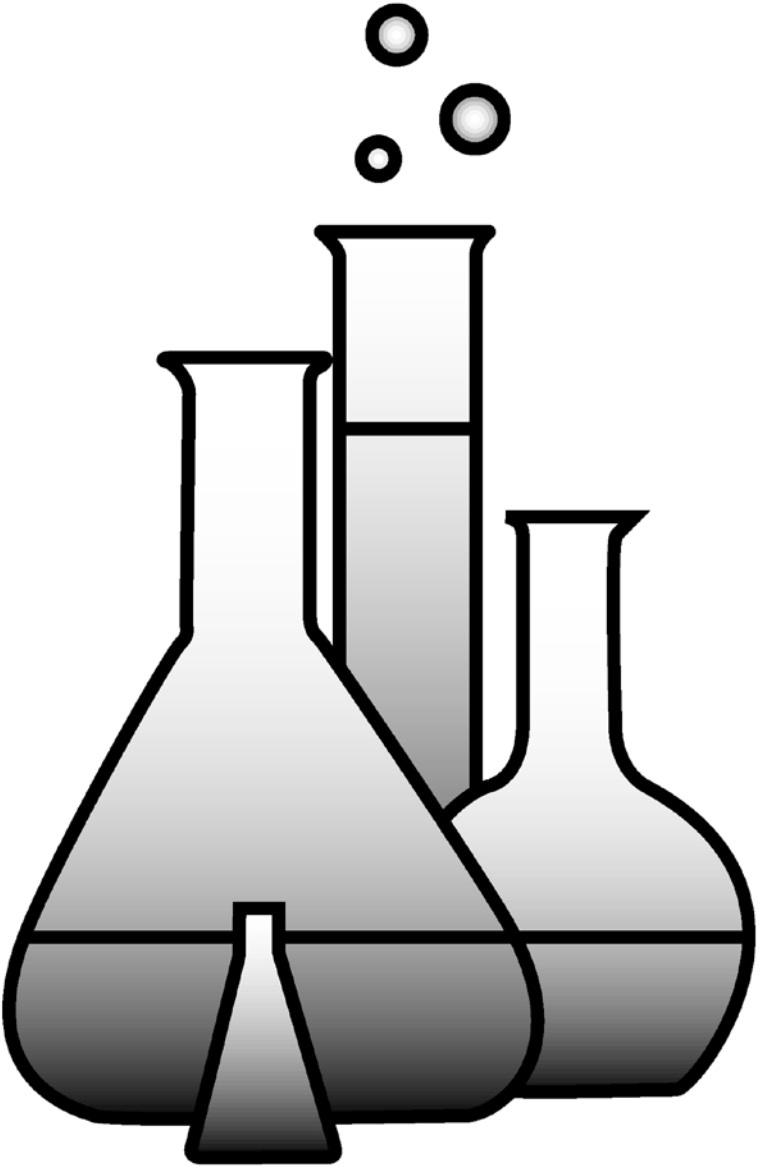
POINT LOMA NAZARENE UNIVERSITY

Research Associates



ANNUAL REPORT

2011

2011 ANNUAL REPORT TO THE RESEARCH ASSOCIATES OF PLNU

Contents

Greetings from Brad Oliver, '77, Chair of Research Associates

Greetings all members, graduates, and friends of PLNU Research Associates,

I am excited to be the chair of Research Associates for the next two years, as Research Associates continues to aid the science departments of PLNU. We support the great research endeavors turned out each year by the students and faculty of this university. I continue to be amazed at the work that is produced at "our" university. We can be proud that we are all a part of PLNU.

I have come in contact with graduate students in their master's and doctorate programs who are envious of the work being done by our undergraduate students. They wish they had had the kind of early training that PLNU students receive.

Raising funds for a new science building is at the head of the list for the university's next new building project. At the last Research Associates board meeting, we were told that the preliminary plans that were made several years ago might already be out of date. This is because the biology and chemistry departments have grown so much. I think this is a wonderful problem, and goes to show the strides that this university has taken to produce top grade programs in biology, chemistry, math, and computer science. We might need to redraw plans. WE NEED MORE ROOM.

Discussions at each meeting of the Research Associates Board about the science building have produced several repeating points:

1. Where can we find a single large donor, either an individual or institutional?
2. How many science alumni donors will we have?
3. Can we get non-science alumni to help?

Our work to address those questions is as follows:

Point 1: Joe Watkins and his staff in University Development are coordinating the search for that large donor.

Point 2: I would like for all Research Associate members and science graduates to consider donating at least $10 toward a new science building. For some of you this would be your only donation, and that would be great.

Point 3: We would like to have all PLNU alumni and friends take part in getting a new science building. All university students would benefit, because they all need science classes to complete their GE requirements.

I would like to have hundreds of donors on our list so that all would know we are behind building a new science building.

In a perfect world we would all give regularly towards a new building and Research Associates. I understand that is not always possible. I have bills, and sending a large amount at one time would be hard. But, I am thankful for what PLNU did for me, and I believe in PLNU. I would like to pledge NOW – $5,000 this year toward the new science building as well as to continue to support Research Associates. I hope you will join me.

Two New Faculty Members Join the Chemistry Department

Katherine Maloney, Assistant Professor, Department of Chemistry

I'm so excited to become a part of the long tradition of undergraduate research in the sciences at Point Loma Nazarene University! I'm an Army brat who grew up in northern and southern Virginia; Oahu, Hawaii; and Tacoma, Washington. I obtained my B.S. in chemistry at Pacific Lutheran University, a small, Christian, primarily undergraduate institution in Tacoma. I fell in love with chemistry there and decided to pursue graduate studies at Cornell University in the field of natural products isolation. After completing my Ph.D., I continued my research training with a postdoctoral fellowship at the Scripps Institution of Oceanography here in San Diego. In 2009, I started a tenure-track position at Harvey Mudd College in Claremont, California, where I spent the past two and a half years teaching and mentoring students in research. At Mudd, I was blessed with excellent colleagues and motivated students, but my personal life left something to be desired, as I was constantly dividing my weekends between my job in the Los Angeles area, and my significant other, whose successful pediatric dental practice in Carmel Valley kept him tightly tethered to San Diego.

Though it was difficult to imagine leaving a job I loved, I felt a strong calling back down to San Diego and listened intently for God's plan about how to make it happen. Ultimately, He sent me a message in the form of an advertisement of an organic chemistry faculty position at PLNU… twice! I accepted the position last spring, to begin this January 1. After turning in my fall grades in mid-December, I packed up my home, office, and research lab, moved everything down to San Diego, married the wonderful Chris Pham in San Jose on January 7, and started teaching at PLNU on January 10! While it's been quite a whirlwind, I am thrilled to link my professional and spiritual lives, and feel honored to belong to PLNU's Christian learning community.

In my research with students, I seek to discover new natural products and understand their role in the ecology and evolution of terrestrial and marine organisms. In a project funded by the American Society of Pharmacognosy, students in my laboratory are examining natural products from endophytic fungi isolated from hosts of the plant pathogen *Xylella fastidiosa*. By isolating new fungal strains from little-studied plants, we hope to develop a niche with an exclusive opportunity for discovery. In a second project funded by The Research Corporation for Science Advancement, students in my laboratory are extracting secondary metabolites from soft corals collected using SCUBA in Palau. In collaboration with a colleague in the Harvey Mudd Biology Department, we are studying whether these chemical profiles can be used to distinguish between different cryptic species of the soft coral *Sarcophyton glaucum*.

Matthieu Rouffet, Assistant Professor, Department of Chemistry

I was born and raised in Reims, France. As I entered college to pursue a degree in sound engineering, I soon realized that I had a passion for organic chemistry, which made me switch majors and obtain a B.S in chemistry from the University of Reims. One year later, I completed my M.S in natural product synthesis and decided to move on to get a Ph.D. in organic chemistry. I was really interested in medicinal chemistry and was able to do my research at the School of Pharmacy of Reims working on the synthesis of novel Matrix metalloproteinase inhibitors. While in the middle of this graduate program, I visited a research laboratory at the University of California San Diego for six months. This fruitful experience not only broadened my knowledge of organic synthesis and bioinorganic chemistry, but I was also offered a post-doctoral position. I went back to France to finish my dissertation and then I met my wonderful wife, got married on December 13, 2008, defended my thesis on the December 15, and moved to San Diego three weeks later to start my post-doctoral position.

