2010 Highlights of Undergraduate Research

Summaries of selected research projects presented at the 15th annual Denman Undergraduate Research Forum
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Many undergraduate students at Ohio State are involved in research and other creative activities outside of their normal course work. Working with faculty, graduate students, peers, or independently, these talented and highly motivated students are an inspiration to the entire university community. Each year, students are invited to present completed projects or works in progress at the Denman Undergraduate Research Forum. Some of these projects are quite technical because they are carried out in specialized fields of study. To make them more accessible to a general audience, we collected the following non-technical summaries from representative students.

We invite you to browse these pages to see the excitement, value, and diversity of their accomplishments. This is a brief introduction to the types of research projects our students are working on. A list of all student projects with complete abstracts from this event is available at the Denman Forum web site, denman.osu.edu. In 2009, 522 students participated in 463 projects. You can also find undergraduate honors theses at Ohio State’s Knowledge Bank, kb.osu.edu.

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Professor Allison A. Snow
Director
Undergraduate Research Office

Amanda Harper
Student Advisory Committee Co-Chair
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Coral Reefs and Global Warming

Corals are symbiotic animals related to jellyfish and sea anemones, whose skeletons form the structural basis for coral reef development. While they have tentacles and a mouth for eating, most of their energy comes from symbiotic plant cells they harbor in their tissue. When it gets too hot, corals lose their symbiotic plant cells, turn white, and “bleach.” Although healthy corals acquire most of their daily energy from the plant cells, some can compensate by enhancing their feeding rates during bleaching and recover. My research focuses on resilience to bleaching in three species of Caribbean corals: Montastraea faveolata (Boulder star coral), Porites astreoides (Mustard hill coral), and Porites divaricata (Thin finger coral). In the summer of 2009, we reared coral fragments from all three species of coral: half in tanks at normal temperatures, and half in tanks at elevated temperatures. After two-and-a-half weeks in the tanks, the elevated-temperature corals had bleached and the control corals had not. To compensate for the lost plant cells, bleached-coral feeding rates appeared to increase in P. astreoides and P. divaricata, but not in M. faveolata. Thus, both Porites corals are potentially more resilient to bleaching events. Therefore, we hypothesize that as the oceans continue to warm, the abundance of Porites coral species will increase while M. faveolata will decrease—fundamentally changing the structure, diversity, and ecological health of Caribbean reefs.

My research took an economic approach to animal welfare in farm animal housing, specifically for egg-laying hens. It was inspired by a possible ballot initiative in Ohio, which would dictate housing regulations for several livestock species, including egg-laying hens, by banning the use of battery cages, a type of housing currently used in 98% of Ohio’s egg-laying operations. I hoped to determine the economic effects such legislation would have on egg farmers and consumers in Ohio. I used data from USDA, industry experts, and previous studies to calculate the total cost to transition Ohio’s egg industry from its current system to cage-free housing. I also compared the costs of remodeling barns for cage-free production to the potential revenue gains from sales to this market. I found that banning caged housing in Ohio would create significant costs for egg producers. If production became cage-free, the cage-free market would be flooded and current retail price premiums would disappear. Without them, farmers would not be able to afford the production costs of cage-free eggs and might stop
farming, leaving only current cage-free producers, whose costs would also increase. Consumers would see little difference in price unless cage-free production was mandatory nationwide.

The search for dark matter is currently one of the most active topics in physics. Using the Fermi Gamma Ray Space Telescope, we searched for evidence of its existence in our galactic neighborhood. Dark matter is inherently non-luminous—it does not interact with electromagnetic radiation—and does not fit in the current theoretical framework of particle physics. As such we do not know very much about it, nor are we certain of its existence. However, due to gravitational interactions, dark matter particles may clump together to form gamma ray-emitting accumulations called “microhalos,” which exist as substructure in the Milky Way halo. Using computer programs and data from the Fermi satellite, we examined each gamma source in the sky for evidence of “proper motion,” or movement across the sky relative to the background stars, as this would be a distinguishing characteristic of microhalos. We didn’t see any evidence of such motion, and proceeded to simulate the observation of a microhalo. We found that the Fermi satellite had a very low probability of successfully measuring the proper motion of a real microhalo, and we plan to share our results with the scientific community so it will be aware of the abilities of the equipment.

