Lower Division Classes, Upper Division Classes, Undergraduate Research
Holt 225

Graduate Classes, Thesis Research
Holt 227

Entomology class Display
Holt 235

Ornithology Display
Holt 235
Tom Rodgers
Outstanding Researcher Award

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1999 Moaid A. Kanaan
2000 Carina M. Jung
2001 Cary Coburn
2003 Glen Lubke, Jack Campbell, Gary Lechner
2003 Julia Terry
2004 Colleen Martin, Michelle Sopoliga, Michelle Ocken
2005 Alan Rater
2006 Khang V. Do, Chris L. Clifford
2007 Adam M. Ferris
2008 Nicole J. Huber
2009 Akiko Masuda
2010 Brandee Stone
2011 Ninette Daniele
2012 Areeje Almasary
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Michael Abruzzo
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Recipients:

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Chelsea Riggz and Nicole Tunnell

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2009 - Amir Bagheri, Broderick Illa, Crissy Nelson, and
Danny Weller

2009 - Jonathon Schneider, Jordanna Forman,
Justin Peek, and Katie Collins

2009 - Lee Ho, Lisa North, Meghann Sherrock,
and Reid Griggs

2009 - Robert Marvin, Samn Burriel, Vanessa Cox,
and Zaira Jimenez

2010 - Melissa Masty

2011 - Ellie Oliver and Juan Mota

2012 - William McCall

2013 - Packard Greer, Branden Hendrix, Taylor
Katoji, and Courtney Silver
Lower Division Class Projects

**LD-1**
**Effect of Competitive Exclusion Principle on Better Boy and Big Boy Tomatoes**
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BIOL 152: Dr. Chris Ivey (ctivey@csuchico.edu)

Georgy Gause, a Russian ecologist, proposed the idea that if two species compete for the same resources, they are unable to coexist, resulting in one species out competing the other species for resources. This has come to be known as the Competitive Exclusion Principle. The significance of our survey was to test this principle using Big Boy Tomatoes and Better Boy Tomatoes, similar species who utilize similar resources, to see which species out competes the other or if competition even occurs. To test this we planted six Big Boy Tomatoes and six Better Boy Tomatoes in one big pot, giving each plant the same amount of resources and energy consumption. Six of each species of tomatoes also grew in separate pots as controls. Height, number of leaves and biomass of the roots as well as of the leaves/stems were the measurable variables after a three week experimental trial. Using t-tests, we concluded that on average, the Big Boy tomatoes saw a lesser increase in height as well as in number of leaves when grown with the Better Boy tomatoes. The Better Boy Tomato, however, showed no significant difference in height or number of leaves when grown by itself as opposed to with the Big Boy tomatoes. There was also no significant difference in either of the plants when comparing the biomasses of those grown by themselves and those grown with the other species. We failed to reject our null hypothesis that Gause’s Competitive Exclusion Principle would not apply.

**LD-2**
**tomato density varies among an oak tree’s distance from a water source**
Sarah Wintsch, Diana Thao, Gabrielle Finley-Vaquera
Biol 152: Mandeep Grewal, mgrewal@csuchico.edu

Stomata aid in the process of photosynthesis in plants by exchanging water and gases. The significance of our study is to determine if stomata density in oak trees varies among trees that are located near Big Chico Creek compared to trees located further. We hypothesized that trees closer to the water source will have a higher stomata density than trees further away.
Conclusions: This study failed to determine phosphate release by two phosphite oxidizing bacteria. Phosphite was successfully identified as the limiting agent. Given the inhibition and toxicity found, it’s clear that soil treated with phosphite does impact bacterial community composition. Adjustments to the study are necessary to determine the long term survival of non-phosphite oxidizers while limited only to phosphite nutrition. This could be done by spinning down Flavobacterium cells every three days and supplying fresh phosphate media before abiotic conversion takes place while monitoring until survival ceases. Also initial contamination of Flavobacterium shown during 16sRNA identification may have skewed this examination and a more careful acquisition of the organism is necessary.

LD-3
Germination of Tropical vs. Temperate Seeds with Respect to Soil Temperatures
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Biol 152: Tag Engstrom tengstrom@csuchico.edu

We decided to conduct this experiment because we wanted to view how significantly the evolutionary changes of temperate and tropical plants have changed their ability to grow in different climates. The main problem under investigation was at what frequency would tropical vs. temperate weather plants germinate in three different soil temperatures: 4°C, 20°C and 30°C. We put 4 cups filled with equal amounts of soil in each temperature with 6 plants germinate in three different soil temperatures: 4°C, 20°C and 30°C. We counted how many of each seed species germinated after one week. It was observed that the seeds used germinated best at room temperature. This can be seen in that seeds germinated at room temperature matured 52.9% more effectively than those used with cold, and 29.9% more effectively than with warm. The mean for the room temperature seeds was greatest of the three. The test proves that experimentally, regardless of what type of seed you are, you will grow best at a moderate temperature than at an extreme. Our hypothesis was partially supported in this experiment. In the National Center for Biotechnology Information, a similar experiment was done and proved that dormancy was induced at higher or lower temperatures, and that optimum growth was found at room temperature. Another experiment was done on tomclothier.hort.net, and proved that of the 24 plants grown at varying temperatures, on average 85.3% grew most effectively at room temperature. It is possible that some sources of error could be due to incorrect soil temperatures.

GR-3
Cyclic-AMP Stimulated Chromatin Remodeling Involved in microRNA-375 Repression
Alexander R. Stanton astanton@mail.csuchico.edu
Thesis advisor: David M. Keller dmkeller@csuchico.edu

MicroRNAs are short 21-25 base pair RNA segments that integrate into RNA-Induced Silencing Complexes and target genes for the protein assembly to inhibit. This process plays an important role in genetic regulation, but can also contribute to development and progression of disease. Previous research has observed the overexpression of microRNA (miRNA)-375 in the pancreatic beta-cells of type 2 diabetic patients. This miRNA inhibits the genes for myotrophin and pdx-1, proteins involved in insulin secretion and beta-cell viability respectively. Little is known about the regulation of miRNA-375, though understanding its repression may lead to insights about type 2 diabetes mechanisms and therapy. My hypothesis is that the cAMP Response Element Modulator (CREM) is recruiting Histone Deacetylase (HDAC)-1 to the miRNA-375 promoter, causing repression through chromatin remodeling. ChIP-qPCR demonstrates that both CREM and HDAC1 can be found at the promoter. Furthermore, digestion of chromatin in a micrococcal nuclease protection assay provides evidence for histone modification localized where CREM and HDAC1 are found on the promoter.
some bacteria possess metabolic pathways for phosphite oxidation, like the ptxD gene, the longstanding hypothesis has been that these bacteria, while utilizing phosphite, may supply converted phosphate to benefit plants unable to otherwise use phosphite. We wanted to use a bioassay approach to test this hypothesis. Additionally, long term effects of phosphite on bacterial communities have not been examined. We hypothesized negative selection on bacteria unable to metabolize phosphite during phosphite soil application. We wanted to discover the mechanism of suspected selection, through toxicity or through inhibition. Population shifts due to selection may prove deleterious to the soil ecosystem as bacterial roles may be eliminated.

METHODOLOGY: Initially greenhouse soil samples were evaluated for change in quantity and percent phosphite oxidizers before and 118 days post phosphite soil treatment. Changes were compared to phosphate treated soil. Next through a variety of growth experiments manipulating phosphorus source and concentration, we analyzed whether soil dwelling phosphite-oxidizers of the genera Acidovorax and Methylobacterium release phosphate into their environment while limited to phosphite nutrition. Flavobacterium, a non-oxidizer, was utilized for a bioassay to detect phosphate release in the supernatant where oxidizers had been growing. Bacterial phosphate storage was tested. Determinations were made of inhibitory and toxic phosphite concentrations for all three genera, as well as phosphate levels necessary to overcome observed inhibition, elucidating the limiting agent.

RESULTS: Phosphate oxidizers showed a greater population increase in phosphate treated soil than in phosphate treated soil. The total percent phosphite oxidizers changed from 17% to 28% oxidizer in phosphate and from 18% to 39% oxidizer in phosphate. This advantage shows an indirect reduction in non-phosphate oxidizers over a relatively short period. Due to apparent abiotic conversion of phosphite in growth studies, levels of released phosphate were unable to be determined. A competitive inhibition was suspected causing late addition of phosphate to fail to overcome phosphite inhibition, while early phosphate addition could. Toxic levels were common between all three organisms at 100 mM phosphite, with pH being a possible contributing factor, while bacteriostatic effects were seen in Flavobacterium in concentrations 50 mM and below. These bacteriostatic effects show a potential mechanism of previously noted selection and explain why over a short period (118 days) non-oxidizers may still yet be present but static in the soil. Also soil studies could not control for initially present phosphates which could be controlled in growth media alone.
was no learned feeding behavior in the birds, that their predation patterns were random, and that the ratio of model to mimic was not significant.

LD-6
Effects of Inorganic and Organic Fertilizer on Cilantro Height
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In the past years, organic products have increased in popularity. Organic products are those which contain no synthesized chemical compounds designed to feed plants. The idea behind organic gardening or farming is to create healthy soil using naturally occurring products. Organic is now an overused word thrown around households everywhere, but how do organic practices compare to traditional fertilizers? Due to the higher nutrient density in inorganic fertilizers, cilantro height will be greater than the height of cilantro grown with organic fertilizers. Cilantro seeds were soaked then planted to aid in germination. Plants were divided into two groups; one received organic the other inorganic fertilizer. Plants were measured before fertilization and after first and second fertilization. Each plant received 452.16 mL of diluted fertilizer. Each fertilizers’ concentration was 14.8 mL/L. Plants with inorganic fertilizers (AV= 8.298, SD=2.233) were 21% taller than plants fertilized with organic fertilizers (AV=6.477, SD=2.952). The heights were significantly different (P=0.00265, df=73, t=1.993) supporting the hypothesis that inorganic fertilizers will aid plant growth better than organic fertilizer. Inorganic fertilizer was the obvious choice between the two fertilizer types. It stands to reason that inorganic fertilizers should be used more than organic because the inorganic is formulated to meet the needs and nutrient requirements of plants more efficiently and effectively than organic fertilizers.

LD-7
Plant Diversity by Altitude
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BIOL 152: Evan Padgett epadgett1@mail.csuchico.edu

In this experiment we observed plant diversity. We researched the changes in a plant’s diversity due to its location. As one moves uphill or to a different side of a hill, will the plants diversity change? Since there are numerous plant species that grow in a variety of places, we decided to find out why. Our hypothesis concluded that when being in more of an inclined area, such as going up a hill there was more plant diversity. The more you increase in altitude, the greater the plant diversity will take place to pursue its natural selection. The location we chose was Bidwell Park where we received our collection of data on plant species. The methods we used
and carbon content. Results show that both IDH and MRH are applicable, but at different forest phases, or age since disturbance, and that the two hypotheses may indeed be complimentary.

GC-12
Correlation between deer browsing and leaf hardness in buckbrush, *Ceanothus cuneatus* in the Big Chico Creek Ecological Reserve, Chico, CA
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BIOL 613: Dr. Chris Ivey, ctivey@cschico.edu

Ungulate browsing has both direct and indirect effects on host plants which alter the structure and composition of ecological communities. This study compared the leaf hardness above and below the deer browse line in buckbrush, *Ceanothus cuneatus* in the Big Chico Creek Ecological Reserve (BCCER), Butte County, California. Columbian black-tailed deer (*Odocoileus hemionus columbianus*) is one of the herbivores present at this site which browse on buckbrush. I hypothesized that there would be a positive relationship between deer browsing and leaf hardness in *C. cuneatus*. Frequent deer browsing on *C. cuneatus* stimulate the plants to produce new foliage, thus compensating for the loss of older foliage. Leaves were collected above and below the deer browse line from fifteen shrubs and measured leaf hardness. The results suggest the probability that deer browsing reduced the leaf hardness in buckbrush. The correlation coefficient was 0.801, but was not significant because the T-value (0.18) was less than the critical value (1.70). To my knowledge, this is the first study to examine the relationships between deer browsing and leaf hardness in *C. cuneatus*.

