2009 Highlights

Undergraduate Research

at The Ohio State University

Summaries of selected research projects
presented at the 2009 Denman Undergraduate Research Forum
Access to Medicine in Nigeria
Chinonye Akunne, ’10; Zoology, Public Health minor

A Look Inside Bone Disease
Thomas Bacon, ’09; Microbiology

Service in Honduras
Jessica Burk, ’12; Electrical Engineering
Rob Kapaku, ’12; Mechanical Engineering
Stephen Marks, ’10; Industrial Engineering
Lisa Reisenauer, ’12; Chemical Engineering

A Psychological Illustration of Human Existence in an Absurd World
Brianna Dance, ’10; Fine Art and Philosophy

Improving Mass Transportation
Susan Earp, ’09; Architecture

Not Letting the Bed Bugs Bite
Neethi Johnson, ’09; Biology and Entomology

Delving into Depression
Kyle Lyman, ’11; Math

Stuff the Turkey, Not Yourself
Bethany Mack, ’09; Human Nutrition-Dietetics

Residents Respond to Appalachian Ohio’s Industrial Legacy
Hudson McFann, ’10; Geography

Computer Simulation Sheds New Light on Early Universe
J. Scott Moreland, ’11; Physics and Mathematics

Preventing Cancer with Exercise and Nutrition
Julianne O. Niswander, ’09; Medical Dietetics

I Need Friends and Don’t Care Who They Are
Rachel O’Connor, ’10; Psychology and Criminology

Winnie-the-Pooh and Spanish Verbs
Teresa Pratt, ’09; Linguistics and Political Science

Resourceful Women
Danetta Richards, ’09; Anthropology

Bird Flu Lurking in Ponds?
Charles F. Schwarten, ’09; Wildlife and Pre-Veterinary Sciences

Old British Novels and How We Vote
Christopher Skovron, ’11; Political Science and English

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Chad Sowald, ’09; Computer Science and Engineering

Just Say No?
Laura Whinnery, ’09; Human Nutrition

“Therapy” for Homosexuals: Snapshots from the Journey
Tiffany Yeager, ’10; Psychology and Criminology
Jeremiah Moorehouse, ’10; Psychology
Tess Berry, ’10; Psychology
Katy Mitchum, ’09; Psychology
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.

We thank Richard and Marte Denman and the Honors & Scholars Center at Ohio State for supporting the forum; corporate forum sponsors Eli Lilly & Company, Honda R&D Americas, Inc., Procter & Gamble, Battelle, and Honda-OSU Partnership; Dr. Gerard and Mrs. Rossala Boutin; and many students, faculty, and staff who contribute to undergraduate research activities at the university. We are grateful to Amy Lee, a visual and communication design major, for the wonderful illustrations in this booklet; to recent Ohio State graduate Lindsey Perry, who created the image of the lantern on the back cover; and to graduate associate Paul Patton, who worked extensively with the students featured here.

Professor Allison A. Snow
Director
Undergraduate Research Office

Teresa C. Pratt
Student Advisory Committee Co-Chair
Undergraduate Research Office

Amanda Harper
Student Advisory Committee Co-Chair
Undergraduate Research Office
Access to Medicine in Nigeria

Nigeria’s health sector faces many challenges that limit the access people have to essential drugs and health care. My research investigated the geographic availability, affordability, and rational use of drugs and health care in Nigeria. I also proposed alternatives for the reform of the Nigerian pharmaceutical and health care system. Data were collected from public regulatory agencies, scientific databases, peer reviewed publications, and documents from public records of the Ministries of Health and Finance. Supplementary statistical data were collected from agencies such as the World Health Organization and the U.S. Census Bureau. I found that barriers to drug access included: (1) lack of national drug policy and regulations; (2) inadequate finances and health care budget; (3) corruption within the health care system; and (4) inadequate infrastructures and health care providers.

A Look Inside Bone Disease

Bone is a dynamic substrate that is regulated in part by the activity of large cells called osteoclasts. These cells are responsible for the breakdown of bone and the transfer of calcium to the blood, known as resorption of bone, and their activity can be influenced by T3 thyroid hormone.

