**
In all 17 trials, the quadrants containing the control disk contained no zones of inhibition. The quadrants containing the 25 and 5 ppm colloidal silver contained zones of inhibition in nine out of 17 trials. The quadrant containing the 50 ppm colloidal silver only contained a zone of inhibition in two of the trials. On average, the zone of inhibition produced by 25 ppm colloidal silver was ten times larger than that produced by 50 ppm colloidal silver, and three times larger than that produced by 5 ppm colloidal silver.

**Conclusions/Discussion**
The gathered data does not support the original hypothesis, as the colloid with the highest concentration produced, on average, the smallest zone of inhibition. Though it appears that colloidal silver does have an inhibiting effect on bacterial growth, and concentration does matter, a higher concentration does not necessarily create a larger zone of inhibition. It appears that there is an optimum range for colloidal silver concentration, though more experiments would be required to confirm this.

**Summary Statement**
This experiment set out to determine which concentration of colloidal silver could produce the largest zone of inhibition on Escherichia coli.

**Help Received**
Biology teacher helped obtain materials and finalize report, used equiptment at school.

# CALIFORNIA STATE SCIENCE FAIR
# 2009 PROJECT SUMMARY

**Name(s)**

**Emily A. Dellinger**

**Project Number**

**S1709**

**Project Title**

## Got Clean Water? Studying the E.coli and Coliform Count in Mission Bay and How It Affects Rowers

**Abstract**

**Objectives/Goals**

The objective was three-fold:1)test the Coliform and E. coli counts at three sites in Mission Bay 2)evaluate the health of rowers who frequent the waters at these three sites 3)correlate the findings of the water samples with the results of the rower health surveys.

**Methods/Materials**

3 water samples were taken at 3 locations for a total of 9 samples on 9 days. Sites were where rowers entered the water. Days varied in tem and tide conditions. Samples were taken at high/low tides. Testing method Quanti Tray 2000 was used;provides fast/accurate counts of Coliforms and Fecal Coliforms in marine water. The water was processed using a 1:10 dilution. Agar was added and incubated for approx 18 hrs. Results were read and recorded.Health Surveys: A rower health survey was distributed to 5 local rowing clubs, based on voluntary participation. The questions were decided upon after researching common symptoms that may develop after exposure to Coliform and Fecal Coliform native to Mission Bay and those commonly complained of at one club were added to eval if other rowers had similar complaints.

**Results**

Ca. State Standards for samples of marine water for Coliforms should not exceed 10000 organism/100mL of water.This study found the levels within this standard. Ca. State Standards for Fecal Coliforms should not exceed 400 organisms/100mL of water. Over 50% of the time(5/9 days)those standards were exceeded at 1,2,or all sites. Rower health surveys:top five symptom complaints for rowers were: dry skin on legs, rash on legs, cuts that won#t heal, increase in colds and increase in appetite. Over 50% of the rowers who answered these surveys had at least two of the symptoms. Rowers who had been rowing < 1 yr had different symptoms (skin rashes and colds) than rowers that had been rowing for > 1 yr. (cuts that would not heal and dry/itchy skin).

**Conclusions/Discussion**

This study tested for indicator bacteria in the waters of Mission Bay. It may be suggested that higher levels of indicator bacteria offer higher health risks. Rowers from all over San Diego, with little in common beside entering Mission Bay waters 5-7 days/wk, offers highly suggestive correlations. alhough it cannot be directly stated that the samples taken were the cause of all the rowers physical symptoms, it can be speculated that they are related. It may be suggested that more beach clean up and water monitoring programs be instituted to keep the bay safe.

**Summary Statement**

Water testing in Mission Bay and it's possible relationship to the health of local rowers.

**Help Received**

Mother and sister typed report. Justin Hohn from San Diego Coast Keepers lent equipment and expertise.

# CALIFORNIA STATE SCIENCE FAIR
# 2009 PROJECT SUMMARY

**Name(s)**

Joshua Hoskinson; Kirt Shelat

**Project Number**

**S1710**

**Project Title**

## The Effectiveness of Allicin on Escherichia coli

**Abstract**

**Objectives/Goals**

The objective of the project was to see if allicin, a natural antibiotic found in garlic, kills the bacterium Escherichia coli as well as penicillin.

**Methods/Materials**

First the agar was made using 23 grams of nutrient agar and it was poured into a liter over water and was set over a hot plate until it boiled. Then we poured the agar solution into each of the 20 sterilized petri dishes and waited 1 day to harden. Then we took the 1 mL of live E.coli, took an inoculating loop, and swabbed E.coli from the vial and into each of the 20 petri dishes and let the E.coli grow for 1 week. After that, we made the allicin solution using 5 garlics, 50 mL of mineral oil, and 100 mL of water, and then waited until the allicin rose to the top. Then we put 1 mL of allicin solution on 10 petri dishes and 1 mL of penicillin solution on the other 10.

