The most exciting part of editing Explorations is learning about the research pursuits of UC Davis’ talented undergraduates, and seeing where new conversations might take place. This year, a compelling theme emerged: competition, conflict, cooperation and creativity. Research on hermit crabs competing to occupy shells and orphan macaques struggling to establish rank made me think about human responses to competition. Studies of couples’ use of humor, and an emergent language that facilitates trade on the Haiti/Dominican border, demonstrate cooperation and creativity as human response to adversity. Research on The Hunger Games, Peter Pan, and Monet’s water lilies show how works of the imagination and the fine arts help us deal with conflict. Human competition with the environment affects mussel shells, the albatross, and ourselves. Finally, a study of meiosis classifies homolog interactions as always paired, never paired, and “kissing.” At which point I succumb to pathetic fallacy, grateful that chromosomes seem to be cooperating during this essential function.

I am grateful to the student authors and their mentors; to Jesus de Loera for his beautiful preface; to Matt Wood, Chris Darwent, Fran Dolan and Brad Henderson for lending their expertise; and to the Undergraduate Research Center and Emily Meehan for their tireless work.

The journal can be found at: undergraduateresearch.ucdavis.edu/explorations
We hope you enjoy it.

Sharon Knox
Editor

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Cover Photographer (penguin): Alexa Kownacki, Senior, Wildlife, Fish & Conservation Biology Title: A Drink of Life

Cover Photographer (glacier): Liam Quinn Title: Icebergs in Pléneau Bay, Antarctica
PREFACE

It is a pleasure for me to open another issue of our wonderful journal Explorations. The 2014 issue, like others before it, is a snapshot of the wonderful creative work that UC Davis undergraduates can produce. This great group of students presents a multitude of fascinating topics, from a deep study of laughter in romantic relationships to the study of meiosis in cellular division. These essays and scientific reports illustrate the wonderful world of inquiry, though beauty, and creativity that we cultivate within our university. We admire all those insights and discoveries, all those jewels of thought and analysis, all those beautiful pieces of art and emotion, all those incredible tales and stories, all those innovative machines and technologies! Our scholarly work is precious, delicate, unique, and truly a wonder to behold. But what makes such creativity possible? Where did it all begin? And what keeps scholars and artists going in such endeavors?

In trying to answer those questions, I cannot avoid remembering my own beginnings as a scholar. When I was a freshman in college I had the luck of taking a wonderful introduction to geometry. Dr. Alberto Barajas was a white-haired 70-year-old with sparkling eyes and a well-trimmed moustache, who reveled in the beauty of classical geometry and the magic of Euclid, Archimedes, Diophantus, Pappus, and Poncelet. A smartly dressed man always wearing a tie, he had what we thought of as a very old-fashioned and eccentric manner. He would always address everyone as Mr. or Mrs. Last-name. But every so often, in the middle of a mathematical proof or a lengthy calculation, he would stop and reward us younglings with beautiful stories and anecdotes. For example, he told us how, as a young Harvard Ph.D., he discussed his dissertation with Albert Einstein and how he met some of the great mathematicians of the 1940s. Class was a discussion not for the faint of heart, a true engagement of the mind. He would often challenge us and question us, question every response, and give greater and greater challenges and puzzles. And then again, those wonderful stories of the history of science and of life! He would often quote the words of Newton, Galileo, to drive the point that they were not quite different from those you read in declarations of love in Romeo and Juliet, or in the intense poetry of Whitman. He would tell us how university professors rejuvenate every new academic year with the incoming of the freshmen and their fresh energy, emotions and intellects. He asserted many times to be blessed by his students. All of us would only smile politely and admire his flame energy. It was all so exciting to hear.

More than 30 years later, I can still taste the memories of those early years in college. Unlike the young man I was years ago, I eventually began to think a 50 year-old man is not so old after all, that a Ph.D. degree cannot make a fool wiser and, that being a college professor is indeed a gift akin to owning a real time machine and getting paid to have fun (most of the time anyway). By now I have had the pleasure and honor of collaborating in research with more than 50 undergraduate students and over a dozen Ph.D. students. I have taught students in six universities and four countries; although culture and education systems vary, the one common characteristic I find is that young scholars have the boundless energy and desire to grab to ideas and beauty for creation.

