DePaul University • Illinois Institute of Technology • Loyola University

CHICAGO AREA

undergraduate research symposium

April 14, 2007

Loyola University Law Center
Chicago, Illinois

Northwestern University • University of Chicago • University of Illinois at Chicago

CHICAGO AREA UNDERGRADUATE RESEARCH SYMPOSIUM

April 14, 2007

10:00 - 10:45 a.m. **Registration and Breakfast**
Lobby and Lower Level, Law Center

10:45 a.m. **Opening Address**
Kasbeer Hall, 15th Floor, Law Center
Nancy C. Tuchman, Ph.D., Associate Provost for Research at Loyola University

11:00 a.m. **Oral Presentations (Please choose one room)**
Rooms 260, 324, 340, Maguire Hall

12:15 p.m. **Lunch with graduate/medical school information tables**
Lower Level, Law Center

1:15 p.m. **Poster Presentations, Session I**
Kasbeer Hall, 15th Floor, and Lower Level, Law Center

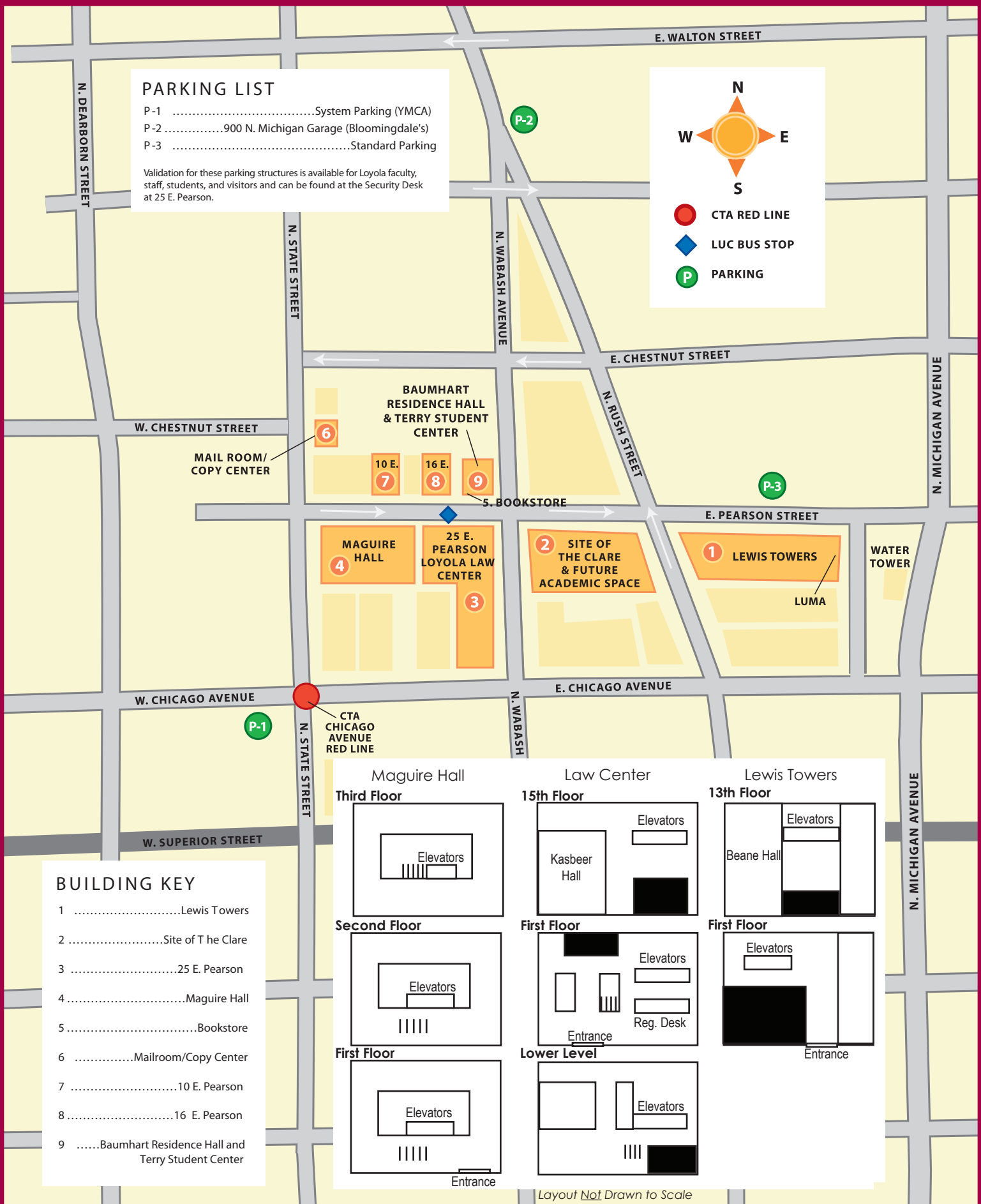
2:15 p.m. **Coffee Break**
Lower Level, Law Center

2:45 p.m. **Poster Presentations, Session II**
Kasbeer Hall, 15th Floor, and Lower Level, Law Center

3:45 p.m. **Research Lecture**
Beane Hall, 13th Floor, Lewis Towers
Thomas J. Meade, Ph.D., Professor of Chemistry, Biology, and Radiology at Northwestern University

4:30 p.m. **Banquet Dinner and Awards Ceremony**
Beane Hall, 13th Floor, Lewis Towers
Keynote Address by Nancy J. Zeleznik-Le, Ph.D., Associate Professor of Medicine at the Cardinal Barnardin Cancer Center

MAP OF LOYOLA UNIVERSITY WATER TOWER CAMPUS



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P-1 .....System Parking (YMCA)
P-2 .....900 N. Michigan Garage (Bloomingdale's)
P-3 .....Standard Parking

Validation for these parking structures is available for Loyola faculty, staff, students, and visitors and can be found at the Security Desk at 25 E. Pearson.

BUILDING KEY

1 .....Lewis Towers
2 .....Site of T he Clare
3 .....25 E. Pearson
4 .....Maguire Hall
5 .....Bookstore
6 .....Mailroom/Copy Center
7 .....10 E. Pearson
8 .....16 E. Pearson
9 .....Baumhart Residence Hall and Terry Student Center

Layout Not Drawn to Scale

Contents

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Thy Nguyen, Northwestern University

The Chicago Area Undergraduate Research Symposium would not have been developed without the help of countless people at all 6 participating institutions. In particular, we would like to thank the following individuals for their help and support:

DePaul University
Rev. Dennis H. Holtschneider, C.M., President
Victoria Simek, Staff Council

Illinois Institute of Technology
Allan S. Myerson, Ph.D, P.E., Provost and Senior Vice President
Carlo Segre, Professor of Physics and Associate Dean of the Graduate College

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Teresa K. Woodruff, Ph.D., Thomas J. Watkins Memorial Professor of Obstetrics & Gynecology
Thomas J. Meade, Ph.D., Professor of Chemistry, Biology, and Radiology
Thy Nguyen, Assistant Director of Engineering & Science, University Career Services

University of Chicago
Robert J. Zimmer, Ph.D, President
Richard P. Saller, Provost

To CAURS participants, faculty, and guests,

Welcome to the 3rd annual Chicago Area Undergraduate Research Symposium! This year's event promises to be an exciting one as we continue the tradition of collaboration between 6 fine research institutions.

This year we were extremely impressed by the number and quality of submissions. We simply did not expect so many participants, but these growing numbers attest to our continuing aim of promoting undergraduate research in the Chicago area. The purpose of this symposium is to celebrate the efforts of so many students who have worked extremely hard on their research, devoting countless hours in the lab or in the field. We have abstracts ranging from theoretical physics to paleobiology to visual computing to food chemistry to industrial organization - a truly impressive variety of projects.

I also would like to take this opportunity to show my deepest appreciation to the students who organized this event with me. The Chicago Area Undergraduate Research Symposium is a completely student-run event and requires months of careful planning. The students on the Inter-School Board are truly stellar individuals who have incredible achievements themselves.

Of course, we are extremely grateful for the support from so many faculty members and administration who have supported our event. The fact that we have so many professors willing to advise research projects and judge at our event demonstrates their strong support for undergraduate research, and for that we give many thanks.

I sincerely hope you enjoy this year's event and that you will take the time to enjoy the projects of your peers from neighboring institutions!

Terrance Lee
CAURS Co-director, American Undergraduate Research Society Director
Northwestern University

To all CAURS participants,

Welcome to the 3rd annual Chicago Area Undergraduate Research Symposium! This event was started with the goal in mind of giving undergraduate students from universities in the Chicago area the opportunity to show case the research work that they have been working on. CAURS is run entirely by undergraduate student representatives from each of the participating universities so I would like to personally thank each of my fellow co-directors for their continued hard work and dedication in organizing and facilitating this event.

This year our student participation was much larger than we had anticipated and so, although it made the planning process a little more arduous, the extra effort was worth it to know that CAURS' success and popularity is skyrocketing. Albert Einstein once said that, "the most beautiful thing we can experience is the mysterious. It is the source of all true art and all science. He to whom this emotion is stranger, who can no longer pause to wonder and rapt in awe, is as good as dead; his eyes are closed." Therefore, in addition to thanking the students who helped to put this event together, I would like to thank all of the student presenters for your continued dedication toward research and understanding the mysterious.

Good luck and don't forget to take the time to view and appreciate the other research presentations!

Suzzane J. Brown
CAURS Co-director
Loyola University-Chicago

DEPAUL UNIVERSITY

Office of the President
1 East Jackson Boulevard
Chicago, Illinois 60604-2287
312/362-8850
FAX: 312/362-7577

April 14, 2007

Dear CAURS participants,

I would like to welcome you to the third annual Chicago Area Undergraduate Research Symposium. DePaul University is proud to be a sponsor. The symposium does an outstanding job of promoting undergraduate research and providing students the opportunity to present and discuss their work with their peers and faculty members in a professional setting.

I applaud the student leaders who organized this cross-university symposium. It engenders greater insights into your fields of study and enhances a deeper appreciation for the research process and the benefits it provides students, academia and society.

As a university that places a premium on teaching and applied learning, DePaul is delighted to be part of this innovative, interdisciplinary symposium. It is a showcase of the impressive scientific and engineering research being done at the undergraduate level. I congratulate all of you for your dedication to the spirit of scientific inquiry and wish you a successful symposium.

Sincerely,

Rev. Dennis H. Holtschneider, CM

Rev. Dennis H. Holtschneider, C.M.

President

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April 1, 2007

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Allan S. Myerson
Ph.D, P.E.
Provost and Senior Vice President

Perlstein Hall, Room 223
10 West 33rd Street
Chicago, Illinois 60616

312 567 3163
312 567 7018 Fax
myerson@iit.edu

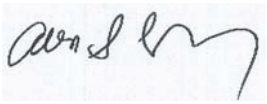
Dear CAURS Participants and Visitors:

On behalf of Illinois Institute of Technology, welcome to the third annual Chicago Area Undergraduate Research Symposium. I am delighted that IIT is helping to sponsor this event and that IIT students are participants and organizers.

Undergraduate research is a vital part of a university's activity. This is the way students truly can understand what they learn in the classroom and make informed decisions about their careers in science and engineering.

Today's events would not be possible without the efforts of the student organizers. Such an inter-institution event is challenging to coordinate and they have all done an outstanding job. Congratulations!

Sincerely,



Allan S. Myerson

Office of the President Northwestern University
Rebecca Crown Center
633 Clark Street
Evanston, Illinois 60208-1100

nu-president@northwestern.edu
Phone 847-491-7456
Fax 847-467-3104

NORTHWESTERN
UNIVERSITY

April 14, 2007

Dear CAURS Participants, Supporters and Guests:

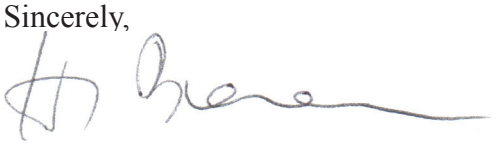
On behalf of Northwestern University, I am delighted to welcome you to the third annual Chicago Area Undergraduate Research Symposium. As a research university, Northwestern is pleased to help sponsor this symposium and the research activities of undergraduate students. It is gratifying to have so many students showcase their ideas and research through poster sessions and presentations.

Research is an integral part of higher education and is vital to the advancement of the new knowledge that will benefit mankind. I hope that your participation here will strengthen your appreciation of the research process and encourage you to invest yourself even further in it. By engaging in research projects, you gain valuable insight into a topic area, strengthen your critical thinking skills and integrate your learning more deeply. Hopefully, some of you will become accomplished researchers and contribute to the advancement of knowledge in your chosen field of endeavor.

I want to acknowledge the American Undergraduate Research Society for its efforts to promote excellence in undergraduate research. In just four years, AURS has established chapters at twenty universities in the United States and Australia, and launched regional symposia in Chicago, St. Louis, Princeton and Melbourne, with a fifth planned for London. In addition, I want to recognize the symposium sponsors whose support made this event possible. Your support of undergraduate research will help to create the next generation of scholars and researchers. Finally, I thank all the student organizers of this symposium. Coordinating this cross-university program involves a great deal of time and effort; their dedication to this exceptional event is apparent and appreciated.

Best wishes for a successful symposium.

Sincerely,



Henry S. Bienen

FACULTY RESEARCH AWARDS

The Faculty Research Awards are presented to professors who have fostered and developed undergraduate research at their academic institutions.

Susan M. Fischer, Ph.D, DePaul University

Dr. Susan M. Fischer received her B.S at University of Michigan - Ann Arbor (1986), and received her M.S. from Colorado State University (1988) in Physics. She completed her Ph.D. at the University of Notre Dame in Nuclear physics (1994) and eventually came to DePaul University in 1998 where she holds currently holds an Associate Professor position in the Department of Physics. In addition to her professorial position at DePaul, she also holds the position of Assistant Scientist in the Physics Division at Argonne National Laboratory. Her research interest covers a large variety of issues in the area of experimental nuclear physics. Her primary research interests lies in the study of atomic nuclei and its possible structures after undergoing nuclear collisions using gamma particles. Dr. Fischer teaches several courses a year which are available to both undergraduate and graduate students. Dr. Fischer's lectures are charismatic and rich with knowledge, and her labs are interactive and enlightening. She is not only a phenomenal teacher in the classroom, but she also an excellent advisor in the laboratory. Having joint positions at Argonne and DePaul has allowed Dr. Fischer to give many undergraduate students a unique opportunity to do research at a national lab. She has always been willing to take on new students and encourages these young researchers to push their limits of patients and analytical skills when dealing with data, results, and even to life in general. When she is not collecting data from germanium detectors, or teaching, she and her husband have their recently born baby boy, Aaron, to keep them busy (December 29, 2006).

Jeffrey L. Doering, Ph.D, Loyola University

Dr. Jeffrey Doering is the Chairman for the Biology Department at Loyola University, the Biology Student Advisory Council chairperson, and a professor of molecular genetics. He received his PhD from the University of Chicago in 1975. His current research focuses on constructing a detailed physical map of the centromere and identifying DNA sequences critical for human centromere function. He is also working on characterizing the molecular nature of deletions in collagen gene loci responsible for osteogenesis imperfecta (OI). Dr. Doering is an accomplished professor and scientist with many years of research and publications under his belt. He is an extremely fervent support of undergraduate research and has advised countless numbers of undergraduate and graduate students on independent research projects. He continually encourages students

to explore new pathways and always serves as a kind, guiding voice of wisdom. Moreover, he has an excellent sense of humor and a caring personality. As one student in his lab remarked, "he truly exemplifies Loyola's motto of 'preparing people to lead extraordinary lives!'"

Richard B. Silverman, Ph.D, Northwestern University

Richard B. Silverman is the John Evans Professor of Chemistry in the Weinberg College of Arts and Sciences. After receiving his Ph.D. at Harvard University, Professor Silverman joined the Northwestern faculty in 1976. His research has been predominantly in the area of epilepsy, cancer, and neurodegenerative diseases with a special interest in the mechanisms of drug actions and the design of medicinal agents. He has received numerous awards for his research and teaching, including a Sloan Research Fellowship, a National Institutes of Health Career Development Award, the Northwestern University Alumni Association Excellence in Teaching Award and the E. LeRoy Hall Award for Teaching Excellence. In 2005, many people at Northwestern associated Professor Silverman's name with Lyrica, a drug he had developed to treat nerve pain associated with diabetes and shingles and for epileptic seizures. For the latter half of this school year, he is known as the chemistry professor who made a significant gift to help fund Northwestern's newest research facility: Richard and Barbara Silverman Hall for Molecular Therapeutics & Diagnostics. But more importantly, many students at Northwestern know him as the professor who made it "worth getting up at 8 a.m." for organic chemistry. Silverman also teaches medicinal chemistry and enzyme chemistry to undergraduate and graduate students. Even with his busy schedule, he never fails to take the time to make sure that his students understand the material and continues to encourage young aspiring undergrads to try research and perhaps discover their talents in the sciences.

Philippe Cluzel, Ph.D, University of Chicago

Philippe Cluzel is a Professor of Physics at University of Chicago whose research is focused on experimental biological physics, non-equilibrium systems, and biopolymers. He also is seeking to understand signaling at the scale of individual cells. He runs an active lab affiliated with the Chicago Materials Research Center, Institute for Biophysical Dynamics, and the James Franck Institute. Recently, collaborating with Argonne National Laboratory, Dr. Cluzel introduced a computer simulation called AgentCell that allows researchers to study the relationship between biochemical fluctuations within a single cell and the cell's behavior as it interacts with other cells and its environment. His lab is an engaging and friendly environment, offering interdisciplinary training opportunities for individuals with either a biological or physical sciences background. Dr. Cluzel's knowledge of the field, patience, and understanding continually motivates his undergraduates to stretch themselves and reap the intellectual rewards.

FACULTY PRESENTERS

Nancy C. Tuchman, Ph.D., Loyola University
Opening Address
10:45 a.m., Kasbeer Hall, 15th Floor, Law Center

Nancy C. Tuchman is the Associate Provost for Research and Professor of Biology at Loyola University Chicago. She received her PhD from the University of Louisville in Aquatic Ecology. Her research focuses on how the alterations of the chemical composition of terrestrial plant leaves that are caused by elevated atmospheric carbon dioxide levels adversely affect leaf litter utilization by aquatic microorganisms, detritivorous invertebrates, and fish. She is also testing the combined effects of elevated atmospheric carbon dioxide, increased global temperatures, and altered precipitation on the above aquatic ecological system. Professor Tuchman will be giving the opening address for the 2007 Chicago Area Undergraduate Research Symposium.

Thomas J. Meade, Ph.D., Northwestern University
Research Lecture
3:45 p.m., Beane Hall, 13th Floor, Lewis Towers

Thomas J. Meade is the Eileen M. Foell Professor in Cancer Research at Northwestern University, as well as professor of chemistry, biochemistry, molecular biology and cell biology, neurobiology and physiology and radiology. He received his PhD in Chemistry from The Ohio State University. Professor Meade's multidisciplinary research focuses on inorganic coordination chemistry with applications to molecular imaging of in vivo gene expression and intracellular messengers, transition metal enzyme inhibitors, and electronic biosensors for early detection of DNA and proteins associated with diseases. He is also the founder of four biotechnology companies and holds more than 50 issued patents with 40 pending. Professor Meade will be giving the research lecture at the 2007 Chicago Area Undergraduate Research Symposium.