LD-8
Behavioral Plasticity in Bees & Their Ecological Preference Towards Clustered Flowers for Optimal Foraging
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Bee pollination is the most efficient method of fertilization, making them an indispensable species. Understanding their foraging behavior is necessary for predicting growth patterns, allowing other organisms to gauge the amount of available resources. Without pollination, the biota of an ecosystem would have great difficulty surviving, because resources are no longer being replenished. By providing favorable flowers, habitats increase their chance of survival as a result of successful bee pollination. This study determined if flower proximity has an impact on bee foraging. Because there is such a large variation in plant forms, behavioral plasticity in how close/far flowers are from each other is the hypothesized method used by bees. Two species of flowers were chosen, individual *Calystegia macrostegia* and clustered *Antirrhinum multiflorum*. An area of two square feet was set aside, which was observed three separate times for sixty minute periods, in order to reduce variation in the results. After recording the number of bee visits, the data was manipulated into a standardized unit of flowers per minute, which was used to compare foraging strategies between the specie-
ld-9
variation in stomatal density of Platanus racemosa (California Sycamore) can be explained by proximity to Big Chico Creek, Chico CA.
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Biol 152: Evan Padgett, epadgett1@mail.csuchico.edu
Phenotypic plasticity is an important ecological ability of trees. The goal of our investigation was to determine if variation in stomatal density was explained by proximity to Big Chico Creek. Given that stomatal density is linked to increased photosynthesis rate and is negatively correlated with water loss in plants, we predicted that trees growing closer to water will have different stomatal densities than those growing further away. CSU Chico’s campus is intersected by a rich riparian habitat. In this habitat Platanus racemosa (California Sycamore) can be seen growing in several different proximities to Big Chico Creek. Statistical comparison between a sycamore tree on the creek bank and a tree ~85m away, resulted in a t-stat of 5.259 and a p-value of 1.24x10^-6. Comparison of average stomatal density resulted in a greater stomata density for the tree further away. These results support our hypothesis that the presence of water can explain variation in stomatal density. This research supports the importance of water and how it influences phenotypic plasticity, especially in organisms found in riparian ecosystems.

ld-10
yerba santa (Eriodictyon californicum) preference for a foothill versus riparian habitat in Upper Bidwell Park
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Eriodictyon californicum, or Yerba Santa, as it is commonly known, is an evergreen, aromatic shrub native to California. This particular organism, once prized by the local Maidu Indians of the area for the medicinal properties it possesses, can be located throughout Upper Bidwell Park. The question then becomes, does Yerba Santa undergo more substantial growth within a riparian or a foothill habitat? The investigation focused on the hypothesis that the species would grow more sizeable within the riparian zone in different environments. In this study, I investigate if this theory holds true on a smaller scale. At Upper Bidwell Park in Chico, CA plant communities were observed on rocky outcrops and were examined to see if the species richness was in accordance with the theory. Species were differentiated based on their morphology. Measurements for size and distance from a source rock were taken. Regression was performed with Microsoft Excel to determine if these factors affected species richness significantly. Both size (F_1, 16 = 16.6, p < 0.001.) and distance (F_1, 19 = 8.26, p = 0.01) had significant impacts on species richness. This data supports that the theory of island biogeography is occurring on smaller scales.

GC-11
Intermediate Disturbance Hypothesis versus Mass Ratio Hypothesis: response of tropical forest composition to varying disturbance regimes
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The effect of disturbance on biodiversity is an ongoing debate, with multiple hypotheses presented to describe the response of diversity to various disturbance regimes. Tropical forests, with their high biodiversity and succession, present ideal conditions for testing these hypotheses. Here I examine diversity in relation to inferred disturbance and species-specific dominance to test the hypothesis that two distinct disturbance-diversity hypotheses - Intermediate Disturbance Hypothesis (IDH) and Mass Ratio Hypothesis (MRH) - are applicable at varying scales across a tropical forest landscape in Lake Hargo Caldera, Papua New Guinea. I used Non-metric Multidimensional Scaling (NMS) and Multi-Response Permutation Procedures (MRPP) to assess overall compositional differences across the caldera, and multiple regression to determine if dominance and disturbance regime are significant in predicting diversity. Forest stands were significantly different from each other (MRPP T = -2.81, A = 0.19, P = 0.01) in composition. Bootstrapped multiple regression showed that species-specific dominance was significant in predicting diversity (R^2 = 0.825, P>0.05). However, results showed that inferred disturbance was statistically significant in determining site diversity metrics (P > 0.05), but this may be a function of forest phase. Lowest diversity was seen in plots with the largest species dominance, and highest diversity was seen in plots under inferred intermediate disturbance regimes. Soil pH did not differ significantly among plots, but volcanic-disturbed soils had suppressed calcium.
demonstrates that mammal study skins may be stable over time, but this varies from species to species and the impact of time on coloration should be considered for all studies evaluating coloration of museum specimens.

**GC-9**

No correlation was found between deforestation in Brazil and drought in northern California

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BIOL 613; Chris Ivey; ctivey@csuchico.edu

A previous study (Medvigy et al. 2013) found a correlation between destruction of the Amazon and lowered precipitation in the Pacific Northwest, and this led to the question of whether or not destruction of the Amazon may be connected with the drought that has plagued northern California from 2013 onward. Another study (O’Brien et al. 1998) found evidence of deforestation leading to changes in daily maximum temperatures in an area of Mexico known as Selva Lacandona, so we also wondered if deforestation could be correlated with changes in temperature as well. This was done so that we could measure for correlation between average maximum temperature and average annual rainfall in upper northern California.

In the middle of the experiment, a very strong correlation was found between deforestation in Brazil and CO$_2$ concentrations in the atmosphere, so CO$_2$ concentrations were an additional variable we tried to correlate with precipitation in northern California. We used monthly rainfall data all the way back to 1913 for the county seats of the 20 northernmost counties in California (in inches) to obtain the average annual rainfall for each year, and compared that to remaining forest cover in Brazil dating all the way back to 1988 (in km$^2$) and CO$_2$ concentrations in the atmosphere dating all the way back to 1959 (in ppm). Our results detected no significant correlation between average annual rainfall in upper northern California and deforestation in

**GC-10**

Island Biogeography in Affect at Bidwell Park, Chico CA

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Islands can be seen as mountain tops or chunks of land off the coast of a continent, which is on a grand scale. These have been commonly studied. The theory of island biogeography allows ecologist to make predictions about the species richness of populations near Big Chico Creek, due to the deep soil and perennial flow of nutrients. Randomly selected sample plants from each of the two regions of the park were catalogued by cubic volume, in meters, and compared via T-test. Statistical results indicate that there was no significant difference between the volume of Yerba Santa regardless of environment. Therefore, the shrub is likely capable of vigorous growth within both the foothill and riparian zones of Upper Bidwell. This hearty individual seems to be able to tolerate the heavy sun exposure and rocky soil of the foothills in addition to the increased shade and water availability of the riparian zone. Because this species exhibits no habitat preference, in conjunction with a relatively similar average volume between two zones, it is likely that this plant is highly versatile and persistent throughout many areas of California.

**LD-11**

Learned behaviors in ants in regards to disruption of pheromone detection through observational analysis

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BIOL 152: Rachel Francis (rfrancis4@mail.csuchico.edu)

In order to determine the extent of ants’ reliance on pheromones, this study aided in learning the extent of the chemically modified learned behaviors of ants through observational analysis. A further understanding was conceived of alarm pheromones and the reactive response time of other ants both along the path and in the colony. It was hypothesized that the ants’ reactivity to the path change would be dependent on the intensity of the chemical obstruction from a range of basic to acidic. Methods employed involved forming a barrier that included bleach, dish soap, vinegar, and urine in the midst of the ant trail and measuring the time it took for another complete pathway to form. Based on the trend, it can be inferred that a basic pH disrupted the ant’s path detection the most. Further studies in this field can further investigate basic chemicals and their influence on pheromone disruption and detection.

**LD-12**

Observational Study on Optimal Foraging Theory Among CSU Chico Campus California Grey Squirrels

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The explanations behind the behaviors observed in organisms have long been a subject of study among ecologists. According to optimal foraging
theory, animals behave in ways that maximize their net energy intake per unit time. This phenomenon can be expressed as $E/h$, where $E = \text{total calorie value of a food item}$ and $h = \text{the handling time for that food}$. To test this theory, an observational study on the foraging behavior of CSU Chico campus grey squirrels was conducted. If the primary factors are $E$ and $h$, the hypothesis is that more squirrels will choose food items that have a higher calorie value and/or shorter handling time as opposed to food items that have a lower calorie value and/or longer handling time. The experiment had two separate groups: group 1 had squirrels being presented with either a large walnut or a small one and group 2 had squirrels being presented with either a nonshelled walnut or a shelled one. Each group had 3 trials. Group 1 had a greater mean large preference than mean small preference. Group 2 had approximately equal means for nonshelled preference and shelled preference. In conclusion, only group 1 produced significant results, thus total calorie value was the more prominent factor of the two in this study. These results could be due to factors that are unique to squirrel species (i.e. storing nuts for winter) or they may allude to a trend that is shared by other species as well.

LD-13
Determining the Interspecific Association Between Bromus ssp. and Astragalus crotalaria
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BIOL 152: Rachel Francis (rfrancis4@mail.csuchico.edu)

The purpose of this experiment is to determine and study interspecific relationships, community structure, and to identify species with similar habitat relations in Upper park Bidwell at Five Mile. Two species were counted using a .25 m² quadrat directly next to the Five Mile road, and twenty yards from the road. The two species being tested were both native to the area; one was a flower species, vetch (Astragalus crotalaria), while the other was an herbaceous, grass species, foxtail (Bromus ssp.). This experiment hypothesizes that two native species to both distances in a landscape will display maximum, or high, co-occurrence based on their natural history in the geographic area. It is predicted that the grass species will occur more often in Five Mile at Bidwell than the flower species because there will be competition between the two for limited resources in the area. Within this experiment, the trend between two individual species, grass species and flower species, was determined to be negative, indicating that the interactions between the two species are detrimental either to one or both of these species. This is indicated by the statistical significance that exists between the observed and expected frequencies recorded are potentially due to interspecific competition or interference between the species. This examination...

Sexual dimorphism is a difference in character between males and females of the same species. It is frequently attributed to (1) sexual selection which is strongly correlated with mating system and/or (2) variation in feeding ecology resulting from differential energetic demands due to unequal parental investment. Most squirrels are polygynous and display female-biased parental care, which is frequently cited as the reason for the sexually dimorphic appearance of most ground-dwelling species in this family. Many tree-dwelling species do not appear to be dimorphic and may have unique pressures or adaptations that preclude or act in opposition to the evolution of sexual dimorphism. The goal of this study was to determine if western gray squirrels, a tree-dwelling species, conformed to the sexual dimorphism hypothesis with regards to their skull size and shape. I predicted that western gray squirrels are subtly dimorphic. To test this prediction, I analyzed and compared digital photographs of the skulls of male and female S. griseus to determine if there were differences in size or geometry. I found no significant difference in size or geometry of cranial morphology between males and females. This suggests that neither sexual selection nor parental investment is the principle driver of the evolution of skull size or shape in western gray squirrels.

GC-8
Color Fastness of Mammalian Study Skins
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Coloration is incorporated into many scientific studies due to its importance to behavior, ecology and evolution of organisms. Museum study skins are often utilized in these studies, however study skins may not accurately represent live animal coloration. As specimens age, colors may break down or otherwise change such that older specimens are statistically different from newer specimens and live animals. Prior to this study most research in color variation of study skins was focused on birds with one study investigating bat coloration. This study analyzed color variation in three rodent species: Otospermophilus beecheyi, Peromyscus maniculatus and Sciurus griseus to evaluate if colors were different between specimens, and if so what factors (age, specimen body size) influenced the color differences. Digital photographs were taken under identical lighting conditions and analyzed using Adobe Photoshops. I found that coloration remained stable for S. griseus with no statistically significant variation in color. Coloration was mostly stable for O. beecheyi, with only total length loosely related to color change ($P = 0.08$). Color variations due to specimen body size and age were found for P. maniculatus ($P < 0.10$). Overall this study...
sequence data from strains in years following these pandemics to sequences from the original outbreaks.

GC-6
Hawai’ian Sandalwood Growth Reconstructed with Three Methods all Correlated to Temperature and Rainfall with Mixed Significance between Techniques
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BIOL 613: Dr. Christopher Ivey, cIvey@csuchico.edu

Tropical tree-ring research has only proliferated recently because of previous literature depicting the infeasibility of the very act due to low seasonal contrast at lower latitudes. Two new methods were developed to reduce potential errors from subtle and abnormal growth. Three techniques were compared. Firstly, traditional transects were measured for width between tree-rings, secondly, pixel area was calculated using scanned images and tracing tree-ring boundaries, and lastly, calculating areas of traced boundaries using Green’s Theorem. The statistical significance of each method was evaluated by Spearman rank correlation applied between samples measured with a corresponding technique, higher correlation coefficients implied a more accurate growth reconstruction of the forest. It was predicted, that area measurements will produce more accurate results than width measurements because of higher sampling resolution. Correlations between samples in the third method were higher relative to the first two techniques at $\rho = 0.434$, whereas the first two techniques yielded $\rho = 0.210$ and $\rho = 0.202$, but an alternate explanation attributes this discrepancy to a measurement error more than anything else. All cross-dating between forest growth averages and climate records such as temperature and precipitation observations yielded unlikely forest growth dates, either too far into the future or into the past. More research must be performed to properly measure incomplete rings, which are the likely cause for poor datings.