My belief today is that while scholarly creative work is clearly based on techniques learned, organization, constant practice, experiments, etc., there is an essential ingredient that is required to produce the best work: Passion! Passion to understand, passion to solve problems, passion for seek beauty and emotion, passion to say what nobody dares, passion to debate and question, passion to assemble the ideas of thinkers from long ago, passion to practice, and above all else passion to persevere in the face of challenges. The passion once conveyed to me by my teacher.

As these student authors graduate and leave UC Davis, some will join graduate schools or go work for business, industry or government. I have also learned that having passion is essential even beyond academic life. Thus I venture one piece of advice to all these young scholars: Keep that flame alive! Stretch your arms and reach for your passion in every aspect of your life.

Artist: Anisa Bashiri, Sophomore, Neurobiology, Physiology & Behavior
Title: The Tree of Life
Exploring Juvenile Relationships: A Comparison Between the Behavior of Orphan and Non-orphan Rhesus Macaques (Macaca mulatta)

By Eric Lal

It has been observed in most species of female-bonded hierarchical primates that females inherit their social ranking from their mother, ranking just below them. However, motherless rhesus macaques (Macaca mulatta) in captivity must also establish a position in the social group. This study compares the behavior of orphan and non-orphan one-year-old rhesus macaques to determine if orphaned macaques have an unstable position in their colony. I hypothesize that if orphans display different behaviors than non-orphans, this aspect of their life history could be used as a predictor for their role in the social group later in life. The data show a difference between the social interactions of orphan and non-orphan rhesus macaques dependent on the juvenile's sex.

Intraspecific Competition of Pagurus samuelis on Shell Selection and Recognition

By Ariana A. Mortazavi

Marine hermit crabs use gastropod shells to protect their soft abdomens. By knowing a hermit crab's shell preference, the dynamics of hermit crab interactions within a species can be better understood for shell selection and exchanges. This research conducted three treatments on the Pagurus samuelis hermit crab to test shell recognition ability and selection. The purpose of this experiment was to test intraspecific competition of P. samuelis on shell selection and recognition. The gastropod shells originally inhabited by the hermit crabs were all C. funebralis. P. samuelis females and males were presented with a choice of their original shell and another similar gastropod shell previously inhabited by a P. samuelis of the same sex. Overall, when tested individually, females preferred their own shell while males had no preference. However, when P. samuelis was presented the same shell choice in the presence of another hermit crab of the same sex, its preference changed. The location of the shell also mattered for the hermit crab's shell choice. The experiments indicate that shell preference is dependent on the presence or absence of a conspecific of the same sex. Also, it was found that a P. samuelis hermit crab's sex does make a difference in shell choice selection and preference.

Love and Laughter: Attachment Style and the Use of Humor When Emotionally Supporting a Relationship Partner

By Jia Chong

In romantic relationships, it is important for partners to master a range of social skills in order to support each other. Yet attachment research has focused mostly on reducing negative emotions without considering how positive processes, including humor, may contribute to the support process. I tested two hypotheses about the use of humor by analyzing videotaped couple interactions during which one partner disclosed a personal problem and the other partner responded. Because the data were taken from an experimental study in which cognitive depletion and experimentally enhanced security were manipulated, I also examined the effects of the manipulations on the use of humor. I predicted that participants who were more securely attached would use more positive humor, as would participants who received the security-enhancement manipulation. The results supported the predictions only weakly, suggesting a need to improve the coding system and study interactions that provide more opportunities for humor.