Nancy J. Zeleznik-Le, Ph.D., Loyola University
Keynote Address
6:45 p.m., Beane Hall, 13th Floor, Lewis Towers

Nancy J. Zeleznik-Le is Associate Professor of Medicine at the Loyola University Medical Center's Cardinal Bernardin Cancer Center and Oncology Institute. She also holds adjunct appointments in the Molecular Biology Program and the Division of Molecular and Cellular Biology. Professor Zeleznik-Le received her PhD in Cellular and Molecular Biology/Immunology from Duke University. Her research focuses on the Mixed Lineage Leukemia (MLL) protein, which is involved in the proper maintenance of expression of downstream target genes, including genes of the HOX cluster, and on MLL fusion proteins that cause leukemia. One goal of her work is to learn how MLL functions to help maintain proper target gene expression. Another focus of her research is the use of mouse models of MLL leukemia to dissect critical functions required for immortalization and leukemogenesis. Professor Zeleznik-Le is the author of over 40 publications, an editor for the journal *Genes, Chromosomes and Cancer*, and an active teacher and research mentor for graduate students. Professor Zeleznik-Le will be giving the keynote address at the 2007 Chicago Area Undergraduate Research

UNDERGRADUATE PRESENTERS

MAGUIRE HALL ROOM 260

Marco Mendez-Duarte, University of Chicago
Neural Control of Temperature

Katelin Mirkin, Northwestern University
Synthesis of Amphiphilic Block Copolymers via Reversible Addition-Fragmentation Chain Transfer Polymerization

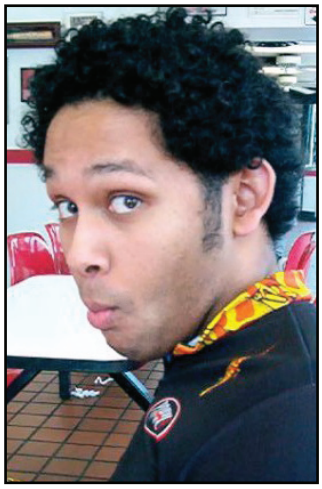
Katelin Mirkin is currently a sophomore at Northwestern University majoring in chemistry. Prior to Northwestern, Katelin attended Marquette High School in Chesterfield, Missouri. There she spent a considerable amount of time running for the track and cross-country team. She graduated second in her class and was a National Merit Finalist. At Northwestern, she is a facilitator for a Gateway Science

Presenters

Workshop, and is active in the Undergraduate Chemistry Council. This past summer, Katelin conducted undergraduate research in the laboratory of Professor Karen Wooley at Washington University in St. Louis, with the support of an NSF REU fellowship. The research focused on the study of the physical shaping of shell crosslinked knedel-like (SCK) block copolymer micelles that contain crystalline hydrophobic core domains. There are intentions for further research to be conducted this summer. Most recently, Katelin presented at the 233rd ACS National Meeting in Chicago.

Alexander Purcell, Illinois Institute of Technology

Employees' Perception of Social Exchange: Leader's Effect on their Engagement

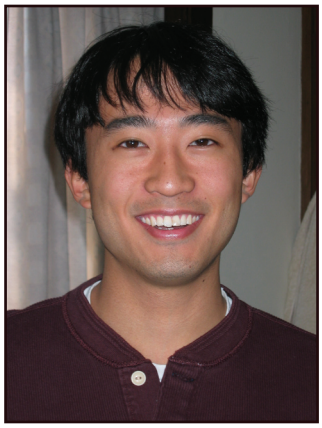


Alexander Purcell, a senior at The Illinois Institute of Technology, is currently studying to obtain a Bachelor of Science degree in Psychology, with Industrial Organization (I/O) as a specification. Alexander has worked with Dr. Roya Ayman for the past year and a half on a research study with a quickly growing U.S. corporate company of which initially held focus groups with several store managers in order to gain insight on common organizational themes and attitudes.

Having also worked for the past year with Dr. Robert Schleser's clinical child development lab, Alex gains experience in other areas of Psychology besides I/O. His interests in the field of I/O include: leadership, organizational culture, and overall he is most interested in working with smaller businesses who cannot afford their own programs, as well as countries that have not fully developed their own I/O programs. In his spare time Alex enjoys bicycling, cooking and playing the saxophone. After graduation, Alex plans to further his studies of Industrial Organization at IIT in the fall.

Ryosuke Kita, Northwestern University

A Dynamical Analysis of Planets in Binary Stars



Ryosuke Kita is a sophomore at Northwestern University, participating in the Integrated Science Program. He was born in Japan, but was raised in Rochester, Minnesota. Upon his arrival at Northwestern, the idea of performing theoretical astrophysics research particularly sparked his interest. Although he had experienced biology and chemistry research before college, this is his first time involved in physics research. During the summer of 2006, with the help of graduate student Genya Takeda, he started his current research on the dynamics of extrasolar planets under the direction of faculty advisor Dr. Fred Rasio. Ryosuke finds his study of theoretical astrophysics fascinating and enjoys listening to guest speakers in his area of research.

As an integrated science major, Ryosuke takes classes in all of the sciences. Because of his strong interest in every science and math, he has difficulty choosing a particular area of study. His love for learning conflicts with many of his other interests, but when he has time, he enjoys playing the piano and participating in several sports. Although Ryosuke is unsure of his future plans after school, he ultimately wants to become an astronaut.

MAGUIRE HALL ROOM 324

Julia Hand, Caitlin Feehan, Jennifer Raber, Siti Zuraidah "Aida" Abidin, Northwestern University

Water to Water: Reengineering the "Nature" of Chicago's Water Cycle for 2107

From left to right: Jennifer Raber, Caitlin Feehan, Julia Hand, Siti Zuraidah Abidin

Julia Hand is an undergraduate environmental engineering student (B.S. expected June 2007) from Winnetka, IL. Aside from environmental engineering, Julia's academic interests include applied mathematics, natural capitalism, globalization, outsourcing, climate modeling, financial engineering, and sustainable design.

Caitlin Feehan is from Milwaukee, WI. She is an environmental engineering student (B.S. expected June 2007). Her academic interests include sociology, sustainability and massive change. Her research interests revolve around innovative water technologies.

Jennifer is from Springfield, OH and will receive her B.S. in Environmental Engineering in June 2007. Her academic and research interests include technology, sustainable development/ design, renewable energy, and global warming.

Aida is from Kuala Lumpur, Malaysia. Her expected graduation date is June 2007 with a B.S. in environmental engineering. Her academic interests include biomimicry, sustainable design, bioremediation, and wetlands.

Presenters

Michael DiMarco, DePaul University

RNA Editing in Didymium iridis

Michael DiMarco is a graduating senior at DePaul University. He is a double major in biology and psychology. Michael has concentrated his studies on biotechnology and is profoundly interested in molecular biology and the applications of science in general. For the last two years, he has worked in Dr. Silliker's lab studying the mitochondrial genome of the slime-mold, Didymium iridis. As enthusiastic about science as one can be, Michael wishes to continue contributing to research and eventually pursue an MD/PhD degree. Generally, he is interested in studying molecular mechanisms and their relation to human health, growth, and development.

When Michael is not pipetting, he can probably be seen discussing politics and current events or reading the news. He has been a teaching assistant for histology and is currently a supplemental instructor for genetics. These positions have allowed Michael to learn to communicate science in order to teach, which he has enjoyed very much.

Genna Cohen, Northwestern University

Health Mindedness during the Transition to Adulthood

Genna Cohen is a senior at Northwestern University (NU) majoring in health care social policy in the School of Education and Social Policy (SESP). She graduated magna cum laude from the Woodward Academy in Atlanta, Georgia where she was a nationally ranked policy debater and founding member of her high school's chapter of Amnesty International. At NU, Genna has worked as a Research Assistant with the Dr. Chase-Lansdale research team at the Institute for Policy Research (IPR) and at Cells to Society (C2S): The Center on Social Disparities and Health. She has also sat on the SESP Undergraduate Committee and volunteered with the Y-ME National Breast Cancer Organization Illinois Affiliate.

Genna's thesis project was generously supported by the Health Literacy and Learning Program (HeLP). Her study of health mindedness and health behavior among emerging adults was developed and executed with the help of Dr. Michael S. Wolf, Dr. P. Lindsay Chase-Lansdale, and the Chase-Lansdale research team at IPR. Her favorite distractions from work are snowboarding, cooking, aerobic kickboxing, and Joey's Brickhouse.

Amy Winans

Beta-sheet Templating Of Amyloid-beta Protein By Anionic Phosphatidylglycerol Membranes

Amy Winans is a fourth year at the University of Chicago majoring in Biological Chemistry. She has worked in Professor Ka Yee Lee's lab for the past two years under the direct supervision of Dr. Eva Chi examining the effects of model membranes on amyloid-beta fibrillization. She was selected to be a Beckman Scholar in the spring of 2006. The Beckman Scholars Program has generously funded her research since then. She has been a member of the Phi Beta Kappa Society and the Sigma Xi Scientific Research Society since 2006. In her free time (and when procrastinating) she enjoys reading, playing the piano, and chilling with her nearest and dearest. She has been a member of her dormitory's council for the last three years and recently finished her second term as President.

MAGUIRE HALL ROOM 340

Yonatan (Yoni) Kahn

Searching for Dark Matter in Elastic Electron/Proton Scattering

Yoni Kahn is in his third year at Northwestern University, pursuing a B.A. in physics, a B.Mus in horn performance, and a Certificate in music composition. In the fall of 2006, he participated in an exchange program with the Ecole Polytechnique in France, where he studied quantum optics under Prof. Alain Aspect. Yoni is a member of the Mortar Board Academic Honor Society and was recently awarded a Goldwater Scholarship, one of the most prestigious undergraduate science awards.

Since the summer of 2005, Yoni has been a research assistant for Professor Michael Schmitt, a high-energy experimental physicist at Northwestern University. He has worked with Prof. Schmitt on the design of an experiment to produce and detect dark matter particles in the laboratory, the success of which could shed significant light on the structure and makeup of our galaxy. Yoni will continue his research with Prof. Schmitt at CERN this summer, working both on the dark matter project and the CMS detector, which is scheduled to come online in late 2007.

Yoni's musical activities at Northwestern include playing in the symphony orchestra and wind ensemble, and his music compositions have been commissioned and performed by several Northwestern students. He is also a member of the Phi Kappa Psi Fraternity. After graduation,

Presenters

Yoni intends to pursue a Ph.D. in theoretical physics and a career in research.

Heather Selby
A Novel Affibody-Alexa Fluor Fluorescent Probe For In Vivo Imaging of HER2 Receptors

I am currently a student at the Illinois Institute of Technology pursuing a double major in biomedical engineering and humanities. In 2003, my aunt was diagnosed with stage three breast cancer, and I moved from Toronto to Chicago to care for her. As I watched my aunt fight and defeat her breast cancer with the assistance, support, and medical expertise of the many doctors at The University of Chicago Hospitals, I knew I needed to be at the forefront of medical research to make a difference. Over the past two years, I have had the privilege of studying biomedical engineering at the Illinois Institute of Technology during the academic months, and being a student intern at the NIH in Dr. Jacek Capala's laboratory in the Radiation Oncology Department of the NCI during the summer months. It is the amount of dedication and hard work, the frustration and disappointment, and the thrill of discovery that continues to inspire me to pursue a life in medical research.

Jane Solomon
Dialect Diffusion

Jane Solomon is an English major and Linguistics minor at Northwestern University. She has worked at the Project on Child Development at Northwestern University, a child language acquisition lab, for the past two years. During the 2005-2006 academic year, Jane studied at the University of Edinburgh where she had an embarrassing amount of conversations with her British peers about the subtle differences between British and American dialects. On her return from Scotland, she was awarded an Undergraduate Research Grant to study dialect diffusion (specifically: what happens to the accents of Americans after they have lived in the UK for eight months). Dialect diffusion is the topic of her 2007 CAURS presentation. Jane graduates in June and currently spends much of her free time looking for an interesting job. She hopes to eventually return to the UK (for a year or so) if she can attain a work visa.

Christina David

Gametocytogenesis of the Malaria Parasite

Christina is a native Chicagoan. Currently, she resides in a suburb of Chicago. She is also completing her senior year at Loyola University Chicago and graduating in May 2007 with a double major in B.S. Biology: Molecular Biology and B.A. Theology, Minor in Chemistry and with honors. Christina is also a triage volunteer at Community Health, Illinois' largest free clinic for the uninsured. Her travel, volunteer and research experiences have fostered her interest in tropical medicine and in providing health care for the needy. That is why she loves working in the Malaria Research Lab. She is doing her Senior Honors Thesis with Dr. Williamson on the Gametocytogenesis of the Malaria Parasite. Malaria kills more than a million people worldwide and 75% of these deaths are those of children. She hopes that her research will help save at least one child from malaria.

Abstracts

BIOLOGY

1 Assessment of Soil Microbial Communities in Surface Applied Illinois River Sediments

Block D. Baniulyte, E. Favila, J. J. Kelly, Loyola University

Field: Microbial Ecology *Advisor: John J. Kelly, Ph.D*

Soil microorganisms are critical to the health of soils and the growth of plants due to their roles in the soil carbon and nitrogen cycles and their contributions to the development of soil structure. Many human activities, such as the release of pollutants and changes in land use, can negatively impact soil ecosystems and can prevent or limit microbial activity and plant growth. The Illinois Department of Natural Resources has developed an innovative approach to the reclamation of degraded soils which involves the surface application of large amounts of sediment dredged from the Illinois River. This approach has two significant benefits: 1) sediment removal will help restore the Illinois River system, and 2) the nutrient rich sediment can be used as a soil amendment to restore damaged soil and encourage the growth of plants. This approach is currently being used to remediate soils at the US Steel Site in Chicago which were badly degraded by over 100 years of operation of a steel mill. In 2004 over 100,000 tons of Illinois River sediment was deposited at the site, covering approximately 35 acres to a depth of 3 to 4 feet. We have collected soil samples annually since 2004 and have assessed changes in soil microbial communities as well as changes in soil physical and chemical properties which have occurred. Total soil moisture and total soil nitrogen have decreased significantly since 2004, while pH and organic matter content have remained stable. Microbial biomass and microbial activity have not changed significantly since 2004, however phospholipid fatty acid (PLFA) analysis revealed that microbial community composition has changed significantly each year since the sediment was land applied.

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2 Impacts of Elevated Atmospheric Carbon Dioxide on Microbial Communities Colonizing Leaf Detritus in a Temperate Woodland Stream

Amit Bansal, Marie Wencel, Anna P. Taber, Patricia Belt, Nancy C. Tuchman, and John J. Kelly, Loyola University

Field: Microbiology *Advisor: John J. Kelly, Ph.D*

Atmospheric CO_2 concentrations have been increasing since the Industrial Revolution and are expected to double within the next 50 years. Elevated CO_2 accelerates photosynthetic rates, leading to significant changes in the chemical composition of plant tissues. In temperate woodland streams, leaf litter serves as a food source and substrate for aquatic microorganisms, and microbially colonized leaves serve as a major food source for aquatic invertebrates. Therefore, changes in leaf litter composition could have significant impacts on the food webs of these streams. We hypothesized that growth of trees under the level of CO2 predicted for the year 2050 (720 ppm) would result in chemical differences in leaves, and that these leaf changes would impact the microbial communities colonizing the leaves

in a temperate woodland stream. To test this hypothesis Aspen trees (Populus tremuloides) were grown for six years under either ambient (360 ppm) or elevated CO2 (720 ppm) at the University of Michigan Biological Station. Chemical analysis of the leaf litter revealed increases in carbon to nitrogen ratio and lignin content for the leaves from the elevated CO_2 treatment. Leaf litter was then hung in mesh bags across the East Branch of the Maple River for 14 days to allow for microbial colonization. Afterwards, fungal and bacterial communities colonizing the leaves were analyzed using terminal restriction fragment length polymorphism (T-RFLP) analysis and the results indicated that there were significant difference in fungal and bacterial communities with CO_2 treatment. In order to examine these differences in community composition more closely, I have constructed clone libraries for bacteria (reflecting 16S rRNA genes) and fungi (reflecting ITS sequences) from both the ambient and elevated CO_2 treatments. I currently have sequenced over 100 bacterial clones and over 30 fungal clones. Preliminary analysis of these clone libraries has revealed some differences based on CO_2 treatment.

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3 **Physical Mapping of the Centromere and Proximal Short Arm of Chromosome 21**

Susanna Bracken, Loyola University
Field: Genetics *Advisor: Jeffrey Doering, Ph.D*

The centromeres and other heterochromatic were not mapped and characterized along with the rest of the human genome. Previous work has resulted in an almost complete physical map of the centromere and proximal p arm of HC21. Two gaps exist on this map. The goal of my research was to complete this map by closing the gaps and extending the map in the direction of the short arm. In an effort to close the gaps, the nucleotide BLAST function on the NCBI website was used to find sequences matching to those at the boundaries of each gap. Pairwise Flag alignment was then used to determine the quality and orientation of each of these matches. Through the course of this research, a second location of the marker D21S1276 was found. Another marker, ABM-C78, is present in the proximal gap (Wang et al). This marker is contained in a HC21 BAC, AF105153. We have been able to extend AF105153 in each direction, however both of the matching sequences are from HC4. No match has been made yet to any sequence bordering the gap or any other HC21 sequence. Hybridization to a blot of two YACS containing HC21 sequences present on the proximal short arm indicated the presence of KFC37. Results are pending for a hybridization to the same blot with a probe of alpha 21-II to determine its presence and location on the map.

Abstracts

4 Characterizing Satellite I Sequences on Human Chromosome 21

Purnima Chennamaneni, Shervy Xavier, Riddhi Patel, Payal Patel, Jeffrey Doering, Loyola University

Field: Genetics *Advisor: Jeffrey Doering, Ph.D*

Heterochromatic regions comprise 10-15% of the human genome but have not currently been sequenced by the Human Genome Project. The short arm of chromosome 21 (HC21) can be used as a model for gaining understanding of heterochromatic regions. The short arm and centromeric regions of HC21 consist of several tandemly repetitive sequences. One such sequence, satellite I (sat I), is found on the short arm of HC21 and on the short arms of all acrocentric chromosomes. Satellite I is the most A-T rich DNA fraction in the genome and consists of alternating 17 base pair and 25 base pair repeats, forming a consensus of 42 base pairs. Previous work has identified two subfamilies of satellite I on HC21 – the N6.4 subfamily which is located solely on the p arm distal to the rDNA cluster and the pTRI-6 sequences present on the p arm proximal to the rDNA and in the centromere. A portion of the sat I array most proximal to the centromeric D21Z1 alphoid array was subcloned from an HC21-specific YAC. Our primary goal was to fully sequence this ~4.5kb sat I subclone, ps21Sat 1B, in order to determine its candidacy as an HC21 specific centromeric marker. We have utilized a combination of primer walking and transposon insertion reactions using the EZ::TN<KAN-2> Insertion Kit (Epicentre) to obtain the sequence. We have currently sequenced ~3.8 kb of the 4.5 kb array. Using BLAST analysis on the currently available sequence we found that the new sat I sequence is highly internally heterogeneous, with 85% or less sequence similarity between different regions. This new sat I sequence is quite distinct from the N6.4 subfamily or any other sat I sequences in the database, indicating it represents a new subfamily. Its distinct sequence coupled with the fact that this centromeric satellite I cluster is not found in the centromeres of other chromosomes makes it a strong candidate for being a HC21 specific centromeric marker.