**Results**

The petri dishes that were treated with the penicillin solution did about 10% better than the petri dishes treated with the allicin solution, proving that allicin is a potential alternative to penicillin.

**Conclusions/Discussion**

Throughout the course of this investigation, it was found that allicin in fact did kill the bacterium E. coli as well as penicillin; however penicillin killed slightly more E.coli colonies. With this conclusion, it is found that allicin is as powerful as penicillin and could be used as an alternative to penicillin in developing countries that do not have modern medicine, especially those countries that have used penicillin, but the bacteria has developed a resistance to the medicine.

**Summary Statement**

The project is to find out if allicin kills E .coli as well as modern medicine or not.

**Help Received**

Vijay Shelat received the penicillin solution; Kristine Jennings helped to put E. coli onto the petri dishes; Michelle Hampton helped with the formatting of the board

# CALIFORNIA STATE SCIENCE FAIR
## 2009 PROJECT SUMMARY

**Name(s)**
Kevin R. Kaufmann

**Project Number**
**S1711**

**Project Title**
# Virus-Based Lithium Ion Batteries

**Abstract**

**Objectives/Goals**
This project was done to create fully functional nanowires that could be used as a battery electrode. An objective is that the synthesized nanowires be uniform in structure.

**Methods/Materials**
A bacteriophage (a virus that specifically infects bacteria) is used as a template for creating precisely positioned materials. The bacteriophage becomes a template when the functionality of certain proteins are changed through genetic modifications in the M13 bacteriophage's genome. Because of the addition of a tetraglutamate to a specific protein, FePO4 will bind to the phage. The resulting clone is named E4.

**Results**
The nanowires formed by binding FePO4 to the E4 phage are more environmentally friendly and less costly to make than existing FePO4 battery components. The FePO4#E4 battery is almost completely biodegradable also. The only part of the battery not biodegradable is the electrolyte. The virus-based batteries could hold any voltage, except that the electrolyte for lithium ion batteries is only stable from approximately 1 volt to 5 volts. The virus-based batteries are also rechargeable, meaning they are not just one use.

**Conclusions/Discussion**
These virus-based batteries are both environmentally friendly and economical. They will last longer than other commercially available batteries and help to create less waste for the future. The nanowires can be used to build batteries applicable to most aspects of life requiring a power source.

**Summary Statement**
Genetically modifying a bacteriophage to produce nanowires for a battery electrode.

**Help Received**
Used lab equipment at Massachusetts Institute of Technology under the supervision of Professor Angela Belcher and Mark Allen PhD.; Neighbor Eric Acree helped with wire display; photos taken by Diane M. Kaufmann

# CALIFORNIA STATE SCIENCE FAIR
## 2009 PROJECT SUMMARY

**Name(s)**
Emelia E. Maglieri

**Project Number**
**S1712**

**Project Title**
# Effectiveness of Different Materials In Preventing the Transmission of Airborne Material

**Abstract**

**Objectives/Goals**
The purpose of my science project is to determine which material blocks the most amount of bacteria when sneezing. The reason that I am doing this investigation is to figure out which material is most effective in stopping the spreading of bacteria. Everyone is concerned about health and no one wants to get ill. People are buying the product Airborne and taking vitamin C to keep them from getting viruses. What if using a simple handkerchief could stop others from getting infected.

**Methods/Materials**
I am using seven different types of materials in my investigation. The materials are a paper towel, napkin, tissue, a cloth handkerchief, and a bandana handkerchief. I will inoculate a nutrient broth with Bacillus Substillus.
I plan to spray the Bacillus Substillus in a spray bottle at a two inch distance through the seven different materials onto a Petri dish. I will repeat this 10 times per material. The Petri dish will have agar and the bacteria will grow for 48 hours. I will count the bacteria colonies using a centimeter grid transparency and figure out which material is most effective in blocking the spread of bacteria. I will count the bacteria in 5 squares and multiply that number by 10. There are 50 squares on the centimeter grid that cover the petri dish. I will than average the amount of bacteria on the 10 petri dishes counted for each material.
In the control group I will not use any material to block the spray of the Bacillus Substillus.