USAID in Kenya: Development of the Client State

By Rosa Klein-Bacr

This essay explores the workings of the United States Agency for International Development (USAID) in Kenya, focusing on the role of various global actors in development projects. To illustrate the variety of priorities at play in USAID programs, the paper has three sections, highlighting the agency’s role in military, political, and economic interests, respectively. Through examining various USAID initiatives in Kenya and their implications within larger global processes, this paper suggests that the agency is used as a tool to subordinate the Kenyan state to global capitalist interests. The organization thus promotes and perpetuates a client state relationship between Kenya and a powerful global network of financial institutions, corporations, and governments that consolidate their interests in U.S. development aid.
Kreñòl: A New Language in the Hispaniola?
By Lady Carolina Tavárez Varela

Scholars from a wide range of disciplines have approached the Hispaniola to study its historical and cultural richness. However, they have not yet addressed the linguistic barriers that impact the economic and social interactions between both countries. This study investigated language interactions of Haitian Creole and Dominican Spanish speakers in the border city of Anse-à-Pitres, Haiti. The study looked at 20 hours of recorded natural speech between Dominican Spanish and Haitian Creole speakers interacting at a market. It was revealed that these speakers used, among other mechanics, a newly emerging pidgin language. This paper explores the meaning that is constructed in this emerging language, which for the purposes of this research, will be called Kreñòl.

Celebrity Culture in The Hunger Games and The Fault in Our Stars
By Shauna Stewart

The concept of celebrity that has developed out of the Internet culture of young adults is significant when considering the trends and topics in the most popular novels of young adult fiction. Graeme Turner’s idea of the “demotic turn,” or the trend towards the celebrity of the “ordinary person,” dominates not only cable television, Twitter, and the blogosphere — it is also present in YA literature. We see this in the online communities of young adult fans that have cropped up around works like The Hunger Games, the Twilight series and Harry Potter, and also in some of the works themselves. It seems to matter little whether the subject of fanfare is an actor, real person, or a fictional hero. This phenomenon of online fandom and society’s newest iteration of “celebrity” are evident in the novels I will discuss: John Green’s The Fault In Our Stars and Suzanne Collins’s The Hunger Games. Both novels address celebrity culture for teenagers and Western culture as a whole. Green’s novel represents a cautionary tale about the celebrity phenomenon while Collins’s novel is a prediction of a dystopian future driven by the cultural obsession with reality shows.

Monet’s Water-Lilied Defense
By Sarah Bietz

Claude Monet donated many of his water-lily triptych paintings to the French government after WWI, leading critics to theorize that his artistic motivation was a patriotic love for his war-torn homeland. This paper explores other theories on Monet’s motivation to create the works. Drawing from the analysis of art historian Tamar Garb in her paper, “Painterly Plentitude”, I will argue that we should not overlook the significance of the water-lily series as Monet’s final work. The painter’s health was deteriorating with his increasing age, and yet his last project was his most ambitious. Applying Garb’s thesis to Monet’s final series, it appears that his fascination with painting water, the association he made between water and death, and Monet’s choice of huge canvases all suggest that the paintings were an intensely personal project, rather than patriotic.

Screening the Nightmare: Terror Management in Children’s Media
By Katie English

Producers of children’s media often aspire to create content that is both entertaining to children and meaningful to adults. This course of action has resulted in children’s literature and other media that challenge the notion of an “innocent child” audience, engaging with often unresolved themes that are more appropriate to adult society. Such instances threaten the traditional notion of purely naïve, tender childhood. This study focuses on Adventure Time, a Cartoon Network series, as a contemporary retelling of “Peter and Wendy” by J.M. Barrie. I will examine the transformation of the distinctly violent “Peter and Wendy,” a stage play (1904) turned novel (1911), into the deceivingly subdued Disney animated film adaptation Peter Pan (1953), and then into the whimsical yet ominous Adventure Time cartoon series (2010-present). It is important to consider the intersection of Adventure Time with these prior iterations of the Peter Pan story, because all of these versions expose seemingly irresolvable conflicts, such as society’s desire for continued growth and its exhaustion of the environment into a post-apocalyptic landscape.