5 Cloning, Expression and Biophysical Studies of STR Rod Motifs from the C-terminus of Dystrophin

Lien Choi, Mireille Wojtanek, Nick Menhart, Illinois Institute of Technology

Field: Biochemistry and Biophysics *Advisor: Nick Menhart, Ph.D*

Dystrophin is the protein that is defective in Duchenne Muscular Dystrophy, a common fatal genetic disease characterized by muscle deterioration. This long rod shaped links the myocyte membrane to the machinery of muscle function, the myofibrils, and by doing so provides the essential stabilization necessary for long-term survival of this tissue. Because myocytes experience large changes in shape during repeated contraction/relaxation cycles, these two attachment points experience large relative movements, and so a completely rigid rod is not suitable. The dystrophin rod is consists of 24 so called spectrin type

repeat, STR, motifs mad up of ~100 amino acids each. They are linked in tandem to produce the ~200 nm long dystrophin rod. How these regions communicate structurally with each other is unknown; whether they fuse to form a single unit (the rigid rod model) or whether they behave independently (the beads on a string model). This has obvious implications for the flexibility of the molecule as a whole and so its biological function. We have undertaken a project to produce recombinant dystrophin STR motifs spanning the entire dystrophin rod, and are using biophysical measurements including fluorescence and circular dichroism measurements of thermal and urea mediated unfolding to determine which STRs interact with their neighbors, and which are independent. The current study focuses on motifs in the C-terminus of the rod, STRS 21 through 24.

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6 Gametocytogenesis of the Malaria Parasite

Christina David, Loyola University
Field: Molecular Biology *Advisor: Kim Williamson, Ph.D*

According to the World Health Organization, there are 300-500 million malarial infections worldwide that lead to more than 1 million deaths. Malaria, in humans, is caused by 4 protozoan parasite species. The parasites enter humans as sporozoites from the saliva of infected mosquitoes. In the liver, they develop into schizonts with 10,000 to 30,000 daughter parasites per schizont called merozoites. Merozoites either continue asexual replication or differentiate into gametocytes. The gametocytes are required for the transmission of the parasite to the mosquito where they continue sporogonic development. It has been reported that the number of gametocytes produced by different parasite strains varies, but the reason for this is unknown. Our lab recently compared clonal G lo and G hi parasite lines and found a 18.9 kb deletion on chromosome 9 that eliminated a 1.8 kb gene named Pfg 4 in the G lo line. My project is to extend this work by determining whether the ability of different parasite strains to make gametocytes correlates with the presence of Pfg4. The data was collected by growing four distinct parasites strains and determining the number of gametocytes produced. Simultaneously, PCR and gel electrophoresis were used on the DNA from these strains to determine if they contained Pfg4. I have found that the 2 gametocyte producing strains have Pfg4. While the 2 G-lo strains are negative for Pfg4. These results suggest that the presence of Pfg4 is important for gametocyte production. Currently, I'm in the process of finding the exact breakpoint of the deletion which eliminates Pfg4 in G-lo strain FCR.

Abstracts

7 RNA Editing in Didymium iridis

Michael DiMarco, DePaul University
Field: Molecular Biology *Advisor: Margaret Silliker, Ph.D*

Mitochondrial genomics has provided insight into evolutionary relationships amongst diverse eukaryotic species, however, in some organisms, the mitochondrial DNA genes appear to be scrambled; functional genes arise after the mRNA undergoes an editing process. RNA editing has probably evolved independently in several distinct lineages. In the myxomycetes (slime molds) editing is primarily by cytosine-base insertions; based on observations in Physarum polycephalum and Didymium iridis. The insertions alter the transcript to remove stop codons. We characterized editing events in two mitochondrial genes, atp8 and nad4L of D. iridis. Based on our DNA sequence, we designed primers for RT-PCR. Total RNA was isolated, reverse transcribed, cloned, sequenced, and aligned with the original DNA sequences to reveal the editing sites. Nad4L was edited evenly throughout by C-insertions (approximately every 21 bases), while atp8 was predominantly edited at the beginning of the transcript, and less frequently (approximately every 28 bases). Editing sites were downstream of a purine-pyrimdine dinucleotide 67% of the time. Given the base composition of the genes, A-T dinucleotides are predicted to occur in 16% of the sequence, however, this dinucleotide pair was found immediately upstream at 57% of all the upstream pur-pyr editing sites. Upstream pur-pyr dinucleotides are the most consistent feature of the editing sites in D. iridis. The C-base insertions were preferentially inserted in the 3rd position (wobble position) of the codon to create a correct reading frame. Editing sites were conserved 63% and 85% in the atp8 and nad4L, respectively, between D. iridis and P. polycephalum. Our observations support the hypothesis that editing maintains protein function and that the mechanism is similar in D. iridis and P. polycephalum, given the regularity of C-insertions with upstream pur-pyr dinucleotides. By establishing a better understanding of the editing patterns in this group of organisms we hope to develop testable hypotheses concerning the mechanism of editing.

The differing frequencies and distributions of editing sites for each gene suggests that each is edited uniquely which may be related to restoring functional motifs of their proteins. The evidence also supports that editing occurs by the same mechanism in D. iridis and P. polycephalum, given the regularity of C-insertions with upstream Pur-Pyr dinucleotides. The position bias supports the idea that reading frame adjustment is the main goal of the mRNA editing.

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8 Condition-related sound production in the skunk loach (Botia morleti): behavioral correlates

Daniel Elke, DePaul University
Field: Behavioral Ecology *Advisor: Tim Sparkes, Ph.D*

The skunk loach (Botia morleti) is a highly aggressive freshwater fish that produces sounds

during contests over shelter. Previous studies have shown that sound quality (specifically sound pressure level) correlates with physical condition in these organisms. Here, we examined the relationship between physical condition, sound production and behavior during aggressive contests. Using two lab-based experiments, we staged contests between residents and intruders and recorded both behavioral interactions and sound production. In the first experiment, we exposed resident B. morleti to non-conspecific intruders (orange-throated darters). This experiment allowed us to obtain standardized measure of condition-related aggression for each resident. We found that both aggressive behavior (bites) and sound production (number of sounds) correlated with physical condition. In the second experiment, we exposed residents to conspecific intruders and examined behavior and sound production in relation to the difference in condition between opponents (condition asymmetry). For this experiment, we found that the size of the condition asymmetry correlated negatively with both the number of bites and the number of sounds produced during contests. These results are consistent with the interpretation that sounds produced during contests could act as signals of condition, hence fighting ability in these organisms.

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9 **Search for Novel E2 and E3 Ubiquitin Ligase Regulators of Notch Signaling in Caenorhabditis Elegans**

Jason W. Eng, Northwestern University

Field: Molecular Biology Advisors: Hamid Band, MD, Ph.D, Aaron Solomon, Ph.D, Yousaf Mian

Notch signaling has been identified as one of the key signaling pathways involved in the creation of cellular gradients and, among many other processes, cell fate and differentiation. In addition to its own pathways, Notch has also been observed interacting with numerous other cell signaling pathways, making it a versatile vehicle for relaying information from the environment in to the cell. Recently, researchers have shown that problems with Notch signaling may play a key role in promoting tumorigenesis and angiogenesis in certain cancers. According to the World Health Organization, nearly 13% of all deaths are a result of cancer, making it one of the leading worldwide causes of death. In this study, we will identify negative regulators of Notch signaling through the use of the round worm, Caenorhabditis Elegans. Through the use of RNAi-mediated gene knockdown, we were able to develop a viability assay to screen the over twenty E2 ubiquitin-conjugating enzymes and the over eighty E3 ubiquitin-ligating enzymes that commonly regulate cell signaling pathways. We have so far identified at least six enzymes that associate with Notch in a poorly understood manner or were previously not known to associate with Notch at all. The future hope of this research is to identify even more novel targets for drug therapies that would have greater success at halting the development of cancer in humans than the current remedies offered.

Abstracts

10 Alkylation Repair Proteins and their Interaction with DNA: A Single Molecule Approach

Zishaan Farooqui, University of Chicago
Field: Biophysics *Advisor: Chuan He, Ph.D*

A central question of DNA protein interactions is how DNA-binding proteins can rapidly locate specific substrate sites in the midst of high concentrations of non-specific DNA to carry out repair function. Specifically, human alkylguanine-alkyltransferase (hAGT) and C-Ada, a prokaryotic homolog, must be able to locate and repair potentially carcinogenic alkylated bases. Using single molecule studies, we report the trajectories of a single protein traversing along a 45 kb stretch of DNA. We qualitatively and quantitatively observe bi-directionality of protein movement that seems unbiased to flow. Using two different fluorescent labels, we are able to also see two proteins cross each other on the same strand. In addition, mean-square displacement plots compared to theoretical plots provide evidence for restricted one-dimensional motion of the protein. With this data and further analysis, we now hope to put constraints on the system that will narrow down the possibilities of how the protein interacts with non-specific DNA in search of damage.

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11 Organization of satellite III sequences on human chromosome 21

Kellen Gregori, Rachael Hettinger, Joubin Bavarian, Loyola University
Field: Genetics, Chromosome Sequencing & Characterization *Advisor:* Jeffrey Doering, *Ph.D*

While 10-15% of the human genome is composed of heterochromatic DNAs, these regions are not included in the completed sequence. We are creating a detailed physical map of the centromere and p arm of HC21 as a model for the organization of such regions. In the course of this work we have isolated several new satellite III (sat III) sequences from an HC21-specific library, and have shown that these sequences are located on the short arm of the chromosome. The current project focuses on the sequencing and characterization of the p1-6.8 clone of sat III. This clone contains an estimated 4300 bp of sat III, of which thus far approximately 3080 bp have been sequenced. Because of the highly repetitive nature of the sequence, primer walking could not be easily used in sequence determination. We therefore used the Epicentre EZ::TN <KAN-2> Insertion Kit, where transposons are randomly inserted into the DNA to be sequenced, permitting sequence determination in both directions from the point of insertion. We then properly aligned the sequences by mapping the location of the transposon insertions, using restriction digests with EcoRI and HindIII. The sequence obtained from the transposon system also permitted further sequence to be determined by primer walking. The sequence obtained so far indicates that p1-6.8 is a member of the Group I subfamily of sat III DNA, characterized by a high percentage of the typical 5'-GGAAT-3' repeating monomer, with a much smaller percentage of the 5'-GGAGT-3' variant monomer repeat. The sequence has a highly heterogeneous internal organization with no obvious higher order repeats. BLAST comparisons showed that p1-6.8 has less than 80% sequence identity to any other known sat III sequence in the human genome. Thus, it is

a candidate for an HC21p-specific probe that could be useful in Down syndrome diagnosis and further characterization of HC21p structure.

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12 **MR Microscopy of premalignant pancreatic lesion in a transgenic mouse model of pancreatic cancer**

Daniel Heiferman (Northwestern University), Palamadai N. Venkatasubramanian, Paul Grippo, Alice W. Wyrwicz, Richard Knop

Field: Cancer Detection *Advisors: Alice Wyrwicz, Ph.D*

EL-Kras transgenic mouse pancreata exhibiting premalignant lesions were imaged using magnetic resonance (MR) microscopy and compared to control mouse pancreata. The transgenic and control pancreata were excised from 11-month-old mice and fixed in paraformaldehyde. Using high-resolution 3D imaging with the field strength of 14.1T and a pixel size of 50μm, acinar cells, pancreatic islets and ducts were identified in the normal pancreas. In the T2 weighted images, ductal fluid had the greatest signal intensity, acinar cells had the lowest intensity, and islets were of moderate brightness but could be identified by their circular shape. There was a detectable morphological difference between the two groups. The EL-Kras pancreas showed many lesions with hypointense cores and a bright, jagged-edged rim, while this formation was not found in the control pancreas images. The lesions were verified with histology. This was further characterized quantitatively with T1 and T2 relaxation time measurements. T1 between the two groups were similar in all pancreatic areas; but T2 of the EL-Kras acini was longer than that of the normal acini, while the T2 of the ducts and fluid was shorter in the transgenic pancreas than in the control. Having the ability for noninvasive detection of premalignant lesions can lead to earlier detection and more proactive treatment options for pancreatic cancer in humans.

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13 **The Effects of Inspiratory Resistance on Motion Sickness and Its Hemodynamics**

Michael Jung (Northwestern University), Richard Ha, Dave R. Bush, Don F. Doerr, and Kenneth D. Cohen

Field: Human Biology *Advisor: Kenneth D. Cohen, M.D*

A common source of discomfort for many, the study of motion sickness carries notable importance for the National Aeronautics and Space Administration (NASA) as it is an issue that affects a number of its most important human resources, including its astronauts, aviators, and sailors. A previous study has shown that: (1) cerebral hypoperfusion (reductions in cerebral blood flow velocity) precedes the onset of motion sickness and (2) that inspiratory resistance (resistance to breathing in) is an effective treatment in maintaining cerebral bloodflow. In the initial part of our study we constructed an improved off vertical axis rotation (OVAR) chair in order to collect real-time physiological data on a computer system contained within the chair. After chair construction, we began studying a potential

countermeasure to motion sickness. Our preliminary data collection investigated if the application of resistive breathing through an inspiratory Impedance Threshold DeviceTM (ITD) mitigated motion sickness symptoms through the prevention of motion sickness-induced decreases in cerebral bloodflow. Three males and 3 females susceptible to motion sickness were observed during OVAR while breathing through either an active ITD or control SHAM. Though further studies are necessary for more conclusive findings, the resulting data from this preliminary experiment showed that while the ITD was shown to maintain cerebral bloodflow, it did not appear to significantly mitigate motion sickness symptoms. The findings from this study indicate that reductions in cerebral bloodflow may be a physiological variable correlated with, but not an underlying cause, of motion sickness.

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14 **Project QS**

John Kaldis, Loyola University
Field: Biological Study of Microorganisms *Advisor: Dominic Castignetti, Ph.D*

Project QS is a research project to investigate whether the bacterium Mesorhizobium loti can produce quorum sensors, or QS. Quorum sensors are small molecules that are made by individual bacteria that, when they accumulate to a significant concentration, promote a coordinated response by the entire bacterial population. It is our working hypothesis that M. loti makes QS as a response to a particular, unique metabolism. Our goal is thus to determine if the bacterium makes QS in general, and if so, does it also make QS when invoked to perform the unique metabolism.

We have searched an online program called Genbank to compare M. loti's nucleotide sequence against dozens of other bacteria that are known to make QS, and determined that M. loti has nucleotide and protein homology with many QS protein and nucleotide sequences that are produced by QS synthesizing bacteria. This genomic data of M. loti was collected in two tables that will be presented during the poster presentation of this symposium.

We are currently testing for the production of QS in M. loti through the use of many media that we have used to grow the bacterium. The A. tumefaciens assay is the main assay that we are performing to test for the production of QS in M. loti. The A. tumefaciens assay causes a compound (X-Gal) to turn blue if QS are present, and therefore to form a blue diffuse zone around bacteria that make QS. To date, none of the media used to grow the M. loti have resulted in its producing QS. We are extending our study to include new media and culture conditions to determine if these will induce the M. loti to make QS.

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15 **Expression of Functional Folate Receptor α In a Subset of Multiple Myeloma Patients**

Jungjin Kim (University of Chicago), Zimmerman, T., Alkan, S., Ulaszek, J., Kang, J-H., Doorneweerd, D., Low, P.S., Wickrema, A.
Field: Multiple Myeloma, Cancer, Drug-Targeting *Advisors: Amittha Wickrema, Ph.D and Ying Zhou, Ph.D*

Cellular uptake of folate in humans is mediated by either a cell surface folate receptor (FR) or reduced folate carrier (RFC). RFC is expressed in nearly all cells but FR expression is restricted to certain cell types. Unlike RFC, which utilizes a bidirectional anion exchange mechanism to transport folate, FR after binding folic acid is taken up into cells by receptor-mediated endocytosis. FR expression, especially the α isoform, is highly upregulated in malignant epithelial tumors. Based on these observations folic acid-conjugated therapeutic agents have been developed as target therapies in solid tumors. Data on the expression of folate receptors in hematopoietic malignancies is limited, although in certain myeloid leukemias FR β isoform is up regulated. We examined the expression of FR in bone marrow aspirates obtained from 36 multiple myeloma patients utilizing a polyclonal antibody that detects the α isoform and a fluorochrome-conjugated folate that specifically binds FR. Mononuclear cells obtained from fresh bone marrow samples were analyzed for FRα expression in CD138 positive and CD138 negative fractions by flow cytometry. Fifteen samples (42%) showed FRα expression in greater than 10% of the cells within the CD138-positive population. Only 2 samples (5%) showed no FR expression. Interestingly, many of the samples that showed a high level (>20%) of FRα expression within the CD138-positive population were also FRα positive in the CD138 negative population. CD34 positive early hematopoietic cells and bone marrow mononuclear cells isolated from normal donors did not express FRα. In order to further confirm our findings and to verify that the receptors detected on myeloma cells were functional, we incubated 15 of the myeloma samples with fluorochrome- conjugated folate followed by extensive washing prior to flow cytometry analysis. The results of these experiments showed specific binding, indicating that the receptors were functional. Although further studies need to be performed to precisely define which subsets of myeloma patients express high levels of folate receptors, our observations suggest the possibility for development of FR-targeted therapeutics for treatment of multiple myeloma.

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16 **Costs of intra-specific host sharing in the acanthocephalan parasite Acanthocephalus dirus: effects on body size and reproductive potential**

Darin Kopp, DePaul University

Field: Parisitology *Advisor: Timothy Sparkes, Ph.D*

The acanthocephalan parasite *Acanthocephalus dirus* infects the aquatic isopod, *Caecidotea intermedius*, as an intermediate host and creek chub as a final host. While inside *C. intermedius*, the parasite develops from the egg stage to the cystacanth stage, which is both infective to final hosts and reproductively mature. Since infection of *C. intermedius* often involves multiple *A. dirus* competing for nutrients within the host, the potential exists for intra-specific host sharing to influence energy allocation to both growth and reproduction. We examined whether intra-specific host sharing influenced reproductive potential in *A. dirus* by quantifying variation in body size (volume) and either testes size (volume, males) or ovary production (females). Parasites were recovered from *C. intermedius* that were collected from nature (Buffalo Creek, Kildeer, IL). We found that intra-specific host sharing correlated

with a decrease in body size for both male and female *A. dirus* (host sharing: female n=61, male n=96; no host sharing: female n=67, male n=89). This decrease can be significant because body size correlates positively with the parasite's ability to establish in final hosts. We also found that host sharing correlated with a decrease in testes size for males but did not correlate with variation in ovary production. Thus, it appears that intra-specific host sharing results in gender-specific effects on the reproductive potential of *A. dirus.*

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17 **Visualization of individual mRNA transcripts in single living yeast cells**

Tami Lieberman, Northwestern University
Field: Molecular Biology *Advisor: Jonathan Widom, Ph.D, Dan Grilley, Ph.D*

Traditional studies of gene transcription have been constrained to looking at average number of transcripts per cell within a population, and this can result in misleading or ambiguous conclusions. GAL1, a gene involved in the metabolism of galactose, is a classic example. Early studies showed that on average, GAL1 mRNA was produced in proportion to the concentration of galactose in the surrounding media. Contrastingly, recent work with proteins has shown that the level of expression in GAL1 under certain conditions is binary; expression is either "all on" or "all off." Rather than the amount of mRNA in each cell varying with galactose concentration, it is instead the proportion of cells expressing GAL1 that changes1. While protein studies can be revealing, data collected after translation cannot conclusively portray transcription. We will utilize green fluorescent fusion proteins to directly count the number of mRNA transcripts in individual cells, something that has never been done before in eukaryotes. We have already begun to set up this system, and have successfully visualized individual mRNA transcripts. We will use this system to answer a variety of questions about the transcription regulation.