During my post-doctoral position at UCSD, I worked on the development of several metalloenzyme inhibitors using novel metal binding groups and was able to gain new bioinorganic chemistry skills while maintaining high-level organic synthesis. Our focus on the design and synthesis of novel and selective metal binding groups eventually led to a very fruitful collaboration and later the creation of a biotech company in the South Bay area. While I was working on the synthesis of several molecules for this company, my contract with UCSD came to an end. As I was pondering about how I could find a job where my faith and science would be integrated, I came across the PLNU chemistry professor position, which I started in August 2011. I am very grateful to be able to strive for excellence in teaching and research in chemistry while being able to share my strong faith with my students.

Since my position at UCSD, I have found how relevant metalloenzymes are to treat several important diseases and how amenable to undergraduates this program could be. My interest lies in the development of potent and selective inhibitors of anthrax lethal factor, which is a zinc metalloenzyme. This project is particularly suitable for undergraduate research since it involves organic synthesis, biological assays, and computer modeling. I am looking forward to maintaining collaboration with UCSD as well as a protein crystallography lab in order to initiate PLNU chemistry students to high-end research. I believe that this type of summer research program would greatly benefit students who are interested in working in the health field.

2011 SAACS NEWS

By Sara Choung

The American Chemical Society (ACS) Student Chapter at Point Loma Nazarene University (Chemistry Club) has continued to be active throughout the school year with a variety of activities including fundraisers, social activities, graduate school information sessions, national scientific meeting, and outreach events. Outreach to students in the community has included 1) classroom demonstrations for Wilson Middle School eighth grade students, 2) PLNU campus visit by Tri-City Christian High School students, and 3) ChemExpo in Balboa Park which is sponsored by the

San Diego Chapter of the ACS. Nine students attended the National ACS meeting in Anaheim, California in March 2011. Five of them presented research posters and the club presented a poster including the club's activities (see page 16). The club has also hosted various meetings and parties throughout the year including ice cream socials, end of the school year party, mole day party, and a Christmas party. The club officers for the 2011-2012 academic year are Troy Kurz (president), Seth Simonds (president), Luke Vickers (vice president), Amber Gillett (secretary), Kayla Kendric (treasurer), and Summer Bunting (publicity/public relations). The club once again received an Honorable Mention Chapter Award from the ACS for its 2010-2011 activities. The Award was presented at the spring ACS meeting in San Diego in March 2012. The club has helped foster deeper relationships and a sense of community between our students and helped students get more involved with the Chemistry Department.

Pre-Health Professional Program – 2011

The pre-health professions program at PLNU has grown over the years and there are currently 186 students who are declared as pre-health professions students. We have had a number of meetings and various speakers during the spring and fall of 2011.

Thirty-four students participated in the "sophomore" pre-health interviews and 24 students were involved in the "junior" pre-health interviews that were conducted by the health professions advisory committee in the spring of 2011. The current members of the health professions advisory committee are David Barrows (Sociology), Ryan Botts (Mathematics), Sara Choung (Chemistry), Catherine Crockett (Mathematics), Greg Crow (Mathematics), David Cummings (Biology), Michael Dorrell (Biology), Rebecca Flietstra (Biology), Jamie Gates (Sociology), Vic Heasley (Chemistry), Ken Martin (Chemistry), Kendra Oakes Mueller (Psychology), Dawne Page (Biology), Marc Perry (Chemistry), and Paul Schmelzenbach (Physics).

The Point Loma Pre-Health Student Association was launched in the fall of 2011. The executive council includes Zack Sedillo (president), Marcus Anthony and Daniel Kwon (co-VP allopathic medicine), Alexis Hernandez (VP dentistry), Christina Issa (VP optometry), Michael Geiger (VP osteopathic medicine), Allison Zakaroff (VP pharmacy), Carolyn Houser (VP veterinary medicine), Caitlyn McGue (secretary), Brooke Collins (treasurer), and Levi Williamson (communications director). They have already successfully planned and coordinated several meetings and volunteer opportunities.

We are very proud of our graduates who began their studies at various health professions programs in the fall of 2011 – 16 of 21 applicants were accepted during the 2011 application cycle. The following students entered allopathic medical school: Seth Bricel ('10) at University of Southern California, Kelli Hickle ('11) at University of Arizona Phoenix, Hannah Howard ('11) at University of Oklahoma School of Community Medicine, Anthony Kuleto ('11) at University of California San Diego, Jonathan Laroya ('09) at University of California San Diego, Melissa Leopard ('10) at Drexel University, Blake Morgan ('10) at Uniformed Services University of the Health Sciences, Cooper Morgan ('10) at Uniformed Services University of the Health Sciences, Rachel Tennant ('10) at Creighton University, Karissa Vaillancourt ('11) at Loma Linda University, and Jared Yee ('11) at Creighton University. Jennifer Luong ('11) and Nicole McFarland ('08) enrolled

in osteopathic medical school, Jennifer at Western University of Health Sciences and Nicole at Lincoln Memorial University. Peter Ivey ('10) started dental school at the University of California San Francisco. Jessica Chen ('10) and Renae Minnema ('11) both began pharmacy doctorate programs, Jessica at University of California San Francisco and Renae at University of the Pacific. We wish them all the very best as they pursue careers in the health professions.

Graduate School Acceptances – 2011

by Michael McConnell

Several graduates from PLNU's biology and chemistry departments started graduate programs in 2011. Those entering Ph.D. programs include Jacob Thorpe ('10), Audra Evoy ('10), Caleb Bryce ('11), and Mark Boerneke ('11). Jacob is studying pharmacology at Ohio State University, Audra is studying environmental life sciences at Arizona State University, Caleb is studying ecology and evolutionary biology at UC Santa Cruz, and Mark is working towards the Ph.D. in organic chemistry at UC San Diego. Those starting M.A. or M.S. programs include William Taylor ('10), Abel Salgado ('10), Kathryn Thompson ('11), and Rachel Siliki-Mbassa ('11). William is pursuing an M.A. in education at DePaul University, Abel is studying neurobiology at USC, Kathryn is working towards an M.S. degree in environmental health at the University of Michigan, and Rachel is enrolled in the M.S. program in biology at PLNU. We are very proud of each of these alumni.

2011 Biology Summer Research Program

First row: Caitlyn McGue, Kim Schroeder, Halsie Donaldson, Dani Matonis, Jake Tremblay, Andrew Montano, Troy Kurz, Keeley Shaw **Second Row:** Ruben Vasquez Jr., Megan Edgbert, Jenna Lavenuta, Rachel Siliki-Mbassa, Angelica Barr, Kayla Kendric, Jack Rusing, Joy Walters **Third Row:** Dr. David Cummings, Sarah Schale, Amy Woods, Weston Bennett, Fidel Tercero, Colton Erskine, Mike Marcacci, Alex Barnett, LeAnne Elizondo **Fourth Row:** Daniel Virden, Ryan Dahl, Sean Heavey, Dr. Michael McConnell, Caleb Bryce, Austin Fares, Hannah Green **Fifth Row:** Dr. April Maskiewicz, Kerri Sevenbergen, Dr. Mike Mooring Back Row: Dr. Dawne Page, Dr. Mike Dorrell, Dr. Bob Wiese, Doug Zuill, Gio Villegas, Michael Geiger **Not pictured:** Dr. Darrel Falk, Dr. Robert Elson, Tori Haase, Hannah Kelly, and Trisha Stull

Students Directed by David Cummings

Michael Geiger (Visalia, CA), **Jenna Lavenuta** (Escondido, CA), **Kim Schroeder** (Albuquerque, NM), **Tori Haase** (Long Beach, CA) and **Doug Zuill** (Poway, CA)

Research in the Cummings lab is focused on the spread of antibiotic-resistant bacteria from urban watersheds into coastal habitats where they may act as a reservoir, threatening future public health. In 2011, we used mating techniques to induce bacteria in coastal wetlands to share resistance plasmids, transferrable DNA elements, with a lab strain of *E. coli* in order to isolate them and characterize the resistances they encode. Senior Doug Zuill spent two weeks at the University of Idaho learning one of these mating techniques, which we now use routinely in our lab. Senior Michael Geiger worked alongside Doug capturing resistance plasmids while senior Jenna Lavenuta and juniors Kim Schroeder and Tori Haase screened through hundreds of transconjugants for unique plasmids. We now have dozens of new plasmids from the environment that confer multiple drug resistances and we are in the process of determining their nucleotide sequences in collaboration with the University of Idaho.