**Results**
After my investigation I learned that the napkin was the most effective material in blocking the bacteria from spreading. The petri dish with the bacteria had an average count of 9 bacteria colonies.
After completing my investigation, I found that my hypothesis was incorrect. My hypothesis stated that the bandana would be the most effective material in blocking the spreading of bacteria but it was in fact the one of the least effective materials. The bandana had an average bacteria count of 970.

**Conclusions/Discussion**
The Petri dish with the bacteria from the bandana and the scotchguarded handkerchief had the most bacteria. The paper towel had a count of 25 bacteria colonies, and the tissue had 266 bacteria colonies. The washed handkerchief had 958 bacteria colonies and the cotton handkerchief had 945 colonies.
In conclusion people should use a napkin when sneezing to stop the spreading of bacteria.

**Summary Statement**
My experiment tested which material effectively blocked bacteria from spreading in a sneeze.

**Help Received**
Mom helped type.

# CALIFORNIA STATE SCIENCE FAIR
# 2009 PROJECT SUMMARY

**Name(s)**

**Raman V. Nelakanti**

**Project Number**

**S1713**

**Project Title**

## Inducing Anaerobic Conditions for Hydrogen Production in Chlamydomonas reinhardtii

**Abstract**

**Objectives/Goals**

With the world facing an enormous energy crisis, it is necessary to develop renewable energy sources. Chlamydomonas reinhardtii is a potential source of renewable hydrogen energy, but its use is practical only if vital steps in the hydrogen evolution process are improved. The requirement for anaerobic conditions is a major obstacle for hydrogen production by these algae in real world applications. The objective of this experiment was to explore anaerobic hydrogen production using sulfur deprivation to initiate anaerobic conditions.

**Methods/Materials**

The algae were cultured in TAP media with four different concentrations of sulfur. Oxygen concentration and cell density was measured over a 140-hour period. Additionally, a fuel cell was implemented to determine the amount of hydrogen energy the algae were producing.

**Results**

There was a statistical difference in the rate of oxygen consumption across the various concentrations of sulfur. Algae cultures with 6.727mM and 13.455mM sulfur had the greatest rates of oxygen consumption, compared to the control with 20.182mM and the group where no sulfur was added.

**Conclusions/Discussion**

Sulfur concentrations of 6.727mM and 13.455mM exhibited the most promising results for improving the initiation of anaerobic conditions. Sulfur deprivation inhibited algae cell growth, while concentrations of 6.727mM and 13.455mM did not. The experimental setup accounted for algae reproduction and growth in low sulfur conditions, which could help design self-sustainable hydrogen production methods using C. reinhardtii. This research proposes an alternative method for anaerobic hydrogen production by C. reinhardtii that may help the algae become a renewable energy source.

**Summary Statement**

The purpose of this study was to develop conditions that would improve the anaerobic production of hydrogen by Chlamydomonas reinhardtii for energy applications.

**Help Received**

Ms. Alonzo supervised me during my work at school; Dr. Elizabeth Harris of Duke University provided the C. reinhardtii algae and growing media; Dr. Prinz of Stanford University supervised my work with fuel cells.

# CALIFORNIA STATE SCIENCE FAIR
## 2009 PROJECT SUMMARY

**Name(s)**
Phoebe G. Ng

**Project Number**
**S1714**

**Project Title**
## Hand Washing? I'd Rather Touch a Toilet

**Abstract**

**Objectives/Goals**
This project's objective is to determine if hand washing is really necessary; and if it is, if the time spent on washing one's hands would decrease the amount of bacteria colonies grown.

**Methods/Materials**
Design a questionnaire to determine hand washing habits after bathroom use. Recruit additional interviewers and train them to conduct interviews and collect samples in a uniform manner. Study was conducted around the same school bathroom area during lunch. Every 5th student exiting the school bathroom will be debriefed on the purpose of the study and invited to participate for this research. Upon consent to participate, subjects will be asked to swipe their fingers across the surface of the agar. Subjects will be asked to fill out the questionnaire. Place all dishes in the home-made incubator. Count and record the number of bacteria colonies and the temperature over the 5- day period.

**Results**
There were a total of 118 who completed the questionnaire. 62 of the subjects were female (53%) and 56 were male (47%). Of all subjects, 51 (43%) did not wash their hands after using bathroom, 49 (42%) of the subjects rinsed, 15 (13%) subjects washed for 5 seconds, 2 (2%) subjects washed for 10 seconds, and 1 (> 1%) subject washed for 20 seconds. 34 (29%) used soap; 27 (79%) females and 7 (21%) males out of the 34 used soap.
The non-wash subjects have the highest number of colonies grown; however, the rinse subjects have a similar number of colonies, while the subjects that washed their hands for 20 seconds have the least number of colonies. However, some rinse subjects in the category have almost the same number of colonies as the non-wash group.