Photographer: Malina Loeher, Senior, Environmental Toxicology
Title of Work: Hidden Until
HUMANS AND THE ENVIRONMENT

Wood vs. Stone Mortar Technologies: An Experimental Approach to Food Grinding Efficiency
By Christina M. Murray

Groundstone technologies have been used for millennia to process various materials, the most important being plant foods. Native Californians relied heavily on the consumption of gathered acorns and grass seeds which comprised a large percentage of their diets. Groundstone technologies such as mortars and pestles were used extensively to render these foods edible. In the Central Valley, however, large stones were not readily available for mortar production due to the presence of extensive silt and clay alluvium. Instead, hardwood mortars were often used to process foods, as documented in the ethnographic record. The effectiveness of wood versus stone for grinding foods is not well known. This paper details an experiment that gauges the relative efficiencies of two mortar designs, deep and shallow, and two raw material types, stone and wood, at grinding two foods, acorns (Quercus lobata, Quercus douglasii) and chia seeds (Salvia hispanica). Efficiency is assessed by comparing how much time it takes to manufacture each item against the time it takes to process a specific amount of food material to a pre-defined consistency. The data are then applied to the Point Estimate Model (Bettinger et al., 2006) to predict when one design is advantageous over another.

The Effect of Multidrug Resistance Transporter Activity on Mercury Bioaccumulation in Strongylocentrotus purpuratus Pluteus Larvae from Consuming Contaminated Isochrysis galbana
By Rae Porter-Blackwell

Mercury (Hg) contamination via prey can be significantly effected by bioaccumulation of mercury through trophic levels. However, a complete understanding of how mercury bioaccumulates through trophic levels is not fully understood. This study expands on knowledge of multidrug resistance (MDR) transporters on the uptake of mercury through trophic levels and investigates whether MDR activity in algal cells may alter Hg accumulation. Four-arm pluteus stage larvae of Strongylocentrotus purpuratus were exposed to the MDR inhibitor Reversin 205 and then fed inorganic mercury-contaminated algae. Results show that at the four-arm pluteus stage, S. purpuratus is more resistant to mercury contamination. Reversin 205 exposure resulted in increased survival of plutei, with no significant difference between Reversin Only and Mercury plus Reversin treatments, although overall health was reduced as compared to controls.

The Effects of Anthropogenic Copper on the Native Marine Mussel Mytilus californianus in Spud Point Marina, Bodega Bay, California
By Catherine Funk

Established marinas act as gateways for human impact on the natural environment. One of the major ways this occurs is through the leaching of biocides from antifouling paints applied to marine vessels. These paints often contain copper, which can have an effect on non-target organisms, especially those in fouling communities within marinas. In this study, I hypothesized that the level of copper in Spud Point Marina in Bodega Bay, CA., would affect the local population of the native mussel Mytilus californianus at the larval stage. I tested this by measuring the level of copper in the marina using diffusive gradients in thin films (DGTs), and exposing larvae to different copper concentrations in the laboratory. I found that while increasing copper does decrease normal larval development, increased exposure time has the same effect on development. These factors interact with each other to produce a combined influence on larval development.

Invertebrate Fossil Correlation to Climate Trends in Sediment Core MD02-2504 from Santa Barbara Basin in the Past 24 kyr
By Miranda Stripe

In the Southern California Bight, the upper reaches of minimally oxygenated waters rest at a depth of ~500 m. In such environments, invertebrate communities are adapted to low-oxygen levels and can exist due to annual oxygen replenishment events. Throughout the past 24 ka, oxygenation of this area fluctuated, with higher oxygenation occurring during glacial and stadial periods and hypoxic environments manifesting in interglacial and interstadial phases. To identify patterns between community structure and oxygen levels, I quantified invertebrate assemblages in Core MD02-2504 (481 m; Santa Barbara Basin, California, 34.23°N, 119.86°W) between 0.18-24.38 ka. These assemblages included ostracods, molluscs, and echinoderms. Molluscs were also identified to their lowest taxonomic groupings, where Lucinoma aequizonata and Astyris permodesta were the most abundant species within the core. Ostracod and mollusc densities increased with cooler, more oxygenated periods (e.g. the Last Glacial Maximum) and decreased in warmer, hypoxic intervals (e.g. the Bolling Allerod).
Determining Haplotype Diversity of Modern North Pacific Albatross (Phoebastria) Using Ancient and Historic Mitochondrial DNA