GC-7
No sexual dimorphism in absolute geometry or size of the cranial morphology in western gray squirrels (Sciurus griseus)
Melissa Sutton MSutton6@mail.csuchico.edu
Biology 613: Dr. Chris Ivey, cIvey@csuchico.edu

No sexual dimorphism in absolute geometry or size of the cranial morphology in western gray squirrels (Sciurus griseus)

Almonds are naturally sweeter in contrast to walnuts, which have more elevated tannin levels. Therefore it is advantageous to farmers in areas with high populations of Otospermophilus beecheyi, common name ground squirrel, to know to what extent this species prefers one nut to the other. In the experiment, one tray containing 15 walnuts and 15 almonds was laid out in a preselected location on a ranch. The tray was laid out at 7 am every morning and recovered at 7 pm every night over the course of a week. Data was collected, a chi squared test was performed and a bar graph was made. Based on the results from this experiment, Otospermophilus beecheyi was determined to prefer almonds over walnuts. Therefore it would be more advantageous for farmers in areas with high ground squirrel populations to plant walnuts and not almonds.

LD-15
Sexual selection in Homo sapiens
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BIOL 152: Rachel Francis (rfrancis4@mail.csuchico.edu)

The purpose of this research was to examine sexual selection within a small subset of Homo sapiens. To do this, Chico State students were surveyed and asked questions to determine if they had preferences for certain traits and whether or not those preferences were similar (or not) to their own. Questions focused on very basic physical features including but not limited to: build, height, origin, eye and hair color. It was hypothesized that students would be more likely to select characteristics that were similar to their own based on positive assortative mating theory. We also hypothesized that women would be more selective, meaning they would answer more questions with specific preferences, than males. Results indicated that both male and females significantly choose different characteristics from their own and that there was no difference between choices made by
males and females. Some examples of popular trait choices were straight teeth was facial hair. There were also non-genetic factors found that influenced trait selection, like the fact that women wearing makeup. In conclusion the stated hypothesis was not supported but results rather support negative assortative mating where people prefer traits that were phenotypically different from their own. (Special note: This project was approved by the board for Human Research)

**LD-16**  
The potential for *Trochilidae* to select for a higher concentration of nectar  
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Optimal foraging theory predicts that species will forage for a more calorie dense food substance. It is more beneficial to consume food with more nutrients, we expect to see a significant difference in the feeding habits of *Trochilidae*. We tested the hypothesis that due to optimal foraging theory we expect to observe *Trochilidae* to select for the nectar of high caloric densities. Each day two sets of three feeders with different sugar contents were presented for selection. Recording the data occurred at six hour intervals, for fourteen days. Data stated that none of the feeders gave off a significant difference. Through the ANOVA test and the three T-test the values were much higher than the stated p-value.

**LD-17**  
Fitness Dependent on Species Richness  
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In order to better understand the concept of species richness and its affects on other populations, one particular species of plant was chosen as the main subject of the experiment and it was observed growing amongst three differing plant species. The goal was to determine if the subject was more or less successful depending on which plant species it lived the closest to and this would be calculated by comparing the proportion of damaged leaves and buds amongst our three samples of plants. We hypothesize that the plants living amongst the more dense species would have a greater fitness than the other samples living amongst slightly less dense or scarce species and predicted that the samples taken from densely populated areas would have little to no damaged on leaves and buds. Three samples each
can infect a person with 18 particles compared to 100 particles for other strains. Regardless of the genogroup, noroviruses have principle open reading frames: ORF1, ORF2, and ORF3. The ORF1 encodes nonstructural polyproteins that are cleaved by viral 3C-like protease into probably 6 proteins, including the deduced RNA-dependent RNA polymerase. ORF2 and ORF3 encode the major (VP1) and minor (VP2) capsid proteins, respectively. At this time, I am interested in looking at the P2 region of the VP1 protein, that is associated with attachment, in GII.4 Sydney and comparing this region to other genotypes and strains to see if there is a difference in protein sequences. My hypothesis is that the P2 protein sequence is not conserved in the VP1 region and potentially enhances norovirus virulency.

To address this question I am going to compare the results of a multiple sequence alignment of the P2 region of 5 different GII noroviruses, make a phylogenetic tree, and compute a pairwise distance test.

GC-3
Prevalence of Mutation Q226L in H7N9 Influenza Strains: A Bioinformatics Assessment
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Influenza, one of the leading causes of death worldwide, is characterized by rapidly mutating variants that make vaccine development for this virus difficult. Avian influenza A (H7N9) is a subtype of influenza viruses that until 2013 had not been transmitted to humans. A mutation in the hemagglutinin (HA) subunit at position 226 from glutamine to leucine has enabled transmission from avian to mammalian hosts by altering the binding between the HA subunit and sialic acids, the cellular receptor. The purpose of this study is to examine the prevalence of this mutation in H7N9 strains using bioinformatics tools. Data from such tools indicate that this mutation has an insignificant prevalence and is unlikely to further transmit to human hosts.

GC-4
Mutations in Hemagglutinin (HA) protein and the phylogenetic analysis of pandemic H5N1 influenza viruses in different species from different geographical locations
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H5N1 avian influenza virus is highly pathogenic virus which causes of the same plant species surrounded by a differing plant and labeled each observation area. An overall average was calculated for the proportion of damaged leaves and buds for the three different areas. An ANOVA tested for both the proportion of damaged leaves and buds but did not receive a significant value, however, we cannot completely rule out that there is no correlation between the sample plant’s fitness and the species it is living amongst. While our data did not show any significance, we can conclude that this is partly due to our very small sample size and that neither one of our hypotheses can be accepted without further research on a larger scale.

LD-18
Analysis of herbaceous plant species present in prescribed burn and unburned areas in Butte County, Chico, California
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We set out to determine the differences in species frequency for two species of herbaceous plants in areas that had undergone disturbance by fire and areas, which had not. Data was collected through random sampling of an area that had experienced a recent burn and of a separate unburned area and data was subsequently analyzed using a t-test statistical analysis. It was expected that some variance would be noted due to the apparent lack of detritus blocking growth and sunlight in the post-burn region. Of the two species, Species 1 and Clover, it was expected that Clover, which didn’t appear to be growing in areas with normal detritus, would be more abundant due to increased growth opportunity. Alternatively, Species 1, which appeared to grow in equal amounts in both areas of thin and thick coverage, was expected to have similar distributions in both types of regions. We were able to conclude that Clover population is more abundant in areas where detritus had been removed by fire (t = 2.09, df = 19, p < 0.05) and that Species 1 populations are not significantly different between burned and unburned areas (Species 1: t = 2.03, df = 31, p > 0.05). Because fire can occur in foothill oak woodland and other habitats, it is important to study and understand the long-term effect fire (naturally occurring or prescribed) can have on plant species populations.
Avian Predators’ Superstition of new Objects Leads to Inconclusive Test of Batesian Mimicry
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BIOL 152: Rachel Francis (rfrancis4@mail.csuchico.edu)

In nature, many prey animals have evolved defenses to keep them safe from predators. One of the more interesting evolutionary traits is the ability for certain palatable prey animals to mimic more noxious prey (Batesian mimicry). To understand the effectiveness of this trait, the question is then posed: will birds recognize the ‘warning’ colors (orange and yellow) on food trays containing seeds and learn to avoid food on those trays? The hypothesis stated that if the model tray (orange paper) contains less palatable seeds than the control tray (white paper), then the birds will learn to avoid both the model and the mimic (yellow paper). To test this hypothesis, three trays were set out in a field surrounded by houses off Bidwell Avenue in Chico. The trays consisted of a model (orange paper on a tray containing 75% unpalatable seeds), a mimic (yellow paper on a tray containing 50% unpalatable seeds), and the control tray (white paper on a tray containing 100% palatable seeds). Through the experiment, none of the trays were visited. Our results showed that the density of the flowers that were closer to a water source were higher than those that were farther away. This led us except our null hypotheses and reject our alternative hypothesis. The significance of our data allows for the research and understanding of the biological processes involved in the success and health of flowering plants. This information can lead to trends set in order to establish well made crops, farmlands, and inhabitable areas for animals, insects, and humans.

Designing a Synthetic Regulator for microRNA-375 Overexpression
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BIOL 612: Troy Cline and David M. Keller (dmkeller@csuchico.edu)

While endogenous regulatory gene interactions are necessary for the functioning of a cell, aberrations in these interactions can have detrimental effects. One important class of molecule for genetic regulation are microRNAs, small 21-25 nucleotide sequences that inhibit genes through an RNA-Induced Silencing Complex. This study focuses on the misregulation of microRNA (miRNA)-375 that contributes to the type 2 diabetic state. While miRNA-375 is an important factor for beta-cell development, the overexpression observed in type 2 diabetic patients may significantly reduce myotrophin (involved in insulin secretion) and pdk1 (involved in beta-cell viability) thus exacerbating the diabetic state. In other diseased states, synthetic gene constructs have been employed in vivo to restore healthy regulation, but no constructs have been created for miRNA-375 in pancreatic beta-cells. Here a repressor- normally an oscillatory network of three genes - has been tailored to include endogenous miRNA-375, instead allowing for detection and inhibition of miRNA-375 overexpression. Construction and simulation of a repressilator containing tetR, antisense miRNA-375, and miRNA-375 does not overlap any SNP in the UCSC Genome Browser or Ensembl to ensure universal efficacy.

Investigation for Human Norovirus
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There are five different human norovirus genogroups (GI, GII, GIII, GIV, and GV), more than 25 different genotypes, and countless numbers of strains. Currently, genogroup II genotype 4 strain Sydney (GI.4 Sydney) is one of the most virulent strains. GI.4 Sydney
lizard) actively selected basking sites with surface temperatures that were within the optimal body temperature range of *S. occidentalis*. We found that any basking rocks showed higher surface temperatures than ambient, with dark colored rocks being significantly warmer than other basking sites. When ambient temperatures were below optimum levels, lizards preferred to bask on darker colored rocks. Our results stress that behavioral thermoregulation has high priority in lizard behavior, and also shows that lizards are acutely aware of temperature variation within microhabitat and exploit sites that will allow them to optimize body temperature when temperatures fall below optimum levels.

**UR-6**

**A novel set of fibrillin-like proteins identified from RNA-seq analysis of *Emiliania huxleyi***
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Sponsoring faculty: Gordon Wolfe gwolfe2@csuchico.edu

*Emiliania huxleyi* and some related haptophyte algae produce as neutral lipids a set of PolyUnsaturated Long-Chain (C37-39) Alkenones, Alkenoates, and Alkenes (PULCA). These hydrocarbons are package into cytoplasmic lipid bodies (LBs), and have potential for biofuels, but their biosynthesis and mobilization is still poorly understood. A prior proteomics analysis (Wolfe, unpublished) found several fibrillin-like proteins associated with lipid bodies. These proteins are known to structure plastoglobules (LBs) from higher plants and green algae, but are poorly studied in haptophytes. We used RNA-seq to study global gene expression of *E. huxleyi* CCMP 1516, employing a time-series experiment where lipid production was increased by a combination of phosphate limitation and bicarbonate boost, and lipid catabolism increased by placing cells in continuous darkness. Results show a diverse set of ~30 fibrillin-like proteins, most in the range of 25-35 kDa. Some show plastidial targeting, but others appear cytosolic. Almost all show increase of expression during PULCA and LB accumulation, some strongly, as well as down-regulation in the dark. This suggests these proteins may facilitate LB function in the plastids, as well as possible transport to cytosolic lipid bodies, and their ultimate mobilization.

LD-21

**Habitat and area variation improve the prediction of bird richness at a local level**
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BIOL 152: Rachel Francis (rfrancis4@mail.csuchico.edu)

The aim of this study was to analyze the relationship between bird richness and ecological environment, and to understand why bird diversity varies across different habitats within the lower Bidwell Park region in Chico. Since lower Bidwell Park offers distinct types of ecological environments it was important to investigate if there are particular area and habitat conditions that attract not only one species, but a diversity of birds. It was hypothesized that there would be more bird diversity in those areas where there was less human intrusion and more natural resources like water and plant abundance. With the help of binoculars birds were observed and counted by their individual species for 20 minutes in two distinct areas within lower Bidwell Park. Area #1 was near the river, it had plentiful plant and tree coverage and there were no humans around. Area #2 was further away from the river, had larger distance among trees and less plant coverage, also there were humans walking and sitting around. It is important to mention that it was around 3:00 in the afternoon and the weather was sunny with a clear sky. The results demonstrated that in area #1 there was more species richness as predicted. On the other hand, area # 2 demonstrated to have less bird diversity but more bird abundance of a particular species. Thus, it is apparent that there is a significant relationship between the ecological environment and the bird diversity found in the two areas of lower Bidwell Park.