**Conclusions/Discussion**
The results support the hypothesis that the more time spent on washing hands produces less bacteria colonies. The categories of No Wash and Rinse produced almost the same amount of bacteria.
With gender, males were more dominant in Rinse and No Wash. Females, while still present in the Rinse and No Wash categories, tended to have better hand washing habits. Subjects who washed their hands/used soap had cleaner hands than the subjects that only washed their hands. This experimentation proved that not washing and rinsing your hands is ineffective at killing bacteria colonies that are possibly pathogenic.

**Summary Statement**
This project seeks to research after bathroom usage hand washing habits, along with the effects of time spent on washing hands and additional variables, such as gender and soap usage.

**Help Received**
Father helped dispose colonized petri dish; mother assisted with cutting the board

# CALIFORNIA STATE SCIENCE FAIR
# 2009 PROJECT SUMMARY

**Name(s)**
Connor J. Rutten

**Project Number**
**S1715**

**Project Title**
## Escherichia coli Bacterial Pollution in the Santa Rosa Watershed

**Abstract**

**Objectives/Goals**
The purpose of this experiment is to test the level of Escherichia coli (E. coli) in the local creeks of Santa Rosa and determine if the levels change according to where the samples were taken in relation to the center of town. The objective is to determine whether levels of E.Coli in the creeks are a factor of human influence and what hazard it may pose.

**Methods/Materials**
Establish appropriate sample sites to test for E. coli inputs. Observe any variables e.g. human activity, temperature, and creek flow. Make sterile collections and label. Mix one Coliscan Easygel with 5mL of sample, label and fill Petri dishes. Culture samples for 48 hours; count the number of purple/blue colonies in each Petri dish. Report results in number of E. coli colonies per 100mL of water; 100mL/5mL=20mL x # of E. coli colonies = # of E. coli colonies per 100mL of water. Compare and evaluate results from each sample and to see if the level of E. coli and its location correlates to the observed human activity.

Coliscan Water Quality Kit (30 each Easygel test bottles, Petri dishes, sterile collection bottles, and sterile 3ml droppers. rubber gloves, a black marker, map, bleach, and cooler samples.

**Results**
The data collected showed that rain was causing dispersion of E. coli bacteria. At first, E. coli concentration was high in just two locations within the watershed, but after the first rainfall it had dispersed throughout the creeks/sample sites. The data also showed a spike in the level of E. coli in Spring Creek, a creek next to a local ranch, suggesting that fecal matter had been washed into the creek by the rain. As Spring Creek intersects the mainstem of Santa Rosa Creek and progresses further into town, Santa Rosa Creek is collecting increasing levels of fecal mattern and therefore E. coli.

**Conclusions/Discussion**
The results conclude that the presence of E. coli is related to human influence and activites; E. coli concentration is influenced by stream flow. The spike in E. coli levels in Spring Creek was defining proof that human activity, in this case a ranch, largely contributed to the levels of E. coli present. E. coli concentration is affected by stream flow; E. coli dispersed during rain events, and was concentrated in the downstream samples of Santa Rosa Creek. Concentrations exceeded State drinking water standards and were high enough to be considered a heal hazard for body contact and definitely human consumption.

**Summary Statement**
My project tested for the presence of a hazardous bacterium, Escherichia coli (E. coli) in the Santa Rosa watershed and if this bacterium correlated to human activity and impacted water quality.

**Help Received**
My dad helped me to order the necessary supplies, and he also drove me around town so I could collect my my water samples.

# CALIFORNIA STATE SCIENCE FAIR
# 2009 PROJECT SUMMARY

**Name(s)**
Alexandria P. Sharpe

**Project Number**
**S1716**

**Project Title**
## Chumash Medicine: Antibacterial Properties of Native California Plants

**Abstract**

**Objectives/Goals**
My objective was to test if natvive California that the Chumash used (native American tribe)for antbiotic perpouses actually worked and if they worked better than some of the antbiotics today like Neosporin.

**Methods/Materials**
Materials:California Poppy,California Fuchsia,White Sage,Rosemary, Methanol,Water,Blade,Philter Paper,Petri Plate, ropper,Agar,Glucose, Albumin Powder,Cotton balls,Test tubes,bottles/caps,Goggles,Gloves, Bacteria, Neosporin,stirrer,Beaker,Graduating cylinder,tubing,Dichoromethanol,Steam
Procedures:Making Extracts- (1.)Cut plants a sterilized plate into fine pieces(2.)Measures the weight in grams, try to get the same test soluble in the same range when weighing.(3.)Add an alcohol or liquids,to plants that are in test tubes.Crush cut plants with a stirring rod until a shade of dark or light green appears depending on which liquid used.
(4).Separate the plant material from the extract, the plant material by filtering it with a glass pipette with some cotton in the bottom to catch the plant material leaving only the extract.