To examine the effects of thyroid hormone, I incubated osteoclasts with varying concentrations of T3 for various amounts of time and observed them using confocal microscopy, an optical imaging technique. This allowed for the study of TRIP6 protein, which binds to T3, and for the direct observation of phenotypic changes. T3 affects osteoclast attachment by causing the cells to flatten and lose unique attachment structures on non-bone substrates, called podosomes. An overall increase of podosomes occurred during long-term T3 treatments. Additionally, T3 causes the resorption structure to decrease in size on bone. Both short term and long term T3 treatment caused the shuttling of TRIP6 from the nucleus to the cytoplasm, resulting in very large cells, which I assessed using measures of perimeter and nuclear number. These results suggest that T3 increases osteoclast fusion by removing TRIP6 repression on osteoclast genes, but decreases resorption by altering actin structures. By investigating regulatory mechanisms of osteoclast function, we can continue to combat major diseases like osteopetrosis and osteoporosis.
Service in Honduras

Engineers for Community Service is an Ohio State student organization that utilizes engineering skills and technologies for service projects. Its recent primary international work has been at Montaña de Luz (MdL), an orphanage for HIV-infected children in rural Honduras. This year our team focused on reducing MdL’s energy expenses. Consulting with experts from Ohio State and Battelle Memorial Institute, we conducted an extensive audit of MdL’s equipment and appliances, studied the effect of relocating appliances to better-ventilated locations, and evaluated the current lighting design. We developed an economic model for replacing the facility’s fluorescent and incandescent lights with more efficient lights. We estimated that this simple change would reduce energy consumption by 3.5% with a 4.8 year payback on investment. We also investigated a variable frequency drive method to reduce power consumption of the electric water pump. We met with Honduran electric energy department officials to ascertain the national policies on energy utilization and billing, and we established recommendations that would further reduce energy consumption at MdL, including natural lighting solutions and informing MdL staff and children about energy-saving practices. Although we found no “silver bullet” for reducing electric energy consumption, we identified many small, easily implemented measures that will provide a positive cumulative effect on electric energy efficiency at the orphanage.

A Psychological Illustration of Human Existence in an Absurd World

For quite some time, I have used the human body as the subject in my artistic work, with video as the medium. The human body has the ability to externalize our intrapersonal experiences through body language and facial expressions. However, I am interested in externalizing a more existential and psychological experience through the human body. More specifically, I am inspired by the philosophical ideas of absurdism. Absurdism is marked by man’s continuous search for the meaning of life and the disharmony of finding only its meaninglessness. With video art, I am interested in investigating absurdism by motifs that characterize this philosophy, such as nonsense, the failure of language, banal situations, and so on.

(continued)
Psychological Illustration (continued)
I manipulate the human body in a surreal-like way in order to present an interpretation of reality that personifies the psychology of this existence. By doing this creative work, I hope to offer the viewer a psychological and other-worldly perspective of reality that may differ from his/her own, in order to create a more well-rounded understanding of others’ experiences. Also, I hope to show the profound ability our bodies have in illustrating conceptual ideas in simple and subtle ways.

Improving Mass Transportation

This research project began with delving into the impact that transportation has had on the city of Columbus in the past. When cars were not as accessible as they are now, most cities consisted of a dense fabric of neighborhoods connected by public transportation. However, mass transportation went by the wayside when individual vehicles became more popular. Now with new technologies and gas prices that could easily skyrocket, mass transportation systems need to be implemented and placed back into the city plan. Columbus needs to look into the future of transportation to explore how people can move more easily from the suburbs into the city to live, work, and play. New systems such as monorails and robotic taxis are becoming more feasible. My research explored the positives and negatives of old and new ideas. After determining which technologies should be used in Columbus, an architectural project for the plan of the future became my focus and I investigated how new technologies could work to enhance circulation. In the end, I gained a better understanding of the impact that transportation has had and will have on cities all around the world.

Susan Earp, ’09
Architecture
Advisor: Dr. Doug Graf

Project Title
Columbus Needs to Catch Up

What’s next? Susan will be attending graduate school in architecture at Ohio State.
Cimex lectularius (the “bed bug”) feeds nocturnally by obtaining a blood meal from a sleeping human. Flattened with an ovoid body, the bed bug is wingless and the adult is typically about 6 mm long. The resurgence of bed bugs has created major concerns due to their insidious feeding habits. Bed bugs, which are treated with chemicals, are a common nuisance to homeowners and property managers throughout the United States. Since the areas of treatment include bed frames, mattresses, couches, baseboards, etc., there are legitimate health concerns about exposure to insecticides. To search for alternatives, my research tested the effects of ultraviolet-C light on survival at different life stages, including the egg, five nymphal stages, and adult males and females. Insects in each stage were placed in petri dishes and exposed to a console containing a UV-C light bulb. After one week, the dishes were checked for death or molting into subsequent stages. In all trials, there was a statistically significant difference and a positive correlation between UV-C exposure time and bed bug mortality. Later instars were less susceptible to UV-C than eggs and early stages. The pest control industry is searching for novel control tactics and further research on UV-C may be able to provide a safe, effective technology.