LD-22

**Feeding Behavior of Squirrels with Native and Non-native Nuts**
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The purpose of this project was to observe and measure the feeding patterns and choice behaviors of squirrels. Our scientific hypothesis was that squirrels would prefer native nuts over non-native nuts and would therefore eat more native nuts. We set up one tray that included three different kinds of nuts, walnuts that are native, and pistachios and almonds that are non-native to California. Over the course of seven days we set out and moni-
tored the status of the nuts at two locations. We found that the feeding behavior of squirrels was significantly different on the different type of nut on during the last two days. Squirrels seemed to have a preference for the non-native pistachios and almonds on these days. But on four of the days, there was no significant trend in the type of nuts that squirrels preferred. In the beginning they had no preference, and by the end of the experiment they had a significant preference for a type of nut. This shows us that the squirrels gained a preference for nuts over the course of our experiment. Though, there are multiple factors that go into the preference of nut chosen by the squirrels that would require further testing as shown by Smith and Follmer (Smith and Folmer 1972), our data led us to reject our hypothesis and conclude that squirrels have a preference of nuts, most likely non-native.

**LD-23**

**Backyard squirrel and bird foraging preference in background color**

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An investigation focusing on the idea of color in warning colors nature was conducted by questioning whether background color will affect the foraging behavior of native birds and squirrels even when faced with food. To test this hypothesis we put out three trays lined with green, yellow, and red colored paper. In a 3 hour window over a four day period we observed how many of the seeds on the trays disappeared in the afternoon to early evening. Every hour we counted how many seed had been taken. We predicted that squirrels and birds would favor the green background as the most favorable for its similarity to grass, and shrubbery; and red being the least favorable for there are rarely red colored backgrounds of foraging locations in nature. With our results we used the average number of seeds taken from each colored tray over the four days to perform a t-test. The data shows that when comparing the green and red backgrounds to each other, there is slightly significant data. When comparing green to yellow, and the red to yellow the data shows that they are not significant. With these results we found that there is not significant evidence to show that squirrels and birds avoid areas where they are more visible to predators. This could suggest that native squirrels and birds do not take the environment in which they are foraging into account in regards to visibility due to background color.
Sponsoring Faculty: Tag Engstrom

Long term monitoring projects involving salamanders have been problematic due to limitations emplaced by physiology and life history. Here we describe a new method for individual identification of members of the Rough-skinned Newt Taricha granulosa (Salamandridae). The BCCER hosts a small population that is sympatric with the more common Taricha sierra. Little is known about the life history, population, and range of our local population, and previous attempts to tag individuals has been unsuccessful. Using 18s image recognition software we constructed a baseline photographic index using preserved specimens in the lab (n=30). Using the lab specimens we matched photos of individuals with 97.22% accuracy. We then compiled photographs of individuals obtained from the field and tested them against our baseline database to show that the system can differentiate live individuals as well with similar results. To our knowledge this is the first case of using photographic identification software on members of this genus. With this method, we hope to emplace a long-term monitoring project for the BCCER population.

UR-3
Analysis of Bioplastic Degrading Microorganisms
Ryan Sauer, Rajinder Bola, Hector Vargas, Steven Holl*, My Lo Thao*, Larry Kirk, Larry Hanne
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According to the U.S. Environmental Protection Agency, in 2012 alone, 32 million tons of plastic waste was generated, representing 12.7% of the total municipal solid waste. The majority of these plastics are not biodegradable, however some are made of polyhydroxybutyrate (PHB) and polylactic acid (PLA) which are examples of biodegradable (compostable) plastics. Our team set out to characterize several environmental sources for their ability to degrade PHB and PLA. Various compost and sewage facilities were sampled for the frequency of bioplastic degraders, which were detected by observing zones of clearance on PHB plates. Microorganisms that degrade PHB were successfully enriched for, and isolated, from these environments. PLA degraders were not detected in any tested environment. PHB degrading isolates were shown to utilize PHB as a sole carbon source. Preliminary data suggests that the PHB degradation enzyme is inducible. Future work will involve identification of these microorganisms and characterization of the enzyme(s) that catalyze degradation of PHB.

LD-24
Squirrel Food Preference by Optimal Foraging
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When squirrels are given the choice to choose which nut to consume, they may exhibit that behavior of which, eating a high caloric nut while using the least energy output, be more favorable. This is called the optimal foraging theory. Squirrels will pick the highest caloric food source based on this theory. Ten of each nut, walnuts, cashews, and almonds, were obtained and placed onto a grid. This was repeated for a total of two grids. The grids were left out for a series of days in the time when squirrels are most active. Nuts missing are recorded after each day. Results obtained by performing a t-test for each type of nut, as well as an ANOVA test, showed no significance. Trend lines increased relatively throughout the days. Cashews showed the most consumed instead of walnuts, which had the most calories. This showed that squirrels may exhibit optimal foraging, but results did not reflect a significant difference.

LD-25
Minimal Population Count of California Newts at Table Mountain
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A population can be affected by habitat size, the bigger the area, the higher amount of species. Species that rely on water, such as California newts, will live in or around water sources, like pools and creeks, for food, protection, and reproduction. California newts are more inclined to resign to the main water source (larger habitat size) in comparison to the other water sources further from main water source because the size can support more species. California newts are more inclined to minimize population size with an increase in distance from main water source due their aquatic attraction to water. The waterfall located in North Table Mountain, is a main water source for creating habitats for the newts; it also maintains the largest pool area of the stream. Starting from the waterfall, newts are counted in five pools separated by about one hundred feet. The pool with the highest amount of newts were in the waterfall (pool 1), with the downstream pools containing decreasing amounts of newts. Due to the reliability of the waterfall and the size of the pool, a higher population resided in there and concludes the pool had higher security of maintaining water and a stabilizing
habitat. Since few samples were gathered, the population was insignificant towards the area and distance of the habitat.

LD-26
Effects of Water Availability on *Lupinus nanus*
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*Lupinus nanus*, more commonly referred to as sky lupine, is an annual herb native to California. Studies have shown that factors such as flowering time, flower size, and length of anthers are variable in *Lupinus nanus* based on the genes of the specific plant. However, there are few studies that examine whether environmental factors can affect the phenotype of the plant. This study examines the effects of proximity to a water source on flower size in *Lupinus nanus* flowers. The flower lengths of 100 *Lupinus nanus* were measured at varying distances from a water source (0-50 meters) and plotted. A regression analysis of the data showed a significant negative correlation ($r^2 = -0.82$, $p=0.044$) in flower length based on proximity to a water source. From the regression analysis it can be shown that *Lupinus nanus* flowers reduce in size the greater their distance from a water source which was consistent with the original hypothesis. These findings are significant as they show that *Lupinus nanus* flower length is a phenotypically plastic characteristic.

LD-27
Effects of Creek, Bottle, and Tap water on the Growth of Chive Plants
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This experiment investigated the direct effects of human influence on plant growth and asks what the effects of filtered and deionized water have on these house grown plants compared to unfiltered rain and river water that comes naturally from their surroundings? This experiment will give us an idea of the growth difference between tap water, bottled water, and creek water each having different nutrient components. Since the human population is taking over more and more of the earth, we have a larger impact on the environment than we know and this experiment proves only a miniscule amount of the effect that we are having on the environment. We predict that the plants being fed creek water (from Big Chico Creek) will grow the most successfully, having less of a human impact than the plants being fed tap water and bottled water. We predict the plants being fed tap water will grow slightly more than the plants being fed bottled water, however both will not be as successful as the creek water. Although bottled water still has some
ranging from 5.00 to 5.99 cm in size (p-value=0.10). This shows that the larger galls are more productive for the wasps than the smaller galls.

form of nutrient, it is not nearly as much as natural creek water. We planted several chive seeds in three small pots and watered each plant with our samples of water. Our data is insufficient, in means of not being able to measure the growth of the plants thus far, although there is obvious progress and we predict we will be able to collect more data to support our predictions in the future.

LD-28
The effects of pH due to soil to coffee ground ratios on the growth of Lactuca sativa
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Understanding the relationship between soil pH and plant fitness is important in determining the conditions in which plant growth can occur. Previous research has indicated that most vegetable plants favor a slightly acidic soil. The use of coffee grounds as a mechanism for altering soil pH could provide gardeners with an affordable and organic method to improve soil conditions. In this experiment, mixtures of used coffee grounds and soil were created and pH and the growth patterns of garden lettuce (Lactuca sativa) were recorded. The hypothesis stated that the growth of L. sativa would occur at different rates depending on pH of the soil mixture, with most growth occurring at a slightly acidic pH. Opposing previous research, the pH of coffee grounds was found to be more basic than pure soil. The results indicated that pH was not as important of a factor in plant growth than was the ratio of each mixture.

LD-29
Mimicry Experiment on Grey Squirrels
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Mimicry is the artificial similarity to one organism to another. Can squirrels learn that certain characteristics of nuts are not palatable? In this experiment responses of the native squirrel frequencies to a variety of nut colorations was measured. Arrays of the different nut colorations were set out with random order relative to their palatability and measured over eighteen
hours. Chi squared test was then conducted which showed that the feeding behavior of the squirrels was significantly different (p-value < 0.001) from the three different colored nuts during the feeding times allotted. The measurements were taken between late night and early morning. Dusk had the most random feeding patterns. Overall the end point of this was that squirrels could learn feeding behaviors by mimicry.

**LD-30**

**Leaf Surface Area Differences In Relation To Water Source Proximity**

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BIOL 152: Mandep Grewal

*Nasella pulchra* (Purple Needle Grass) is a native California plant found in many of the diverse regions including hills, valleys and mountain ranges. It is well adapted for both dry areas as well as wetter climates. This now begs the question whether proximity to a water source will increase plant size, specifically, leaf size. An investigation was conducted to determine if *N. pulchra* will have a greater leaf surface area near a water source as compared to *N. pulchra* located at a further distance. Eighteen samples of *N. pulchra* were collected from both near a water source and greater than twenty feet from the same water source. Surface areas of the first undamaged leaf were calculated by taping the leaf onto standard graphing paper with 1 cm² squares where they were then traced. The squares were then counted to determine the surface area in cm² with only those squares covered by at least 50% or more being counted. The mean surface area of leaves near water was approximately 41 cm², and leaves farther from water were approximately 15 cm². With a p value of 0.0000199 the standard deviation of the leaves close to the water source was calculated to be 20.02294 and the leaves greater than twenty feet from the same water source was calculated to be 5.146545. Thus, the results conclude that *N. pulchra* leaves closer to a water source have a significantly greater leaf surface area than plants farther away.

**LD-31**

**Analysis of the Effect of Water Availability on Vigna radiata** (Mung Bean Plants) and *Phaseolus vulgaris* (Black Garden Bean Plants) – April 2014

Victoria Matthews (*vmatthews1@mail.csuchico.edu*), William Mende (*wmende@mail.csuchico.edu*), and Alexandra J. Smith (*asmith154@mail.csuchico.edu*)  
BIOL 152: Mandep Grewal (*mgrewal@csuchico.edu*) and Christopher Ivey (*ctivey@csuchico.edu*)

**UD-38**

**Title:** The Effect of Oak Apple Gall Quercus lobata Size on the Density of California Wasp Larvae Andricus californicus  
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**Sponsoring Faculty Member:** Shelly Kirn (*sakirn@csuchico.edu*)  
**Course Number:** BIOL 350  
**Category:** Class Project (Upper Division)

This experiment was conducted to distinguish the difference in the amount of California Gall Wasp larvae (*Andricus californicus*) that hatch from the Oak Apple Gall (*Quercus lobata*) in relation to the size of the gall. Fallen Oak Galls of varying sizes were collected from Bidwell Park and data were collected of the diameter as well as number of holes in each gall which we assumed were caused by the California Gall Wasp. It was speculated that the larger the diameter of the gall the more larvae would emerge from the gall due to more space and nutrients provided for the developing specimen. An ANOVA test was run and suggest that the larger galls (6.00 cm in diameter or greater) had, on average, a significantly higher number of emergence holes than galls with diameters of 2.00-2.99 cm (p-value=0.03), of 3.00-3.99 cm (p-value=0.01), and of 4.00-4.99 cm (p-value=0.01). However, not significantly more holes than galls
Macroinvertebrate Community Composition in Ephemeral and Permanent Depressional Wetland Pools in Butte County, California

Holly Cochran, Badri Ghimire, and Haley Mirts

BIOL 484: Colleen Hatfield

Shallow water bodies that arise from stream runoff, precipitation, or groundwater filling up depressions in the landscape are called depressional wetlands. Many macroinvertebrate species exist in depressional wetlands, and indeed spend most or all of their life cycles within them. Some aquatic macroinvertebrates require a period of desiccation during their life cycle while many others require the constant presence of water. One of the considerations when studying macroinvertebrate communities in depressional wetlands is the hydroperiod, or length of time the pool exists as a body of water. Our hypotheses are that species richness and abundance increase as the hydroperiod of the wetland increases, and that the taxonomic orders represented in ephemeral pools versus permanent pools would differ. We examined four pools that are seasonal and exist for only a number of weeks or months, and four pools that are present year round. Using standard dip-netting protocol, we sampled macroinvertebrates from each of the eight bodies of water in March and April of 2014. The samples were then picked and sorted by taxonomic order. The numbers of individuals in each order as well as the total number of orders represented were compared between the ephemeral pools and the permanent pools. We found that species richness was higher in the permanent pools versus the ephemeral pools, and the community composition between pools types differed in that there were five taxa present in permanent pools that were not found in the ephemeral pools.