Students Directed by Mike Dorrell

Troy Kurz (Chino, CA), **Jake Tremblay** (Poway, CA), **Jack Rusing** (Prescott, AZ), and **Halsie Donaldson** (Redlands, CA)

Project 1: All four students (Troy, Jake, Jack, and Halsie) worked together on the identification of novel combinations of angiostatics that demonstrate synergistic activity in a CAM model of angiogenesis. This model was previously developed in the Dorrell laboratory. Students worked hard to generate dosing information of several angiostatics using this model so that we could identify the maximum ineffective doses. Students then designed and implemented several experiments combining these angiostatics using their maximum ineffective doses to identify which combinations demonstrated strong, synergistic angiostatic activity. This summer, we identified one particular combination (Avastin and Thalidomide) that showed significant synergistic activity. Students finished the summer by repeating this experiment and adding various third angiostatics to the combination of Avastin and Thalidomide to see if this synergistic activity could be extended even further. We are currently analyzing the data from those final experiments. We hope to identify some combinations of angiostatics, which demonstrate potent activity blocking tumor vascularization so that these treatments can be used to 'starve' tumors as part of cancer therapies. Students worked on this project at both PLNU and The Scripps Research Institute.

Project 2: In addition, these four students initiated a project designed to identify and characterize bone marrow-derived stem cells (BMSCs) that are capable of specifically targeting to, and localizing within, glioblastoma brain tumors. Students tested the specific migration of BMSCs to the onplanted tumors, developing and optimizing these assays so that tumor-targeting cells can be further identified and characterized. The ultimate goal is to identify autologous cells that localize specifically to the glioblastoma tumors. These cells will be loaded with chemotherapy or angiostatics and used as 'smart bombs', migrating to, and producing the drugs specifically within, the tumors to kill tumor cells while reducing the normal side effects of chemotherapies that are caused by the

chemotherapy activity on normal, non-tumorous cells.

Troy Kurz and **Michael Marcacci** (Fountain Hills, AZ) both conducted Senior Honors Projects involving a continuation of the above projects during the 2011-2012 academic year.

Students Directed by Mike Dorrell in collaboration with faculty at TSRI

Ruben Vasquez Jr. (San Diego, CA), and **Keeley Shaw** (Oceanside, CA)
Ruben Vasquez worked in the laboratory of Dr. James Quigley at TSRI studying the role of neutrophils and immune cells on tumor progression. Keeley Shaw worked in the laboratory of Dr. Martin Friedlander, also at TSRI, studying the use of induced pluripotent stem cells as cell therapy for degenerative retinal diseases.

Students Directed by Robert Elson

Angela Barr (Hemet, CA), **Amy Woods** (La Mesa, CA), and **Weston Bennett** (Twin Falls, ID)

We are studying the roles of key neurohormones and neuromodulators in the control of arousal and vegetative functions in developing larvae of model insect species – to answer basic questions in neural development and for insight into the control of important pests.

In the summer research program of 2011, we continued to make progress in two projects:

1. The development of neurons expressing the enzyme that synthesizes octopamine – the invertebrate equivalent of norepinephrine. This project uses the tobacco hornworm moth, *Manduca sexta* (an important research model). Octopaminergic neurons control central and peripheral arousal, and octopamine and its receptors are targets or models for insecticide design. Hence, it is important to know how the neurons capable of synthesizing this neurotransmitter develop within the central nervous system from the larva (caterpillar) through metamorphosis to the adult.

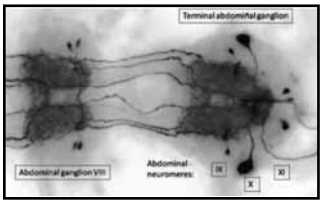
We have been using a sulfide-silver histochemical technique to stain for the presence of the copper-containing enzyme, tyramine-beta-hydroxylase (TBH), which synthesizes octopamine. We have now pursued the development of neurons expressing this enzyme in the ventral nerve cord from early larval stages though the pupa and into the early adult.

Dramatic changes occur in the number and cell body size of the TBH-expressing neurons as the last (5th) instar (stage) larva prepares to metamorphose into the pupa. We have now shown that these neuronal transformations are postponed when the larva is forced to go into a supernumerary (6th) instar. This result strongly suggests that the neuronal changes occur in response to the hormonal surges normally preceding pupation, rather than simply being a consequence of the elapsing of the absolute number of larval instars. The publication of the findings is getting nearer. In the coming summer we will use immunocytochemistry to check the presence, as expected, of the neurotransmitter octopamine in these neurons. Hormonal intervention experiments are also possible.

2. The development of neurons expressing the transmitter, serotonin. This project studies the development of the ability to synthesize serotonin of a small set of identifiable neurons in the terminal abdominal ganglion of the large mealworm,

Zophobas morio, a close relative of commercially important pests of stored grains and flours. This important nerve center controls viscera such as the lower gut and reproductive organs.

We have found that the number of serotonin-expressing motor neurons and interneurons changes during the metamorphosis of the insect, some coming online later in development while other neurons that previously expressed serotonin either die or stop making the transmitter. We are doing parallel studies using antibodies raised against the enzymes involved in serotonin synthesis.



Immunocytochemical staining of neurons containing serotonin in abdominal ganglia of Zophobas morio. The total length of the piece of central nervous system pictured here is about 1.5 millimeters. The original fluorescence image has been converted to grayscale and reversed.

Students Directed by April Maskiewicz

Hannah Kelly (Sacramento, CA)

Quantitative and Qualitative Analysis of Freshman Biology Majors' Principled-reasoning in Ecology. Hannah is analyzing freshman biology majors' responses to a pre/post ecology diagnostic question cluster that measures students' principled-reasoning. She is determining if, after a specially designed active-learning intervention, students began to reason at multiple scales (organismal, cellular, and molecular) and apply principles such as conservation of matter and energy to explaining ecological phenomena. Upon completion of coding the pre- and post-tests using a validated coding scheme, we will statistically analyze the results.

Students Directed by Michael McConnell

Megan Edgbert (Petaluma, CA), **Sean Heavey** (San Diego, CA), **Danielle Matonis** (Poway, CA), **Andrew Montano** (Oceanside, CA), and **Rachel Siliki-Mbassa** (San Diego, CA)

A distinguishing feature of all Gram-negative bacteria is the presence of lipopolysaccharide (LPS) on the cell surface. LPS is a structurally complex molecule consisting of: 1) lipid A, which anchors the molecule in the outer membrane; 2) R-core, an oligosaccharide attached to lipid A that contains unusual sugars and most of the charged groups of the LPS molecule; and 3) O-polysaccharide, a hydrophilic polymer generated from 3-6 sugar repeat units that becomes attached to the outer tip of the R-core and which projects outward into the cell's aqueous environment. Lipid A (a.k.a. endotoxin) is considered the most dangerous part of LPS from a medical standpoint, but the O-polysaccharide is also of great significance to human health, in that it is the part of the LPS molecule with which our immune system initially interacts during an infection by Gram-negative bacteria.

The members of the McConnell research group continue to study Group E1 Salmonella O-polysaccharide biosynthesis and the mechanisms whereby viruses such as Epsilon 15 and c341 are able to interfere with, and thereby modify the structure of this O-polysaccharide. Although the structure of *S. anatum* O-polysaccharide was determined long ago (1960s) by researchers working at

MIT, the enzymes involved in its synthesis still remain largely uncharacterized. A big step toward eventual characterization of this biosynthetic machinery was taken in the summer of 2009 when PLNU students Courtney Hall ('10) and Anthony Montano ('10) both successfully used the gene knockout procedure developed by Barry Wanner and Kirill Datsenko at Purdue University (*PNAS* 97, 6640-6645, 2000) to knock out *Salmonella anatum* genes *res1* and *rfbD*, respectively. Their work was possible in part because the J. Craig Venter Institute had just published a partial genomic sequence for *Salmonella weltevraden*, another Group E1 organism so closely-related to *S. anatum* that its gene sequences can be used successfully for the design of knockout PCR primers that are effective against *S. anatum*. The 2010 summer research group knocked out five more *S. anatum* or phage genes involved in O-polysaccharide biosynthesis (bacterial genes *rfaL, Orf9.6, Orf17.4,* and phage E15 genes *21* and *22*).

This gene deletion effort was continued in the summer of 2011 with successful knockouts of *S. anatum* genes *rfaK*, *rfaB*, *dam*, and *hsdR*, as well as phage g341 conversion genes *OAcT*, *Gtr*, and *g23*. The *hsdR* gene codes for the major restriction endonuclease enzyme of *S. anatum*, so successful elimination of this gene means that we should now have a strain that can be manipulated more easily by the input of exogenous genetic material.

The impact of each deleted gene's loss on O-polysaccharide structure is characterized using a variety of experimental approaches, including phage sensitivity patterns; the ability of bacteria to remain suspended in liquid medium at low temperatures; ELISA assays; gel electrophoretic analysis of purified LPS molecules; and phage adsorption assays, involving the use of purified, radioactive phage particles. The results obtained for most deletion mutants fall in line with our expectations, but there have also been some surprises along the way; in fact, some deletion mutants display phenotypes that are downright baffling! We are resilient and determined, though. Hopefully, we will eventually have a better understanding of not only the process of O-polysaccharide biosynthesis in Group E1 Salmonella bacteria, but also the ways in which various phages are able to modify that pathway, resulting in the production of novel O-polysaccharide structures.