Scientists are always searching for new ways to combat cancer, including looking to plants for help. This natural approach is based on the idea that, over time, plants have produced unique chemicals that could potentially stop cancer cells from growing. Our goal is to borrow from the design of nature to develop new anti-cancer drugs. One natural cancer-fighting compound, silvestrol, was recently identified by researchers at Ohio State. Silvestrol is produced in Aglaia foelalata, a tree native to Indonesia, and shows promising anti-cancer activity against leukemia.

(continued)
Using Trees to Fight Cancer (continued)

We are interested in exploring how this compound interacts on the molecular level with biological targets. We use both computational and synthetic chemistry to make this possible. Computational chemistry is used to visualize the interaction of silvestrol with various proteins of interest. We then use synthetic chemistry to make changes to the structure of the compound. This approach allows us to systematically determine which pieces of the molecule are necessary for anti-cancer activity in hopes of one day developing a new drug.

American Dance, European Roots

Victoria DeRenzo, ’10
Dance
Katie Stehura, ’10
Dance
Advisors: Meghan Durham-Wall and Norah Zuniga-Shaw

Project Title
Translating Athleticism in European Dance Training onto the Stage

For two summers, we studied at ImPulsTanz International Dance Festival in Vienna, Austria, to distinguish essential differences from our dance training in America. Through classes and performances, we noticed two juxtaposed aesthetic markers: 1) a rigorous physicality in European training, and 2) a pedestrian minimalism in European performances. This disconnect shaped our research. Our goal was to incorporate rigorous physical training into choreography that holds artistic integrity, to explore athleticism as more than just a training tool. First, we commissioned a duet in Vienna by Ákos Hargitay, a European choreographer known for his extreme physicality. In Ohio, we constructed a class using ImPulsTanz techniques and gave six dancers a three-week workshop in our personal interpretation of the “European Training Aesthetic.” We then began to choreograph. By having our dancers trained in a technique prior to creating a dance, we were working with informed and able bodies. The physicality became an underlying assumption in the choreographic process, allowing us to focus on the artistic concept. Our research manifested itself in a 30-minute stage presentation including an excerpt of our commissioned duet, a documentary featuring an interview with our European choreographer, and our 20-minute group work.
What if we could put a hospital inside an airplane, fly it to an impoverished area, land anywhere, and treat anyone? Project MedWing aims to do exactly this in order to help our global community members facing the gravest circumstances—whether they are earthquake victims in Haiti or suffering children in Africa. Suitable aircraft (presently, a C-130 transport) can be outfitted with a modularized medical facility (including a surgical theater and classroom), and aircraft aerodynamics and propulsion can be upgraded to drastically reduce takeoff distance (from 3,500 ft. to 1,500-2,000 ft., according to aerodynamics and performance analysis in the present research). These retrofits would allow this "Clinic with Wings" to land on 99% of African runways—generally short, dirt strips—and countless remote areas lacking runways, granting access to unreachable populations. Furthermore, the hospital modules and medical team could remain on-site, enabling the same aircraft to perform other tasks, such as rescue and transportation. Moreover, the modules could serve as start-up clinics for local communities, providing education, knowledge, and skills-transfer to local doctors, and, hopefully, sustainability.
Hawai'i has a uniquely extensive magma plumbing system compared to other volcanic systems, and it has a special eruptive pattern of somewhat alternating compositions. My research studied how deep this process occurred in the earth's interior. I used over 1,000 glass samples to calculate the depth of the magma chamber beneath the Hawai'i Islands. The results indicate that there is one chamber feeding different conduits with magma to create eruptions. This magma plume does not move, but rather the Pacific tectonic plate moves over it, creating the Emperor Seamount Island Chain. I used a technique created in 1996 to calculate the pressure at which a given mineral crystallizes. For example, olivine is the first mineral to crystallize out of a melt because it is extremely rich in magnesium. Once a pressure has been calculated, it can be converted into a depth. We found that the magma chamber beneath Hawai'i resides at a pressure of ~1Kbar, which is 3-4km deep. Compared with chambers beneath other volcanoes around the world, this depth is shallow—yet another way the Hawai'i volcanoes are unusual.