Tipping the Scales: the Imbalance of the Turtle Community within Teichert Ponds

Gary Day, Robert DeLucie, & Marian Furumi

BIOL 484: Colleen Hatfield

Invasive species are known to cause negative impacts on ecosystems and for this reason it is critical to track their progress for conservation of native fauna. Commonly, invasive species are introduced near urban areas. The red-eared slider (Trachemys scripta elegans) is one such invasive species that has become an increas-
density with the bottom having a significantly greater trichome density ($p<.05$). The results suggested that predation is greater at the bottom of the plant. Greater trichome density may be artificially selected in domestic plants in defense to insect predation.

**LD-33**

**Effect of Sunlight in Predator Consumption Rates**

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Predation rates for plants are a concern for plant health and agriculture settings has tremendous effects on crop yields. By asking whether predation rates will increase in a greater or lesser presence of light, our study will help growers maintain the most efficient and healthy environment for their plants. Our hypothesis has aligned with previous scientific research to conclude that predation increases in areas with greater sunlight. We observed several plants of the same species in One-Mile Bidwell Park. Half of the plants were shielding from sunlight by a large tree, the other half were exposed to sunlight. They were observed for unnatural damage indicating herbivore predation. Using a t-test we concluded that there is no significant difference between predation rates in sunlight and shade ($p$-value=0.043). Our experiment suggests that there is more predation in plants that are found in sunlight.

**LD-34**

**Foraging Habits and the Effect of Size Exclusion**

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Given the option of two pieces of food with the only variance being in size, a predator will take the larger food source for an equal energy expenditure for a greater reward. The purpose of this study is to distinguish the predatory behaviors involving prey of different sizes, large (1.89 in$^2$) and small (1 in$^2$). By changing the palatability (quinine) of the preferred bigger meal, we will determine if the predator will choose a smaller meal. Our team set out to determine if the size of food will determine foraging habits given an unpalatable proxy. Quinine was used as the palatability variable, because it has been shown to be unpalatable by many species. Trays of Cheez-It® of two different sizes (large and small) were left out for a week, and the number of large to small Cheez-It® taken were recorded. After a week of data collection, a new set of trays were placed outside with the large Cheez-Its® (of which approximately 50%) were coated in quinine. Summarily a de-

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We conducted a survey of the avian community within a remnant riparian forest habitat adjacent to the Sacramento River, 6 mi west of Chico, Butte County, California. Birds were surveyed for 2h beginning approximately a half hour after sunrise during April 2014. Transects were designed and surveyed for both plants and birds within our 1 ha study area. Our goals were (1) to determine the species composition of both the avian and plant communities within are study area, (2) to calculate a foliage height profile of the vegetation present, (3) to calculate Shannon (H') diversity values for plant species, foliage heights, and bird species to be used in a comparison with values generated within other habitats, and (4) to determine whether birds use the various plant species and foliage heights randomly or selectively; our null hypotheses being that there are no difference in the utilization of these habitat components by each bird species relative to the availability of each habitat component. Our results, including data analysis, will be presented on our poster.

**UD-35**

**Characterization of Bacteriophages Isolated from Sewage**


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Bacteriophage (phage), or “bacteria eater,” can be defined as viruses that infect bacteria. Phage are specific for the host that they can infect, and for every bacterium found in nature, there is likely a phage that can infect it. In this experiment, samples of raw, untreated sewage (a source of phage diversity) from the Chico City Wastewater Treatment plant were collected and phage enriched for using 9 bacterial host cultures. We were able to enrich for and isolate phage that can infect: *E. coli* MM294, *E. coli* B, *E. coli* C91, *Pseudomonas syringae*, and *Serratia marcescens*. Key characteristics of different phage were determined including: host range, temperature stability, attachment specificity, characterization of phage structural proteins, and burst size. This information can be useful for characterizing potentially novel phage.
height and plant species profiles for our study area, (3) to generate 
Shannon diversity (H') values for plant species, foliage heights, and 
bird species, and (4) to determine whether birds are using the vari-
ous plant species and foliage heights randomly or selectively; our 
null hypotheses being that there are no differences in the availability 
of both plant species and foliage height intervals, and the utilization 
of these habitat components by birds. The most common avian spe-
cies at our site included the Brewer’s blackbird, downy woodpecker, 
and yellow-rumped warbler. Our results will be presented on our 
poster.

UD-33 
Habitat Utilization and Selection by Birds of the Big Chico Creek Riparian Forest with Notes on Avian and Plant Diversity
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BIOL 434: Jay Bogiatto rbogiatto@csuchico.edu

We conducted a survey of the Big Chico Creek avian community 
within a riparian forest habitat in Upper Bidwell Park, 0.5 miles 
south west of the Bidwell Park Golf Course, Chico, Butte County, 
California. Surveys were conducted during April and May 2014. 
Our 1 hectare study area was divided into transects designed for 
surveying both the plant and bird communities. Our goals were (1) 
to determine the species composition of both the bird and plant 
communities within our study area, (2) to calculate foliage height 
and plant species profiles for our study area, (3) to generate Shan-
non diversity (H') values for plant species, foliage heights, and bird 
species, and (4) to determine whether birds are using the various 
plant species and foliage heights randomly or selectively; our null 
hypotheses being that there are no differences in the availability 
of both plant species and foliage height intervals, and the utilization 
of these habitat components by birds. The most common avian species at 
our site included the Brewer's blackbird, downy woodpecker, 
and yellow-rumped warbler. Our results will be presented on our 
poster.

UD-34 
Habitat Utilization and Selection by Birds within a Remnant Sacramento River Riparian Forest, with Notes on Avian and Plant Diversity
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increase in large Cheez-Its® was observed, with an increase in small Cheez-
It® consumption. Despite being a bigger meal, the variability of eating quin-
ine lead to an increase in smaller prey consumption.

LD-35 
Title
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Earth worms rely on their porous skin for gas and water exchange. Having 
to live in constantly moist environments is vital to their life style and survival 
rate. This begs the question of how stable their environment needs to be for 
their survival rate to remain relatively constant. As acid rain becomes in-
creasingly more common, if earth worms are able to survive in and environ-
ment with increasing acidity then they will be selected for. Our null hypothe-
sis is that there will be no significant difference between the control and 
experimental groups. Our alternative hypothesis is that the control group 
will have a higher survival rate than the experimental group. The experi-
mental set up was a pairwise comparison with three control groups and 
three experimental groups. Soil samples were collected from CSU Chico 
campus, Lower Bidwell Park (Chico, CA) and Upper Bidwell Park (Chico, 
CA). The control soil was tested for pH levels and the experimental pH was 
 alters to be one pH level lower. The experiment was run for one week. 
With a calculated G value in all cases being 0, there is no significant differ-
ence between the survival rate of worms living in a pH of 5. This made us 
conclude that we cannot reject the null hypothesis. This shows that earth 
worms are adapted to slight fluctuations in pH values.

LD-36 
Effects of sunlight on growth of the Anthriscus caucalis plant
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In this study, observations were made on the plant species Anthriscus cau-
calis found on the CSU Chico campus to examine how plant height and 
plant leaf area are affected by the degree of sunlight they receive. Due to 
the photosynthetic activity of terrestrial plants, plants directly exposed to 
sunlight are expected to exhibit enhanced growth when compared to the 
same photosynthetic plant that is found in a less-ilt area such as a shaded 
region. Four plants of each treatment were chosen at random to represent 
a random sample of each population. Plant height and plant leaf area of
Anthriscus plants found in direct sunlight were compared to the plant height and leaf area of the Anthriscus plant found in shaded regions. Statistical analysis revealed a significant difference in plant height, as expected, between plants found in direct sunlight and those in shaded areas. With a p-value of 4.5x10^{-5}, we can confidently state with over 95% confidence that sunlight directly affects plant height. However, such statistical analysis revealed no significant difference in leaf area of plants in either well-lit or less-lit regions, our p-value being 0.189. These results suggest that plant height directly depends on exposure to light, yet leaf area may be related to some other factor.

LD-37
Effects of Soil pH on Bermuda Buttercup Plant Growth
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The Bermuda Buttercup (Oxalis pes-caprae) is a type of plant that is commonly found in Chico and can grow in a variety of conditions. In order to test what conditions were most favorable for Bermuda Buttercup prosperity in Chico, we decided to test our hypotheses that if soil pH affects the growth of plants in Chico, then plants in basic soil should be more abundant than plants in acidic soil. Since this plant is abundant in the Chico area, we were able to collect both a sample of basic as well as one sample of more acidic soil from Bidwell Park near the creek. Bidwell park not near the creek, and near the creek on the Chico State Campus. At each location, we found two areas where there were Bermuda Buttercup plants growing and took a measurement of the pH and collected soil from one that was basic and one that was acidic as well as counted the number of Bermuda Buttercup plants and flowers that present at each location. We concluded that when the soil had a pH of 7 or higher, there were more Bermuda Buttercup plants and flowers growing in that soil than the soil that had a pH of 6 and lower. With our results, we were able to accept our experimental hypotheses.

UD-31
Bird Diversity and the Utilization of Vegetation in a Foothill Woodland Community
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BIOL 434: Jay Bogiatto rbogiatto@csuchico.edu

We conducted an investigation of habitat utilization by birds within a mid-elevation foothill woodland community, located on the ridge between highway 32 and Big Chico Creek canyon, east of Chico, Butte County, California. Data were collected between April 11 and April 21, 2014, along 100 m transects within our 1 ha study site. The objectives of our study were (1) to determine avian and vegetation species composition within our study area, (2) to generate a foliage height profile for our site, (3) to calculate and then assess the relationship between Shannon Diversity values (H') for avian species, foliage height, and plant species within our habitat type, and (4) to determine whether birds are randomly or selectively using those plant species and vegetation foliage height intervals present within our study area; our null hypotheses state that there are no differences in the proportion of plant species and foliage height intervals available within our study area and the utilization of these habitat components by birds. Our results will be presented on our poster.

LD-38
Effect of overcrowding on plant growth
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results were not significant. This shows that female mice do not discriminate against non-kin in communal rearing of young.

UD-32
Habitat Utilization and Selection by Birds within a Restored Riparian Forest, with Notes on Avian and Plant Diversity
Kim Armstrong, Bill Pendergraft and Jordan Sanchez
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We conducted a survey of the avian community within a restored riparian forest habitat located Northwest of Chico at River Mile 198.5-L, Butte County, California. Our study site was located within the Pine Creek Unit of the Sacramento River National Wildlife Refuge. Surveys were conducted during April 2014. Our study area was divided into 100 transects within a 10,000 square meter area, designed for surveying both the plant and bird communities. Our goals were (1) to determine the species composition of both the bird and plant communities within our study area, (2) to calculate foliage
(NEBION / ETH Zurich, 2008). PSORT computer program predicts that the AT2G43480 peroxidase enzyme is expressed in the cell wall of the plant cells (Nakai and Kanehisa, 1991). Tri-template PCR was performed to insert the Yellow Fluorescent Protein (YFP) reporter gene sequence into the AT2G43480 gene sequence. The tri-template PCR products were cloned into the pDONR221 plasmid vector and were then subcloned into the pMN20GW plasmid vector (subsequently referred to as pM43480). Plasmid vector pM43480 was then transformed into Agrobacterium tumefaciens cells. A. thaliana was inoculated with A. tumefaciens and seeds were then harvested and grown. Fluorescence microscopy detected expression of YFP in epidermal cells of the root tip, supporting the prediction from Genevestigator. Upon further fluorescence microscopy, we can identify the location of expression in the root tip epidermal cells and further the understanding of the peroxidase enzymes’ function.

UD-30
Preferential cooperation by kin in communally nesting female mice
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Communal nesting in house mice is common and has been observed in the wild, in laboratory and semi-natural conditions. According to kinship theory we expect that females will preferentially form communal nests with relatives to minimize exploitation and further increase inclusive fitness. We hypothesized that female mice do not contribute parental care to kin and non-kin equally and predict that kin will discriminate against non-kin in communal raising of pups. To observe whether kin mice will offer more help than non-kin in the rearing of offspring we set up four terrariums, each with 2 pups. To observe whether kin mice mothers and non-kin mothers were then harvested and grown. Fluorescence microscopy detected expression of YFP in epidermal cells of the root tip, supporting the prediction from Genevestigator. Upon further fluorescence microscopy, we can identify the location of expression in the root tip epidermal cells and further the understanding of the peroxidase enzymes’ function.

Our experiment was conducted to see if overcrowding of two different types of flowers with three different seed distributions affected the growth of the plant. Observations of Marigolds and Nasturtium indicated that overcrowding on these specific species appeared to have a positive effect on plant growth. Our results show that height was greater with more seeds planted together. Based off of two different trials we found similar results. In the first trial the Marigolds and Nasturtiums with one seed did not grow at all, so we decided to use the second trial since each of our plants grew. After analyzing these two separate trials, we determined there was a significant difference based off of our T-test (t=12.38, p<.05, df=11). Our results indicate that we reject our null hypothesis. Therefore, overcrowding positively effects plant height.