Students Directed by Mike Mooring and Involved in Costa Rica Research

Caleb Bryce (Wells, ME), **Austin Fares** (Mesa, AZ), **Ryan Dahl** (Sandy, UT), **Trisha Stull** (Cherry Valley, CA)

"Elusive mammals of the Savegre Valley, Costa Rica"

The Talamanca Cordillera is the largest block of protected tropical montane forest in Costa Rica, but little is known of the current status of mammal populations in these high-elevation cloud forests. Because apex predators are most likely to suffer from alterations to the local landscape from human activities, they serve as a barometer for the overall health of cloud forest ecosystems. At the same time, the presence of key prey species establishes the potential for healthy populations of predators. Our goal is to survey the large mammalian predators and prey in the Talamanca range, with a focus on jaguar (*Panthera onca*) and other apex predators such as puma (*Puma concolor*) and ocelot (*Leopardus pardalis*). We survey these populations by using a network of motion sensor cameras ('camera traps') on mountain trails to determine species presence and infer population abundance, activity budgets, and potential prey. Our pilot study in 2010 established the presence of several large predator species including jaguar, which

had not been sighted in the valley for over 40 years. In 2011, we expanded the camera trap grid to 31 camera stations throughout the valley, from lower montane forest (2100 m) to alpine páramo habitat (3100 m) within Los Quetzales National Park and the Las Vueltas Biological Reserve.

The results from the second year of survey effort in the Savegre Valley revealed nearly all the medium- to large-sized terrestrial mammals that would be expected in a pristine cloud forest. A total of 20 mammalian species were confirmed present by the camera traps: eight predator species and 12 prey species. The predators included the six felines that might occur at these elevations: jaguar, puma, ocelot, jaguarundi, margay, and oncilla. The other predators include a canid (coyote) and a mustelid (tayra). Jaguar and margay are listed in the IUCN Red List as near threatened, and oncilla are considered vulnerable. The prey species ranged from Baird's tapir, which at 250 kg is the largest mammal in MesoAmerica, to the red-tailed squirrel at less than1 kg. The tapir is listed on the IUCN Red List as threatened. Coyote and puma were the most commonly observed predators, while collared peccary was among the most frequently sighted prey species. Both tapir and red brocket deer were only found at the highest elevations in the Las Vueltas Reserve and Quetzales National Park. Coyotes were primarily nocturnal, with 91% of their activity occurring at night and only 9% of sightings during the day. On the other hand, puma were cathemeral, being active almost equally during the night (52%) and day (48%). Other species that were primarily active at night included tapir, paca, and raccoon, while brocket deer, peccary, and coati were primarily diurnal.

Puma appear to be common, which is good news because it indicates an ecosystem with a healthy prey base to support apex predators. Although puma were photographed on every trail, individual identification is difficult using traditional camera trap methods designed for spotted cats like jaguar. Two new approaches may enable us to ascertain the number of puma in the future. First, investigators are now developing methods to identify individual puma from camera trap photos using natural markings, but this requires high-resolution photos. We will explore the use of a chemical attractant (Calvin Klein's Obsession for Men) that is reputed to stimulate investigation behavior, ensuring that target animals remain still long enough to provide high resolution photos. The second approach to calculating puma population size is by means of fecal genetic analysis. This technique now provides a means of extracting DNA from the feces of predators to enable the species and individual to be identified. We will collaborate with the Conservation Genetics Lab at the University of Costa Rica to analyze all scat samples collected from the trails in the years ahead.

The abundance of coyote may not be such good news. Coyotes are a recently arrived invasive species that might compete with and even displace native Neotropical predators such as the small cats. Pasture expansion allowed coyotes to invade the Savegre Valley in the 1960s, and this species will probably have ecological impacts because they are competitors with, or prey on, a wide array of species. It will be important to identify the range and magnitude of ecological effects produced by coyotes in the Talamanca region in the years ahead.

Our next step will be to collaborate with local scientists, conservationists, and community members to expand the camera trap survey further north within the Talamanca Cordillera and further south into the La Providencia watershed. Because the Talamanca range is a critical Jaguar Conservation Unit, one goal will be to deploy new camera trap grids within Tapanti and Chirripó National Parks,

where little is known of mammal populations. We hope to estimate population density, abundance, activity budgets, and principal prey of jaguar and other predators for comparison with our results from the Savegre Valley.

The fieldwork was exhilarating, to say the least. Our team spent hundreds of hours hiking the strenuous mountain trails of the Talamanca Cordillera, deploying and monitoring camera traps and searching for mammal tracks and scat. We also spent many hair-raising hours driving the scenic, winding roads of the Pan American Highway in search of collaborators and groceries while listening to "Super Radio". And let's not forget all the data management activities as we catalogued and analyzed hundreds of photos. But our summer research was not all work and no play. We spent a weekend visiting the beaches of Dominical and Quepos on the Pacific coast, and visited Manuel Antonio National Park where mammals are not as elusive as they are at higher elevations. Many afternoons would find our *futbolistas* (Austin, Ryan, and my son Timmy) playing Tico-style soccer with the locals on the dirt pitch next to QERC. Our cook, Nancy's, dinners were always mouthwatering and replenished calories burned up on the trails. And an evening was not complete without a game of Pictionary or Trivial Pursuit. On weekends, we always headed up to Laura's Bakery for lunch and socializing, and Sunday evenings were devoted to a study on Doctor Luke's gospel, which we continued in the fall semester. We thank the Lord for the opportunity to serve His creation!

Students Directed by Dawne Page

Kayla Kendric (El Cajon, CA), **Sarah Schale** (Bakersfield, CA), **Fidel Tercero** (San Diego, CA), **Colton Erskine** (Rancho Bernardo, CA), and **Caitlyn McGue** (Modesto, CA)

I spent 2008/09 on sabbatical in Dr. David Traver's lab at UCSD in order to transition my research on the immune system to using zebrafish as a primary animal model. Compared to rodents, the advantages of zebrafish include their small size, rapid external development, embryonic transparency, high fecundity, low cost of maintenance, a completed genome project, and a high efficiency of producing transgenic animals. Importantly for immunological studies, zebrafish possess all of the blood cell lineages of mammals. Moreover, several transgenic reporter lines have been created to fluorescently label and subsequently track specific populations of blood cells. By combining fluorescent transgenesis with advanced imaging techniques, zebrafish offer unique advantages over other vertebrate models for visualizing the behavior of hematopoietic cells in living animals.

My students and I are specifically exploring B cell development and maturation in zebrafish. B cells secrete antibodies that bind to pathogens and mark them for destruction. Analysis of the DNA sequence of zebrafish predicts that they have two populations of B cells: one that expresses IgM and another that expresses a unique isotype, IgZ, which has been found in other fish, but not in amphibians, birds, reptiles, or mammals. Since fish are the most ancient vertebrates with an adaptive immune system, analysis of these B cell populations in zebrafish should produce insights into the evolutionary development of adaptive immunity. Thus, in collaboration with David Traver and Brad Magor (Canada), we have made transgenic lines in which these B cell populations are marked with fluorescent proteins. In this way, we can both track and manipulate these populations in order to understand how and where the B cells develop in zebrafish and how and where they respond to pathogens.

Kayla Kendric made some of the DNA constructs that were injected into

Zebrafish embryos to make the transgenic lines. Colton Erskine and Fidel Tercero assessed the expression of B cell-specific genes in various zebrafish organs by quantitative PCR. Caitlyn McGue and Sarah Schale assessed the B cell proliferative response in immunized fish and also the B cell phagocytic response.

Students Directed by Bob Wiese, '82

Alex Barnett (Edina, MN) and **Daniel Virden** (Reynoldsburg, OH)

Daniel and Alex's primary research was on the behavioral patterns of the Malayan tigers at the San Diego Zoo. The tigers have a long history of spending most of their time in the top, back portion of their exhibit near their bedrooms where they are rarely visible to the guests. Daniel and Alex observed the tigers for four-hour sessions under several different conditions, including positive reinforcement techniques, negative reinforcement techniques, and control observation sessions. Positive reinforcement (i.e., enrichment items) to encourage the tigers to more viewable areas of the exhibit did not show a significant difference in behavior. They did find that negative reinforcement of the tigers' favored area, specifically a mister running constantly over the spot, greatly reduced the amount of time the tigers spent in this area of the exhibit. For Danai, the adult female tiger, time spent at the back area was reduced by 20%; for Paka, the adult male, there was a 60% decrease in time spent at the previously favored area. Daniel and Alex also watched the introduction of a new female gorilla into a breeding troop, recording interactions between the new primate and the females already in the troop. This was to make sure that there was not too much aggression in the troop toward the newly introduced female.