Little research has explored the relationship between adolescents' sexual behavior and their perception of their parents' and peers' attitudes toward sexuality. My study examined the sexual behavior of 50 Ohio State students aged 17-19. We looked at the adolescents' sexual behavior; hypothetical and actual perceptions of their behavior compared to others'; perceptions of punishment and disappointment; and whether the adolescents had a talk with their parent(s) about contraception methods. We found that both parents and peers affect adolescents'
sexual behaviors. If adolescents perceive their closest friends to be sexually active, they are more likely to be sexually active as well. What’s more, we discovered that adolescents’ perceptions of their friends’ sexual behaviors influence their own behavior. Parents also influence behavior through attitude: if adolescents expect that their parents will be disappointed or will punish them, they are less likely to engage in sexual behavior. In addition, if an adolescent has spoken with his/her parent(s) about sexual contraception, s/he perceives the parent(s) to be less disappointed in the child’s sexual behaviors. Overall, we found that adolescents’ decisions about their sexual behavior are not made in isolation; they look to others for guidance and cues.

Fighting Cancer with Vitamin D?

Vitamin D deficiency is increasingly common throughout the world, raising the risk of certain internal cancers (among other health problems). Increased sun exposure can raise vitamin D levels, but it also raises the risk of DNA damage and skin cancer. Previous studies had not revealed whether increased vitamin D levels play a protective role against non-melanoma skin cancer; we hypothesized that dietary vitamin D may inhibit ultraviolet light B (UVB)-induced inflammation, a precursor to skin cancer. To test this hypothesis, we fed hairless mice various levels of vitamin D for four weeks and then exposed them to UVB light. We monitored the mice for edema, changes in skin morphology, tumor formation, and various biochemical markers. Vitamin D appeared to have no effect on inflammation, and its role in protecting against DNA damage was inconclusive. All our results together suggest that dietary vitamin D supplementation may not be a viable option for prevention of UVB-induced cutaneous cancer.
Glioblastoma multiforme cells are a uniquely aggressive type of brain tumor cell, and currently very little is known about their movement in the brain. The median survival rate of affected patients is only about a year, and treatment of the disease would greatly benefit from a better understanding of the cells’ migration mechanisms. Current migration studies are performed in two-dimensional culture dishes, but research has shown that in a soft, three-dimensional environment, more like the brain, the cells exhibit much different behavior than on two-dimensional plastic. We aim to develop a hydrogel system that mimics the key mechanical and chemical features of brain tissue to aid in the study of the cells and in investigation of potential treatment techniques. We are currently studying cellular responses such as morphology and migration rates to evaluate the success of the systems.

I explored the interactions and conflicts between Ohio State and the neighborhoods around it. I looked at historical change on five streets in the University District: Maynard, Iuka, Frambes, 15th, and 11th. On some days, I spent hours looking up names of residents in historical city directories, which are similar to phone books but include more information about individuals. On other days, I walked up and down the streets and looked for architectural changes, like balconies newer than the rest of the house or additions. I also interviewed long-term neighborhood residents. At the same time, I studied Ohio State’s changes over the years: when dorms were built, student enrollment totals over the 20th century, and how the campus grew. Finally, I used old newspaper articles and Ohio State and neighborhood archival sources to track conflicts between the neighborhoods and the university. Contrary to popular conception, I found that the University District neighborhoods’ history of change is not a simple “rise and fall” narrative with a “Golden Age” (similar to memories of “the good old days”) before Ohio State grew. Rather, the neighborhood’s changes varied by street, and the university’s relationship with the community was and is more complicated and contradictory than memory or rhetoric may allow.
Wonder Woman: Icon and Puzzle

Wonder Woman is an icon. Ostensibly, she presents an image of powerful femininity. But has Wonder Woman represented feminism without ambivalence? The image of Wonder Woman is more complex; she simultaneously represents both oppression and possibility, and thus has not been a simple representative of feminist power—she has been a symbol of paradox. In this project, I conducted a content analysis of Wonder Woman cover art and showed how explicit stereotypes can represent contradictory ideas about American women, ultimately exposing the paradox. Comic book cover art serves as the entry point into the Wonder Woman narrative: it is designed to appeal ideologically to consumers, and it is a streamlined archive that we can trace over time. A historical approach helps us understand how social constructions of identity and ideology have changed over time. Specific moments when common stereotypes are most prevalent provide insight into historical constructions of femininity and how they relate to the status of women. Although American comic books are often limited to genre conventions that rely almost entirely upon recognizable tropes, readers interpret these texts through appropriated or subversive readings, inscribing seemingly stable icons such as Wonder Woman with multiple (even contradictory) meanings.