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18 **Partial Degradation of the Gli protein by the proteasome**

Sean Austin Ong Lim, Northwestern University
Field: Molecular Biology *Advisor: Andreas Matouschek, Ph.D*

The ubiquitin-proteasome system controls various proteins and influences almost every aspect of cellular regulation by degradation. When this system does not function properly, diseases including cancer and neurological disorders may result. The proteasome usually degrades the targeted substrate protein completely, however exceptions in the case of transcription factors, such as mammalian NF-κB, Drosophila Cubitus interruptus (Ci) and its vertebrate homologue Gli3 protein, which are regulated by the proteasome via partial protein degradation. A simple sequence immediately upstream of a tightly folded domain serves as the signal that leads to this specific degradation. In human there are three

homologs of Ci: Gli1, Gli2, and Gli3. Among them, only Gli3 is processed by the proteasome. Following the zinc finger motif in Gli3 is a simple sequence region. We found that the proteasome recognizes the processing signal that is formed by the combination of the simple sequence region and the upstream zinc-finger motif. This leads to partial degradation of Gli3 by the proteasome. However, when Gli1 and Gli2 do not have the simple sequence, the protein is degraded entirely. Adding a simple sequence, such as a glycine rich region after the zinc finger motif allows the processing of Gli1 and Gli2. Stabilizing the zinc finger motif with zinc ion also serves the same purpose. Gli3 is the only Gli member that contains a simple sequence downstream the zinc finger motif. The simple sequence is necessary for partial degradation. Greater stabilization of the zinc finger motif causes further fragment accumulation.

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19 **Lidocaine's Frequency and Voltage Dependent Blockage of Human Cardiac Sodium Channels Expressed in Human Embryonic Kidney (HEK) Cells**

Tinlee Lin, Northwestern University

Field: Molecular Pharmacology and Biological Chemistry *Advisor: Jay Z. Yeh, Ph.D*

As many as 2.2 million Americans are living with atrial fibrillation or arrhythmia. Untreated, this condition can lead to problems such as heart disease, stroke, or even sudden cardiac death. Lidocaine is a synthetic drug used as both a local anesthetic and an antiarrhythmic drug. This drug treats arrhythmia by affecting the cardiac action potential in the heart by blocking cardiac sodium channels. Here I focused on investigating the antiarrythmic properties of the drug. Specifically I studied the frequency-dependent blockage as well as the membrane potential block of human sodium cardiac channels using the whole-cell patch clamp on Human Embryonic Kidney (HEK) cells with stably expressed human sodium cardiac channels. Sodium currents were recorded fromHEK cells perfused both a 10-20% external sodium control solution and the solution containing100 μM lidocaine. It was found that at higher frequencies, lidocaine was indeed much more effective in blocking sodium channel currents. Also, the voltage-dependence of sodium inactivation was shifted towards the hyperpolarizing direction when the channels were exposed to lidocaine. This indicated that less sodium channels were available for opening in the presence of lidocaine. Thus, lidocaine's antiarrythmic effect is related to its frequency dependent and membrane potential blockage properties.

Abstracts

20 Rapid Universal Pathogen Identification with Oligonucleotide Microarrays: *Census, Mechanisms, and Discovery*

Parijata Mackey, University of Chicago
Field: Biology, Genetics, DNA Microarray, Bioinformatics *Advisor: Tom Slezak, Ph.D*

The purpose of this research is to design and implement a series of biosensor chips that can rapidly and accurately identify a wide range of bacterial and viral pathogens. In addition to accuracy, these chips must be robust enough to detect new or mutated viral strains and locate evidence of genetic engineering or antibiotic resistance genes.

The biochips consist of long (70mer) and short (30-50mer) oligonucleotide microarrays. Optimal chip configurations were determined by testing various combinations of melting temperature (Tm), free energy (dG), and mismatch length and location within probes. These probes detect known genes for virulence, antibiotic resistance, genetic engineering, conserved markers for a pathogen family or serotype, and unique markers for a species or strain.

The Census chip is focused on detecting known bacterial and viral pathogens, with probe design based on unique regions in specific pathogen genomes. The Discovery chip aims to detect previously unidentified viral and bacterial pathogens. The probe design for the Discovery chip will utilize conserved regions within viral and bacterial families, which can assist in pathogen classification.

The Mechanisms chip searches for virulence or drug resistance genes and genetic engineering vectors present in the organism. Antibiotic resistance and virulence probes are designed using Hidden Markov Models (HMMs) to locate sequences indicative of virulence or antibiotic resistance; the resulting sequences are labeled with MSET-ID numbers. The Basic Local Alignment Search Tool (BLAST) and KPATH compared MSET-ID sequences to all GenBank and several unpublished sequences, including those of select pathogenic agents. Genetic engineering probes are designed using cloning vector sequences contained in the UniVec database, as well as from commercial sources.

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21 Neural Control of Temperature

Marco Mendez-Duarte, University of Chicago
Field: Neurobiology *Advisor: Peggy Mason, Ph.D*

Typically, as a human female nears the end of her ability to ovulate, menopause begins comes about and physiological changes come occur. Such changes include changes in hormone levels, palpitations, and hot flashes. In our study, we seek to understand the physiology of a hot flash. In previous studies, it has been observed that the thermoneutral zone (TZ) of a female is greatly reduced in symptomatic women, which leads to both a low shivering and sweating threshold (Freedman 2005). Using this information, we propose

to look at controlling the source of the shivering threshold, the nucleus raphe magnus (Hinckel 1987) in the brainstem. Using the rat as a model animal, we propose to find a way to manipulate the thermoneutral zone through manipulation of the raphe magnus (RM). Using both agonist and antagonist drugs we hope to expand and reduce the thermoneutral zone. Subsequently, the next stage will consist of expanding the thermoneutral zone of a perimenopausic female rat.

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22 **Estrogen May Repress GnRH Gene Expression in the Ovary**

Keeley Mui, University of Chicago
Field: Biological Chemistry *Advisor: Peggy Kim, M.D.*

Gonadotropin-releasing hormone (GnRH) is produced in the ovary and can modulate ovarian function. Due to low levels of GnRH expression in the ovary, factors regulating ovarian GnRH gene expression are only beginning to be identified. To identify transcription factors that regulate ovarian GnRH expression, RT-PCR was first performed to confirm the presence of GnRH transcripts in the mouse ovary and in an immortalized mouse ovarian granulosa cell line (KK cells). An appropriate 560 bp band was amplified in the hypothalamus, ovary and KK cells. To identify regions of the mouse GnRH (mGnRH) gene promoter that are critical for mediating GnRH expression in the ovary, transient transfection studies were performed in the KK cells with various fragments of the mGnRH promoter (-2078/+23, -2806/+23, -3446/+23) fused to a luciferase reporter gene. GnRH promoter activity was high in constructs containing 2078 bps of the mGnRH promoter, but low in constructs containing 2806 bps or 3446 bps, suggesting that sequences between -2806 and -2078 bps mediate repression of GnRH in the ovary. Examination of this promoter region revealed a potential estrogen response element (ERE) at -2459 to -2446 bps. Although the sequence does not contain consensus ERE, it has been shown to bind estrogen receptor (ER) and mediate estrogen action. Estrogen has been shown to repress GnRH transcriptional activity in other tissues. RT-PCR demonstrated the presence of both ER-alpha and ER-beta in the mouse ovary and in KK cells. The existence of a potential ERE and the presence of ER-alpha and ER-beta transcripts suggest that estrogen may be a repressor of ovarian GnRH expression. Additional studies are being performed to determine whether the ERE mediates negative regulation of ovarian GnRH.

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23 **Synthetic Evolution of the TTG2 Gene in *Arabidopsis thaliana***

Kara Nordin, Paul R. Zurek, Matt Kolinski, Sam Putman, Loyola University
Field: Molecular Plant Development *Advisor: F. Bryan Pickett, Ph.D*

Under the classical model of duplicate gene evolution it is assumed that the most common outcome of a gene duplication event is the loss of one duplicate to degenerative mutations. In contrast to this hypothesis, research has now shown that new gene retention and gene family expansion are relatively common outcomes of gene duplication. Our

Abstracts

Duplication-Degeneration-Complementation model (DDC model) presents one approach by which genes are likely preserved through accumulation of complementary mutations. However, because many epigenetic processes facilitate mutational change, it is likely that epigenetic changes precede mutational changes. To test this possibility we engineered the Transparent Testa Glabra2 (*ttg2*) gene using the tools of molecular biology to create two synthetic duplicate genes. By inserting these duplicated genes into the genome of the plant *Arabidopsis* we may be able to see the complementary partitioning of expression of the genes to different tissues in the plant. This result would be consistent with the hypothesis that epigenetic regulation of gene activity could pre-adapt duplicate genes for retention by DDC processes. If our hypothesis is correct each of the duplicates will be expressed in distinct subsets of the tissues in which the normal gene is expressed.

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24 **Determining Protein Tyrosine Kinase Activity with Fluorescent Luminex Beads**

Shariska S. Petersen, Ding Wu, Stephen J Kron, University of Chicago
Field: Molecular Genetics and Cell Biology *Advisor: Stephen J. Kron, MD, Ph.D*

Chronic myelogenous leukemia (CML) is due to the expression of the oncoprotein Bcr-Abl. Small molecule inhibitors such as Gleevec (Imatinib meslyate) that target Bcr-Abl have been shown to cause remission in patients but drug selection, primary and acquired resistance and dosage remain challenges. It has been shown that drug resistance can be predicted using an assay to detect protein tyrosine kinase activity and inhibition. Furthermore, this kinase assay can also be used to evaluate drug efficacy easily and non-invasively. However, a significant challenge is to develop a straightforward and robust kinase assay for use in a clinical setting and that is also amendable to the high-throughput format necessary for screening potential small molecule therapeutic agents in drug development. Here, we describe a method in which kinase substrates fused to glutathione-S-transferase and conjugated to Luminex fluorescent microspheres, are phosphorylated, then assayed using Luminex technology to detect kinase activity. It was found that the activity of recombinant abl or Bcr-Abl kinase in cell extract can be detected with sensitivity and specificity. Most importantly, inhibition of kinase activity in recombinant or Bcr-abl cell extracts by Imatinib mesylate can also be detected. This kinase assay, although in its early stages of development has proven to be a robust and straightforward assay making it favorable for clinical settings. A 96-microwell plate is used to conduct multiple assays in one setting thereby rendering it an assay amendable to high-throughput format.

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25 **Identifying Circadian and Homeostatic Sleep Genes in *Drosophila Melanogaster***

Suraj Pradhan, Northwestern University
Field: Molecular Neuroscience *Advisor: Ravi Allada, M.D.*

The circadian and homeostatic components of sleep in the fruit fly, *Drosophila Melanogaster*, are controlled by a distinct set of interactions between specific genes.

Significant progress has been made in elucidating the core mechanism governing circadian sleep-wake rhythms. However, the molecular mechanisms regulating homeostatic sleep remain completely unknown, although intuition dictates that it is similarly regulated. In an effort to shed more light into the interaction between the circadian and homeostatic systems, I designed and implemented stringent statistical analyses to identify rhythmically expressed genes. Using data generated from previous microarray experiments, a gene expression survey was carried out that produced 212 cycling gene candidates from a pool of over 14,000. Upon closer examination of gene ontology, CG17100 was chosen as the best candidate for a circadian or homeostatic gene. The cyclic expression of the gene was verified by using real-time RT-PCR to conduct timepoint experiments. Subsequently, several fly strains with mutant forms of CG17100 were tested molecularly and behaviorally. The molecular results confirmed that two homozygous mutant lines showed dramatically reduced transcript levels of CG17100. The behavioral data proved that this reduction in levels caused a measurable lengthening of circadian rhythm period, while having negligible effect on homeostatic sleep. Therefore, CG17100 is probably a circadian, and not a homeostatic gene. Thus, statistical analysis followed by molecular and behavioral studies can be successfully used to identify circadian or homeostatic sleep genes. Characterization of their molecular interactions will enable us to understand their role in regulating sleep, leading to new insights on treatments for sleep disorders.

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26 **Developmental Regulation of Hippocampal Vulnerability to Injury: Role of Mitochondrial Calcium Homeostasis**

Khalil Qato, University of Chicago

Field: Pediatric Neurology *Advisor: Jeremy D. Marks, M.D., Ph.D*

The vulnerability of the hippocampus to N-methyl-D-aspartate (NMDA)-induced Ca^{2+} overload, a central mechanism of neuronal death following hypoxic-ischemic brain injury, increases markedly during postnatal maturation from the newborn to the adult. However, the mechanisms of this developmental regulation are unclear. A key regulatory mechanism in promoting neuronal death following NMDA is uptake of Ca2+ into neuronal mitochondria, a central mechanism of Ca^{2+} homeostasis. Consequently, understanding how postnatal development modulates the ability of mitochondria to respond to NMDA-induced $[Ca^{2+}]_i$ increases is critical to understand how vulnerability increases during postnatal maturation. The goal of this project is to understand how postnatal development alters the kinetics and magnitude of NMDA-induced $[Ca^{2+}]_{mito}$ increases in postnatal hippocampal neurons of different ages, and to pharmacologically dissect the contribution of the known mitochondrial Ca^{2+} uptake and efflux pathways in this response. Understanding how postnatal development alters mechanisms of mitochondrial Ca^{2+} handling will provide basic insights into the development of Ca^{2+} homeostasis and shed light onto how developmental regulation of hippocampal vulnerability to acute injury is mediated.

Abstracts

27 Manipulation of Molecular Chaperones to Suppress Polyglutamine Aggregation in *C. Elegans*

Michael Schieber, Northwestern University
Field: Molecular Biology, Cell Biology, Genetics *Advisor: Richard Morimoto, Ph.D*

Many neurodegenerative diseases are triggered by the toxicity associated with the misfolding of proteins in a cell. In a major class of neurodegenerative diseases, including Huntington's disease, the mechanism of misfolding is dependent on polyglutamine (polyQ) expansions within a protein. It has been previously demonstrated that reduced levels of the constitutively expressed cytoplasmic HSP70 molecular chaperone, HSP-1, produce an earlier onset of polyQ aggregation in C. elegans. Molecular chaperones, including HSP-1, are required for proper folding and function of many cellular proteins that participate in diverse pathways. Therefore, interfering with chaperone function by expression of aggregation-prone proteins may titrate critical chaperone function, perturbing a wide range of cellular pathways. Through overexpression of HSP-1 in our C. elegans polyQ disease model, we are interested in genetically identifying the proteins and processes requiring HSP-1 activity to maintain protein homeostasis throughout the cell. If HSP-1 overexpression is able to increase the tolerance of a cell to polyQ aggregation, then manipulating chaperone levels could be a possible therapeutic approach for protein misfolding diseases.

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28 Examination of Siderophores as Potential Inhibitors of Anthrax Lethal Factor

Matthew Thomas, Loyola University
Field: Microbiology, Biochemistry *Advisor: Dominic Castignetti, Ph.D*

Anthrax is caused by the bacterium *Bacillus anthracis* and can be treated with readily available antibiotics; treatment with antibiotics is often too late, however, because the bacterium has already released its toxins, one of which is Lethal Toxin (LF). LF, a zinc-metalloprotease, targets the cell's signaling system and sets off a cascade of biochemical events that eventually leads to toxic shock and death. We proposed using a variety of metal-chelating siderophores and monohydroxamates to inhibit LF by binding the zinc ion and therefore making the enzyme less active or even inert. We examined the activity of LF by using a substrate that becomes optically active upon cleavage by the enzyme and therefore can be measured by a spectrophotometer. We were able to observe minor inhibition of the enzyme with the use of some siderophores and had the most significant inhibition using one of the monohydroxamates. Experimentation is continuing and we i

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29 High-Throughput Protein Degradation Assays

Merina Thomas, Northwestern University
Field: Molecular Biology *Advisor: Andreas Matouschek, Ph.D*

Protein degradation is an integral step in several cellular processes, including cell cycle

control, gene expression, antigen presentation, and signal transduction. The unfolding and degradation of proteins is a multistep process. Proteases first bind the protein destined for degradation on the protease chaperone ring where the protein is recognized by its targeting signal. The chaperone ring then unfolds the protein sequentially along its polypeptide chain (from the protein's point of attachment to the protease to the opposite terminus) in a process that requires ATP hydrolysis. The unfolded polypeptide is translocated one amino acid at a time to a central proteolytic chamber where it contacts the proteolytic sites and is degraded rapidly, releasing short peptide fragments. Aberrant degradation is associated with such diseases as Alzheimer's disease, prion disease, and Huntington's disease.

I focused on characterizing selectivity in protein unfolding and destruction by ATP-dependent proteases to determine whether proteases differ in their ability to degrade proteins. I worked to adapt a biochemical protein degradation assay used to measure protease unfolding strength to high throughput automation. The results indicate that the developed methodology decreases experimental error that accrues by pipetting at individual timepoints during the biochemical assay, increases the general ease of experimental operation, and allows an increased throughput, thereby facilitating large scale proteomic studies. Additional high-throughput degradation assay techniques will be developed for future experiments involving the characterization of ATP-dependent proteases.

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30 Calvin Williams, DePaul University
Field: Biological Sciences *Advisor: Margaret Silliker, Ph.D*

Didymium iridis is a member of the Mycetozoa, a group of organisms believed to have diverged early in the history of eukaryotes. Mitochondrial rRNA genes have been used to understand evolutionary relationships, however, the DNA sequence of these genes, in *D.iridis* and other Mycetozoa, are edited during the process of transcription so that the functional rRNA molecules differ from their genomic sequence. RNA editing in the Mycetozoa is very complex; typically cytosine bases are inserted. In this study we determined the editing pattern for most of the large (LSU) and small (SSU) mitochondrial rRNA genes. We wanted to compare the editing pattern to that observed in *Physarum polycephalum*, a related Mycetozoan, to see if it was conserved. Primers were designed from our DNA sequences for reverse transcription and PCR (RT-PCR) to generate cDNA products which were cloned and prepared for sequencing. Clustal W was used to align edited and unedited *D. iridis* sequences and to make comparisons to *P. polycephalum*. In *D. iridis*, C insertions were the major single nucleotide insertions, consisting of 45 insertions in the LSU and 32 insertions in the SSU, over 2601 and 1859 base pairs, respectively. Comparison of RNA editing insertion sites between *D. iridis* and *P. polycephalum* revealed a similar pattern of editing, though none of the actual sites were conserved in LSU between the two organisms. By contrast, a large majority of the SSU insertion sites were shared. The majority of C insertions followed purine-pyrimidine nucleotides. This could be a feature that signals RNA editing machinery. The higher degree of conservation of editing sites in SSU genes could be due to greater constraints on a smaller molecule. When the sequences are complete we plan to fold

the molecules to see if the editing helps to maintain important features of the secondary structure.

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31 **A dolichosaurid lizard, *Coniasaurus* cf. *C. crassidens*, from the Upper Cretaceous Carlile Shale in Russell County, Kansas**

Tracy Ystesund, DePaul University

Field: Paleobiology *Advisor: Kenshu Shimada, Ph.D*

Coniasaurus Owen is a small Late Cretaceous marine lizard. Here, we describe two isolated vertebrae of *C.* cf. *C. crassidens* from the Fairport Chalk Member of the Carlile Shale in west-central Russell County, Kansas. This report constitutes the first proper documentation of *Coniasaurus* from the stratigraphic unit. Whereas *Coniasaurus* has been reported from the Late Cenomanian and Middle Santonian deposits in Kansas, the two vertebrae described here substantiate the presence of the taxon during the early Middle Turonian (ca. 92.1–91.2 Ma), adding a new insight into the paleoecology of the Late Cretaceous Western Interior Sea of North America.