Hannah Green (El Cajon, CA)

Hannah studied the behavior of the young female jaguar at the San Diego Zoo in order to determine how her behavior changes throughout her reproductive cycle. A new male jaguar was recently brought to the zoo for the purpose of breeding with the female, but jaguars are naturally solitary animals and therefore cannot be housed together. The male can only be put with the female when she is in estrus and receptive to the male. Although it is possible to track hormonal changes in the female through fecal hormone metabolites, it is not currently possible to assess her hormone levels fast enough to know whether she is in the right stage of her cycle for breeding. Therefore, zookeepers must rely on behavioral cues from the female in order to know if the male can safely go in with her. Hannah's research involved collection of detailed behavior profiles throughout the female's reproductive cycle, which she later correlated with the hormone levels once the fecal hormone metabolites could be analyzed. Hannah's work revealed that some of the most reliable behavioral signs of estrus seem to be a sharp decrease in the amount of time that the female spends pacing, accompanied by loud vocalizations.

Giovanni Villegas (Rancho Santa Margarita, CA)

Giovanni performed observational research for the San Diego Zoo Safari Park investigating the Park's flamingo population. The flamingos have not been mating since moving to their new enclosure and Giovanni was able to collect data on their habits that may help determine changes needed to encourage mating. During his time at the park, Giovanni learned more about flamingos and the techniques used for collecting field observations. Using a scan-sampling method (among

other methods), he was able to record the activity of the birds throughout the day. From the data collected, he found that flamingos are more active during the early mornings and late evenings. They choose to rest and sleep during the hot hours of the late morning and early afternoon. Although progress was made during the summer, this problem has proven to be a difficult task and will demand further attention. Giovanni was also able to work alongside the park's bird curator and develop skills working on a team to solve complex biological problems.

2011 Chemistry Summer Research Program

Front row (left to right): Dr. Victor Heasley, Jack Kleinsasser, Amber Gillett, Dr. Michelle Chen, Christina Moulton, Summer Bunting, Chris Evans, Dr. Dale Shellhamer, Dr. Sara Choung, Danielle Shipowick, Hannah Ponek **Back row (left to right):** Jake Milligan, Luke Vickers, Justin Hsu, Bradly Baer, Justin Weststeyn, Dr. David Lingner, Parker Horn, Dr. Marc Perry. **Not pictured:** Dr. Ken Martin, Michael Douglas, and Seth Simonds

Students Directed by Sara Choung

Brad Baer (Fresno, CA) and **Chris Evans** (Peoria, AZ)

During the summer of 2011, Brad, Chris, and I worked with Dr. Michelle Chen and Hannah Ponek from the Physics Department. We worked together on two research projects: 1) Effect of thiophene and pyridine on partial oxidation of ethanol and methanol over $Fe_2(MoO_4)_3$ catalyst, and 2) Graphene synthesis by chemical vapor deposition. The first project was work that stemmed from a collaboration with Dr. Chelsey Baertsch's research group in the Chemical Engineering Department at Purdue University. It addressed the need for selective ethanol microsensors with applications including analysis of renewable liquid fuels and pollution monitoring of exhaust gases from automotive and refining applications. We investigated the effects of pyridine, a nitrogen containing compound, and thiophene, a sulfur containing compound, on the reaction rates, product selectivity, and regeneration of the partial oxidation of ethanol and methanol over a $Fe_2(MoO_4)_3$ catalyst. With Dr. Chen, we also designed and constructed a chemical vapor deposition system to synthesize graphene, a one-atom-thick film of carbon with attractive strength, flexibility, and electrical conductivity, using a copper foil catalyst.

Students Directed By Victor Heasley and David Lingner

Tina Moulton (San Marcos, CA) and **Luke Vickers** (Oceanside, CA)

"Reaction of Selected Aromatic Hydrocarbons with Monochloramine, NH_2Cl and Dichloramine, $NHCl_2$."

The following studies by Tina and Luke summarize the discoveries in reactions of aromatic hydrocarbons and the chloramines: phenol and resorcinol reacted with NH_2Cl and $NHCl_2$ in H_2O and ether to form intermediate aromatic hypochlorites whose structures were established; the intermediate aromatic hypochlorites functioned as a chlorinating agents; both chlorines in $NHCl_2$ chlorinated phenol and resorcinol; other hydrocarbons in ether and water such as anisole (methoxyphenol), 1,4-dimethoxybenzene, 2,4,6-trimethoxybenzene, and 2-methoxynaphthalene did not react with the chloramines.

Justin Hsu (Downey, CA)
"Reaction of Styrene and 1-Hexene with Bromamine, NH_2Br." Since a greatly improved synthesis (ease of reaction and higher concentration) of aqueous NH_2Br had recently been discovered in our laboratory, reaction of NH_2Br with two common alkenes justified an extensive study. Justin thoroughly investigated the yields of the reactions of styrene and 1-hexene with NH_2Br. He determined that the yield in the reaction with styrene was acceptable, but 1-hexene could not be made to react to any extent.

Student Directed by Ken Martin

Michael Douglas (Elk Grove, CA)

Michael returned for a second year as we continued our investigations of solid state phase transitions in substituted naphthalenes. In Michael's project, we focused most of our attention on 1-, and 2-methyl naphthalenes and their interactions with separately deposited adlayers of nonradiative molecules of a homologous series of alkanes. These studies of bilayer systems are aimed at understanding the various solid state phase transitions these materials undergo as the temperature is increased to the point of allowing desorption of the molecules from the surface. As in past years, the substituted naphthalene compounds were deposited as thin films (in some cases only a few hundred monolayers thick) on a cryogenically cooled Al_2O_3 (0001) crystal in an ultra high vacuum (UHV) chamber. When irradiated with UV light, these naphthalene compounds form excimers (excited state dimers). By monitoring the fluorescence emission, we are able to observe the transitions from one stable excimeric form to another as a function of temperature. We also detected the effects of mixing as we impart thermal energy to the bilayer system. After computer analysis, these observations give insight into the physical transformations that occur in the elementary process of desorption from an inert surface or mixed crystal.

Seth Simonds (Chandler, AZ)

Seth also returned for a second year to continue his investigations of solid state phase transitions in substituted naphthalenes. In this project, we focused most of our attention on 1-, 2-methyl- and 2-ethylnaphthalene as potential energy donors and on phenanthrene as an energy acceptor. We also investigated the interaction of these substituted naphthalenes with the non-emissive 1-chlorohexane molecule. Bylayers of donor and acceptor molecules were deposited from vapor in an ultra high vacuum (UHV) chamber onto a cryogenically cooled Al_2O_3 (0001) crystal. The sample was irradiated with UV light so that the emission spectra could be observed and monitored. The adlayer molecules mixed as the sample was steadily

heated, imparting thermal energy to the molecules of the system. Resonance energy transfer was apparent when the molecules mixed and came within the critical energy transfer distance.

The studies done by both Michael and Seth have been written up and published in peer reviewed scientific journals. Their work was conducted at Westmont College (Santa Barbara, CA) over a ten-week period during the summer of 2011, under the joint direction of Ken Martin and Allan Nishimura (the Kathleen Smith Professor of Chemistry, Westmont College).

Students Directed by Marc Perry

Research in my group is primarily focused on the development of iron-catalyzed cross-coupling reactions as a low cost and environmentally benign alternative to known palladium-based systems.

Justin Weststeyn (Ballwin, MO) and **Jack Kleinsasser** (Pismo Beach, CA) worked together to develop a modified method for the synthesis of monosubstituted imidazoles. These monosubstituted imidazoles are important building blocks for the ligands we would like to use in our iron-catalyzed cross-coupling reactions. Formaldehyde is now a highly regulated chemical that is frequently used in the synthesis of imidazoles. Justin and Jack worked on a formaldehyde free method for the synthesis of N-aryl imidazoles. The reaction worked as well as other methods so long as the N-aryl substituent had groups in the ortho position. After tying up some loose ends, this work should result in a publication.

Amber Gillett (New Berlin, WI) worked on the iron-catalyzed cross-coupling of unactivated aryl chlorides with primary and secondary alkyl Grignard reagents. She found that the tetrahydrate of iron (II) chloride was the best catalyst precursor and that bulky N-heterocyclic carbene ligands allowed for the cross-coupling of even challenging aryl chlorides. A paper has been drafted on her work and will be submitted to *Tetrahedron Letters* in the very near future. Also, her work allowed for the development of an NSF-RUI proposal that was submitted in November 2011.