Biochemistry of Brain Cancer

Malignant gliomas are responsible for over 13,000 annual deaths in the United States and have poor prognosis due to their ability to rapidly invade brain tissue. My research focused on key proteins involved in glioma invasion: in order to establish new targets for cancer therapy, we must first understand the invasive mechanisms. Some background: Fibulin-3 is a protein overly expressed in glioma cells that activates the Notch-signaling pathway by unknown mechanisms. The Notch protein is known to inhibit cell differentiation and is involved in cell invasion, proliferation, and apoptosis in several cancers, including gliomas. Notch-1 is also known to interact directly with CCN3, another protein that is involved in tumor progression. My research tested for a direct interaction between a major fragment of Notch (“Notch-1ECD”) and Fibulin-3. I created Notch-1 ECD cDNA through a polymerase chain reaction, then inserted it into HEK293 cells. I then ran tests for a direct interaction between Notch-1ECD and Fibulin-3, but the results were negative. It’s possible that a mediator protein could be required to form a complex with Notch and Fibulin-3, so the search continues: current research is testing for the interaction between CCN3 and both Notch and Fibulin-3.
How to Feed a Baby

Many infants are born very preterm and lack the coordination to breast or bottle feed effectively, so they are fed with small tubes passed through the nose to the stomach. Because infants are now sustained at younger ages, the equipment must be adapted to be still smaller. Feedings are ideally 20-30 minutes in length, but feedings using the smallest tubes take much longer. Prolonged feedings may force the infant to eat continuously, rather than mimicking normal feeding times (every few hours). This laboratory study evaluated gravitational feed times using different feeding types, tube sizes, and tube materials (silicone and polyurethane). As tube sizes and feeding height increased, feeding time was shortened. Also, more calorically dense feedings increased feeding time. Most importantly, feedings using silicone tubes took up to four times longer than those with polyurethane. The implications are great, as practitioners could use this information to quicken an otherwise consistently slow feeding, or vice versa. However, little to no attention is given to tube material, as it is often not even printed on the tube package. Further research is needed to evaluate the manipulation of feeding times and the benefits of considering tube material while prescribing feedings.

Drinking and Islamic Law

This thesis project was a chance for me to understand how Islamic law came about and affected Muslim societies starting from the foundation of Islam in the 7th century CE into modernity. I narrowed the scope of my research to the injunction against alcohol, a distinctive feature of Islam. By exploring how the ruling came about, I gained a better grasp of Islamic morality. The source of all guidance in Islam is, first, the Qur’an and, secondarily, the Hadith, or narratives of the actions and decisions of the Prophet Muhammad (peace be upon him). I consulted these sources as well as translated treatises of Muslim jurists, which were originally written as early as the 9th century, and the secondary scholarship of notable modern scholars. I discovered that the Qur’an’s ruling regarding alcohol is ambiguous; for this reason, intoxicants were, in some respects, legal in Muslim-majority societies for many centuries. In fact, almost five centuries after the death of the Prophet in 632 CE, Muslims
were imbibing without guilty consciences. Ultimately, in a 14th-century religious revival, religious scholars officially rendered alcohol illegal. Nevertheless, I found that Muslims continued to drink alcohol socially, as we see in Safavid and Ottoman-era poetry, tapestries, and other artworks.

In our lab, we focus on multiple sclerosis, in which the body’s own immune system destroys the nerve cells in the spinal cord and brain, causing loss of motor functions, prominently walking. We found that in animals, a specific protein, MIF, is necessary for susceptibility to MS. We wanted to determine the specific cell type producing MIF in MS, to allow for targeted therapy. I investigated MIF production by B and T lymphocytes, the two important white blood cell types, by creating mouse models where the only MIF production was from either B or T lymphocytes. By evaluating clinical scores, I eliminated both B and T lymphocytes as the source of MIF. I next investigated the B and T lymphocyte populations in mice without MIF. While I observed no differences in the T lymphocytes, MIF-deficient mice had significantly fewer mature B lymphocytes. Further investigation showed impaired proliferation of B lymphocytes, meaning they are less pathogenic in MS. Taken together, these results show that, while MIF is important for B lymphocyte survival, it is not produced by the B lymphocytes. Instead, it is produced by another immune cell before acting on the B lymphocytes.