CHEMISTRY

32 New Cyclophanes as Supramolecular Scaffolds

Sarah Bigley, Loyola University
Field: Synthetic Organic Chemistry *Advisor: Daniel P. Becker, Ph.D*

Supramolecular chemistry involves the formation of complex molecular entities that have the capacity to participate in specific molecular recognition of guest molecules. Cyclophanes are molecules comprised of aromatic units with bridging chains that may form cage-like structures. These molecules have applications in molecular and receptor recognition, they are also used as building blocks for organic catalysts. In addition, they can be used in the preparation of crown ethers and cryptands. Other biological and pharmaceutical uses for cyclophanes include muscle relaxant reversal agents by employing their host-guest recognition properties, as modulators of cholesterol metabolism, and as water soluble inhibitors of HIV protease to treat AIDS. The goal of this research is the synthesis and characterization of a novel cyclophane, tribenzo-1,4,7-triazacyclononene, 2, and derivatives thereof.

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33 Synthesis of an MRI Contrast Agent for Zinc Detection

René Boiteau, Northwestern University
Field: Bioinorganic Chemistry *Advisor: Thomas Meade, Ph.D*

Magnetic Resonance Imaging (MRI) is a noninvasive technique for obtaining three dimensional images of the interior of tissues and organisms. Recently, "smart" MRI contrast agents have been developed that respond to specific biological triggers by controlling inner sphere water access to a chelated gadolinium(III) ion. Zinc(II) is the second most common transition metal found in biological systems after iron. It plays an important role in gene expression, cellular mitosis, neural signal transmission, and protein function. However, the regulation and biological pathways of zinc are still poorly understood at the molecular level. We are developing a zinc-activated MR contrast agent that modulates inner sphere water access upon Zn^{2+} binding resulting in a dark to bright signal change. This contrast agent utilizes a di-2-picolylamine (DPA) zinc(II) binding group that has high specificity for zinc at physiological concentrations and is commonly used as a chelator in fluorescent zinc sensors. Zinc-activated MRI contrast agents are well suited for the imaging of areas with high concentrations of free zinc such as neuronal synaptic vesicles and β-islet cells. They will provide a non-invasive method to study zinc(II) in vivo at the molecular level to give us insight into diseases characterized by a disorder in zinc metabolism including epilepsy, Parkinson's and Alzheimer's.

Abstracts

34 Solving the Supply Side Problem of Marine Natural Product Chemistry: A Directed Approach

Brian Chaikind, Northwestern University
Field: Marine Natural Product Chemistry *Advisor: John Hudson, Ph.D*

The world's oceans are a bastion of unexplored chemical diversity, containing thousands of novel secondary metabolites that have the potential to cure disease. The limited supply of these marine natural products, however, is one of the major factors preventing the development of drugs from these biologically active compounds. The structural complexity and natural scarcity of these metabolites makes them difficult to obtain in the scale and at the cost required for drug development programs. This research reviews alternative methods to wild harvest and synthesis for obtaining large supplies of marine natural products for drug development. The reviewed methods include aquaculture, ex situ culture, in situ culture, microbiological techniques, and genetic modification. An illustrative case study of ET-743 examines the utility of each method for overcoming the supply problem. Traditionally, each method is weighed on its own merits and evaluated for its ability to solve the supply issue. However, it is possible to view these methods not as individual strategies for overcoming supply-side problems, but as techniques that can be employed together, in a directed program, to increase the supply of marine natural products. This novel "directed approach" to resolving the supply-side problem of marine natural products provides a clear direction for future research in the field.

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35 Infrared scattering and absorption characteristics of multi-component aerosols

Geralyn Dickey, Shannon McGinty, DePaul University
Field: Physical Chemistry *Advisor: Richard F. Niedziela, Ph.D*

Most aerosols found throughout the atmosphere are made from many different compounds. Knowledge of their size, shape, and optical properties is important with regard to understanding the chemistry they participate in and how they interact with electromagnetic radiation. Our laboratory has been involved in developing methods to determine such properties based on the analysis of infrared extinction spectra of model multi-component aerosols. In this presentation, we report the results of a study on the applicability of refractive index mixing rules to two-component liquid organic aerosols in an effort to yield in situ measurements of particle size and composition. We also report on the optical characteristics of aerosols made from two immiscible liquid substances, namely oleic acid and water. In this case, we retrieve information on particle size and coat thickness directly from aerosol extinction spectra.

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36 An NMR Investigation of Coffee Staling

Benjamin Farah, Northwestern University
Field: Food Chemistry, Analytical Chemistry *Advisor: Shelby Hatch, Ph.D*

An investigation of the chemical changes that occur when ordinary coffee is brewed was undertaken. Samples of coffee were examined at various times in the brewing process, using NMR spectroscopy. A large decrease in the integration of a peak with a chemical shift of δ 2.15 was observed. The methylpyridines, known coffee flavor molecules, absorb in this region. Thus, this suggests that methylpyridines are partly responsible for the flavor changes that accompany extended brewing.

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37 Practical, Efficient, and Scalable Preparation of Amino Acids

Hyun Beom Lee, Illinois Institute of Technology
Field: Organic Synthesis *Advisor: Hyun-soon Chong, Ph.D*

Radioimmunotherapy (RIT) is proven to be an effective modality of cancer treatment. Tumor-targeting monoclonal antibodies (mAbs) have been employed for selective delivery of cytotoxic radionuclide only into tumor cells without affecting healthy cells in RIT. The development of the adequate ligands to effectively hold radionuclides after being conjugated with mAbs is a critical step for enhancing the efficacy of RIT. The new type of ligand possessing both a macrocyclic cavity and an acyclic pendant binding group has been designed. The hypothesis based on the design of the new ligands is that the bimodal binding using both a macrocyclic cavity and an acyclic pendant donor groups may provide enhanced kinetics in metal complexation while maintaining a high level of complex stability. The structually new ligand NETA was reported to bind several promising radionuclides for RIT with excellent kinetics, and in vitro and in vivo stability. To evaluate the effect of alkyl spacer between NETA and the reactive site for conjugation to antibody on metal binding, we have designed two NETA analogues having a functional group, p-NCS. We report our effort to synthesize precursor molecules of the bifunctional ligands in a large quantity.

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38 Peptide-bridged MRI contrast agent for the detection of Matrix Metalloproteinase-7

Dana Liu, Northwestern University
Field: Synthetic Chemistry and Biochemistry *Advisor: Thomas Meade, Ph.D*

Matrix metalloproteinases (MMPs) are a family enzymes that mediate the breakdown of connective tissues. Overexpression of these enzymes has been linked to several degenerative diseases including cancer invasion, and tumor metastasis. The detection of MMP activity is critical for identifying metastatic cancer and could be used to monitor and optimize the proficiency of anti-cancer therapeutic protocols. Current methods of detecting MMP activity have been limited to ex vivo assays on excised tissues or fluid samples and in

vivo fluorescence analysis that are restricted to the observation of cells and tumors near the surface of the skin due to limited light penetration. Alternatively, magnetic resonance imaging (MRI) allows for the noninvasive imaging of opaque organisms in three dimensions at millimeter resolution. MRI contrast agents help distinguish between diseased and normal tissue through its interactions with varying water proton concentrations in different tissues.

The goal of this project is to synthesize a contrast agent that can specifically detect MMP-7 activity. The target molecule consists of a seven amino acid peptide with the consensus sequence, P-L-K-L-K-A-W, that bridges over a metal-coordinating macrocycle. In the presence of MMP-7, the agent is proposed to be enzymatically cleaved between the lysine-leucine (K-L) peptide bond. Upon cleavage, the exposed metal chelate will have an increase in the number of coordinated water molecules, creating an increased signal on the MR image. The peptide was synthesized using solid phase synthesis, and a macrocyclic chelator was synthesized and coupled to the peptide. Characterization of the molecule was performed using ESI-MS, ^{13}C-NMR, ^{1}H-NMR, and HPLC. Future work includes the metallation of the bridged compound with various lanthanide ions, the structural and chemical analysis of the compound to determine its efficacy as a MRI contrast agent, and enzyme studies to establish how effectively the agent is cleaved by MMP-7.

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39 **Generation of New Synthetic Ligand for Targeted MRI**

Joshua Marell, Vinu Mohan, Illinois Institute of Technology
Field: Organic Chemistry *Advisor: Hyun-soon Chong, Ph.D*

Magnetic resonance imaging (MRI), a non-invasive and high resolution imaging technique has become a powerful tool in diagnostic medicine. The lanthanide Gd(III) is known to be an optimal paramagnetic metal for MRI due to high electronic spin (7/2) and slow electronic relaxation rate. Free Gd(III), however, is toxic with severe side effects. Thus, organic molecule is used to chelate Gd(III) producing a safe MRI contrast agent. A number of Gd(III) complexes such as Gd(DOTA) are clinically approved for use in MRI. However, most contrast agents have non-specific extracellular distribution and the disadvantages of low relaxivity, low tissue specificity, and rapid clearance. We have recently prepared a heptadentate chelator, NE3TA for use in MRI. At clinically relevant field strength (60 MHz), the relaxivity of Gd(NE3TA) is comparable to that of the clinically used contrast agent. With the promising result, we have designed folic acid containing NE3TA for targeted MRI. Herein, we present the progress we have made on this project.

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40 New Motifs in Antimicrobial Peptoids

Tyler Miller, Northwestern University
Field: Biochemistry, Peptidomimetics, Drug Development Advisor: Annelise Barron, Ph.D

Drug-resistant strains of microbes currently pose a troubling threat to our ability to treat infectious diseases. Antimicrobial peptides (AMPs) are a naturally occurring and ubiquitous class of proteins that kill microbes by disrupting or permeating cellular membranes. Unlike conventional antimicrobials, AMPs are unlikely to allow the development of drug resistance because of their generalized mechanism of cell death. Furthermore, because AMPs are able to selectively kill a broad spectrum of microorganisms while not harming human cells, biomedical researchers are increasingly regarding AMPs as interesting lead compounds for the development of complements to conventional antimicrobial therapies. Despite these favorable properties, however, AMPs have yet to see widespread clinical use because they suffer from vulnerability to rapid proteolysis, potential immunogenicity, and poor metabolic stability in vivo. To circumvent the shortcomings of natural AMPs, we have been developing non-natural, biomimetic analogs of these peptides based on peptoids (oligo-N-substituted glycines). Unlike AMPs, peptoids have been shown to be protease-resistant, thereby increasing bioavailability, and their non-natural architecture may impart reduced immunogenicity in comparison to peptide analogs.

Previous generations of antimicrobial peptoids have been successfully selective and potent with low-μM MICs. Here, we report a new generation, incorporating new structural motifs commonly found in natural AMPs into already selective and potent peptoids. Two motifs examined have been the incorporation of a central kink in the a-helical structure and the attachment of N-terminal alkyl chain monomers with various lengths ranging from 5-13 carbons. In both cases, the selectivity of the compounds has been improved without any decrease in antibacterial potency. Additionally, alkylation has allowed us to make potent antibacterial compounds consisting of only four peptoid residues. Interestingly, unlike previous compounds which range from 12-16 residues in length and have a well-defined helical structure, these novel ultra-short peptoids lack a well defined secondary structure, yet are still functionally active.

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41 Synthesis of a Polymer-based Cancer Cell Diagnostic Probe for MR Imaging

Sarah Moum, Paul Endres, Northwestern University
Field: Inorganic Chemistry, Biology Advisor: Thomas Meade, Ph.D

Coupled with FDA approved, image enhancing contrast agents, magnetic resonance imaging (MRI) is an extremely powerful, noninvasive imaging technique that gives both researchers and clinicians the ability to inspect an organism's physiology in the temporal domain. As a result, a complete series of high-resolution three-dimensional MR images can be analyzed forward or backward in time to reconstruct cell divisions and movements. However, a barrier to the development of new contrast agents is the inability of these

complexes to cross cell membranes. Therefore, modified contrast agents with the ability to transduce cellular membranes will drastically enhance our understanding of normal and diseased cellular processes. This project involves the synthesis of a polymer-based cancer diagnostic probe that will surpass current clinical contrast agent limitations. The contrast agent will be built upon a norbornene monomer scaffold that will make the molecule susceptible to ring opening metathesis polymerization (ROMP). This chemistry will provide a highly customizable system for the preparation of high relaxivity contrast agents with enhanced image resolution. Block A of the diagnostic polymer will contain a norbornene monomer attached to arginine octomers. This block will function as a delivery vehicle to transduce cellular membranes. Block B of the polymer will be a norbornene monomer functionalized with commercially available contrast agents (e.g. Gd-DOTA or Gd-DTPA). Block C will be a norbornene monomer coupled to a domain of the anticancer drug Bleomycin, specifically the disaccharide functionality. This moiety was chosen because it provides the diagnostic polymer with cancer cell surface binding and recognition. The development and use of this diagnostic polymer will provide insights into the interrelated problems of developmental biology and clinical disease by generating an MR probe that will function as a real-time in vivo reporter that tracks gene expression and correlates this information with developmental events.

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42 **Montmorillonite K10 Clay-Catalyzed Allylsilation of Benzaldehydes**

Massimo Pacilli, Dominic J. Pileggi, Matthew M. Zuziak, DePaul University
Field: Organic Chemistry *Advisor: Matthew R. Dintzer, Ph.D*

Heat activated Montmorillonite K10 clay was found to catalyze the addition of allyltrimethylsilane to benzaldehyde derivatives to give the corresponding homoallylic silyl ether products in good yields. The electron deficient benzaldehydes, especially the nitro-benzaldehydes, were found to be the most reactive and selective substrates for this reaction.

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43 **Pair Correlation Function in Narrow Grooves**

Ream Qato, Sergey Novikov, Sebastian Villarreal, T.R. Stratton, Binhua Lin, Stuart Rice, DePaul University
Field: Physical Chemistry *Advisor: Binhua Lin, Ph.D*

We are investigating a colloid fluid constrained in narrow hard-wall grooves of varying widths in order to study the effects of spatial confinement on the properties of the hard-sphere fluid. We have been using this system to study the structural transition between quasi-one- and quasi-two-dimensional confinement. Our observations show that a narrow groove generates stratification in a dense colloid liquid. In this poster, we show the calculation of the pair correlation function, g(r), both along those strata and in the groove as a function of the concentration of the colloid fluid and the width of the groove.

44 An in silico strategy for the characterization of DNA sequences flanking the 1,000-member SIRE1 retroelement family in soybean

Ellen Rebman, Meg Garland, Khanh Nguyen, Loyola University
Field: Biochemistry *Advisor: Howard Laten, Ph.D*

We have devised an in silico protocol for collecting and analyzing the DNA flanking repetitive transposable element insertions using raw unannotated genomic sequences from incompletely sequenced genomes. Specifically, we have collected sequences flanking over 1,000 members of a retroelement family in the soybean genome using a database of primarily BAC-end sequences (Genome Survey Sequence Database) to ascertain the nature of insertion site selection. Despite its high copy number, the SIRE1 element is found in a very small number of fully sequenced genomic contigs that have been deposited in Genbank. The flanking sequences are recovered by performing BLASTn searches using the terminal 150 base pairs at the 5' and 3' ends of one of the members of the SIRE1 retroelement family. Because the ends of retroelements are composed of long terminal repeats (LTRs), this strategy also generates hits to DNA within SIRE1. A scheme was devised to easily distinguish these hits from truly flanking DNA. Hits from the Genbank database containing sequences upstream of the 5' end and downstream of the 3' end were collected, trimmed, and used to query the Genbank and Repbase databases to determine 1) their copy numbers, 2) their similarity to known DNAs, 3) their coding potential, and 4) location within the genome (if known). The results indicate that SIRE1 copies are most often inserted into other repetitive DNAs in the soybean genome, including retrotransposons, DNA transposons, and satellite sequences.

45 Hydroquinine-based Chiral Ionic Liquids

Claire M. Schmerberg, So-Hye Cho, and SonBinh T. Nguyen, Northwestern University
Field: Green Chemistry and Asymmetric Catalysis *Advisor: SonBinh T. Nguyen, Ph.D*

Much current research in chemistry is in the areas of green chemistry and asymmetric catalysis. Green chemistry attempts to conduct chemical reactions with the highest efficiency and lowest waste possible. Asymmetric catalysis attempts to selectively create chiral compounds from achiral ones. The goals of these two fields are similar, and in this paper, we combine them to create green compounds that may be useful in asymmetric catalysis. The synthesis of four compounds that can be used as chiral solvent media for asymmetric catalysis is reported. These compounds fall into the family of chiral ionic liquids (CILs) and are synthesized via amine quarternization and anion exchange reactions with good yield. These CILs may allow for easier catalyst recycling and enantioselectivity induction in asymmetric catalysis. In addition, the starting material for their synthesis is a naturally occurring compound and therefore a renewable carbon source.

Abstracts

46 Increase in Permeability of Lipid Vesicles Induced by Antimicrobial Peptide Protegrin-1

Ting Ann Siaw (University of Chicago), Kin Lok Lam,Yuji Ishitsuka, Alan J. Waring, Robert I. Lehrer and Ka Yee C. Lee

Field: Chemistry *Advisor: Ka Yee C. Lee, Ph.D*

Protegrin-1 (PG-1), a cationic antimicrobial peptide, kills bacteria by causing an increase in membrane permeability to ions or larger molecules. It has been suggested that PG-1 selectivity originates from the difference in lipid composition between membranes. The outer leaflet of the eukaryotic lipid bilayer consists mainly of zwitterionic phosphatidylcholine (PC). On the other hand, prokaryotic membranes contain substantial amounts of anionic phospholipids such as phosphatidylglycerol (PG). Earlier monolayer studies showed a more favorable insertion of PG-1 into 1-Palmitoyl-1-Oleoyl-sn-Glycero-3-[Phospho-rac-(1-glycerol)] (POPG) compared to 1-Palmitoyl-2-Oleoyl-sn-Glycero-3-Phosphocholine (POPC). In order to determine if such a trend can be observed in bilayers, we employ a fluorescence leakage study. Addition of PG-1 causes an increase in fluorescence intensity indicating leakage of Calcein dye. The timescale of leakage is shorter with higher concentrations of PG-1. This indicates that the dynamics of vesicle leakage has a dependence on the concentration of PG-1. The POPC:POPG (7:3) system showed a shorter timescale of leakage with the same amount of PG-1 used in the POPC system. The results from our fluorescence leakage study seem to agree with the monolayer study.

47 Synthesis of Fluorescent DNA-modified Polymer Nanoparticles for use in a Highly Sensitive DNA Detection Assay

Sharan Srinivasan, Northwestern University

Field: Biochemistry, Biomedicine *Advisor: SonBhin Nguyen, Ph.D*

DNA-modified amphiphillic polymer nanoparticles (PNPs) were formed from block-copolymers consisting of a block containing pendant hydrophilic polyethylene glycol tosylate (PEG OTs) groups and a hydrophobic block with pendant terthiophene (TTT) groups. Norbornene based monomers with the aforementioned hydrophobic and hydrophilic groups were synthesized and various block copolymers were prepared via ring-opening metathesis polymerization (ROMP). Using these block copolymers, particles were formed by slow addition of water to a dilute polymer solution up to the critical water content (CWC), as determined by Static Light Scattering (SLS). After reaching the CWC, the particle solution underwent dialysis to achieve an aqueous PNP solution. The resulting PNPs were characterized using Dynamic Light Scattering (DLS) and Transmission Electron Microscopy (TEM) to determine size, shape, and polydispersity. Subsequent functionalization of these PNPs with DNA oligonucleotides allows them to be used in a three-strand DNA detection system. Gold Nanoparticles (GNPs) functionalized with complementary DNA strands were

then hybridized to these PNPs to verify the proper functionalization results. Detection methods utilize the fluorescent and electrochemical properties of the terthiophene block of the copolymer. These methods include the use of fluorometry and cyclic voltammetry.