Students Directed by Dale Shellhamer

Parker Horn (Vista, CA), **Jacob Milligan** (Vista, CA), and **Danielle Shipowick** (Spokane WA)

Parker, Jacob, and Danielle carried out kinetic measurements on the reaction of chlorosulfonyl isocyanate with several hydrocarbon and monofluoroalkenes to obtain their activation parameters. The Arrhenius plots were linear at temperatures above 25^{O} C. The plots are not linear below 20^{O} C and the rates increase with decreasing temperature. These data suggest a pre-equilibrium complex on the reaction pathway below 25^{O} C. Quantum chemical calculations performed by Dr. Jerry Boatz, from the Edwards Air Force Research Laboratory at Edwards, CA, confirmed the existence of a pre-equilibrium complex on the reaction pathway located just before the rate determining transition state.

Summer Bunting (Whaleyville, MD)

Summer studied methods to increase the percent yield for reactions of monofluoroalkenes with the sluggish electrophile chlorosulfonyl isocyanate. She

found that microwave irridation increases the efficiency of the reactions and reduces the time required for completion. The reaction times and temperatures were also decreased using L-proline ester catalyst or N-heterocyclic carbene catalysts. Carbene catalysts can be prepared from optically active substrates, and the proline catalysts are optically active. Summer's studies opened a new area of research to synthesize optically active *beta*-lactams and *beta*-fluorolactams. *Beta*-lactams are a class of antibiotics. Synthesis of optically active *beta*-fluorolactams is of interest to medicinal and pharmaceutical chemists because there is a need for new and potent antibiotics.

2011 Student Seminar and Poster Presentations (astericks denote students)

Students Sponsored by Sara Choung

Mark Boerneke*, Carli Coco*, Summer Bunting*, Amber Gillett*, Ryne Holmberg*, Parker Horn*, Troy Kurz*, Renae Minnema*, Seth Simonds*, David Vandenbroek*, and Sara Yu Choung. "Sharing Chemistry with Students at PLNU and in the San Diego Area." Presented at 2011 Spring Meeting of American Chemical Society, Anaheim, CA (March 27, 2011).

Students Sponsored by David Cummings

1. Peter Gilson* and David E. Cummings. "Thermal ecology of a heat-sensitive, tropical montane lizard: *Norops pachypus*." Seminar presented by Peter Gilson at the West Coast Biological Sciences Undergraduate Research Conference, Tacoma, WA, 2011 (April 16, 2011).
2. Karisa Archer*, David Arriola*, Pieter Baker*, Grace Faucett*, Jonathan Laroya*, Jenna Lavenuta*, Kelly Pfeil*, Cody Ryan*, Kelsey Ryan*, Douglas Zuill*, and David Cummings. "Contamination of the urban coastal environment with plasmid-encoded antibiotic resistance genes." Poster presented by Jenna Lavenuta and Kelly Pfeil at the West Coast Biological Sciences Undergraduate Research Conference, Tacoma, WA (April 16, 2011).

Students Sponsored by Victor Heasley and David Lingner

1. Renae Minnema* and Victor L. Heasley. "Synthesis and Studies on the Stability of Hypochlorous Acid, HOCl, in Water, Ether, and Ether-Methanol" Presented by Renae Minnema at the 240th Annual Meeting of the American Chemical Society, Anaheim, CA (March 27, 2011).
2. Mark Boerneke* and Victor Heasley. "Studies on the Reaction of Monobromamine with Styrene." Presented by Mark Boerneke at the 240th Annual Meeting of the American Chemical Society, Anaheim, CA (March 27, 2011)
3. Ryne Holmberg* and Victor Heasley. "Determination of Active Chlorine in Dichloramine." Presented by Ryne Holmberg at the 240th Annual Meeting of the American Chemical Society, Anaheim, CA (March 27, 2011).

Students Sponsored by Ken Martin

1. Samantha Gardner* (a), Seth Simonds* (b), K.A. Martin (b), and A.M. Nishimura. (a) "Evidence of Resonance Energy Transfer in Molecular Bilayers," 58th Annual Western Spectroscopy Association Conference at Asilomar

Conference Center, Pacific Grove, CA, Jan. 2011. (a) Department of Chemistry, Westmont College. (b) Department of Chemistry, Point Loma Nazarene University
2. Laura Selby* (a), Michael Douglas* (b), K.A. Martin (b), and A.M. Nishimura (a) "Perturbation in the Formation of Excimers in Methylnaphthalene Adlayer," 58th Annual Western Spectroscopy Association Conference at Asilomar Conference Center, Pacific Grove, CA, Jan. 2011. (a) Department of Chemistry, Westmont College. (b) Department of Chemistry, Point Loma Nazarene University

Student Sponsored by Michael McConnell

Megan Edgbert*, Natasha Jundt*, Anthony Montano*, Andrew Montano*, and Michael McConnell (2011). "A gene deletion analysis of O-polysacchairde biosynthesis in *Salmonella enterica*, Serovar anatum, a serotype Group E1 organism" Seminar presentation by Megan Edgbert at the 36th Annual West Coast Biological Sciences Undergraduate Research Conference, Pacific Lutheran University, Tacoma, WA (April 16, 2011).

Students Sponsored by Mike Mooring

1. Caleb Bryce*, Jared Yee*, William Taylor*, Robert Perry*, and Mike Mooring. "Phototrapping elusive mammals in a Costa Rican montane cloud forest", presented by Caleb Bryce at the 36th Annual West Coast Biological Sciences Undergraduate Research Conference at Pacific Lutheran University, Tacoma, WA, (April 16, 2011).
2. Jared Yee*, Caleb Bryce*, William Taylor*, Robert Perry*, and Mike Mooring. "Retrospective interviews to establish historical presence of mammals in the upper Savegre Valley of Costa Rica", presented by Jared Yee at the 36th Annual West Coast Biological Sciences Undergraduate Research Conference at Pacific Lutheran University, Tacoma, WA, (April 16, 2011).

Students Sponsored by Dawne Page

Sarah E. Schale*, Bradley H. Jacobsen*, David N. Pratt*, Noemi Delgado*, Alyssa R. Scott*, Brad G. Magor, David Traver, and Dawne M. Page. "Creation of IgM:GFP Reporter Lines in Zebrafish." Presented by Sarah Schale at the 2011 West Coast Biological Sciences Undergraduate Research Conference, Tacoma, WA (April 16, 2011).

Students Sponsored by Dale Shellhamer

Kelli Hickle*, David Vandenbroek*, Parker Horn*, and Dale Shellhamer. "A Kinetic Study of Monofluoroalkenes with Chlorosulfonyl Isocyanate Supports a Concerted Mechanism," presented by Parker Horn at the 240th Annual Meeting of the American Chemical Society, Anaheim, CA (March 27, 2011).

Faculty Seminar/Poster Presentations

Mike Dorrell

Michael I. Dorrell, Stephen Bravo*, Edith Aguilar, and Martin Friedlander. "Angiogenesis in development and disease." Presented by Mike Dorrell at the 2011 Gordon Conference on Endothelial Cells in Development and Disease in Biddeford, Maine.

April Maskiewicz

1. April Maskiewicz. "Using Qualitative Information to Improve Your Teaching and In Your Research: An Introduction to Conducting and Analyzing Interviews." Organized Workshop presented at the Ecological Society of America's 95th Annual Conference, Austin, TX (August 2011).
2. Ronald Michelotti* and April Maskiewicz. "Context-based Learning of Genetics by Means of Authentic Practice." Poster presented at the National Association of Biology Teachers, Professional Development conference, Anaheim, CA (October 2011).

Michael McConnell

1. "A Gene Deletion Analysis of O-Polysaccharide Biosynthesis in *Salmonella enterica*, Serovar anatum, a Group E1 Organism", Seminar presented at the 16th Annual Meeting of the San Diego Microbiology Group, Scripps Institute of Oceanography (May 14, 2011).
2. "A Gene Deletion Analysis of O-Polysaccharide Biosynthesis in *Salmonella enterica*, Serovar anatum, a Group E1 Organism", Seminar presented at Jack Johnson Lab Group Meeting, The Scripps Research Institute, La Jolla, CA (June 3, 2011).

Dawne Page

Dawne M. Page, David N. Pratt*, Noemi Delgado*, Alyssa R. Scott*, Bradley H. Jacobsen*, David L. Stachura+, Brad G. Magor#, and David Traver+. Dept. of Biology, Point Loma Nazarene University, San Diego, CA. #Dept. of Biological Sciences, University of Alberta, Edmonton, Canada. +Dept. of Cellular and Molecular Medicine, UCSD, La Jolla, CA. "Creation of IgM:GFP Zebrafish Reporter Lines." Presented by Dawne Page at the 2011 Strategic Conference of Zebrafish Investigators, Asilomar, CA (Jan. 2011).