LD-39
The Effect of Differing Organic and Inorganic Ratio Compost on the Growth Rate of Salvia elegans Vahl (Pineapple Sage) in Butte County, Chico, California (April 2014)
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BIOL 152, Tag Engstrom, tengstrom@csuchico.edu

Crop yield is becoming of greater concern as the human population continues to increase exponentially. The same plots of land or even smaller subdivisions must now produce more plant yield in order to meet growing food demands. Compost is portrayed as one solution in the farmer’s arsenal to increase crop yield. Our group hypothesized that a ratio of more organic matter to inorganic matter compost would yield the greatest growth rate of the fast growing herb, Salvia Elegans Vahl. Compost was made with varying ratios of organic to inorganic content. Two plants for each of the six compost ratios were planted and measured weekly. The results portrayed that we reject our null hypothesis. Therefore, overcrowding positively effects plant height.

LD-40
Higher stomatal density on developing versus mature leaves of Sarcosa confusa measured by tape impressions
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BIOL 152: Evan Fadgett

Plants are known to detect and physiologically respond differently to environmental changes in their photosynthesis processes. Stomata are tiny pores on the undersides of leaves that open to allow carbon dioxide to enter for carbon fixation, and water and oxygen to escape. The aim of this
experiment was to find if there is a significant difference between the stomatal density of developing plants versus mature leaves. Leaves were taken from Sarcosa confusa evergreen plant. 20 mature leaves and 20 developing leaves were picked from the same plant under the same conditions, and an average number of stomata were calculated. The developing leaf stomatal densities were found to be significantly higher (8.44, SD 0.70) than the mature ones (6.05, SD 0.54). This is thought to be due to growth potential of and signaling from mature leaves of the plant.

LD-41
Determining intraspecific competition in pea plants when planted different distances apart
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In nature, factors of competition for resources in an environment can be indexed. One method for testing factors influential to competition is to isolate a potentially influential factor, and observe the events that follow to determine if that factor is in fact influential. This general method was implemented into this experiment of intraspecific competition in pea plants. With an isolated factor of distance, the main mechanism of competition observed is competition for limited resources. We tested this by planting peas different distances apart: a control plant group was planted the recommended (by the manufacturer, Burpee) distance of 2 inches apart, a second group was planted ½ inch apart, and the third group was planted 3 inches apart. Our alternate hypothesis claims that with reduced distance between the plants, intraspecific competition will increase. The null hypothesis claims that there is no significant difference between the levels of plant growth; therefore distance between pea plants is not a factor in intraspecific competition. On average, the control plants grew 0.66 cm, the second group grew 8.14 cm, and the third group grew 30.57 cm (measured from tip of root to tip of plant). We ran an ANOVA statistical test, which revealed a low P-value (1.02E-06) between groups. We reject the null hypothesis.

LD-42
Stomata density varies among an oak tree’s distance from a water source
Sarah Wintsch, Diana Thao, Gabrielle Finley-Vaquera
BIOL 152: Dr. Christopher Ivey, civey@csuchico.edu, Mandeep Grewal, mgrewal@csuchico.edu

Peroxidases are found in all land plants. The polymerization of monolignols to form lignin is required for the waterproofing and strengthening of xylem in plants. Class III secretory peroxidases are believed to catalyze this polymerization, allowing it to proceed through a free radical mechanism. We predict that these peroxidases are used to modify cell walls with lignin in elongating cells in the root apical meristem. A gene for a class III secretory peroxidase of Arabidopsis thaliana, AT2G43480, was identified for study using Genevestigator, according to which the peroxidase is expressed comparatively highly in the root tip of the germinating plant. A reporter construct incorporating Yellow Fluorescent Protein was created using a tri-template PCR reaction and cloned into the pDONR211 vector and subsequently subcloned into the PMN20 plant transformation vector. Agrobacterium tumefaciens was transformed with our recombination vector and used to transfect A. thaliana plants. The seeds produced from the transfected plants were then grown on agar plates containing the antibiotic kanamycin. When the root tips from the germinating seeds were observed under a fluorescence microscope we found that strong fluorescence can be detected in the root tips of some plants. This fluorescence is stronger than in the controlled plants. We concluded that the gene AT2G43480 produces an enzyme that accumulates strongly in the root tips of our plant.

UD-29
Arabidopsis thaliana class III peroxidase gene AT2G43480 expression
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Class III peroxidase genes are found in all vascular plants. Scientists suspect that peroxidase enzymes produce monolignol radicals that polymerize to form lignin, which provides structural support in plants. Further research into the expression of peroxidase genes in plants could provide a better understanding of the enzymes’ function and the potential application for modification of lignin production. In Arabidopsis thaliana, there are 73 peroxidase gene families. In this study, the location of expression in the plant cell of class III peroxidase gene AT2G43480 was investigated. A heat map generated from Genevestigator, an online database, shows high accumulation of mRNA in the epidermal cells of root tips of A. thaliana.
expression potential of AT1G05250 (AtPrx02) within anatomical parts of A. thaliana was generated by GENEVESTIGATOR (Hruz et al. 2008 and Zimmermann et al. 2004) indicating that AT1G05250 is strongly expressed in the root tip. To confirm this, AT1G05250 was tagged with a YFP (yellow fluorescent protein) gene to produce a reporter gene and was transformed into Agrobacterium tumefaciens. Arabidopsis thaliana plants were transformed with the reporter gene through floral inoculation of Agrobacterium tumefaciens. The seeds of the transformed Arabidopsis thaliana were grown and the presence of the construct containing YFP was verified through confocal microscopy. This verification showed successful genetic engineering of the YFP reporter gene into the genome of Arabidopsis thaliana which produced a fluorescent protein.

References


Location of a Class III Secretory Peroxidase in Arabidopsis thaliana

Location of a Class III Secretory Peroxidase in Arabidopsis thaliana

Stomata aid in the process of photosynthesis in plants by exchanging water and gases such as carbon dioxide. The significance of our study is to determine if stomata density in oak trees varies among trees that are located near Big Chico Creek compared to trees located further. We hypothesized that trees closer to the water source will have a higher stomata density than trees further from the water source because trees closer to the water will have a higher rate of water exchange for photosynthesis therefore increasing carbon dioxide exchange. One leaf was obtained from an oak tree 3.6 meters away and one from an oak tree 26 meters away from Big Chico Creek. Nail polish was applied on the lower epidermis of each leaf to obtain an impression, which was examined under a microscope. Average numbers of stomata per field of view and standard deviation were calculated on a leaf closer (AV=427 per mm²; SD=6.67) and further (AV=253 per mm²; SD=23.09) from the creek. The averages were compared using student t-tests, which produced the p-value of 0.003. The stomatal density is significantly higher in the leaves of the oak tree closer to the creek as compared to the leaves of the oak tree further away from the creek. Stomata density does vary among oak trees depending on the distance from the water.

LD-43 Latex Production Relative to Environmental Conditions in Euphorbia Peplus

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Varying amount of latex production is used as a defensive mechanism in plants in order to immobilize herbivores with the toxins present in latex. In this experiment, the differences in latex production from Euphorbia Peplus in different environments were observed. We hypothesized that there will be more latex production in the plants that are in the sunny environments compared to plants in shade, because plants in sun are more visible to insects and experience higher level of herbivory. According to our alternative hypothesis, there will be more latex production in the plants that are in shaded environments compared to plants growing in the sun because insects prefer to feed in the shadier areas. A total of ten plants were picked, five form a sunny uncovered environment and five from the shaded covered environment. The plants in the sun had yellowed leaves and stunted growth compared to the plants in the shade. The latex was collected and measured from the stem broken directly under the flower. The average latex produced in the sunnier plants (1.5uL; SD 0.3 uL) and the average latex produced in the shaded plants (4.1uL; SD 1.01 uL) were calculated, graphed, and means were compared using student t-test (p 0.03). There
was significant difference in the latex production. In conclusion, the plants in the shaded area produce more latex because they need higher protection from herbivores. This could be due to the herbivores preferring to feed in the shadier areas than the sunnier areas.

LD-44
Analysis of the Effect of Trap Color and Location on Insect Collection
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The motivation for our project is to see if insects are more attracted to an orange trap or a white trap. We also tested to see if the location of the trap would play a role in the number of insects collected. Our study was conducted by making insect traps with orange and white bowls, water, and soap. We placed the traps in a yard and near garbage cans for three 24 hour periods. After each 24 hour period we counted the number of insects for each bowl and location and analyzed the data. The average number of insects (SD) in the orange bowls is 16.33 (6.18). The average number of insects (SD) in the white bowls is 16.61 (8.62). After performing a t-test, our tcalc value is 0.111 and our tcred value is 1.6909 with a p-value of 0.05 and 34 degrees of freedom, df. Next we did an analysis on the location data. The average number of insects (SD) in the yard area is 16.39 (7.40). The average number of insects (SD) in the garbage area is 16.56 (7.60). We performed a t-test with these data and our tcalc value is 0.067 and our tcred value is 1.6909 with a p-value of 0.05 and 34 df. Given these t-test results we conclude that our findings are not statistically significant and that insects didn’t show a preference for white or orange traps and the location of the traps did not play an important role in number of insects collected.

LD-45
Occurrence of nitrogen fixation in cultivated vs. uncultivated grassland was insignificant
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Tag Engstrom (tengstrom@csuchico.edu)
Biology 152: Class Project (lower division)

Tiny prokaryotic organisms living symbiotically on the root hairs of certain types of plants are responsible for transforming, or fixing, life sustaining nitrogen into a usable form. Without a source of usable nitrogen, the synthesis of proteins and nucleic acids would be impossible. The purpose of this study was to compare the occurrence of nitrogen fixers found in flood irrigated pasture-grass as opposed to wild grassland. Randomly selected patches of grassland in each environment were investigated and each plant

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Class III secretory peroxidases have a major function in the synthesis of the cell wall (Tognolli et al. 2002). Through the process of lignification the peroxidase enzyme binds with hydrophobic monolignols, and through the process of oxidation, monolignol radicals and water are generated. Of the 73 class III peroxidase genes that Arabidopsis thaliana contains, gene AT2G43480 was selected for transgenic research due to its high potential of expression in root tips and flower petals. The DNA reporter construct was cloned and subcloned into Agrobacterium tumefaciens, allowing for transformation of Arabidopsis thaliana. A yellow fluorescent protein gene was transformed into gene AT2G43480, which allowed tracking of gene expression through fluorescence microscopy. Successful gene transformation showed YFP expression in the protein of the root tips.

References
further confirmed with multiple gram stains, motility test, and oxidase test. The results revealed that the final isolate is a gram-negative and motile sulfate-reducing bacteria; however, we are able to identify both the genus and species of the isolate.

Enrichment and Progress Towards Isolation of Purple Nonsulfur Bacteria
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Purple nonsulfur bacteria are a nontaxonomic group of photosynthetic bacteria which thrive in anaerobic environments that have access to sunlight, such as mud in ponds or other water sources. These bacteria are unique among photosynthesizers because they do not utilize water as a reducing agent and consequently do not generate oxygen as a product of photosynthesis. Purple nonsulfur bacteria can be sourced from a bacterial growth chamber known as a Winogradsky column, which creates a gradient that divides the chamber into several “zones” having variable nutritional, oxygen, and light content. Our research group sought to enrich and isolate a pure culture of a purple nonsulfur species sourced from a classroom Winogradsky column. To begin, approximately 8cm3 of red/brown colored biomass taken from the anaerobic zone of the column was used to inoculate an enrichment broth consisting of yeast extract and various inorganic nutrients. The inoculated broth mixture was sealed in a glass bottle with minimal air and allowed to incubate under sunlight. Although initial growth was slow, over the course of several weeks formation of a deep purplecolored cloudiness began to permeate the broth. A wet mount was prepared, revealing a broad diversity of pigmented microorganisms. The redishbrown pigment together with the sewagelike smell (hydrogen sulfide) of the medium indicated that the enrichment procedure was successful. An attempt to isolate a pure culture using a dilution series was unsuccessful, but may still be feasible with some modifications to the growth medium and/or conditions.

Origin of Peroxidase Gene AT2G43480 in Arabidopsis thaliana
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type examined for evidence of the presence of nitrogen fixers, telltale nodules fixed to the root hairs. We hypothesized the occurrence of nitrogen fixers would be more abundant in wild grassland. Our study yielded insignificant results (t=-2.82, P = .0519). If this study had yielded significant results, it and others like it would, reach into the realm of responsible land management.