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48 **Impact Triggered Fires at the End-Pleistocene**

Adrienne Stich, DePaul University
Field: Geochemistry *Advisor: Wendy Wolbach, Ph.D*

The End-Pleistocene refers to a time period roughly 13,000 years ago that witnessed the extinction of over 30 species including the woolly mammoth. Previous studies have found traces of extraterrestrial material from a possible impact that blanketed the Earth with debris at the End-Pleistocene. Analysis of rocks taken from the End-Pleistocene period suggests only local fires that may or may not have been triggered by the impact.

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49 **Progress towards the total synthesis of the Penarolide sulfate A_1**

Christine Toh, University of Illinois at Chicago
Field: Organic Chemistry *Advisor: Duncan J. Wardrop, Ph.D*

Glucosidase inhibitors have a profound effect on glycoprotein processing, oligosaccharide metabolism, and cell-cell and cell-virus recognition processes. Consequently, there is much interest in the identification and synthesis of potent members of this class since they have considerable therapeutic potential. Isolated from a marine sponge collected in the waters off Hachijo-jima island, Penarolide sulfate A1 is a potent inhibitor of α-glucosidase (IC50 = 1.2 μg/mL). Our progress toward the total synthesis of this unique, 30-membered trisulfated macrocycle will be presented.

Abstracts

ENGINEERING

50 **Towards the Fundamental Limits of Optical Detection: An Exploration of Noise**

Prem Ghandi, Northwestern University
Field: Fiber Optic Communications *Advisors: Prem Kumar, Ph.D, Oo-Kaw Lim, Ph.D*

The presence of noise makes any measurement of weak optical signals a big technical challenge in the field of optical communications. Although a key goal of any measurement is to minimize the noise level, certain noise processes such as Johnson noise and shot noise are unavoidable in a real system. Johnson noise arises from the thermal excitation of electrons causing tiny voltage fluctuations across the electrical components. On the other hand, shot noise is caused by the random arrival of discrete particles such as electrons and photons. Such phenomenon can be observed in a photodetector where photons arrive in a Poissonian fashion. Due to its intrinsic particle origin, shot noise is known to be the fundamental limitation of any optical measurements. Hence, any detection of light that is limited only by shot noise represents the optimal achievable optical measurement. In this project, we employed two optical measurement techniques to study shot noise: direct detection and homodyne detection. Direct detection of the noise with a single detector was shown to be limited for optical intensity noise measurements. On the contrary, homodyne detection that utilizes a pair of identical photodetectors and a strong local oscillator represents a powerful measurement technique that is capable of detecting shot noise in different quadratures of light such as amplitude and phase.

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51 **Assisting Stroke Survivors in Donning an AFO + Shoe**

Maureen Gilmour, Northwestern University
Field: Mechanical Engineering *Advisor: Stacy Benjamin, M.S.*

Our Engineering Design and Communications team was charged with the task of designing a device to assist stroke survivors in donning an Ankle Foot Orthosis and shoe. Stroke survivors experience partial paralysis in one side of their body subsequent to suffering the stroke, and as a result struggle completing daily tasks like putting on their shoes.

Our design, the Ankle-Mate, is a two-piece strap that secures the weak leg in position over the strong knee. The user attaches one end of the strap to a post, such as the arm of the wheelchair or bedpost, near his knee. The first time the device is used, the user may need assistance in securing the strap to the post. To secure the second strap to the post strap, the user clips an attached carabiner to the D ring in the post strap.

The user crosses their weak leg over their strong knee as they did before to don their shoes, but now connects the ankle strap to their weak ankle, securing it to the wheelchair arm. The Ankle-Mate can also be used to help strap the AFO onto the ankle, provided that the user is able to Velcro one strap on the AFO.

The Ankle-Mate is inexpensive, extremely portable, and easy to use. Although the design incorporates a variety of features, the overall use of the Ankle-Mate is straightforward. Furthermore, the anchor is adjustable to various sizes. Adjustment of the device requires a full function in both hands, and therefore the users need assistance completing the adjustment during first time use.

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52 **Reengineering the "Nature" of Chicago's Water Cycle for the 22nd Century**

Julia Hand, Caitlin Feehan, Jennifer Raber, Sitizuraidah "Aida" Abidin, Northwestern University

Field: Civil and Environmental Engineering *Advisor: Kimberly Gray, Ph.D*

By 2107 oil production among all nations will have peaked and we will have generated renewable energy alternatives. Unlike oil, however, there is no alternative to water; in order to conserve and effectively manage Chicago's water supply we must change our methods of use. In the past, civil engineers transformed cities to make them livable. Now the task at hand involves long-term planning to transform existing habitable communities into self-sufficient and sustainable entities. Our reengineered "natural" system utilizes coupled cycles of reuse and renewable energy resources, thereby creating a closed ecological system that promotes sustainability.

The guiding principles of Chicago's water system in the 22nd century adhere to the ideology of sustainable design, reduced and renewable water and energy supply, and biomimicry. Our design team has created a highly integrated, decentralized, closed-loop water system that is capable of handling the projected water demands of the Chicago proper in 2107. Current trends indicate that Chicago's population will increase to 5.01 million people in 2107, far exceeding the present infrastructure's capabilities and rising per capita water demands.

Today, Chicago treats more than one billion gallons per day in order to serve the metropolitan region. The total amount of water currently supplied to each sector far exceeds the potable requirement. Our design is tailored to the advanced treatment of only the potable fraction. Thus, future freshwater withdrawals from Lake Michigan will be significantly diminished.

According to our water demand forecast, the total amount of potable water in 2100 will be reduced by 23.6% relative to 2000. A flow of 353.5 MGD will be treated by a series of membranes and UV disinfection; sensors will provide assurance for high quality. To supply the remaining portion of nonpotable water, we designed a dual water system to recycle grey water, which after its use will be sent to the wastewater treatment system

We have slightly modified UrbanLab's "Living Machine" wastewater treatment design. We have replaced the anaerobic and aerobic systems with a series of microbial fuel cells

(MFC) which recover energy in the form of electricity from the oxidation of organic material. Water is disinfected by UV after the MFC. Nutrients are recovered in the hydroponic system expanding urban micro-farming and local production of agricultural products. The treated effluent is then discharged to eco-boulevards. This wastewater flow provides baseline conditions resulting in a two week detention time for final polishing before the ultimate return of high quality water back to Lake Michigan.

Stormwater is also routed directly to the eco-boulevards but at diminished volumes since green roofs and cisterns capture and store a portion of the stormwater. Using a 100 year design storm, the eco-boulevards will store maximum flow. We have engineered attached benthic microbial communities in wetlands to provide nutrient uptake at high rates under these varying hydraulic and temperature conditions.

We have taken UrbanLab's concept of ecologically sound urban design a step further to show the benefits of intense water reuse and energy efficiency, as well as energy production and resource recovery.

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53 **LEAP microanalysis of 50Ni-38Ti-4Al-8Zr shape memory alloy**

Derek Hsen Dai Hsu, Northwestern University
Field: Materials Science and Engineering *Advisors: Gregory B. Olson, ScD, Matthew Bender*

NiTi shape memory alloys are often used to make cardiovascular stents. This application requires these alloys to have high output strength during martensitic transformation, high radiopacity, and long fatigue life. Alloy additions of Al, Zr, and Pt are combined with NiTi to improve these properties. In this study, the chosen method of strengthening these alloys is nanodispersion precipitation hardening. The alloy composition of 50Ni-38Ti-4Al-8Zr is of interest because its microstructure consists of Ni_2TiAl precipitates ($L2_1$ Heusler structure) in a NiTi matrix (B2 structure). Samples of this alloy were solution-treated at 950°C, and then heated at 600°C to form precipitates. The evolution of precipitate size and composition as a function of time was determined using the Local Electrode Atom Probe (LEAP). The average precipitate diameter increased with time: 1 nm, 4 nm, 5 nm, and 7 nm corresponded to 1, 3, 20, and 100 hours at 600°C. The maximum hardness value was measured to be 1738 MPa at 20 hours of heat-treatment by using the Vickers Hardness (VHN) Test. The LEAP was also used to measure the overall alloy composition and the $L2_1$ and B2 phase fractions of the sample heated for 100 hours. These LEAP compositional data are plotted as a tie line on the Ni-(Ti+Zr)-Al ternary phase diagram. Future design of alloys will be based upon compositions along this tie line.

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54 Smaller Olfactory Glomerular Sizes in Connexin 36 knock out mice implicates importance of connexin 36 in olfactory sensation

Winmin Htut, Illinois Institute of Technology
Field: Chemical Engineering, Biology *Advisor: Chunbo Zhang, Ph.D*

Sense of smell plays an important role in influencing our quality of life. Detection of odorants is mediated by the olfactory system. When we identify an odor, olfactory glomeruli in the olfactory bulb form an activation pattern specific to the odor. It is known that the sizes of olfactory glomeruli are activity-dependent. Here, we hypothesize that connexin 36, a neuronal gap junction protein subunit, are important for odor sensation. We study whether elimination of connexin 36 by gene-targeting method affect olfactory activity by comparing the glomerular sizes between heterozygous connexin 36 knock out (KO36-/+) and homozygous (KO36-/-) mice. Our data suggest that average sizes of olfactory glomeruli are reduces in several regions in KO36-/-. Further, it appears that KO36-/- has less glomeruli compared to KO36-/+. Our data suggest a possibility that connexin 36 is involved in olfactory sensation.

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55 Opinion Mining and Visualization

Minseung Kim, Illinois Institute of Technology
Field: Opinion Mining and Visualization *Advisor: Shlomo Argamon, Ph.D*

Recently, analyzing opinionated or evaluative text, as opposed to directly informative text, has been an interesting topic at the crossroads of information retrieval and computational linguistics. In that area, called 'sentiment analysis', several researches have been attempted regarding with setting up fundamental components of the analysis, but also discovering the relationship between components and the sentiment expressed in a text, that is, finding a pattern. 'Appraisal expressions' such as "I am so thrilled that I win a prize." or "The movie was quite boring" are the basic elements that we have defined for analyzing what attitudes are expressed in a text. To extract and characterize those attitudes are main tasks of our research. Each appraisal expression is categorized through the lexicon of appraising and modifiers that is built using semi-automated method. We have already mined movie reviews based on these techniques, reporting remarkable accuracy of 78%. Now, we have been struggling with detecting patterns from various kinds of online news sources: New York Times, Fox News, Washington Post, Aljazeera, and CNN. Along with analyzing data mining results from them, we have been making visualization of our appraisal extractor using Treemap interface from HCIL at UMCP in order to find some interesting facts that are hardly captured in the way of automated mining. For example, different newspapers might contain their own editorial policy for the same target like 'Al-Qaeda', and may be found through these techniques. We will present up-to-date images of the visualizations that we find.

Abstracts

56 **Bio-Inspired Flight: Simulating the High Lift Produced by Insect Wings**

Crystal R. Lybolt, Illinois Institute of Technology
Field: Aerospace *Advisor: David Williams, Ph.D*

My research attempts to mimic the flow conditions used by birds and insects to obtain high lift. This is different than the lift developed by conventional aircraft, and is more efficient at low flight speeds. In fact, it is known that bumble bees could not fly if they had to rely on the lift producing mechanisms used by a standard wing. This research is part of the MURI (Multidisciplinary University Research Initiative) and is being conducted collaboratively between the California Institute of Technology, Princeton University, Northeastern University, and Illinois Institute of Technology. The purpose of this research is to simulate bio-inspired flight by creating a stable leading edge vortex (LEV.) Without the LEV, insects could not fly. The LEV provides high amounts of lift at high angles of attack, but is unstable and tends to be swept away by the flow. The stability of the LEV in insect flight has been attributed to a spanwise axial flow of vorticity towards the wing tip, similar to the flow generated on delta wing aircraft.

Previous research at IIT has shown that open-loop control systems with unsteady mass injection can control flow separation. Air was injected from valves located along the leading edge of the wing, which greatly affected the airflow. We are now attempting to use a closed-loop control system to achieve the stable LEV observed during insect flight. During the summer of 2006, I participated in these experiments, and learned techniques of data acquisition. The primary forms of data acquisition that I have dealt with include force and torque measurements from the force transducer, hot-wire anemometry, smoke wire visualization, and DPIV (Digital Particle Image Velocimetry).

A future biomorphic flyer would be able to achieve the low cruise speed, agility, propulsive efficiency, and sensor-based control that insects are endowed with. After completing the control system, we will demonstrate perch-type landing maneuvers in a wind tunnel using the active flow control wing. I will therefore pursue my primary objective of studying the flow field physics associated with small bird and insect flight.

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57 **Skin Friction Measurement using Oil Film Interferometry**

Minaz Virani, Brian Neiswander, Illinois Institute of Technology
Field: Fluid Mechanics *Advisor: Candace Wark, Ph.D*

As a result of the no-slip condition, fluid velocity at fluid-surface interfaces must be equivalent to the surface velocity. This condition gives rise to viscous shear stresses, or skin friction, on all surfaces within a flow. Determination of skin friction is essential in many fluids experiments in order to understand more complicated phenomena. Ideally, skin friction can be found from conservation equations, but in some situations with turbulent flows this approach no longer provides acceptable accuracy. Consequently,

superior techniques have been developed over the past two decades. This research investigates the use of oil-film interferometry to find such shear stresses on a wind tunnel floor within a turbulent boundary layer. The method entails placing small drop of silicon oil on a surface inside the wind tunnel. With a free stream flow, the shear stress on the oil's surface causes it to thin out in the flow direction. When carefully illuminated by a monochromatic light source, Fizeau fringes become visible within the oil and invariably change with time. Single images of these fringes are captured with a video camera at some time interval. Measuring the distance between each fringe at every time interval and correlating it with known parameters yields the time-dependent thickness of the oil film. These results in conjunction with the thin oil-film equation reveal the value for the shear stress on the surface.

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58 **A Novel Affibody-Alexa Fluor Fluorescent Probe For In Vivo Imaging of HER2 Receptors**

Heather Selby, Illinois Institute of Technology
Field: Biomedical Engineering *Advisor: Jacek Capala, Ph.D*

HER2 over expression is used as a marker associated with a poor patient prognosis and resistance to hormonal therapy. To identify the patients suitable for targeted therapy aimed at the receptors and provide means to monitor the immediate response (receptor down-regulation), we are developing molecular probes for in vivo imaging of HER2 receptors. The goal is to provide probes that will minimally interfere with the studied system, i.e. whose binding does not interfere with the binding of the therapeutic agents, and whose effect on the target cells is minimal. As a targeting agent we use Affibody® molecules (for detailed description of Affibody® molecules visit the web site of our industry partner: http://www.affibody.com). Affibody® molecules were conjugated to Alexa Fluor® molecules 680 and 750 dye in its C-terminal Cysteine using maleimide chemistry. SK-BR-3 cells, human breast cancer cell line, were incubated with the conjugates, and examined under a confocal microscope. The specificity of a novel Affibody-Alexa Fluor® fluorescent optical probe in the detection of HER2 receptors was assessed using near infrared optical imaging. In vivo imaging was performed on mice with subcutaneous SK-BR-3 tumors, and the specificity of binding was addressed. After completion of in vivo biodistribution studies, we are planning to use our probe to monitor down regulation of HER2 receptors following treatment with Herceptin®. Taken together, Affibody-Alexa® Fluor conjugates may be used as a specific near infrared probe for non-invasive imaging of HER2 expression and monitoring of responses to molecularly targeted therapy.

Abstracts

59 **Procoagulant Microparticles and Their Role in Thrombosis on Biomaterials**

Michael Turturro (Illinois Institute of Technology), S. Patchipulusu, D. Crandall, S. Chacko
Field: Biomedical Engineering *Advisor: Connie Hall, Ph.D*

Microparticles are membrane vesicles that are released from various blood and vascular cells upon activation or during apoptosis. In healthy individuals, microparticles are typically found in relatively low numbers. Studies have shown that the quantity of microparticles tends to increase in certain disease states such as myocardial infarction or Diabetes. Microparticle populations have been shown to contain active membrane-bound proteins, such as tissue factor (TF). In its active state, TF initiates blood coagulation, resulting in a fibrin clot. Previous work has indirectly demonstrated the ability of microparticles to bind to artificial surfaces and support fibrin deposition. This suggests that microparticles are involved in the eventual failure of all cardiovascular devices. Current efforts are directed at further understanding the specific role of microparticles in biomaterial thrombogenesis through direct visualization using multi-labeling fluorescent microscopy. Microparticles derived from both human monocytes and an immortalized monocytic cell line were labeled for TF, combined with stained platelets and introduced to a transparent artificial surface (glass and polystyrene) under flow. Following a one-hour perfusion, the surfaces were removed and examined. Preliminary results suggest that microparticles are incorporated into growing thrombi via platelet interactions. Continued work is directed at further characterizing the specific receptor-ligand complexes that facilitate both the platelet/microparticle interactions as well as the microparticle/surface interactions. Lastly, efforts are also directed at developing a technique for real time visualization of thrombus formation on both transparent and opaque surfaces for a whole blood system containing microparticles.

MATHEMATICS AND ECONOMICS

60 Exploring a Paradise in the Desert of the Middle East: Progressive Strategies for Economic Development in Dubai

HongJu Lee, Northwestern University
Field: Marketing and Public Relations *Advisor: Mónica Russel y Rodríguez, Ph.D*

Despite the economic volatility of the Middle East, Dubai City is now emerging as the fastest growing city in the world. Dubai authorities play a critical role in the economic growth of the area by encouraging both tourists and investors from all over the world. Authorities' goals are to develop world-class facilities for the city: the indoor 'skiing in the desert' facility, the luxury "seven star" hotel on the Dubai coastline, the world's largest man-made island, and the world's tallest building (2,651 ft) are only a few examples of the extraordinary progress they have already achieved. The purpose of this study is to look into Dubai's economic development directed by Prime Minister Sheikh Mohammed (who is also the vice-president of the United Arab Emirates), and to explore the city's strategic approach not only to stimulating the economy but also to providing luxurious attractions for the whole world to enjoy.

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61 Comparative Visualization of Soft Tissue Pure Patches in 3D Space

Carl Philips, Stephanie Valencia, DePaul University
Field: Visual Computing, Data Mining *Advisor: Daniela Raicu, Ph.D*

Anatomical structures classification and segmentation are very active fields of medical image analysis research and are two important steps towards the goal of computer-aided diagnosis (CAD) and in this paper we compare the effectiveness of two texture analysis methods, Markov Random Fields (MRF) and Co-occurrence Matrices, for organ classification. To perform the comparison, we analyzed pure organ patches of four organs (liver, spleen, kidney, and the trabecular bone) from five patients and used principal component analysis to plot the texture values in a 3 dimensional space. Since humans generally interpret data better when it is presented visually as opposed to numerically, the 3D plot allows us to quickly and easily interpret the results with regard to the uniqueness of organs and patients. We then compared the organ clustering of the two texture models; the methodology with the smallest variance within the clusters and the largest variance between the clusters is considered to be more effective for organ classification. Our results show that while both texture models have some organ clustering, the co-occurrence model produced slightly tighter organ clusters across all patients, however, both texture models have low variance between the clusters and the trabecular bone showed no clustering for either methodology.

PHYSICS

62 **Gluon Asymmetry Inside the Proton: How Computers Can Teach Us New Physics**

Yevgeny Binder, Loyola University
Field: Theoretical Physics, Applied Math *Advisor: Gordon Ramsey, Ph.D*

Current research in high energy physics investigates the internal structure of hadronic particles. Composed of a submicroscopic sea of quarks and gluons, this dynamic system eludes direct observation and necessitates theoretical modeling. One topic that is still unresolved is the asymmetry between polarized and unpolarized gluons in the hadron. Several competing particle models depend on the value of this ratio. The results of this have a direct bearing on the internal motion of the hadron's components, so determining its value is important. We have written a computer program whose purpose is to calculate the asymmetry from theory and compare it to results determined by particle accelerator experiments.