2011 Book and Journal Article Publications (asterisks denote student coauthors)

Sara Choung

Nair, H., Gatt, J.E., Zhang, R., *Thomsen, J.M., *Bordley, J.A., Choung, S.Y., Baertsch, C.D., "Simulating the Performance of a Catalytic Microsensor for Quantifying Ethanol in Inert and Reactive Environments." *Industrial and Engineering Chemistry Research*, 50 (2011) 10972-10981.

David Cummings

Cummings, D. E., K. F. Archer*, D. J. Arriola*, P. A. Baker*, K. G. Faucett*, J. B. Laroya*, K. L. Pfeil*, C. R. Ryan*, K. R. U. Ryan*, and D. E. Zuill*. 2011. "Broad dissemination of plasmid-mediated quinolone resistance genes in sediments of two urban coastal wetlands." *Environ. Sci. Technol.* 45:447-454.

Ken Martin

1. "Observation of Resonance Energy Transfer in Naphthalene-Phenanthrene Molecular Bilayers on Al_2O_3 (0001)", Seth W. Simonds*‡, Samantha R. Gardner*, K.A. Martin‡ and A.M. Nishimura†, *Journal of Undergraduate Chemistry Research,* **2011**, *10(1)*, 1.
2. "Observation of Resonance Energy Transfer in Dichlorobenzene-Fluorenone

Bilayer on Al_2O_3 (0001)", Laura M. Selby*, Michael S. Douglas‡*, K.A. Martin‡ and A.M. Nishimura†, *Journal of Undergraduate Chemistry Research,* **2011**, *10(1)*, 5.
3. "Evidence of resonance energy transfer in molecular bilayers on Al_2O_3 (0001)", Samantha R. Gardner, Seth W. Simonds, K.A. Martin, A.M. Nishimura, *Journal of Undergraduate Chemistry Research,* **2011**, *10(3)*, 95.
4. "Evidence of resonance energy transfer in molecular bilayers on Al_2O_3 (0001)", Samantha R. Gardner, Seth W. Simonds, K.A. Martin, A.M. Nishimura, *Journal of Luminescence,* **2011**, *131*, 1661-1663.

April Maskiewicz:
*Alvarado, M. & Maskiewicz, A. "Teaching High School Physiology Using a Popular TV Medical Drama." (2011). *The American Biology Teacher,* 73(6), 322-328.

Research Grants Awarded (or pending)
David Cummings
1. NOAA California Sea Grant Program. "Transferrable antibiotic resistance plasmids in urban coastal wetlands." $10,000. 2011. D. E. Cummings and E. M. Top.
2. PLNU Research and Special Projects (RASP). "Measuring the concentration of antibiotic resistance genes in polluted wetlands." $1,126. 2011. D. E. Cummings.
3. PLNU Alumni Association Research Grant. "Triparental mating: research collaboration with the University of Idaho." $2,000. 2011. D. E. Cummings.
4. PLNU Wesleyan Center for 21st Century Studies. "Effects of tropical deforestation on *Norops* lizard behavior." $2,000. 2011. David E. Cummings and Peter Gilson.
5. National Institutes of Health (NIH). "Capture and Characterization of Self-Transmissible Plasmids from Urban Wetlands Encoding Clinically Relevant Antibiotic Resistance Genes." $360,000. D. E. Cummings, R. T. Botts, and E. M. Top. (Pending)

Mike Dorrell
1. NIH AREA (R15), "Identifying Synergistic Combinations of Angiostatic Therapies for the Treatment of Glioblastomas". $250,000 (pending).
2. NSF MRI (Major Research Instrumentation) grant for funding to obtain a confocal microscope at PLNU. ~$275,000. Re-submission.
3. Blasker Science and Technology grant: "Combination Angiostatic Therapy to Treat Glioblastoma Brain Tumors". $40,000 (pending).

Katherine Maloney
1. Research Corporation Multiple Investigator-Cottrell College Science Awards, "Variation in secondary metabolite chemistry among cryptic species of the soft coral *Sarcophyton*, a source of bioactive *cembranoids*", $75,000. 2010-2012. Katherine N. Maloney and Catherine McFadden (Harvey Mudd College).
2. University of California Pierce's Disease Research Grant, "Control of Pierce's disease with fungal endophytes of grapevines antagonistic to *Xylella fastidiosa*", $101,804 ($1,500 to KM). 2010-2012. Katherine N. Maloney (cooperator) and Philippe Rolshausen (PI, University of California, Riverside).

April Maskiewicz
1. NSF, "Learning Progressions for Scientific Inquiry: A Model in the Context of Energy," 5 PI's (San Diego State University, University of Maryland, Point Loma

Nazarene University), January 1, 2009 - August 31, 2012. $2.9 million
2. IBP (Introductory Biology Project Catalytic Mini Grant), "Identifying differences in discourse and teaching about matter and energy in biology, chemistry, and physics courses, and the challenges this poses for learners of biology". 4 PI's (University of Colorado, Hampshire College, University of North Dakota, Point Loma Nazarene University). August 1, 2010 - July 31, 2011. $2,000

Mike Mooring
1. Zoological Society of San Diego (2011): "Jaguar and other predators of the Talamanca Cordillera, Costa Rica"; $10,000
2. RASP (2012): "Jaguar of the Talamanca Cordillera, Costa Rica"; $2,000
3. PLNU Alumni Grant (2012): "Camera trapping to survey jaguar in the Talamanca Cordillera of Costa Rica" ($2,000)

Dawne Page
NSF, "B cell development and activation in zebrafish", (four years, $466,000). This is a joint effort between PLNU & UCSD with Dawne Page of PLNU as PI and David Traver of UCSD as co-PI.

Marc Perry
Petroleum Research Fund (three years; $65,000).

Dale Shellhamer
National Science Foundation (NSF-RUI) Research Grant, "Electrophilic Reaction of Fluorosubstituted Alkenes with Chlorosulfonyl Isocyanate and some other Electrophiles". $134,277. (May 1, 2010 - April 30, 2013).

Other Professional Activities by Faculty Members
David Cummings
1. Proposal reviewer for the US-Israel Binational Agricultural Research and Development (BARD) Fund
2. Reviewed one article for the *International Journal of Biotechnology and one for Journal of Hazardous Waste Management.*

Mike Dorrell
1. Tri-beta faculty advisor; Tri-beta continues to actively participate in/support several science outreach programs. In addition, a student led seminar was created to inform younger students of the research opportunities available here at PLNU.
2. Off-campus research internships; Dr. Dorrell is also active in helping students find internship and summer research opportunities off-campus as the number of highly qualified candidates for research at PLNU continues to grow.

April Maskiewicz
Director of University NOW. UNOW is a program for under-represented high school juniors that helps them (a) envision themselves as college students, and (b) successfully complete a university-level integrated biology/writing course. The students come to PLNU three days per week in the afternoon and take a specially designed college level interdisciplinary course in Human Biology & Bioethics (Bio

101) and Writing 99 that extends over two semesters. Currently we have 18 students from the AVID program at Point Loma High School attending UNOW. Due to budget cuts at San Diego Unified, Lincoln High School was unable to pay for transportation to get their students to PLNU this school year. We have submitted grant proposals to various organizations to try to find the transportation funds so that we can bring Lincoln students back into the UNOW program.

Katherine Maloney

1. Refereed two articles for the *Journal of Natural Products*
2. Elected Member-At-Large, ACS Division of Organic Chemistry Executive Committee (effective January, 2012).

Michael McConnell

Accepted an invitation to serve on the Editorial Board for *World Journal of Virology*, a new online, open access science journal being produced and published by Baishideng Publishing Group, with branches in Beijing and Hong Kong, China. The first issue of the journal was published on February 12, 2012.

Mike Mooring

Refereed two articles for *African Journal of Ecology*, one for *Current Zoology*, one for *Conservation Biology*, and one for *Biological Journal of the Linnean Society*.

West Coast Biological Sciences Undergraduate Research Conference

by Michael McConnell

The 36th Annual WCBSUR Conference was hosted for the first time by an institution in the Pacific Northwest; namely, Pacific Lutheran University in Tacoma, WA. The aunt and grandparents of PLNU student participant, Megan Edgbert, live in nearby Olympia, and because they were kind enough to open their homes to Megan and five other PLNU students, there were sufficient funds available (including those provided by Research Associates and the PLNU administration) for 10 students and faculty to be able to represent PLNU at the conference (ours was the largest out of state contingent in attendance). The student participants, in addition to Megan, included Caleb Bryce, Peter Gilson, Jenna Lavenuta, Kelly Pfeil, Sarah Schale, Doug Zuill, and Jared Yee. The faculty members who attended were Mike Mooring and Michael McConnell. Altogether, PLNU students presented four seminars and two posters at the conference. All of these presentations are described in more detail elsewhere in this report.