Survival rates of Earthworms in soils with Lowered pH
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Earthworms rely on their porous skin for gas and water exchange. Having to live in constantly moist environments is vital to their life style and survival rate. This begs the question of how stable their environment needs to be for their survival rate to remain relatively constant. As acid rain becomes increasingly more common, if earthworms are able to survive in and environment with increasing acidity then they will be selected for. Our null hypothesis is that there will be no significant difference between the control and experimental groups. Our alternative hypothesis is that the control group will have a higher survival rate than the experimental group. The experimental set up was a pairwise comparison with three control groups and three experimental groups. Soil samples were collected from CSU Chico campus, Lower Bidwell Park (Chico, CA) and Upper Bidwell Park (Chico, CA). The control soil was tested for pH levels and the experimental pH was altered to be one pH level lower. The experiment was run for one week. With a calculated G value in all cases being 0, there is no significant difference between the survival rate of worms living in a pH of 5. This made us conclude that we cannot reject the null hypothesis. This shows that earthworms are adapted to slight fluctuations in pH values.
Upper Division Class Projects

UD-1
Resource Quantity and Productivity in Gallling Wasps
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The objective of our study was to determine if Valley Oak gall size has a
relationship with wasp larva, inquilines and other insect abundance, as well
as if gall size and the number and size of holes on the outside of the galls
have any correlation. The greater the quantity of resources (gall size) the
more productive the galls. We randomly collected fresh galls from Valley
Oaks and then placed each individual gall into a ziplock bag. We recorded
the circumference of each gall, and the number and size of the holes on the
outside of each. Next, we cracked open the galls and collected any and all
insects that were inside of them. We predicted that larger galls would have
great insect activity versus a small gall due to greater resource availability.
The significance of this study is to determine the correlation between galls,
hole sizes and number of insects inside each gall. This is due to larger
galls having a higher quantity of resources, therefore more gall wasps will
occupy it in order to utilize those resources.

UD-2
Interspecific Competition between Acorn Woodpeckers
(Melanerpes formicivorus) and European Starlings (Sturnus
vulgaris) in a Local Granary
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Abstract: Interspecific competition is a form of competition in which individu-
als of different species compete for the same resource in an area. This in-
teraction has far reaching effects that reach the entire community and can
even influence evolution so that species may adapt to avoid competition.
The purpose of this experiment is to determine whether there is significant
competition between acorn woodpeckers and European starlings for local
resources. We predicted that if acorn woodpecker and European starling
numbers increase, interspecific competition will escalate. Observing a local
acorn woodpecker granary, numbers of acorn woodpeckers and European
starlings that entered and left the granary were recorded within a set radius
(20 feet from the granary) at different times of the day throughout one
day.

UD-3
Isolation of Sulfate-reducing bacteria from Chico Creek
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Our goal was to obtain a pure culture of sulfate-reducing bacteria, obligate
anaerobes that reduce the electron acceptor sulfate to produce hydrogen
sulfide. One good indicator of sulfate-reducing bacteria is to see a black
precipitation when iron is present. These bacteria are ubiquitous in freshwa-
ter and marine areas that include muds and soils. Our project focused on
the enrichment and isolation of sulfate-reducing bacteria from freshwater
creek mud collected underneath the bridge outside of Selvester’s Café. We
suspended our original sample in creek water and incubated in room tem-
perature while covering the beaker with foil to reduce oxygen from penetra-
ing. We inoculated molten agar test tubes and treated them under anaero-
bic conditions. Two days after inoculation, we observed black growth
throughout the jar. All Gram stains were inconclusive, although most likely
Gram-positive with endospores when viewed under the microscope. We
will present results from multiple sugar fermentation tests, oxidase test and
catalase test to identify our microorganism.

UD-4
Isolation of sulfate-reducing bacteria from soil outside of Holt
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In this experiment, we enriched sulfate-reducing bacteria (domain: Archaea;
phylum Delta-proteobacteria; family: Firmicute families) using a specific
media with ferrous ammonium sulfate as an indicator (and a reducing
agent) and succinate as a carbon source. Sulfate-reducing bacteria are
anaerobes that reduce sulfate to hydrogen sulfide. A sample of soil was
taken from outside of Holt Hall and the sulfate-reducing bacteria were en-
riched for over a period of six weeks by means of multiple serial dilutions in
agar, liquid culturing, plating, and re-isolation to liquid culture. The presence
of the sulfate-reducers was indicated by the FeS, a black precipitate result-
ing from the reduction of ferrous sulfate. The identity of the isolates were
would be able to characterize a species of carbon from starch. In our project, our goal was to isolate and characterize a species of bacteria that obtain their energy by phosphorylation from fermentation and produce powerful endotoxins that are responsible for disease. These bacteria are rod shaped and form terminal endospores. They are mostly found in animal intestines, sewage, soil, and marine sediments. These bacteria are also fermentative. These bacteria are gram negative. They are typed of bacteria that are primarily Clostridia.  

**UD-21**  
**Isolation and Temperature Sensitive Analysis of Rhizobium from Legume Root Sample**

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Rhizobium cultures were obtained from root nodules of a clover harvested outside of Holt Hall. Rhizobium are nitrogen fixing bacteria that are gram negative, motile rods that form a symbiotic relationship with plant roots. Our group focused on enriching and isolating Rhizobium from clover nodules in an agar with mannitol as the main carbon source. After crushing up the root nodule and disinfecting it with antiseptic, we streaked the preparations onto the autoclaved Rhizobium agar. After one week we saw growth and ran a gram stain to ensure we had gram negative rods. Our goal was to run phenotypic tests to help confirm that we have a Rhizobium microbe. Once we had an isolated nitrogen fixer that we hoped was Rhizobium we then inoculated the fresh culture into sterile water blanks and preformed three dilutions for three separate temperature trails. We grew our bacteria at 28 °C, 37 °C, and room temperature and our question was at what temperature we would see maximum growth after two days. Our results indicated that 28 °C was the prime temperature for our nitrogen fixing bacteria to grow.

**UD-22**  
**Isolation of Soil Clostridium from Creek Leaves**

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Species of the genus Clostridium are typed of bacteria that are primarily fermentative. These bacteria are gram-positive obligate anaerobes. They are rod shaped and form terminal endospores. They are mostly found in animal intestines, sewage, soil, and marine sediments. These bacteria are powerful endotoxins that are responsible for disease. These chemo-organotrophs obtain their energy by phosphorylation from fermentation and carbon from starch. In our project, our goal was to isolate and characterize a species of Clostridium. To do this we inoculated and grew isolates on egg yolk and starch in an anaerobic environment. Multiple tests were ran that would be able to characterize a species of Clostridia. The tests that we

week. Direct interaction between woodpeckers and starlings was recorded. The p-value calculated supported our experimental hypothesis. Increasing numbers of woodpeckers observed were positively correlated with numbers of starlings. This research can be used to determine whether native acorn woodpecker populations risk lowered fecundity, growth, or survival due to interspecific competition with invasive European starlings. Removal of one competitor involved may result in a trophic cascade affecting members of the ecosystem at every trophic level.

**UD-3**  
**Effect of shading by English walnut (Quercus lobata) in Bidwell Park**

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Persistent decline in valley oak from its native range has prompted study into the factors that affect its regeneration. In Bidwell Park, a former walnut orchard is assessed to determine the factors responsible for the widespread oak regeneration occurring at this site. Frequency, distribution, and height of valley oaks were measured around English walnut trees in the orchard. Significant increases in valley oak frequency and height occurred on the northern and eastern sections of the English walnuts, suggesting that shading from the western sun by the English walnuts may be an important contributor to the successful oak regeneration observed at this site.

**UD-4**  
**Estimating Importance Value and Dispersion in Trees of Upper Bidwell Park**

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An analysis for dispersion of trees and importance value was conducted in the upper part of Bidwell Park in Chico, CA. Fifteen random points were selected using a random number chart and procedures were based off Holgate’s and the point centered quarter method. The five highest importance values for trees were held by CA foothill pine (1.89), Sycamore (1.27), Cottonwood (1.23), Blue Oak (1.19) and Ash (1.12). An index of aggregation value (A=.13) supported that dispersal of trees in Upper Bidwell Park was aggregated, but not significantly (p > 0.05). Relative frequency values ranged between 0.03 (maple) and 0.18 (CA Foothill Pine, Sycamore, and Ash). By understanding dispersion patterns and quantify importance values
in species in a given community we are able to help better understand how to manage and conserve that system more effectively.

**UD-5**

Giving-up densities of Western gray squirrels and optimal foraging in suburban and forest areas  
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An optimal foraging strategy is necessary for the survival of all organisms. Foraging behavior can be studied to increase ecological understanding of optimal feeding processes for various species and communities. In this study, we were interested in observing the differences in giving-up density (GUD) of Western gray squirrels (Sciurus griseus) between a suburban and forest habitat. We predicted that the GUD of gray squirrels would be significantly greater in the suburban habitat due to the risk involved in foraging in a populated, high-traffic area. Five substrate tins were dispersed randomly in two locations representative of the two habitat types and GUD was recorded after a period of 24 hours. We analyzed the GUD values in each location and compared them using a statistical t-test analysis (t = 2.57, df = 5, p = 0.049). Our results suggest that, contrary to our original predictions, foraging squirrels in a forest habitat had a higher GUD than those in a suburban type habitat. This may be due to the abundance of other available substrate resources in a forest habitat that require lower energy to obtain, and therefore are more energetically favorable. This study was conducted with a relatively small sample size and further studies could repeat this experiment with an increased sample size to increase the strength of the statistical conclusions. Additionally, detailed observations of the foraging patterns of squirrels in the surrounding areas may provide insight into the foraging mechanisms and help explain the results.

**UD-6**

Biodiversity Comparison of Invertebrates in Upper Bidwell Creek and Lower Bidwell Creek.  
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This experiment is investigating how water quality in creeks affects local

**UD-19**

Isolation of Nitrogen-Fixing Bacteria from Root Nodules  
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Diatomic Nitrogen is the most abundant element in the atmosphere, while nitrogen is often the limiting nutrients in the natural ecosystem. Nitrogen fixers are gram negative, motile, and non-spore-forming bacteria that can convert atmospheric diatomic nitrogen to biologically available forms like ammonia and organic amines. As ammonia and organic amines are formed, they are used by other organisms to make amino acids and nucleotides. Nitrogen fixers are bacteria found in the genus Azotobacter and Rhizobium. This enrichment focuses specifically on the isolation of Rhizobium, a symbiont in the roots of the legumes. The bacteria were taken from a root nodule, cleaned with tap water and then allowed to soak in disinfectant of 10% bleach and 70% ethanol for two minutes. The bacteria were inoculated onto Rhizobium agar plates containing mannitol, which favors the growth of the organism since few bacteria can metabolize mannitol. The bacteria were incubated at room temperature in a drawer and growth of nitrogen-fixing bacteria was indicated by the appearance of slimy colonies on the agar. Our goal is to obtain a pure culture of Rhizobium by providing an environment lacking nitrogen to inhibit the growth of non-nitrogen fixing bacteria.

**UD-20**

Cyanobacteria Isolation Abstract  
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We isolated Cyanobacteria from a fresh pond water supplied by the CSU Chico Microbiology department. We grew multiple species of Cyanobacteria in a glass vile in direct sunlight. The colonies were visible to the naked eye after several weeks of growth. We enriched for nitrogen fixing filamentous Cyanobacteria by plating them on media with and without nitrogen. Our plates grew slowly, but after several weeks we were able to streak additional plates with varying pH levels. Although our second round of plates did not generate visible growth within our class’s time restraint, we were able to see ample growth on the plate with a pH of 5. In order to determine the specific species of Cyanobacteria that we preliminarily isolated, we would need to conduct genetic test. Phenotypic tests, such as a Gram stain, would not lead to conclusive results. Although we were not able to obtain the quality or specificity in results we set out to achieve, we are confident in our isola-
enrich for bacteria that can degrade oil. For our source of inoculum we chose to sample oily water from a street gutter outside of Holt Hall on the CSU, Chico campus. In an attempt to isolate oil degrading bacteria, we autoclaved a standard nutrient broth and added a 3 in 1 petroleum distillate, which was used for the initial carbon source. We also added Miracle-Gro to provide trace elements, nitrogen, and phosphorus. This solution was incubated with the source of inoculum on a shaker at 28 C and eventually the bacteria was streaked onto oil and TSA plates. We isolated two different bacterium and obtained pure colonies from culture. When viewed under phase contrast microscopy, it was observed that both bacterium were seen to cluster around oil droplets. To further characterize both organisms a variety of phenotypic test were performed.