Clinical depression is a complicated disease that is difficult to diagnose and even harder to treat. The disease targets several neural groups that are involved in generating alertness and sleep. We developed a mathematical model of these neural groups that is able to produce the sleep-related symptoms of depression. We modeled alertness using a novel dual arousal system paradigm. This is in contrast to previous modeling studies that view arousal as a binary process between sleep and wake, and between REM and NREM sleep. The dual arousal system is composed of a drive towards cortical synchrony and a drive towards cortical desynchrony. During waking, both systems are active, providing a baseline cortical activation consistent with EEG studies reporting alpha (8-12Hz) and beta (12-30Hz) waves. However, during sleep, EEG activation ranges from delta waves in NREM sleep (<3Hz) to gamma waves (34-100Hz) during REM. The reciprocal interaction between the “synchrony” and “desynchrony” groups provides the range of EEG activation during the sleep cycle. This further allows us to escape from a dichotomous view of alertness and study other behaviors, such as altered states of consciousness. In the future, such a model could be used to better diagnose and treat diseases like depression.
Bethany Mack, ’09
Human Nutrition-Dietetics
Advisor: Dr. Gail Kaye

Project Title
Assessment of Holiday Weight Gain in Children

What’s next? Bethany will be attending graduate school at the University of North Carolina at Chapel Hill to complete her dietetic internship and receive an MPH.

Stuff the Turkey, Not Yourself

Media reports claim that American adults gain an average of 5-10 pounds over the holiday season, but the only clinical study conducted on this topic found that normal weight adults gained an average of one pound, while obese adults gained an average of five pounds. Although the prevalence of childhood obesity has tripled in the last 30 years and continues to rise, no studies have been conducted to investigate holiday weight gain in children. The purpose of my research was to determine whether children experience gains in excess body weight similar to that noted for adults. To address this question, I recorded heights and weights of 96 children at five intervals for a period of nine months. Preliminary results show that the holiday season does not appear to be a high-risk time for weight gain in this sample. However, children who weighed more initially gained more weight over the nine-month period. Identifying high-risk times for weight gain and strategies for intervention could help forestall the development of obesity. Once obesity is established it is difficult to reverse, making the prevention of excessive weight gain the best treatment.

Hudson McFann, ’10
Geography
Advisor: Dr. Becky Mansfield

Project Title
From Company Towns to the Wayne National Forest: An Analysis of Local Agency amid Post-industrial “Regreening” in Appalachian Ohio