Since the WCBSUR Conference was founded by Santa Clara University in 1976, a total of 150 institutions from 27 states have sent participants. PLNU has been represented at the WCBSUR Conference for 29 years in succession and 31 times altogether. The PLNU Biology Department has hosted the WCBSUR Conference seven times (1992, 1996, 2000, 2004, 2006, 2008, and 2009), which is second only to Santa Clara University. Other host institutions have included Colorado College, Loyola Marymount University, Occidental College, Pacific Lutheran University (WA), the University of San Francisco, and the University of California at Irvine. The 2012 WCBSUR Conference will take place at Loyola Marymount University, after which the WCBSURC will return to PLNU for the 8th time in April

2013. Planning for this event is already underway.

PLNU's involvement in the WCBSUR Conference raises the profile of our science program in a very effective way. For the most recent conference hosted by PLNU in 2009, publicity was sent directly to over 12,000 biology and biochemistry faculty at 620 institutions throughout the United States. There is abundant anecdotal evidence indicating that such publicity directly benefits PLNU students when they apply for acceptance into graduate and professional school programs. With steady support from Research Associates, PLNU will continue to be a major player in this outstanding conference for many years to come.

Report on the Annual Meetings of Research Associates

by Michael McConnell

Spring Board Meeting:

The Board of Directors of Research Associates met for its annual spring dinner meeting on May 13, 2011. Members present included Board Chair Jeff Conner ('84), Esther Allen ('55), Rick Bravo ('79), Keith Kortman ('77), Joe McMurray ('85), Kirk Milhoan ('86), Brad Oliver ('77), and Ben Powers ('98). Also present were faculty representatives Ken Martin and Michael McConnell, as well as guests, Joe Watkins (vice president of external relations) and Sheryl Smee (director of alumni relations). There were reports on the various programs supported by Research Associates during 2010-11, including participation by students in science conferences, the annual Science Honors Weekend, and the summer research programs in biology and chemistry. Final decisions were made regarding Endowed Scholarship recipients as well as the juniors who would be awarded Molecular Science Awards at the Annual Breakfast in November (Molecular Science Awards are based primarily upon voting by the outgoing seniors of the Class of 2011). Brad Oliver was elected to a two-year term as Chair of Research Associates, with his duties to begin effective on January, 2012.

Joe Watkins gave the board an update on fundraising for the Science Complex. He indicated that both he and President Brower were increasing their interactions with various foundations as well as building friendships with "movers and shakers" in the greater San Diego community, the latter mainly by becoming more involved in San Diego Civic organizations. Joe also indicated that an effort is underway to expand the University Foundation Board from its current 15 person membership to a much larger group of 50 persons.

Annual RA Breakfast and Fall Board Meeting:

by Michael McConnell

The Research Associates Annual Breakfast and the Fall Board Meeting both took place on Homecoming Weekend (Saturday, November 19, 2011). The attendance at the breakfast was 86 (40 juniors and seniors and 46 alumni). The activities at the breakfast included introduction of graduating seniors by department chairs and introduction of all biology and chemistry summer undergraduate researchers by their various faculty research advisors. RA Chair Jeff Conner introduced the RA board members, then Vic Heasley and Dale Shellhamer introduced all of the other alumni who were in attendance. RA board members present at the breakfast included Chair Jeff Conner ('84), Esther Allen ('55), Rick Bravo ('79), Brad Carter ('82), Jeff Gardner ('92), Keith Kortman ('77),

Kirk Milhoan ('86), and Brad Oliver ('77). The keynote address was given by Dr. Keith Kortman ('77). Dr. Kortman had been honored the previous day in Alumni Chapel with a 2011 APL Award from the Alumni Association. The final events of the morning included recognition of the winners of the Endowed Scholarship and Molecular Science Awards by Jeff Conner (see photographs below) and a brief summary of the important role played by Research Associates by Dr. Ken Martin.

The Fall Board Meeting followed immediately after the breakfast. After introductions, there was a report on the pre-professional program, a final report on the 7/1/10 to 6/31/11 fiscal year, and updates on the funding levels for both the RA General Fund and the RA Endowed Scholarship Fund for 2011-2012 at the midway point. A list of active RA members was provided, from which names were drawn as nominees to replace the six outgoing members of the board who were completing their four year terms; namely, Tom Carter ('80), Jennifer Cato ('94), Jeff Conner ('84), Kirk Milhoan ('86), Keith Kortman ('77), and Hal Wadley ('66). We are very grateful to these alumni for their excellent work on behalf of Research Associates.

The last half of the meeting was taken up with a report by Joe Watkins, vice president of external relations, on the status of the Science Complex fundraising effort… considerable discussion followed Joe's report.

2011 Molecular Science Award Recipients

Left to right: Joshua Hill, Sara Schale, Luke Vickers, Chris Evans, Dr. Jeff Conner, Doug Zuill, Summer Bunting, Jenna Lavenuta, and Parker Horn

2011 Endowed Scholarship Recipients

Left to right: Bradly Baer, Caitlyn McGue, Jake Milligan, Luke Vickers, Dr. Jeff Conner, Summer Bunting, Ruben Vasquez, Jr., and Colton Erskine

FINANCIAL REPORT (Fiscal Year 2010-2011)

ENDOWED SCHOLARSHIP FUND

This fund was created by the action of the RA Board in 1988 to fund scholarships for deserving students in the biology and/or chemistry departments. Contributions were solicited from RA member over several years. The first scholarships were awarded in 1995 once the fund reached the level of $100,000. The value grows from investment earnings and from ongoing annual contributions specifically designated for this fund by RA members. Awardees are determined in the spring and approved at the May meeting of the board of directors of Research Associates. Overall GPA and the recommendation of science faculty are criteria for these awards.

ENDOWED SCHOLARSHIP FUND (ESF)	Amount
Fund as of July 1, 2002	$129,866
Fund as of July 1, 2003	$122,367
Fund as of July 1, 2004	$145,833
Fund as of July 1, 2005	$151,675
Fund as of July 1, 2006	$170,008
Fund as of July 1, 2007	$192,396
Fund as of July 1, 2008	$180,587
Fund as of July 1, 2009	$143,109
Fund as of July 1, 2010	$162,428
Fund as of July 1, 2011	$183,354

RESEARCH ASSOCIATES GENERAL FUND

The General Fund is supported by membership gifts and is used primarily to support the ongoing needs of the summer research programs in the biology and chemistry departments. These funds also help support recruiting efforts and the participation of students in professional conferences where they can present the findings of their research. Funds are divided evenly between the two departments.

RESEARCH ASSOCIATES FINANCIAL REPORT 2010-2011

July 1, 2010 – June 30, 2011	Income	Expenses	Balance
Balance on hand as of July 1, 2010			**$14,956**
Total Gifts (106 donors)	$39,166		
Other Income (interest)			
Transfer to RA Scholarship Fund			
Summer Research Support		$28,902	
Scholarships (8 Molecular Science Awards, $550 each)		$4,400	
Recruiting (Science Honors Weekend)		$2,450	
Conferences		$1,945	
Annual Report (Printing & Postage)		$2,094	
Fundraising		$995	
Breakfast Meeting		$537	
Misc.		$658	
SUM	**$39,166**	**$41,981**	
Balance on hand as of July 1, 2011			**$12,141**

Current Research Associates General Fund Budget

July 1, 2011 to June 30, 2012

Income

Gift Target $40,000 (Received to date: $35,542 from 80 donors)*

Expenditures	Budgeted	Expended*
Recruitment of Students and Public Relations w/ Medical and Graduate Schools	$2,500	$2,500
Outstanding Molecular Science Awards (8 at $500	$4,000	$4,000
Summer Research Program	$27,000	$30,000
Research Conference Expenses	$3,000	$1,500
Annual Report, Directory, and Mailings	$2,000	$2,000
Annual Meetings and Other Miscellaneous	$1,500	$2,000
TOTAL	**$40,000**	**$42,000**

*As of 4/22/2012

POINT LOMA
NAZARENE UNIVERSITY

Research Associates
3900 Lomaland Drive, San Diego, California 92106-2899
Phone (619) 849-2304 · **Fax** (619) 849-2598
mmcconne@pointloma.edu
www.pointloma.edu