**Results**
Averages:(1.)Poppy water Soluble Average-0mm.(2.)Poppy methanol soluble Average-1mm.(1.)Fuchsia water soluble Average-0mm.(2.)Fuchsia methanol soluble Average-1.5mm.(3.)Fuchsia eight eight times plant mass methanol soluble Average-2.5mm.(1.)Rosemary water soluble Average-.3mm.(2.)Rosemary methanol soluble Average- 2.8mm.(3.)Rosemary eight times plant mass methanol soluble Average-3.8mm.(4.)Rosemary Dichlcoromethanol soluble Average-2mm.(5.)Rosemary Steam soluble Average-2mm.(1.)White Sage water soluble Average-0mm.(2.)White Sage methanol soluble Average-.5mm.(3.)White Sage eight times plant mass methanol soluble Average-3.5mm.(4.)White Sage Dichlcoromethanol soluble Average-2.3mm.(5.)White Sage Steam soluble Average-2.3mm.(1.)Methanol Control Average-0mm.(1.)Neosporin Control Average-1.6mm.

**Conclusions/Discussion**
My hypothesis was correct, some of my plant extracts did show medicinal perposes.Although using water as a solvent did not work out very well, it wasn#t able to get very much extract from the plants therefore showing little or no results. The over all average of water soluble extracts when combining all the plant observations of bacterial resistance. Overall, the plants that i used, California Poppy, California Fuchsia, Rosemary, and White Sage acted succesful and in the end my data turned out exceptionally well to help support my hypothesis.

**Summary Statement**
I used native California plants used by the Chumash, a Native American tribe, for antibiotic perposes and made extracts of the plants to see if they truly did work.

**Help Received**
o Mr. Callaway: For letting me work in his class room and taking me to the University of Channel Island to meet with Dr. Hampton. o Dr. Hampton: For letting me make the extracts and use the equipment at the University of Channel Island. o Susan Sharpe (Mom): For proof reading all my work.

# CALIFORNIA STATE SCIENCE FAIR
# 2009 PROJECT SUMMARY

**Name(s)**

**Madeline B. Sides**

**Project Number**

**S1717**

**Project Title**

## The Effect of Ocean Acidification on the Coccolithophore Species Emiliania huxleyi

**Abstract**

**Objectives/Goals**

Ocean acidification is driven by increased amounts of carbon dioxide (CO2) in the atmosphere, which has been shown to have various effects on marine life. This project aims to investigate the possible future effects of increased atmospheric concentrations of CO2 on the productivity and calcification of coccolithophores, a type of calcifying phytoplankton crucial to oceanic carbonate cycling. It was hypothesized that increasing the concentration of CO2 in the growth chambers of the coccolithophores would decrease both cell counts and calcification.

**Methods/Materials**

A strain of the coccolithophore species Emiliania huxleyi (widely used in lab studies) was grown in f/50 seawater nutrient media on a 12h light/dark cycle. Three trials of three different experimental conditions were set up in sealed 70 ml glass jars: 1. Control, containing current atmospheric concentration of CO2 (about 389 parts per million (ppm)), 2. Plus 250ppm above current atmospheric CO2 concentration (created by injecting .25ml of 5% CO2 into the 50ml headspace of the jar with a syringe through the rubber stopper) and 3. Plus 500ppm above current, made by injecting .5ml of 5% CO2. Cell counts were taken after 14 days. Calcification readings were taken by filtering and drying the samples to calculate total dry mass.

**Results**

Clear differences in cell counts and calcification were observed between the three conditions. Cell counts were 75% lower in the +250ppm CO2 condition than in the control and about 80% lower in the +500ppm CO2 condition than control. Calcification recordings showed similar variations by conditions, although the differences between the three conditions were less dramatic. The hypothesis was proven correct- increased CO2 concentration led to decreased productivity and calcification.

**Conclusions/Discussion**

The results show that increasing [CO2] in the growing environment of E.huxleyi has an effect on the population growth and calcification of this species. This means that if current CO2 emission trends continue, the productivity of a major ocean carbonate cycler could be inhibited significantly, upsetting the balance of the carbonate cycle in the open ocean. The world is at a threshold- just another 250ppm of CO2 in the next few decades could spell disaster. This research highlights the importance of awareness and planning in terms of both managing CO2 emissions and predicting future ecosystem changes in the ocean.