Residents Respond to Appalachian Ohio’s Industrial Legacy

My research examines Appalachian Ohio’s transition from extractive industry to forest re-growth and the roles of local agents in this process. Specifically, I am interested in the ways in which Appalachian Ohio’s history of labor and land-use struggles have impacted regional identity and the formation of different alliances and antagonisms among private landowners, government agencies, and environmental groups. My research uses three primary methods: 1) map and document analysis, 2) landscape interpretation, and 3) conversations with residents. My initial results indicate that Appalachian Ohio’s history of being controlled and exploited by mining companies, particularly in the late 19th century, can help us better understand existing attitudes...
In our desire to understand the universe in its very infancy, high-energy physicists are studying a newly discovered state of matter known as the quark-gluon plasma (QGP) created in the extreme conditions that existed mere moments after the big bang. Using the world’s most advanced facilities, physicists have recreated the QGP, giving us a rare glimpse of the primordial universe. The QGP is postulated to be the least viscous fluid allowable by nature, and a means of determining the viscosity of the QGP is now one of the leading problems in heavy-ion physics. Working under Dr. Ulrich Heinz and his graduate student Huichao Song, I used hydrodynamics, a physical and mathematical framework that describes the evolution of fluids, to extract the QGP shear viscosity. The fKLN and Glauber models are two competing methods of hydrodynamic initialization. Without knowing which model is more accurate, any attempt to extract the shear viscosity could be off by as much as 20%. By subtle manipulation of hydrodynamic data, I uncovered a binary “flag” that experimentalists can search for to obtain empirical evidence as to which model of initialization is more accurate. This discovery should advance the precision with which heavy-ion physicists can calculate the shear viscosity of the QGP and help move the community forward on the question of which model of initialization is more accurate.
The goal of this research project was to investigate two lifestyle factors, physical activity and nutrition, and the possible link to obesity-related cancers. I used data on individuals’ diet and exercise habits from the National Health and Nutrition Examination Survey in 1999-2006. The data included adults who were at least 45 years old and who provided information on physical activity, dietary intake, and cancer history. These individuals were stratified into three groups: those with obesity-related cancer (n=821), non-obesity-related cancer (n=637), or no cancer history (n=8860). The overall findings showed that people with no history of cancer reported the greatest amount of physical activity, although differences among the three groups were not statistically significant. People with an obesity-related cancer reported significantly lower intakes of carbohydrates, niacin, vitamin B6, vitamin E, phosphorus, copper, and selenium than those with no cancer history or a non-obesity-related cancer. Those with obesity-related cancer also were less likely to obtain adequate amounts of calcium and vitamin B12. These results suggest that lifestyle factors such as dietary intake and physical activity should be addressed by cancer prevention programs.
In a surprising series of experiments on minimal groups, Tajfel and colleagues (1972) showed that simple random assignment to arbitrary groups was enough to elicit in-group bias. For example, people in these minimal groups had better memory for their own group (Bernstein et. al, 2007). People didn’t need competition or a common goal to prefer their in-group; simple association and connection was enough to change the way they encoded the social world. It remains an open question why people are so quick to associate with these new groups without a compelling reason to do so. In the current study, we tested whether the fundamental human need to belong might be a critical motivator for people to differentially encode social groups. Participants were made to feel either included or excluded. Then, they were assigned to one of two minimal groups, learned the faces of both groups, and completed a face memory task. Overall, people remembered their in-group better than the out-group, but in-group memory was especially exaggerated in the exclusion condition. People who are ostracized may find it even more necessary than usual to try to fit in with a wider-range of people by re-defining their social identity and affiliating with even minimal in-groups. This shows that need to belong may be an important motivating factor for people to associate with arbitrary groups.

When kids are learning their native language, interesting things happen. My project looked at young Mexican children’s understanding of Spanish verbs, both grammatical and ungrammatical. By grammatical, I mean the verb forms that an adult speaker would deem correct. Some scholars have theorized that the verbs adults would label as ungrammatical—something like “I runs” in English—are actually grammatical for a certain stage during child language acquisition. To explore this idea, we conducted an experiment using a Winnie-the-Pooh puppet and a book of picture stimuli, which depicted Pooh in one of three stages of the same action. For the verb dormir (to sleep), Pooh was next to his bed in his pajamas in the first picture, in his bed sleeping in the second, and out of bed in normal clothes with the sun shining through his window in the third. The Pooh puppet asked the children to show him “I’m sleeping” where the target picture was the second picture, or “I sleeps” to track any patterns of comprehension of ungrammatical forms. Although we didn't find a pattern with the ungrammatical forms, the children were competent at identifying the grammatical forms, which added valuable new information to the field.
Danetta Richards, ’09  
Anthropology  
Advisor: Dr. Jeffrey Cohen

Project Title  
*Influences on Mayan Women’s Work in Guatemala*

What’s next? Danetta plans to continue her work while attending graduate school.

Using various journal articles, I identified some of the factors that influence the type of income-generating work carried out by women in Guatemala. These factors include access to capital, land, and other resources; the presence of children, especially girls; and their locations within the country. Although the income these women make is often seen as unimportant, it can be more substantial than the money their spouses provide. In addition, I found that the income of many women is more consistently available than their spouse’s income. In many cases, the work that these women perform enables the family to continue to survive. Research shows that the Mayan women in Guatemala face numerous obstacles that they navigate around and through by employing methods that are similar to those used by women in other areas of the world. This supports the idea that women who encounter similar situations are extremely resourceful.

Charles F. Schwarten, ’09  
Wildlife and Pre-Veterinary Sciences  
Advisors: Dr. Robert J. Gates and Dr. Richard D. Slemons

Project Title  
*Environmental Tolerance of a H4N6 Avian-Origin Type A Influenza Virus*

The presence of avian-origin type A influenza virus infections has been well documented in domestic and wild bird populations. However, research on the ability of these viruses to remain viable under natural environmental conditions, which we have termed environmental tolerance (ET), has led to untested hypotheses about the existence of an environmental source of virus. Therefore, the objective of this study was to examine the ET of an avian influenza
virus in the laboratory, under environmental conditions simulating a pond, to determine the likelihood of a possible environmental source of virus. Our study compared virus persistence in soil, water, and soil-water interface microenvironments. Using a qualitative approach, we observed viral infectivity generally surpassing four weeks in all microenvironments. However, our preliminary quantitative results suggest differences may occur among microenvironments. These results demonstrate that avian influenza viruses can have sufficient ET to persist in ponds for at least 28 days under summer environmental conditions. Therefore, we conclude that ponds could serve as an environmental source of avian influenza viruses and should be considered when managing bird collections.