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63 **Frameworks for Analyzing Sources of Gravitational Waves**

Charles Cherqui, Loyola University
Field: Physics and Mathematics *Advisor: John Dykla, Ph.D*

Einstein began his search for a theory of general relativity in 1907 with a publication on acceleration within the framework of special relativity. It was understood by Einstein and others, most notably the famous mathematician David Hilbert; that a modern theory of gravity would come in the form of a geometric interpretation of space-time. In October of 1915 Einstein published his field equations in their first form. This theory not only correctly described Mercury's orbit, something any theory of gravity would need to do, but it also made other predictions that could be verified. More evidence that the theory was correct came almost immediately when in 1919 Sir Arthur Stanley Eddington's expedition confirmed Einstein's prediction of the bending of light around the sun. Since then other predictions have been confirmed, most notably time dilation. Our interest is in another one of the predictions made by solving the field equations, namely the propagation of gravitational waves whose sources are distributions of mass which are both nonuniform and nonspherical. The discovery and measurement of gravitational waves is difficult due to the nature of the waves themselves. They have the property of having extremely long wavelengths, making testing difficult due to the inability of scientists to develop experiments with a margin of error smaller than the predicted measurements. Despite these difficulties the need to verify Einstein's theory directly is a highly sought after prize in the world of physics. All other verification has come through secondary effects which can only be described with the help of general relativity. There are currently three projects whose sole purpose is to search for these waves. The flood of data that will be coming from these experiments (Ligo, Virgo, Lisa) will need to be analyzed in many different ways to understand whether or not the data is really being created by the gravity waves. The question of what type of system is creating these waves

in the first place will also need to be addressed. We seek to generalize some basic analysis concerning the propagation of gravitational waves in hopes of developing a system that will help make sense of the data which these experiments will provide. We will examine variations of the parameterized post-Newtonian framework (PPN); this framework allows one to compare competing theories of gravity. Changing the parameters of the PPN framework will allow us to look into theories other than Einstein's general relativity and make it possible for us to consider a variety of potential sources for gravitational waves.

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64 **Shape Invarience and The Hamilton-Jacobi Formalism**

Charles Cherqui, Loyola University
Field: Theoretical Quantum Mechanics *Advisor: Asim Gangopadhyaya, Ph.D*

It is known that the Schrödinger equation gives exact solutions for a certain class of potentials that possesses the property of shape invariance. Supersymetric Quantum Mechanics (SUSYQM) exploits the shape invariance of these potentials to derive exact solutions. In other words the way in which the Schrödinger equation uses the shape invariance is understood. This understanding has led to a straight forward approach of solving classic problems that is independent of solving the Schrödinger equation itself. The Quantum Hamilton Jacobi (QHJ) method takes a different approach. It recasts the Schrödinger equation in terms of energy, momentum and potential that describe the interactions. This method also gives the same solutions as given by the SUSYQM method. It is thought that the shape invariance of the potentials used must be at play but the way in which this is done is not understood. While SUSYQM uses an algebraic approach that generates states recursively, the H-J method exploits an analytical approach. In QHJ method, we look at the singularities on both side of the related equation and use a new quantization condition that is very similar to the Bohr-Sommerfeld prescription. Since QHJ method gives the exact solutions for all shape invariant potentials, it is our goal to understand what role the shape invariance plays in this formalism and renders it solvable. An understanding of this mechanism will help us understand the QHJ formalism deeply.

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65 **Scaling Laws of Suspended Flow in Two-phase Systems**

Matthew Hall, Loyola University
Field: Physics of Two-Phase Systems *Advisor: Aleksandr Goltsiker, Ph.D*

One of the common classes of two-phase disperse (particulate) systems is solid particles (or liquid droplets) suspended by the upward (anti-gravitational) flow of the continuous media (gas or liquid). The mass flow (velocity) required depends upon disperse phase properties (size, density, concentration) and also the continuous phase properties (viscosity, density), as well as being dependent upon the gravitational intensity of the system. Numerous empirical, semi-empirical and theoretical approaches can be generalized through proper scaling. Usual power-law scaling leads to a characteristic diameter and a characteristic velocity for

the system being considered, as well as the two different limiting cases (regimes) - viscous ("Stoke's") and inertial ("Newton's" or "turbulent"). The crossover between these regimes/ regions leads to the general formula. Proved for the single-particle approximation (valid for the diluted flow) this scaling approach can be expanded to the condensed flows through the use of the porosity power function. In this generalized approach, valid for the entire concentration range, an interesting transient crossover proves for the optimal heat transfer (due to the maximum mobility of still concentrated solid phase) velocity in the fluidized beds. The physical meaning of the characteristic particle size is also discussed.

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66 **MINERvA Calibration and Normalization Via Neutral Current Neutrino-Electron Scattering**

Jennifer Heller, Northwestern University
Field: High-Energy Physics *Advisor: Heidi Schellman, Ph.D*

MINERvA is a neutrino experiment at Fermilab National Accelerator in Batavia, IL, which "seeks to measure low energy neutrino interactions both in support of neutrino oscillation experiments and also to study the strong dynamics of the nucleon and nucleus that affect these interactions". An important aspect of MINERvA, which I have been working on for the past year, involves the muon-neutrino (υ_μ) electron (e-) neutral current scattering and its use as a calibration and normalization tool. When a muon-neutrino scatters off an electron at rest in the lab frame, one can expect to see a small distribution of scattering angles about the beam axis. However, when a muon-neutrino scatters off a proton, the large mass of the proton causes the scattering to become much wider. This is an important interaction to consider because a neutrino may scatter off a free proton in the beam. The detector will be triggered both by the desired neutrinos scattering off the electron as well as these "false positives" from the neutrino-proton scattering. My research has involved testing and building the fiber readout involved in these measurements. Thus far I have written three programs in LabVIEW: a basic data acquisition program, an optical cable program that communicates with a switch system, and a data acquisition and statistical analysis program for NaI crystal calibration. The tests running these programs will be used to demonstrate the usefulness of neutrino-electron scattering as a means of calibration and indicate the level of uncertainty in the results which MINERvA will obtain.

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67 **The Music of the Stars: Improved Approximations to the Frequencies of Stellar Oscillations**

Jeff Kaplan, Northwestern University
Field: Physics *Advisor: Vicky Kalogera, Ph.D*

Just as a talented musician can identify the type, size, and composition of an instrument just from listening to its melody, asteroseismologists hope to understand the structure of stars by analyzing their natural frequencies of oscillation. The study can be thought of as taking an 'ultrasound' of a star, and furthermore, asterseismology is the only way to

probe the interior of stars! Already, these methods have been used to make breakthrough discoveries about the structure of the sun. While no exact analytical solutions to the equations of stellar oscillations exist, semi-analytical approximations can be of great use in improving our understanding of stellar oscillations. We have developed improved asymptotic approximations for the eigenfrequecies of low-frequency g-modes of stars. In these modes, the main restoring force is gravity, such as the case with a boat bobbing up and down in a still pond. Our analysis can be applied to stars with a convective core, a convective envelope, or both with a radiative region in-between. Improvement over previous asymptotic approximations is achieved by a better modeling of the transition point where the g-mode behavior changes from oscillatory to evanescent. In essence, modes of different frequencies propagate slightly further or less into the star, and our improved analysis is achieved by taking into account this frequency dependence. We apply our results to composite polytropic models and demonstrate an improvement of several percent over past work.

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68 **A Dynamical Analysis of Planets in Binary Stars**

Ryosuke Kita, Genya Takeda, Northwestern University
Field: Theoretical Astrophyiscs *Advisor: Frederic Rasio, Ph.D*

Of the nearly 200 extra-solar planets discovered, more than 40 are found in binary or multiple stellar systems. The effect of a stellar companion on a single planet system has been carefully studied and known to cause long-term, or secular, perturbations that affect stability and orbital evolution. As the capability to detect additional planets has advanced, it has become important to understand more generally the effects of a stellar companion on a planetary system. Using numerical integration of hypothetical binary stellar systems, the presence of a second planet was found to have a significant effect not explained by current analyses of binary stellar systems with a sole single planet. Observed cases included: instability by collision or ejection, stable systems with circular orbits, "coupled" eccentricity oscillations, and "locking" of orbital elements. A semi-analytic approach based on classical perturbation theories was applied to investigate these results. A general estimation of the evolution was obtained by a ratio of the orbital precession caused by the binary stellar companion and the additional planet. When the precession rate caused by the additional planet was two orders of magnitude greater than the rate caused by the stellar companion, the system was stable; otherwise the system resulted in collision or ejection with a few exceptions. In these exceptions, the locking of orbital elements resulted in synchronous eccentricity oscillations leading to a stable system. By understanding the logic behind these systems, it is possible to assert the possibility of a companion or an additional planet in current, discovered planetary systems. In addition, a careful analysis of the dynamical evolution could provide additional insight for planet formation theories.

Abstracts

69 **Diffusion in Patterned Narrow Channels**

Alessandro Lauro, Tony Zitek, University of Chicago
Field: Microfluidics *Advisor: Binhua Lin, Ph.D*

Using digital video microscopy we are investigating the behavior of diffusion of micron-sized colloidal suspension that are confined to narrow channels in various arrangements (e.g. circular, sinusoidal, with corners) and also in varying channel width. This system was chosen so that we could investigate the effect of the spatial confinement and varying patterns on the long time single-file diffusion. Our observation of diffusion patterns has resulted in interesting experimental confirmations that until now have only been predicted theoretically. In particular, we have observed that the long-time mean squared displacement is not linear, as predicted by theory.

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70 **The Methodological History of the Quanta Discovery through Thermal Radiation Studies**

Walter Moore, Loyola University
Field: History of Physics *Advisors: Asim Gangopadhyaya, Ph.D, Jeffry Mallow, Ph.D, Aleksandr Goltsiker, Ph.D*

The discovery of the quanta is usually attributed totally to Max Planck, who had improved Wilhelm Wien's law (1896) by successful interpolation of infrared experimental data with the later formulation of the quantum hypothesis (1901), and to Einstein who in 1905 considered the "gas of quanta" (photons) utilizing the Wien law entropy formula generalization. Actually Wien, Helmholts' last disciple, looked for scaling properties of the black-body radiation spectral law having been encouraged by the Maxwellian success with the molecular velocities distribution and by the similarity of Langley Sun radiation curve (1886) to this one. He discovered a power scaling law and scaled the wavelength (frequency)(Wien's displacement law, 1893), introduced temperature and entropy of radiation (1894), proposed the cavity black-body terrestrial source (with Lummer, 1895) and finally found an exponential scaling function (Wien's distribution law, 1896 - independently proposed by Paschen on an empirical basis). As Planck himself really had shown in 1899-1900, by normalizing the Wien's law semi-empirical constant to the famous "h" this became the first quantum law (not satisfying of course Bohr's correspondence principle: no classical limit to Rayleigh's law). Planck's interpolation being of great interest for the supplementary mathematical technique involved also led to the discovery of quantum statistics as explained by Bose and Einstein in 1924-1925; however, the actual quanta were introduced by Einstein (1905) via Wien's quantum law only. The quantization of energy required by Planck's statistical derivation (1901 - 1912) of his formula was positively introduced by Bohr and Ehrenfest afterwards. So, in contrary to the common (Laue) appreciation of Wien's work as the ultimate achievement of classical thermodynamics and electrodynamics prior to Planck's and Einstein's discovery of quanta (Wien was awarded the Nobel prize in Physics in 1911, before Planck [1918] and Einstein [1921]), it was really Wien himself who first stepped into the non-classical quantum world of the new XX century physics.

71 What part of the sky can VERITAS observe?

Melinda Morang, University of Chicago
Field: Gamma Ray and Particle Astrophysics *Advisors: Simon P. Swordy, Ph.D, Scott Wakely, Ph.D*

Because of the nature of the instrument, the Very Energetic Radiation Imaging Telescope Array System (VERITAS) can observe astronomical sources only under strict conditions. Delicate equipment must be shielded from sun and moonlight, and the observational technique dictates that the telescopes must remain above a certain angle of elevation for reliable results. Consequently, these gamma ray telescopes can only be operated for a limited number of hours per year. In order for the VERITAS collaboration to make the best use of those hours, it must know when and for how long each part of the night sky can be observed throughout the year. With this goal in mind, I wrote a C++ program that first accounts for the strict observation requirements of the telescopes and then plots the observability of the entire night sky as well as a few key gamma ray sources. The program also determines when and for how many hours those sources can be observed in a typical year. Additionally, for comparison, I created a similar map for HESS, a gamma ray instrument of the same type in the southern hemisphere.

72 Manipulating Light in the Nanoscale

Joseph Yelk, Northwestern University
Field: Nanoplasmonics *Advisor: Tamar Seideman, Ph.D*

The interaction of light with metallic, dielectric, and semiconductor nanostructures is considered. Such nanostructures could be used in a variety of devices, such as chemical or biological detectors, or improved photovoltaic (solar) cells. Metals are simulated within the Drude model and semiconductors are modeled using the Lorentz profile. Parabolic nanoparticle lenses and random particle distributions are optimized to focus electromagnetic energy onto dielectric particles. Plasmonic crystals composed of metallic and perfectly conducting materials are studied with periodic and perfect conductor boundaries. Short-pulse simulations are compared with long-pulse simulations in determining absorption spectra of simple structures. Genetic algorithms are demonstrated to efficiently optimize a 30-parameter function, and then are applied to determine Lorentz coefficients for PbS, GaAs, and CdSe, and also to optimize nanostructure parameters. Parallelization schemes of genetic algorithms and of FDTD systems are discussed.

Abstracts

SOCIAL SCIENCES AND PSYCHOLOGY

73 The Essential Evita: Performing Politics, Performing Gender

Barrak Alzaid, Northwestern University
Field: Gender Studies, Performance Studies Advisor: E. Patrick Johnson, Ph.D

Pieter-Dirk Uys is a South African satirist and playwright who produced a critical commentary of Apartheid in the 1980s. Uys conveyed his critiques using a fictional female persona, Evita Bezuidenhout, and depicted her in news paper columns and onstage political revues throughout the 1980s. Evita represented a parody of conservative Apartheid norms that regulated morality and sexual purity. In addition to functioning as a critical mouthpiece for Uys, Evita has attained a status in contemporary South Africa that exceeds Uys' portrayal of her. She accepts awards for her contributions to peace, hosts dinners for Nelson Mandela, and has published biographies on her life. I will interrogate how she exceeds Uys' portrayal by analyzing this shift from a 'fictional' character in the 1980s to a seemingly 'real' individual post-Apartheid. I also analyze how this shift enables her to stand in as the 'Tannie' (aunt or mother figure) of a democratic 'Rainbow Nation'. I am interested in exploring how Evita's relationship to both the Apartheid and post-Apartheid political regimes enables her to exist outside the theatrical space. To address these questions I conduct close readings of performances, news articles, as well as academic analyses of Apartheid-era governance and social norms. My analysis will explicate the role of gender performance as a critical strategy in the anti-Apartheid movement as well as the implications of Evita's contemporary role as 'Tannie of the Nation'.

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74 Men without Ends: The innovation of political community by Argentine human rights activists

Ashleigh Campi, Northwestern University
Field: Political Theory, Political Science Advisor: Sara Monoson, Ph.D

The discourse of human rights is the staging ground for the embattled movements toward justice. These struggles are waged by political actors on the fractured intersections between local and global political spheres. The liberal-juridical definition of rights in state and international law works to re-inscribe power at the institutional level, by delimiting rights claims to legal definitions. The juridical rights discourse interpolates political actors into regimes of state power, setting up the state as the protector and proprietor of human rights. Drawing on a case study of Argentine human rights organizations and their tumultuous relationship to state and institutional powers throughout the transitions from dictatorship to democracy, I will attempt to shed light on alternative forms of political action that are covered over by the dominant narrative of liberal justice. I argue that these non-traditional modes of political action serve as more resilient and vital forms of the protection of human rights than those offered by legal-juridical institutions.

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75 Health Mindedness during the Transition to Adulthood

Genna Cohen, Northwestern University
Field: Social Policy, Health Policy *Advisor: Michael S. Wolf, Ph.D*

Objective: To explore how 18-25 year old individuals understand and utilize health care services during the crucial transition to adulthood.

Methods: In-person, semi-structured interviews were conducted with 40 students enrolled at one Midwestern university. Interviews included a series of open and closed-ended questions and hypothetical health vignettes to assess participants' knowledge, attitudes, beliefs, and behaviors about their personal health and use of services. Use of standard and specialty medical and related services was quantified, and qualitative methods were used to generate themes regarding participants' health-related concerns and decision making.

Results: Overall participants were healthy; 98% (n=39) rating their health as "Good" or better. The average Body Mass Index for the sample was 22.3kg/m2, within the recommended normal range of 19-25. Participants reported a regular use of health care services, averaging 3.3 visits per year over the past three years. Additionally, every participant had visited a physician within the past year, on average 2.8 months prior to the interview. The majority of these visits occurred "off campus"; 52.5% reporting that they saw a physician in their home town compared to 37.5% that used university health services. When asked to predict behavior in a hypothetical illness scenario, 12% of individuals stated they would consult a physician when described symptoms of meningitis (i.e. headache, stiff neck, nausea, and fever). Participants were more likely to "wait out" the problem.

Conclusions: This sample of healthy, well-educated, and insured individuals struggled to explain their behavior when confronted with a new health problem. Many were unfamiliar with terms found on their health insurance plan, and were unfamiliar with available health services on campus. At a time when individuals are becoming independent and developing their personal health schema, this study suggests that individuals need more information to promote a healthy lifestyle and to properly engage the health system.

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76 Survey and Behavioral Measures of Interpersonal Trust

Anthony Evans, Northwestern University
Field: Behavioral Economics, Personality Psychology *Advisor: William Revelle, Ph.D*

The study of interpersonal trust is important to both psychologists and economists. However, one of the fundamental obstacles in trust research is how to best measure and define trust. Contemporary researchers study trust as both an internal "propensity to trust" (Mayer, 1995) and an external, economic decision (Berg et al, 1995). The proposed study will validate a new survey that measures psychological differences in trust and trustworthiness. The survey is based on interdisciplinary research in the fields of psychology and economics. The study will test this survey as a predictor of trusting behavior in an economic experiment known as the

Investment Game. Participants in the game will encounter two dilemmas of trust: 1. Should they invest money in an anonymous partner? 2. How should they share a sum of invested money between themselves and their partners? The study will integrate psychological survey methodologies with experimental practices from behavioral economics. The results of the study will show that the subjects' responses to the trust survey can be used to predict their decisions in the Investment Game. The study will also explore the relationship between trust and trustworthiness.

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77 The Effect of Presentation Media on the Validity of an Asthma Identification Survey Instrument

Mark Graves, Jr. (Northwestern University), Roger Pottanat, M.B.B.S, Anne McLaughlin, M.D., Majed Kolielat, M.D., Mark Graves, M.D., James Brokaw, PhD, MPH

Field: Cognitive Science *Advisor:* James Brokaw, PhD, MPH

Background: An asthma screening tool in the school health curriculum could identify many children with asthma. Treating undiagnosed asthma in children has the potential to improve school performance and reduce behavioral difficulties. Literacy barriers, (failure to be able to understand the mechanics of the words, failure to understand the meaning of the words, and failure to understand the subtleties of the questions in a context), markedly diminish the predictive value of current, paper based asthma questionnaires that are administered to students at school.