**Summary Statement**

This project investigates the effect of ocean acidification, driven by increased atmospheric concentrations of CO2, on the productivity and calcification of the coccolithophore Emiliana huxleyi, an import type of calcifying phytoplankton.

**Help Received**

Used lab equipment under the supervision of Dr. Douglas Nelson in the UC Davis Department of Microbiology

# CALIFORNIA STATE SCIENCE FAIR
# 2009 PROJECT SUMMARY

**Name(s)**
Curtis M. Siegfried

**Project Number**
**S1718**

**Project Title**
## The Penetration Ability of Tinea corporis (Ringworm) in Two and One-Half Hours

**Abstract**

**Objectives/Goals**
I am a wrestler, and in the past I have been infected with Tinea corporis (ringworm). The purpose of this experiment was to determine if ringworm could pentrate through a bandage in two and one-half hours. If a bandage successfully prevents the spread of ringworm, wrestlers can practice without fear of infecting practice partners.

**Methods/Materials**
Ringworm is considered potentially dangerous, therefore I used Aspergillus niger. I created four groups of five plates. The first group was Sterile Petri dishes, the second group was Potato dextrose agar, the third group was Potato dextrose agar with 10 mm2 of Aspergillus niger, and the forth group was Potato dextrose agar with 10 mm2 of Aspergillus niger and a bandage covering the Aspergillus niger. I let the plates sit for two and one-half hours then measured the amount of fungus on them using a microscope and caliper. Once I had my data, I ran an ANOVA test on it. For statistical reasons, I repeated this procedure thrice.

**Results**
The Aspergillus niger grew under the bandages and on the plates without a bandage; based on the ANOVA test there is at least a 14.99% chance that it will grow if I repeated the test. The Aspergillus niger did not grow through the bandages, therefore there is statistically a 0% chance it will grow through a bandage if I duplicated the test.

**Conclusions/Discussion**
Therefore, I concluded that Tinea corporis would grow in size under a bandage but not grow through the bandage, infecting a wrestler's practice partner.

**Summary Statement**
The prevention of the spread of Tinea corporis (ringworm).

**Help Received**
My parents proofread the report; my Biology teacher supervised the experiment; school AP Statistics teacher helped analyze the data.

# CALIFORNIA STATE SCIENCE FAIR
# 2009 PROJECT SUMMARY

**Name(s)**

**Dorothy L. Silverman**

**Project Number**

**S1719**

**Project Title**

## Effects of Calcium and Calcitriol on Plasmodial Shuttle Streaming in P. polycephalum

**Abstract**

**Objectives/Goals**

Calcium fluxes are responsible for both the oscillating shuttle streaming in P. polycephalum and the myofibril contractions in human muscle cells. Calcitriol, active Vitamin D3, is responsible for regulating calcium concentrations necessary to invoke human muscular contractions. The cytoskeleton of P. polycephalum is known to share many physical characteristics with human cells, implying it too will need a combination of calcium and calcitriol. This investigation therefore attempts to determine the effects calcium and calcitriol have on the growth area and growth rate of P. polycephalum.

**Methods/Materials**

P. polycephalum was exposed to four different chemical combinations: calcium, calcitriol, calcium and calcitriol, and water. Concentrations for the #chemical combinations# were found by scaling down the daily human doses of calcium and calcitriol. Plasmodial #test plates# were prepared with a novel plating technique using paper towels as a medium. The chemicals were sprayed onto the Petri dishes with atomizers. An #atomizer spray test# was conducted to verify that an average of 1.7 ml of solution was evenly distributed over each dish. Seven copies of each chemical combination were plated. The dishes were photographed in 2-hour intervals over a 35-hour period. The plasmodia#s area was isolated and analyzed using Photoshop and ImageJ software.

**Results**

The experiment clearly shows that a combination of calcium and calcitriol greatly increases plasmodial growth. Plasmodia exposed to a combination of calcium and calcitriol increased in area by 180%. Their growth was triple that of any other #chemical combination#. The remaining three #chemical combinations# differed from each other in growth by 2.9%. A combination of calcium and calcitriol also produced the fastest growth rate of .0222 in2/hr.

**Conclusions/Discussion**

A combination of calcium and calcitriol is optimal for plasmodial locomotion. This result further supports the theory that plasmodial shuttle streaming is driven by glycolysis. If so, the pyruvic acid produced from glycolysis could be measured to more accurately assess plasmodial activity. This experiment also demonstrates the ease with which P. polycephalum can be used to model human cells. Futures studies like this may help predict human responses to these and other drugs.