My research analyzed the portrayal of characters in several British novels from 1840-1925 who were members of parliament. I was motivated by a phenomenon observed in political science research: voters in representative democracies tend to have very negative views of their legislature but overwhelmingly approve of the individual legislator who represents them. Beyond some of the more structural features of the political system that account for this, I hypothesized that Western society has developed a cultural appreciation of legislators as individuals. I studied four novels from a period of significant change in British politics, when the right to vote was extended to larger segments of the population. In my analysis of these texts, I focused on the portrayal of legislator-characters as individuals who engage with the larger body of the government as a whole. Over time, legislator-characters became more humanized and professionalized, standing on their own rather than simply as members of parties or movements, and the modern conception of the likable legislator developed. This increasing concern in literary texts for the legislator as a well-rounded character helps to explain and support the cultural basis for trends we see today in elections and public attitudes.
Chad Sowald, '09  
Computer Science and Engineering  
Advisor: Dr. Paul Sivilotti

Project Title  
File Harvest: Targeted, Legal Crawling and Downloading of Online Media

What’s next? Chad is working as a software engineer with M.C. Dean in Virginia and plans to continue his research in his spare time.

Laura Whinnery, '09  
Human Nutrition  
Advisor: Dr. Kenneth Hale

Project Title  
Social Norms, Pharmaceutical Populism, and the Abuse of Prescription Drugs by Students at The Ohio State University

What’s next? Laura will be attending Ohio State’s College of Pharmacy.

Clicking hyperlinks, waiting for pages to load, and downloading content for offline viewing can be a slow process that greatly limits and wastes today’s Internet user’s time. I developed a web crawling and downloading program, called File Harvest, that finds and downloads a large amount of content from the Internet, so users can browse and further filter it offline at a much faster speed and without the unnecessary overhead. File Harvest works by following hyperlinks and examining web pages it encounters along the way based on specifications set by the user, such as which web pages to explore, how many levels of hyperlinks to crawl through, and what types of content to download. The primary insight from my work is the value of combining crawling and downloading into a single program—something that related efforts have yet to do. There are some limitations as to what can be found through crawling, and these limitations are the primary focus of my future research. In general, File Harvest can greatly expedite the discovery and downloading of desired media for users.

Prescription drug abuse has become a serious and growing public health problem, and the college cohort is the mean age when prescription drug abuse starts. Therefore, a survey was conducted to assess the self-reported extent of prescription drug abuse by students at Ohio State and the perceptions of abuse by other students. Drug categories studied included pain medications, sedatives, and stimulants. An anonymous, randomized online survey was used to collect data from undergraduate, graduate, and professional students during autumn quarter 2008. A total of 1,054 survey responses was received (21.1%). The reported use of non-prescribed drugs at least once per year was 9.2% for pain medications, 5.1% for sedatives, and 4.4% for stimulants. The perceived misuse by other Ohio State students was significantly higher (35.4%, 32.2%, and 22.8%, respectively). These results indicate that students at Ohio State misuse prescription medications at rates consistent with data reported in national studies. However, perceptions of misuse by others are significantly
higher than self-reported data. This study confirms the misuse of prescription drugs by students at Ohio State, as well as misperceptions of misuse by others, to be of concern. The data suggest a need for enhanced educational programming to inform students of critical issues related to these potentially destructive behaviors.

“Therapy” for Homosexuals: Snapshots from the Journey

Though the American Psychiatric Association removed homosexuality from its list of mental disorders in 1973, religious organizations continue to tell people that it is possible to change their orientation from homosexual to heterosexual. Participants in this “reparative therapy” often find that the process is ultimately unsuccessful and, in some cases, harmful. While we have much information on the nature of the process from popular sources, we still lack a basic understanding of the individual experiences of people as they move through the process of trying to change their sexual orientation. We have been analyzing public archives of Internet message boards for individuals trying to change their sexual orientation. The Internet offers several methodological benefits that other traditional research methods are missing. The preliminary results of this research suggest that the process of trying to change one’s sexual orientation from homosexual to heterosexual can be accompanied by significant negative feelings, although participants report positive attitudes toward the social support that accompanies these programs.