**UD-18**  
Isolation of Sulfate-reducing Bacteria from Filtered Seawater  
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Sulfate-reducing bacteria are among the class deltaproteobacteria. The production of hydrogen sulfide gas, known for producing the scent of “rotten eggs”, is the result of oxidized organic compounds from sulfate to hydrogen sulfide. Sulfate-reducing bacteria exist mainly in environments similar to salt marshes or mud flats, where oxygen is not present. Through an array of experiments, our goal is to enrich and eventually isolate these bacteria for a pure culture. Ten test tubes of sulfate-reducing medium were inoculated and mixed with ferrous ammonium sulfate-cysteine and soil from an unspecified lake. The first tube was given 1 gram of the soil, inverted to mix, and 1/10 dilutions were made. Melted paraffin was used to seal the culture keeping the environment anaerobic; incubation lasted 7 days. Once black colored colonies appeared throughout the tubes, medium was removed for further isolation. Three tests were performed to determine identity, which included the Gram and endospore stain, along with a fermentation test. Microscopic analysis of the Gram stain indicated that at least two types of sulfur-reducing bacteria were present. Both gram positive and gram-negative rods were observed in high densities and equal quantities. The endospore stain results indicated that at least one of the strains of bacteria produced spores and is therefore either a strain of bacillus or clostridium. The fermentation test resulted in strong positives for both color change and gas production for lactose and sucrose. The glucose tube displayed an orange color, indicating a weakly positive result or low amounts of glucose fermentation.

invertebrates in both diversity and number of specimens. Specifically, patterns of preference for either “clean” or “dirty” creeks will be examined along with overall disturbance factors inflicted by humans. Upper Bidwell Park (5-mile) is the least disturbed location while the most disturbed water source belongs to the creek running through the Chico State campus (lower 1-mile). We believe that we will find a larger number of invertebrates at Upper Five Mile because the water should be less polluted and less disturbed due to less human and industrial interference. Collections were taken at each site twice in thirty minute intervals. Smoother areas of water flow will be where the specimen collections will take place. Rocks and debris will be moved and shifted to allow invertebrates to be carried downstream for a couple of feet and collected in a net. From there the specimens will be collected and the type and number of species will be recorded. Through the experiment it was obvious through just observation that Upper Bidwell Creek was a lot more undisturbed and contained a higher number of invertebrate species than Lower 1-Mile. Total number of invertebrates collected in Lower 1-mile where 21 compared to the 96 collected in 5-mile, 5-mile, therefore, had a higher Shannon Index and we can accept or hypothesis.

**UD-7**  
Ecological Facilitation between Blue Oak (Quercus douglasii) and Poison Oak (Toxicodendron diversilobum)  
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This project involved discovering if ecological facilitation exists between two species, Blue Oak (Quercus douglasii) and Poison Oak (Toxicodendron diversilobum). Ecological Facilitation is important for the reason that in the presence of one species it may be an advantage to other species. Our experiment took place at Upper Bidwell Park, above Horseshoe Lake. We surveyed a total of sixteen Blue Oak trees in order to retrieve our data. The data were retrieved from around the base of the trunk making a 0.9144 meter diameter outwards (near). This provided the first set of data points. Then we collected the next set of data from a 0.9144 to 3.048 meters diameter mark from the trunk (far).

Upon examination of the poison oak averages 1.66 (near) and 1.62 (far) from blue oaks, it was clear (P-value of .9514) that there was no relationship between the distance from the trunk and Poison Oak existing. This suggests ecological facilitation does not exist between these two species. Therefore, this research highlights the importance that ecological facilitation plays between species.
The majority of the research on freshwater streams has mainly been done on vascular plants, but there is growing appreciation of the importance of woody plants to the nutrient cycling in aquatic communities. Woody plants tend to contain higher nitrogen and phosphorous concentrations than other types of plants and their woody debris can provide habitat for various aquatic organisms further helping to promote physical stability of the water channel. Freshwater ecosystems are diverse as the dominance of their foliages can range from wetlands, bogs and swamps to marshes and wet tundra. The decomposition rates of three species of woody plants including the Fremont Cottonwood (*Populus fremontii*), Manzanita (*Arctostaphylos* sp.) and the Valley Oak (*Quercus lobata*) were measured to help us better understand the rate at which nutrients are released into the surrounding aquatic community from dead leaves. Leaves were collected from each of the three species and separated into nine mesh bags: three bags of leaves for each species. The bags were then anchored and submerged in Big Chico Creek on the CSU, Chico campus. One bag from each species was retrieved, dried and weighed each week for three weeks. It was predicted that upon performing the experiment, results will show the leaves from the Fremont Cottonwood decomposed in the freshwater stream at a higher rate compared to the leaf fall from the Valley Oak and the Manzanita due to the light, flimsy physical composition of the Fremont Cottonwood with its large surface area and lack of waxy cuticle.

**UD-9**

**Determination of California Acorn Weevil (Curculio uniformis) Preference for Acorn Size for Harboring Larva**

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Acorn weevils, *Curculio uniformis*, are known to be very destructive against acorns from oak trees. Female weevils bore into acorns to feed on their energy rich nutrients and then will deposit one or more of their eggs inside the partially consumed acorn. The goal of this study is to determine whether and isolate a single species of Myxobacteria.

**UD-16**

**Isolation of an Unusual Actinomycete from the Banks of Big Chico Creek**

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Actinomycetes are a group of gram positive bacteria that contains several genera. Often mistaken for fungi, their colony morphology consists of spreading filaments, or mycelia, that radiate out from the center. Their cells can be rods or cocci, and they are often spore formers. Our isolate was unusual as it was a mixture of rods that arranged in chains and cocci that arranged in irregular clusters. The goal of the project was to enrich for cellulose degrading bacteria from a piece of wet and rotting wood, and an aliquot of soil from the banks of Big Chico Creek. The piece of wood and the soil were each suspended in water, and used to inoculate plates of CMC agar and water agar topped with filter paper. Ultimately, a colony that was growing on CMC agar inoculated with the wood sample was selected for isolation. The isolate was streaked and re-streaked to ensure that a pure culture was obtained. It was subjected to a battery of phenotypic tests, and observed under a phase contrast microscope. The results of the phenotypic tests, catalase negative and facultatively anaerobic, in addition to the location of the original sample suggested that the isolate belongs to the genus Streptomyces, but the odd mixture of cell morphologies and arrangements, and the lack of genotypic testing makes it impossible to be sure. One qualitative indication of *Streptomyces* was the smell of fresh, moist soil that the isolate exuded. The scent comes from geosmin, a metabolite excreted from *Streptomyces* spores.

**UD-17**

**Enrichment and Phenotypic Characterization of Oil Degrading Bacteria**

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There are many types of microorganisms that can use these hydrocarbons as an energy source. Oil degrading bacteria are of great significance to humans, because they are used to clean up oil and chemical spills in a process called Bio remediation. There is a broad spectrum of oil degrading bacteria that range from Actinobacteria to Proteobacteria. Our goal was to
Female California Acorn Weevils commonly predate on various oak species throughout Upper Bidwell Park in Chico, California. Weevil predation usually occurs before seed dispersal has taken place, where they obtain their food resources and deposit their larvae inside the acorns. We wanted to determine whether or not the size of the acorns played a part in acorn selection by the weevil. Acorns provide the larvae with nutrient-rich resources including minerals, lipids, carbohydrates and proteins which is most likely the reason the weevils predate before the seeds are dispersed. We hypothesized that the weevils would show no preference in size between the acorns due to the fact that they all provide nutrient-rich resources. To test this hypothesis, we sampled 268 acorns and recorded the infected (with holes) and uninfected (without holes) acorns. We cracked open the infected acorns to confirm that weevil activity had actually taken place. The size mean was calculated for both acorn groups, infected acorn size (3.54cm) and uninfected acorn size (3.50cm). Out of all the acorns sampled, the weevil infection rate was (27.99% or 75 individuals). Mean (infected and uninfected) was 3.51cm in length. Performing a T-test assuming equal variance between the infected and uninfected acorn size resulted in a P-value of 0.75, showing no significance at the 95% confidence interval. The data that we found supports the hypothesis we had proposed. Our results indicated that we were able to accept our hypothesis that there is no preference in acorn size by California Female Acorn Weevils.

UD-14
Preference of acorn size in the California Acorn Weevil (Curculio uniformis)
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Myxobacteria are a family of gram negative bacteria that exhibit intracellular communication, slime mold like motility, and multicellular fruiting bodies. Myxobacteria are predatory and are commonly found where their prey is: degrading organics in either soil or animal dung. Myxobacteria are well known for secondary metabolite production including pigments, antibiotics and protein digestion enzymes. All of these qualities were used to enrich for

UD-10
Allelopathic Effects of Eucalyptus and Walnut on the Germination and Growth of Lettuce Seedlings
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Allelopathy, the chemical interaction in which one plant inhibits the germination or growth of another, has been widely studied in biology because it provides information that is useful in both agriculture and ecology. In the Chico area, walnut and eucalyptus trees secrete allelochemicals through their roots and leaves, inhibiting the growth of understory vegetation. In this experiment, we tested the effects of allelopathy on the germination and growth of lettuce seedlings. We hypothesized that the use of walnut and eucalyptus leaf extracts would significantly stunt seed germination and growth of lettuce seedlings. We soaked 20 g of leaf material in 750 mL of water for 36 hours. We then used for this experiment were selected from a 30 square meter plot around an oak tree near the creek at lower Bidwell Park in Chico, CA. The size of each acorn was recorded and the number of holes cut by weevils were counted. Sampled acorns were placed in a zip-lock bag for three weeks to observe any emergences of larvae to compare to the amount of acorn holes. The results of this experiment showed no significant differences between small or large acorns so the null hypothesis was accepted. This suggests that female weevils do not show a preference towards acorn size for feeding and ovipositing. Regardless of the acorn size the weevils prefer, the acorns still have a very high mortality rate because of these weevils. The results would be more significant if the smaller acorns were found to be the preferred acorn size because they are more likely to sprout and grow into a seedling of an oak tree. This result could be because of predators and cold climate temperatures forcing acorn weevils to quickly deposit their eggs to ensure their offspring’s survival.
values of 0.048 and 0.122, eucalyptus extract significantly inhibited seedling germination, while walnut extract did not.

**UD-11**  
**Decomposition Rates of Woody Litter within Freshwater Streams**  
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The purpose of this experiment was to further understand how the decomposition rates of leaves affect nutrient cycling in and around the freshwater aquatic system of Big Chico Creek on the campus of California State University, Chico. The decomposition rates were measured over four consecutive weeks and the three types of leaves compared in this experiment were: Valley oak (Quercus lobata), Manzanita (Arctostaphylos spp.), and the Fremont cottonwood (Populus fremontii). A total of 12 mesh bags containing exactly 25.0 grams of leaves were immersed in the creek, four from each tree species. At the conclusion of each week, one bag of each type was extracted and incubated for 24 hours until dry, then weighed. Throughout the first three weeks, the data collection suggests that the Valley oak is losing more mass than both the Manzanita and Fremont cottonwood. The statistical results are pending due to the fact that one week remains in the data collection series. Preliminary results suggest that Valley oak leaves undergo decomposition the most rapidly, likely due to the smaller size as well as a lack of a thick, waxy cuticle. This examination will provide a more complete understanding of the biological processes concerning decomposition rates of woody litter and the contribution to the overall depositing and cycling of nutrients within Big Chico Creek.

**UD-12**  
**Estimating importance values and dispersion patterns in coniferous forest ecosystem looking at four different trees**  
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This study was be conducted to see if there was a correlation between four different trees species (tan oak, cedar, ponderosa pine, doug fir) and in an area of the coniferous forest, also to see if the diversity of trees had an effect on the number of dominant trees and prevalence of the largest trees in this type of ecosystem. One question that was asked was does a dominant species of tree relate to the most frequent tree? It is hypothesized if the largest trees are dominant they will also be the most frequent. This study could be beneficial to timber companies who are planning a harvest.

First, four tree species were chosen to compare dispersal patterns in different patches of forest. Using the point-quarter sampling method to set up plots using a transect line in the chosen area of forest. From a determined starting point, five meters were measured out down the transect line and data was taken five meters into the forest area. Data was taken in four different quadrants and recorded. This procedure was repeated fifteen different times. Data collected at each site was used to calculate the relative frequency, relative dominance, and relative density of each species of tree in order to obtain the importance value.

The data showed that tan oak was the most numerous tree counted while ponderosa pine was the least, but had the largest diameter. Due to the fact we measured on the edge of a clear cut, the introduction of greater amounts of light caused tan oak to grow more robust in larger numbers. This coincides with previous studies.

**UD-13**  
**Allelopathic effect of eucalyptus (Eucalyptus globulus) on rice (Oryza sativa) germination and growth**  
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The invasive capacity and allelopathic effects of blue gum eucalyptus (Eucalyptus globulus) have been documented on a wide range of plants from wild native species to cash crops. However, little research has been conducted on the allelopathic effects of eucalyptus on rice (Oryza sativa). To assess the implications of blue gum eucalyptus populations neighboring rice farms in Northern California, eucalyptus leaf leachates of 3 different concentrations were applied to propagating rice grains. Leachates of 5.0 g/250mL, 10.0 g/250mL and 20.0 g/250mL were tested against a control to observe effect on germination rate and plant length after 10 days of growth. Mean germination rate of the groups ranged between 96.7 and 98.3%, and showed no difference (P>0.5). Plant length means varied between 4.6cm and 6.1 cm, and also showed no difference (P=0.13). These results suggest no allelopathic effect by blue gum eucalyptus on rice, which may influ-