Objective: To assess whether the integration of a previously validated student questionnaire into an interactive, web based, computer program can enhance the validity of the survey.

Design/Methods: Based on a previously validated 7 question survey of children (Redline et al), an interactive, web-based questionnaire program (asthmatest.org) was developed that mitigates the 3 barriers discussed above. The test group consisted of patients selected from the practice of a pediatric allergist and a general pediatrician. The subjects use the interactive computer program, learn about asthma, and take surveys about their potential asthma. The parents of these children complete a comparable survey. The allergist provides a definitive diagnosis on the presence of asthma based on available history, exam and spirometry.

Results: The individual questions were variably predictive of asthma. The children learn and improve their knowledge about the signs and symptoms of asthma as they work through the program. A calculated, composite survey score provides an excellent prediction of asthma and is comparable to the parent test for asthma prediction. The area under the ROC curve is about 0.95 for both the parent survey and the children's survey.

Conclusions: Asthmatest.org is an accurate screening tool to predict children's asthma and is comparable to a parent questionnaire. A large scale, school based screening program

could be implemented. The survey requires no paperwork, can be run simultaneously on multiple computers, stores and tracks results, and minimizes adult supervision.

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78 **Maternal Illness During Pregnancy Decreases Infant Birth Weight**

Dominique Heinke, Northwestern University
Field: Biological Anthropology *Advisors: Chris Kuzawa, Ph.D, MsPH*

An adverse prenatal environment, generally reflected by small size at birth, has been linked to permanent alterations in metabolic and immune function leading to an increased risk of adult disease. Although the Developmental Origins of Health and Disease (DOHaD) paradigm has assumed the basis for this adverse prenatal environment to be nutrition, other environmental factors that influence birth weight, such as maternal illness, may also influence birth size and later health. The objective of this study is to examine the effect of maternal illness during pregnancy on birth weight as a marker of the quality of the prenatal environment. This study examines 2918 mother-infant pairs participating in the Cebu Longitudinal Health and Nutrition Survey (CLHNS), a one-year birth cohort study begun in 1983. Data on maternal health, including reports of illness and anthropometric measures of nutritional status, were collected during the baseline interview, which occurred at a mean of 30±4 weeks gestation. Infant weight and gestational age were measured at birth. In multivariate linear regression models, report of maternal illness at baseline predicts a decrease in birth weight (mean 46.2 g) that remains statistically significant after adjusting for potential confounders, including maternal nutritional status. No significant associations were found between birth weight and reported maternal symptoms, gestational age at the time of illness, or infant sex. This study shows that a mother's health and self-reported illness may have effects on birth outcomes that are independent of her nutritional status or other confounding factors. The long-term effects on the offspring are potentially relevant to public health and warrant further research attention.

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79 **Talking Teeth: A Preliminary Analysis of Human Dental Remains from Benta Valley, Hungary**

Gregory D. Lane, Northwestern University
Field: Bioarchaeology *Advisors: Timothy Earle, Ph.D*

The 2005 excavation of the Erd 4 site in Benta Valley, Hungary, yielded 29 skeletons from a Middle Bronze Age Vatya Period village community. In 2006, the first analysis on these skeletons was performed, specifically on the dental remains. To date, these are the only un-cremated remains found in the Benta Valley from the Vatya Period. Although theories about prehistoric politics, society, and economy from this period are currently developing, these theories lack support from osteological data, leaving gaps in the present data sets. Analyzing dental remains for enamel hypoplasias and caries provide insight into the diet and

nutritional levels of this population. In humans, high frequencies of these dental pathologies are usually indicative of a lower social status, but the relationship between social status and dental pathologies is seldom clear-cut. The Erd 4 skeletons range in age from young children to older adults, with considerable frequencies of caries (31.1%) and enamel hypoplasias (30.4%) in most skeletons. Other studies of skeletons contemporary with the Vatya Period indicate low instances of both dental caries (3%) and enamel hypoplasias (1%). Excavation findings yielded cow and sheep bones buried with the skeletons, and analyses of soil layers are indicative of numerous plant species contemporary with the Vatya Period. The considerable amount of dental pathologies is inconsistent with the abundance and variety of floral and faunal species recovered from the excavation site. Dental analyses serve as a pragmatic approach to understanding the role of social status on diet and nutrition, by relating dental pathologies to the accessibility of food resources in prehistoric populations. Further areas of inquiry about the social structure of the Vatya Period will hopefully develop from this preliminary study.

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80 Interactions Between Nutrition, Culture, and AntiRetroViral Treatment in Urban South Africa

Jessie Pinchoff, Northwestern University

Field: Biological Anthropology, Global Health *Advisors: William Leonard, Ph.D*

South Africans currently face one of the highest rates of HIV and AIDS in the world. Until recently, the South African government refused to distribute AntiRetroViral (ARV) medications to HIV positive patients. ARVs remain predominantly available in urban areas, such as the city of Port Elizabeth in which this study was conducted. 114 patients receiving ARV treatment at a private clinic just outside of Port Elizabeth were examined. Half the patients were taking vitamin supplements of vitamin C, B, and B Complex, while the other half were not, and the effects of these vitamin supplements on overall health was examined. Although the findings were significant in the opposite direction, with the vitamin group doing significantly worse than the control group in terms of CD4 count and weight. However, there were many other nutritional factors not taken into account, since the study was retrospective, which will be addressed throughout the paper. For example, the use of traditional herbal remedies and the rising epidemic of obesity have important interactions with ARV treatment. It is estimated that over 70% of South Africans seek traditional medicine as well as ARV treatment, and recent studies have shown that some traditional foods and supplements can have negative effects on ARV efficacy (Nattrass2004 19). It is also estimated that over 20% of South Africans over the age of 15 are obese, which has implications for the dosage and efficacy of ARV treatment which has not been studied in depth (Cauvin 2). Although this study raises more questions than it answers, the fact remains that future research in this area is extremely necessary, as ARV treatments are becoming increasingly available around the world with the potential to ease the suffering of the over 40 million individuals living with HIV worldwide.

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81 Employees' Perception of Social Exchange: Leader's Effect on their Engagement

Alexander Purcell, Illinois Institute of Technology
Field: Industrial Organization *Advisors: Roya Ayman, Ph.D*

The social exchange theory (Blau, 1964) in an organizational setting can explain the factors that can affect pro-work related outcomes such as performance, motivation, and commitment (Mowday, Porter, & Steers, 1982) as well as work satisfaction (Cropanzano, 1997). The idea of employee engagement suggests that people can be motivated by intrinsic factors (e.g. personal growth, working to a common goals) rather than simply extrinsic factors (e.g. distribution of rewards). Understanding the social exchange theory and its impact on a subordinate's behavior and attitudes in an organization can help us go beyond our common knowledge by understanding what intrinsic factors create an engaged employee. This study is about leaders' behaviors and the impact they have on the behaviors and attitudes of their subordinates. Three leader behaviors were assessed: monitoring behaviors, procedural justice, and leader-member exchange (LMX). These behaviors are the antecedents of a social exchange relationship between the leader and the subordinate and result in the subordinate's engagement. Two behaviors demonstrating this engagement examined were organizational citizenship behaviors (OCB) and intention to quit. I hope to have two main significant correlations, LMX contributing to procedural justice and LMX having a negative correlation with Intention to quit.

If these main effects are significant, this could infer a possible mediating effect of LMX. By having a behavior such as LMX as a possible mediator of justice and intention to quit this relationship could give smaller businesses who are having trouble paying their top employees a better opportunity to compete with larger companies. Instead of having employees that either lower their work performance or find a hiring paying job, support could be provided to balance this inequity and therefore, a supportive organization could counter balance a significant amount of factors that contribute to turnover while still staying in a manageable budget.

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82 The Self or the Group: What is Driving the Ultimate Attribution Error

Maya Ragavan, Northwestern University
Field: Social Psychology, Self-construal *Advisors: Wendi Gardner, Ph.D*

Intergroup bias between in groups (groups someone is a member of) and out groups (groups that someone is not a member of) is a well defined social psychological phenomenon, but the source of this intergroup bias is less clear. This research examined two predictors of intergroup bias, (1) self-perception and (2) group perception. Perception of the self in this study was determined by whether an individual considers herself independent (identity focused on the individual) or interdependent (identity focused on the group). Group perception was determined by measuring entitivity – the cohesion of the ingroup. In Study One, I analyzed intergroup biases using both religious and political groups. Entitivity

rather than self-perception determined the level of intergroup bias. Specifically, those who perceived their group as more entitive and cohesive showed greater intergroup bias. Self-perceived independence vs.interdependence did not predict intergroup bias. In Study Two, I "primed" participants to view their ingroup in a high entitive or low entitive way to see whether perceived group entitivity played a causal role in determining intergroup biases. Participants in the high entitive condition showed higher levels of intergroup biases than those in the lower entitive condition. This demonstrates that intergroup biases are influenced by the perceived entitivity of the ingroup.

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83 **The Global Fund in South Africa: Why Internal Factors have Limited the Organization's Potential and Possible Solutions**

Ashima Singal, Northwestern University
Field: Global Health *Advisors: Ian Hurd, Ph.D*

The paper has three goals. This paper 1) will describe the Grant financed by the Global Fund to Fight AIDS, Malaria and Tuberculosis using primary interviews, monitoring and evaluation reports, news articles, and academic reports when available. Particularly, it will examine the monitoring and evaluation processes. 2) Analyze the main barriers and structural problems of the Global Fund in South Africa. 3) Make recommendations on how the grant could be improved.

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84 **Religious Aid: Faith-based assistance to Sudanese Refugees in Cairo, Egypt**

Samina Sulemanjee, Northwestern University
Field: Political Science, International Studies *Advisors: Bonnie Honig, Ph.D*

Faith-based assistance organizations are crucial contributors to the livelihoods of the Sudanese refugee community in Cairo, Egypt. Even though the majority of Sudanese refugees are Muslim, an overwhelming majority of faith-based refugee assistance organizations are Christian. Based on a 15-day field research trip to Cairo and drawing on prior volunteering experiences with the Sudanese refugee community in a faith-based setting, this paper explores whether the religious affiliations of faith-based organizations directly or indirectly affect their delivery of services to Sudanese refugees in Cairo, Egypt. This research analyzes the role of religion in the operations of these organizations, clearly identifies and attempts to explain disparities between Christian and Muslim-based assistance, and evaluates the perceptions of the refugees themselves on this issue. Overall, this paper aims to contribute to knowledge about the relationship between these organizations and refugees in order to determine if faith-based initiatives deserve greater international support and understanding.

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85 **"Rightful, yet Right-less": A documentary on the lives of Sudanese refugees in Cairo**

Juliana Tafur, Northwestern University
Field: Human Rights, Social Science *Advisors: Akbar Virmani, Ph.D*

Approximately 30 percent of Sudanese who migrate to Cairo, Egypt receive refugee status but are not referred for resettlement to recipient countries in the West. For most, local integration in Cairo, an already crowded and impoverished city, does not guarantee a successful livelihood. Although recognized as refugees by the Cairo office of the United Nations High Commissioner for Refugees (UNHCR), their rights to healthcare, employment, schooling, and oftentimes security, are limited. In this urban setting, they find themselves in very similar conditions, with the same jobs and receiving almost equal treatment as non-recognized or illegal Sudanese. They classify as a new type of "rightful", yet "right-less" refugee. But why are better mechanisms of protection not in place for these "rightful" Sudanese?

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86 **Income Inequality Hypothesis among Tsimane' adults in lowland Bolivia**

Amar Vira, Northwestern University
Field: Human Biology, Anthropology *Advisors: Thomas McDade, Ph.D*

A significant body of literature reports an adverse relationship between income inequalities and health in industrialized populations. To explain this negative association, researchers have proposed different mechanisms. The first mechanism is that income inequalities create a negative emotional environment for both the rich and the poor which subsequently translates into biological stress and adverse health outcomes. Secondly, inequalities erode social cohesion and social capital leaving societies without social safety nets to buffer against adverse health outcomes. Little is known about the health consequences of income inequality in smaller, pre-industrial societies. The present study tests the association with data from the Tsimane', a foraging and farming society who live in the Bolivian Amazon. Participants included 2598 adults (15 years or above) from 13 villages at variable distance from the market center San Borja. Dependent variables included a social capital index, various stress indices, and two health indicators. The independent variable is a Gini Coefficient, an economic measure of income inequality within a society. While income inequalities did not correlate with measures of stress, there was a strong negative relationship between income inequality and social capital. Furthermore, there is a strong positive relationship between social capital and body mass index. This suggests social cohesion may be an important link between social inequalities and adverse health outcomes in a traditional society transitioning toward a market economy.

Abstracts

87 Home is Where You Make It: Biases in Students' Mental Representations of their College Campus

Christopher M. Warren, Northwestern University
Field: Cognitive Psychology *Advisors: David H Uttal, Ph.D*

Previous research has shown that people are prone to making systematic errors in judgment when describing relations between landmarks in multiple geographic regions (Stevens and Coupe 1978). These errors occurred for both major North American cities and fictitious landmarks alike. More recent work has demonstrated that where one lives can play a role in the development of subjective representations of superordinate regions (Friedman, Kerkman and Brown 2003). The present study aims to further investigate these issues by looking at how Northwestern University students' subjective representations of the Evanston campus differ based on what region of campus they inhabit, north or south, and how these representations develop over time. Subjects were given a task wherein they rated their familiarity with a series of 28 campus landmarks judged by pilot testing to be highly salient. Then subjects' knowledge of a balanced selection of these locations was assessed using a drag and drop E-Prime interface. Subjects dragged an x representing each tested location onto either a map containing only an X representing Swift Hall, the centrally-located psychology building within which all subjects were tested, or a map with Swift Hall, the CTA tracks and the Lake Michigan shoreline labeled. Bidimensional regression techniques were used to assess the configural similarity and accuracy of the subjective maps of campus gleaned from subjects (Friedman & Kohler 2003). Through the computation and analysis of signed y-bias statistics, which subtracted the pixel location of subjects' responses for each building from the actual pixel location of that building, we found a significant interaction between the region where campus buildings are located and the region where subjects live and primarily attend class $F(4,162)=2.53, p<.05$. We also found cross-sectional evidence for increasing accuracy as a function of year in school with the regression coefficients of Freshmen($r^2=.7453$), Sophomores($r^2=.8160$), Juniors($r^2=.8844$) and Seniors($r^2=.9423$) increasing as subjects gained experience with the campus.

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88 Video Game Play Improves Visual Attention Only in Current Players

Richard Yao, Lucica Iordanescu, KatieAnn Skogsberg, Marcia Grabowecky, & Satoru Suzuki, Northwestern University
Field: Cognitive Psychology *Advisors: Marcia Grabowecky, Ph.D*

Northwestern undergraduate participants were selected for video game playing experience and split into two groups: video game players ("Gamers", N = 16) and non-video game players ("Non-Gamers", N = 42). Both groups completed a battery of visual attention-based tasks, and groups were compared on the basis of individual performance indices. Gamers demonstrated abilities to simultaneously track more moving objects than Non-Gamers ($F = 4.485$, $p = .039$), to shift attention more quickly ($F = 6.117$, $p = .016$), and to better ignore central distracters while responding to peripheral targets ($F = 8.805$, $p = .004$). Further analyses showed tracking and shifting effects were limited to Gamers who played action

games (such as first-person shooter and sports games) while peripheral focus ability was improved by both action and non-action, puzzle/strategy games (such as Tetris). Given the correlational nature of our results, one might argue that people with superior visual attention skills would naturally be inclined to enjoy playing video games; however, there were no effects for Ex-Gamers (i.e., participants who once enjoyed playing video games regularly but had not played for at least a year prior to testing). This suggests that regular video game play may be responsible for the observed differences in visual attention.

About the American Undergraduate Research Society

The American Undergraduate Research Society (AURS) is a nonprofit 501(c)(3) organization that actively encourages and promotes undergraduate scientific and engineering research through the joint efforts of many of the top research universities across the country. The program aims to bring together undergraduate researchers studying at American universities in order to give them an opportunity to share their research ideas and accomplishments with others in annual regional interdisciplinary research symposia.

A unique feature of the AURS is its steadfast dedication to the promotion of excellence in undergraduate research. At each symposium, the best undergraduate student presentations are awarded either scholarships or travel grants to national and international meetings of professional societies. In addition, those faculty members of the participating universities whose contributions best encourage and support undergraduate research are recognized. In doing so, the AURS helps stimulate greater interest in independent learning and discovery at the undergraduate level which goes beyond the typical classroom environment.

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AURS is the parent organization to the various regional undergraduate research symposia across the country, as well as around the world. Symposia have been established in Chicago, St. Louis, Princeton area, Australia and plans are underway to establish the first ever AURS London symposium. Through the collaboration of students across the world, AURS hopes to expand the limits of undergraduates in research for the future.

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Poster Assignments

Each presenter is listed in alphabetical order with his or her corresponding poster number.

Name	Poster #
Alzaid, Barrak	73
Baniulyte, Dovile	1
Bansal, Amit	2
Bigley, Sarah	32
Binder, Yevgeny	62
Boiteau, René	33
Bracken, Susanna	3
Campi, Ashleigh	74
Chaikind, Brian	34
Chennamaneni, Purnima	4
Cherqui, Charles	63, 64
Choi, Lien	5
Cohen, Genna	75
David, Christina	6
Dickey, Geralyn	35
DiMarco, Michael	7
Elke, Daniel	8
Eng, Jason	9
Evans, Anthony	76
Farah, Benjamin	36
Farooqui, Zishaan	10
Gandhi, Prem	50
Garland, Meg	44
Gilmour, Maureen	51
Graves, Mark	77
Gregori , Kellen	11
Hall, Matthew	65
Hand, Julia	52
Heiferman, Daniel	12
Heinke, Dominique	78
Heller, Jennifer	66
Hsu, Derek Hsen Dai	53
Htut, Winmin	54
Jung, Michael	13
Kaldis, John	14
Kaplan, Jeff	67
Kim, Jungjin	15
Kim, Minseung	55
Kita, Ryosuke	68
Kopp, Darin	16
Lane, Gregory	79
Lauro, Alessandro	69
Lee, Hyun Beom	37
Lee, HongJu	60
Lieberman, Tami	17
Lim, Sean Austin	18
Lin, Tinlee	19
Liu, Dana	38
Lybolt, Crystal	56
Mackey, Parijata	20
Marell, Joshua	39
McGinty, Shannon	35
Mendez-Duarte, Marco	21
Miller, Tyler	40
Mohan, Vinu	39
Moore, Walter	70
Morang, Melinda	71
Moum, Sarah	41
Mui, Keeley	22
Neiswander, Brian	57
Nordin, Kara	23
Novikov, Sergey	43
Pacilli, Massimo	42
Petersen, Shariska	24
Philips, Carl	61
Pileggi, Dominic	42
Pinchoff, Jessie	80
Pradhan, Suraj	25
Purcell, Alexander	81
Qato, Khalil	26
Qato, Ream	43
Ragavan, Maya	82
Rebman, Ellen	44
Schieber, Michael	27
Schmerberg, Claire	45
Selby, Heather	58
Siaw, Ting Ann	46
Singal, Ashima	83
Srinivasan, Sharan	47
Stich, Adrienne	48
Sulemanjee, Samina	84
Tafur, Juliana	85
Thomas, Matthew	28
Thomas, Merina	29
Toh, Christine	49
Turturro, Michael	59
Valencia, Stephanie	61
Vira, Amar	86
Virani, Minaz	57
Warren, Christopher	87
Williams, Calvin	30
Wojtanek, Mireille	5
Xavier, Shervy	4
Yao, Richard	88
Yelk, Joseph	72
Ystesund, Tracy	31
Zuziak, Matthew	42

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