By Danielle Nisan

North Pacific albatross—Short-tailed (STAL), Black-footed (BFAL), and Laysan (LAAL)—were over-exploited and driven nearly to extinction in the mid-1900s. The population has begun to rebound since this extreme bottleneck. To further understand the change through time in these species, we have undertaken a genetic approach. This research seeks to determine how many extant haplotypes persist in STAL, BFAL and LAAL. Using samples of ancient and historic individual albatross collected from different regions in the North Pacific, we amplified and sequenced two mitochondrial DNA regions, Cytochrome b and d-loop. The d-loop regions, with a faster mutation rate than cytochrome b regions, are more indicative of recent mutations and diversity within the target species. Cytochrome b data indicated very low levels of diversity within all three species, and especially in the STAL. We found that d-loop regions showed much greater diversity within all of the species, and particularly in the LAAL.

SCIENTIFIC PAPERS, NON-THEMATIC

Can Point Mutations in Kinetochore Proteins Create Haploid Plants in Arabidopsis thaliana?

By Brenda Marin-Rodriguez

Haploid plants can greatly accelerate plant breeding. They were previously generated by crossing wild-type (WT) Arabidopsis thaliana plants to a transgenic haploid inducer with defects in its centromeres. After fertilization, defects in chromosomes from the haploid inducer resulted in their loss from the zygote. The result of these crosses was that 25-50% of progeny had genetic material from only the WT parent. Currently, only one type of haploid inducer exists. To extend the benefits of using haploid inducers to agriculture, not only do more types of haploid inducers need to be made, but also haploid inducers must be made with minimal DNA changes. This study aims to create haploid inducers by chemically inducing point mutations in conserved areas of CENH3. The three point mutations investigated were A86V, R176K and W178*. Results found that A86V and W178* are not haploid inducers, and the R176K point mutant is a weak haploid inducer.

Assay of Chromosome Movement and Pairing During Meiosis in Saccharomyces cerevisiae Using Live Cell Imaging

By James McGehee

Meiosis is a specialized form of cell division, in which homologous chromosomes pair and form crossovers to ensure proper segregation. Improper segregation can lead to nondisjunction and diseases such as Down syndrome. It is not known if chromosome pairing is directed or stochastic, or whether chromosomes are held tightly together or allowed to dissociate. In this research, we assayed chromosome pairing in 3D space over time using Saccharomyces cerevisiae, with the goal of analyzing the role of actin and homology search with respect to chromosome motion and pairing during meiosis. Using homologous chromosomes tagged with Green Fluorescent Protein (GFP), we acquired images of yeast cells, and measured the distance between foci. We identified three classes of homolog interactions: always paired, never paired, and “kissing” where they pair and unpair. We calculated Mean Square Displacement (MSD) and the volume occupied by the foci to quantify chromosome motion. A shorter chromosome was tagged near the centromere, which exhibited active motion and a longer chromosome was tagged in the arm, which exhibited constrained diffusion.

Funding for Explorations was generously provided by the Undergraduate Research Fund of the UC Davis “Students First” campaign of 1993.
ABOUT THE COVER: Photographer: Alexa Kownacki, Senior, Wildlife, Fish & Conservation Biology
Title: A Drink of Life

I photographed this Gentoo penguin in December 2013 while on an eco-tourist trip to the Antarctic Peninsula. As a Wildlife, Fish & Conservation Biology major, it was an inspiration to observe wildlife on all seven continents. I originally photographed this Gentoo penguin, hypothesizing it was drinking water from a melted growler that was beached on this small island. I later realized the penguin was searching for minute krill, swimming in the cold, clear waters of the pond, during low tide. This penguin elegantly hunts incredibly small prey and yet, continues to thrive in what seems like a vast, barren landscape of Antarctica. The water flowing off its beak is a subtle allusion that everything on this planet is connected by water: from the ocean currents, which impact the climates, to the smallest living creatures of the sea, to these near-threatened iconic birds. Water is the basis for life; this small connection between life forms is a reminder that even slight changes in the environment have the potential to affect, not just organisms, but could reshape this planet we call “home”.