In the past decade, same-sex marriage has emerged as a divisive issue in American politics. In a majority of states, the public has weighed in on gay marriage through ballot initiatives, referendums, and voter-approved state constitutional amendments. Out of all these initiatives banning or restricting same-sex marriage or domestic partnerships, only one failed. The results (continued)
How Gay Marriage Bans Won (continued)

in some of these elections, especially California’s in 2008 and Maine’s in 2009, were unexpected. I decided to investigate trends in public opinion over the course of these campaigns to analyze the process leading up to the final outcomes. In the 24 ballot issues between 2004 and 2009, most exhibited a significant trend toward the anti-equality side as voters made up or changed their minds over the course of the campaigns. This finding alone indicates that anti-gay groups can thank strong campaigns for their success. I further analyzed the impact of several variables on the changes in public opinion. Campaign spending had no discernible effect, but public opinion changed the most in close races. This implies that the campaigns really do matter in these races, and hotly contested elections with highly active campaigns swing in favor of the status quo position, banning same-sex marriage.

Our country is in the middle of an obesity epidemic, and despite numerous fad diets, people are continuing to become overweight. Perhaps a creative new approach that allows one to recognize natural hunger and satiety cues (i.e., knowing when you are full) is the answer. One possible approach would involve yoga and meditation. Scientific research that supports these claims is emerging, though insurance companies are not yet willing to cover these and similar integrative methods of preventative health care. We analyzed the effects of yoga and meditation on participants’ health in the form of a stress reduction program, specifically noting the effect on diet. One group practiced yoga and meditation, and received instruction on healthful eating behaviors for one week of the eight-week study: they demonstrated four significant changes in their diets following the intervention. The control group received standard classroom-textbook instruction on healthful eating behaviors for six of eight weeks, yet demonstrated only one significant change in their diet. Based on these results, our study supports the utility of a mindfulness intervention including yoga and meditation as an aid for diet change.

Staying Mindful of Diet

Carly Sopko, ’10
Dietetics
Advisor: Maryanna Klatt

Project Title
Evaluating the Mindful Eating Approach as an Aid for Diet Change

What’s next?
Carly is completing a dietetic internship at Virginia State University.

Flickr/myyogaonline
Long-form improvisation is a unique performance art that has been the starting point for such comedic greats as Tina Fey, Bill Murray, and a host of others. Completely made-up on the spot, the performers create a half-hour play before the audience’s eyes. For my research project, I interviewed professional improvisers on the subject of improv comedy’s applications to the entertainment industry. The interviews were conducted in person in New York City, where I was living for two quarters on internship with The Late Show with David Letterman, and focused less on improv theory, or how to be funny, and more on the lifestyle of pursuing a career in comedy. The interviewees are all at different points in their comedy careers, and included professionals like Charlie Todd of ImprovEverywhere and Lennon Parham of CBS’s Accidentally On Purpose. The interviews revealed that while there is no “path” to becoming a professional comedian as one would follow to being a doctor or a lawyer, professional improvisers all exhibit a number of common behaviors. Most significantly, every one of the 11 interviewees urged aspirants to “work hard and be nice.”

The Consejo Nacional del Niño (National Children’s Bureau) has overseen Argentina’s child welfare programs for decades. However, in 2006 it underwent a significant overhaul of its staff and design. Several factors influenced this major change, including Argentina’s ratification of the United Nations Convention on the Rights of the Child in 1989 and creation of a new constitution in 1994. By 2006 the House of Deputies passed legislation outlining the new structure and responsibilities. Using transcripts from congress, newspaper articles, memorandums from the transition, and budgets, I traced the evolution of the legislation, organization, and funding of the bureau and its beneficiaries. I also examined a parallel trajectory of non-governmental organizations (NGOs) that rose to fill the shortcomings of the bureau prior to its overhaul. I found that the bureau, rather than engulf the preexisting organizations, left room to support nonprofits and NGOs both fiscally and logistically. The bureau’s actions, in a country with precarious social welfare programs, showcase cooperation between government and private initiatives to provide for the children of the country. With continued examination, Argentina can serve as a prototype for many other developing countries.