**Summary Statement**

This project was performed to determine the degree of influence calicum and calcitriol have on the horizontal shuttle streaming of the myxomycete P. polycephalum.

**Help Received**

Dr. Pollock provided double-deionized water; Ms. Andrews taught me Photoshop

# CALIFORNIA STATE SCIENCE FAIR
## 2009 PROJECT SUMMARY

**Name(s)**
Haley F. Washburn

**Project Number**
**S1720**

**Project Title**
## Do Different Juices Affect the Effectiveness of Antibiotics?

**Abstract**

**Objectives/Goals**
The purpose of my science project was to determine if different juices would help my test antibiotics create a larger are of bacterial inhibition than they would have alone. It is commonly believed that green tea, pomegranate juice, grapefruit juice, and cranberry juice are beneficial to your health, for this reason I wanted to see what would happen if I mixed them with penicillin and amoxicillin.

**Methods/Materials**
For my control I tested the antibiotics and juices individually to determine if they created an area of inhibition around the test dot. To do this I dipped an absorbent test dot in the test liquid and placed it in a petri dish that I swabbed with bacillus subtilus bacteria. After I completed my control tests I mixed 10 ml of test antibiotic and 50 ml of a test juiec in a seperate perscription container. I repeated the steps I used to test my control liquids to test my mixed liquids. Each test was completed 11 times for more accurate results. After 48 hrs and 96 hrs I measured the areas of inhibition and documented them in my log book. I had a total of 17 different test substances.

**Results**
After 48 hrs of incubation all of my mixed substances had larger areas of inhibition than the control substances. After 96 hrs the mixed test substances still had larger areas of inhibition than the control test substances, however the overall areas of inhibition were decreasing.

**Conclusions/Discussion**
Through testing I discovered that these juices did help the antibiotics create a larger area of inhibition, however, through my research I discovered that while these juices have health benefits on their own, they also contribute to negative drug interactions. I feel that further investigation is needed before drinking these juices while taking medications.

**Summary Statement**
The objective of this project was to determine if by adding juices with possible health benefits to antibiotics you then increase the antibiotics ability to fight bacteria.

**Help Received**
Dr. Mary F. Paine Ph.D., provided guidance and research information., Dr. John Inouye M.D. provided antibiotics., Professor Bert Tribbey provided guidance with ANOVA testing analysis., My mom photographed my experiment.

# CALIFORNIA STATE SCIENCE FAIR
## 2009 PROJECT SUMMARY

**Name(s)**
Olivia E. Wong

**Project Number**
**S1721**

**Project Title**
# The Effects of Monotherapy vs. Combination Therapy on Methicillin Resistant Staphylococcus aureus to Suppress Resistance

**Abstract**

**Objectives/Goals**
The objective is to study the optimum bactericidal effects of monotherapy versus combination therapy on MRSA by using the Kirby-Bauer method.

**Methods/Materials**
MRSA bacteria was inoculated to six agar plates. Positive battery test was used to dispense various antimicrobial discs: bactrim, cipro, clindamycin, erythromycin, gentamycin, nitrofuratoin, oxacillin as a control, vancomycin, synercid, and zyvox onto three plates. Three other nutrient agars were treated with the following combination antibiotics: vancomycin as a control, vancomycin plus bactrim, vancomycin plus cipro, vancomycin plus gentamycin, vancomycin plus synercid, and vancomycin plus zyvox. Note that the antibiotic combinations were placed side-by-side touching each other in the plates treated with combination therapy. After 18 hours of incubation, the zone of inhibitions were measured, tabulated, and graphed to elucidate the effects of different therapeutic regime with various antibiotics versus the radii of the zone of inhibition of MRSA growth.

**Results**
Combination antimicrobial therapy is superior to monotherapy in treating MRSA infection due to different mechanism of actions and synergistic effects.

**Conclusions/Discussion**
Combination therapy exhibits synergistic antimicrobial effects due to simultaneous assaults on the MRSA by deploying different mechanism of actions. Thus, combination antimicrobial therapy was proven to confer the optimum antimicrobial effects on Methicillin Resistant Staphylococcal aureus (MRSA) infection and thus prevail over resistance.

**Summary Statement**
My project is to compare the antimicrobial effects of monotherapy versus combination therapy on MRSA growth.

**Help Received**
I used the microbiology lab at Desert Medical Regional Center Hospital with the help of lab supervisor John Frazier and under the supervision of Dr. David Wong. In addition, great appreciation to Dr. Jolene Abraham and Dr. Bryan Hodgkin, director of Pharmacology Department for providing information.

# CALIFORNIA STATE SCIENCE FAIR
# 2009 PROJECT SUMMARY

**Name(s)**
Jenny Zhang

**Project Number**
**S1722**

**Project Title**
## The Effect of Complete Chemical, Soluble Synthetic, and Controlled Release Fertilizers on Primary Productivity Growth

**Abstract**

**Objectives/Goals**
Agricultural crops are grown on vast on areas of farmland that require the use of fertilizers to enhance plant growth and health. The overuse of fertilizer by farmers is common and as a result, agricultural runoff carries fertilizer nitrogen and phosphorous particles into natural bodies of water. Eutrophication, an increase in primary productivity, occurs and causes a massive, toxic algae boom that is detrimental to the ecosystem. By determining the type of fertilizer that results in the least amount of primary productivity growth, eutrophication levels in bodies of water can be reduced, resulting in a healthy ecosystem.

**Methods/Materials**
Buckets each containing two liters of water from Machado Lake in Kenneth Mallory Memorial Park were seeded with 2.4 milligrams and six milligrams of the three (complete chemical, soluble synthetic, and controlled release) fertilizers to simulate medium and high fertilizer runoff respectively. The experiment lasted a duration of two weeks, in which the containers were aerated with an air pump and polytheylene tubing and placed outside in direct sunlight for 14 hours a day to model an average light dark cycle.

**Results**
The overall algae growth from in the water seeded with complete chemical fertilizer was 1440%, the highest amount of growth compared to the 1143.75% and 856.24% percents of growth experienced by the soluble synthetic and controlled release fertilizer respectively. However, the percent of algae growth from mesotrophic bodies of water with medium amounts of nutrients to eutrophic bodies of water with high amounts of nutrients was highest in controlled release fertilizer runoff with a 54.54% growth, followed by a 51.91% growth in complete chemical fertilizer runoff and a 29.61% growth in soluble synthetic fertilizer runoff.

**Conclusions/Discussion**
Farmers should use controlled release fertilizers on their crops to prevent nearby bodies of oligotrophic water from experiencing eutrophication. Meanwhile, farmers located near eutrophic bodies of water should refrain from using controlled release fertilizers and instead use soluble synthetic fertilizers until the amount of nutrients in the water decreases to an oligotrophic level, and controlled release fertilizers can be employed.

**Summary Statement**
The purpose of this experiment is to determine the effect of complete chemical, soluble synthetic, and controlled release type fertilizer runoff on primary productivity growth in bodies of freshwater.

**Help Received**
Mother drove me to various stores and provided me with the necessary funds to purchase materials

# CALIFORNIA STATE SCIENCE FAIR
# 2009 PROJECT SUMMARY

**Name(s)**

David K. Tang-Quan

**Project Number**

**S1799**

**Project Title**

## Isolation of Kinase Mutant Genes Governing Stress Response of Candida albicans

**Abstract**

**Objectives/Goals**

In immuno-compromised patients, the fungus Candida albicans can enter the bloodstream, infecting most organs of the body and resulting in disseminated candidiasis, which has a 50% mortality rate, even with treatment. In healthy individuals, white blood cells protect against candidiasis by secreting antimicrobial peptides. For C. albicans to colonize patients and cause disease, it must be able to withstand these antimicrobial peptides.

**Methods/Materials**

Approximately 100 strains were screened for hyper-susceptibility to antimicrobial peptides. Hyper-susceptible strains were retested alongside a second independent clone. Additionally, gene deletion mutants and complemented strains were acquired and tested. Finally, the kinase insertion mutants were transformed with the HIS1 gene and retested in the absence of histadine.

**Results**

Hyper-susceptible strains such as SSK2, PBS2, and HOG1 were discovered, proving their necessity for C. albicans stress response. Hypo-susceptible strains were also discovered, suggesting that C. albicans has an adaptive response when certain genes are removed.

**Conclusions/Discussion**

Kinases are indeed required for C. albicans to grow in the presence of antimicrobial peptides. Most significantly, three members of the HOG1 kinase pathway, Ssk2, Pbs2, and Hog1, are required for antimicrobial peptide resistance in C. albicans. Pharmacologists can then develop medication that can inhibit the HOG1 kinase pathway and thereby prevent Candida infections.

**Summary Statement**

This study discovered that the HOG1 kinase pathway controls the resistance of the fungus Candida albicans to antimicrobial peptides.

**Help Received**

Mentored by Dr. Scott Filler, overseen by Ms. Norma Solis, at Los Angeles Biomedical Research Institute