SOCIETY OF POSTDOCTORAL SCHOLARS
UNIVERSITY OF ILLINOIS AT URBANA-CHAMPAIGN

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6th ANNUAL POSTDOCTORAL RESEARCH SYMPOSIUM

FEBRUARY 5, 2016

Beckman Foyer and Room 1005, Beckman Atrium

8:00	9:00	Registration and Light Breakfast, Assemble Posters

Auditorium: Opening Remarks

9:00	9:10	Welcome from SOPS, Bradly Alicea
9:10	9:15	Remarks from Postdoctoral Affairs Office, Karen Ruhleder

Auditorium: Session 1: Chair, Bradly Alicea

9:20	9:35	**Meng Jiang** *Modeling Complex Behavior in Social Media (1.1)*
9:35	9:50	**Katrina Cummings** *Understanding Parental Engagement within Families of Children with Disabilities in Rural Communities (1.2)*
9:50	10:05	**Enrique Valera** *Multiplexed detection of clinically-relevant biomarker panels using a silicon photonic biosensing platform (1.3)*
10:05	10:20	**Hillary Schwarb** *Hippocampal viscoelasticity and relational memory performance (1.4)*
10:20	10:35	**Marian Breuer** *Towards a whole-cell computational model of a minimal cell (1.5)*

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10:35	11:00	Break (coffee, water, tea)

Beckman Auditorium

11:00	12:00	Keynote, Dr. Adam Kruse (School of Music) Bring the Noise: Challenging the Relationships Between Hip-Hop and School Music

Beckman Foyer and Room 1005, Beckman Atrium

12:00	12:30	Lunch
12:30	2:00	Poster Session

Auditorium: Session 2: Chair, Maryam Shakira

2:00	2:15	**Sumbul Khan** *Regenerating lost wings: Lessons from an insect model (2.1)*
2:15	2:30	**Ahmed Orabi** *Trends of Egyptian Journalistic Discourse about Political freedom practicing during Mubarak Era (2.2)*
2:30	2:45	**Sudipta Dutta** *Binding to Immobilized Oviduct Glycans Prolongs the Lifespan of Bovine Sperm (2.3)*
2:45	3:00	**Matthew Lira** *Students learning to coordinate mathematical and physical models in science education (2.4)*
3:00	3:15	**Vincent Reverdy** *From cosmology to bit hacks: a story of abstraction (2.5)*

Beckman Foyer and Room 1005

3:15	3:30	Break (coffee, water, tea)

Auditorium: Session 3: Chair, Ilaria Berteletti

3:30	3:45	**Fei He** *Study the developmental plasticity through public gene expression data (3.1)*
3:45	4:00	**Silvia Soto** *Rebuilding a Mayan World: Awakening, Presence, and Possibilities (3.2)*
4:00	4:15	**Muhammad Rabanwaz** *An Antismudge Coating Free of Flourine (3.3)*
4:15	4:30	**Ozlem Ece Demir-Lira** *Early parental decontextualized language input predicts neural basis of narrative processing at child age 7-9 (3.4)*

Auditorium: Session 4: Chair, Roberto Andresen Eguiluz

4:40	4:55	**Hui Fang** *Chronically Stable, Flexible Bio-Electronics for Brain and Heart Activity Mapping (4.1)*
4:55	5:10	**Gianluigi Rossi** *The importance of being clean: biosecurity measures in farm operations (4.2)*
5:10	5:25	**Yue Zhuo** *Quantitative Measurement of Cell Adhesion with PCEM (4.3)*
5:25	5:40	**Adam Brandt** *Prion protein gene sequence and chronic wasting disease susceptibility in white-tailed deer (Odocoileus virginianus) (4.4)*

Auditorium: Closing Remarks

5:40	5:45	Closing Remarks from SOPS, Brian Mosby

Beckman Atrium

5:45	7:00	Reception (Audience Choice Talk, Audience Choice Poster)
7:00		Removal of Posters

Organizers: Bradly Alicea, Roberto Andresen Eguiluz, Ilaria Berteletti, Jia Dong, Brian Mosby, Brian San Francisco, Maryam Shakiba, Qian Wu

Sponsors: Graduate College, Postdoctoral Affairs Office, and Office of the Provost

Special Thanks: Institute for Genomic Biology (IGB) Postdoctoral Association

TALK ABSTRACTS

1.1 **Meng Jiang** (mjiang89@illinois.edu)
Department of Computer Science
Modeling Complex Behavior in Social Media

Social media has enabled behavioral data collection of unprecedented size. Given the big data, can we understand, predict and intervene the human behavior? What are the behavioral mechanisms in social media platforms? How can behavioral data mining revolutionize the intelligence of industrial applications such as recommendation, target advertising and anti-fraud service? In this talk, the most recent work of behavioral modeling will be introduced. We uncover the complexity of human behavior in social media from different perspectives: (1) social and spatiotemporal contextual dependency, (2) cross-domain and cross-platform property, (3) lockstep and synchronized pattern of suspicious behavior.

1.2 Katrina Cummings (ksangute@illinois.edu)
College of Education
Understanding Parental Engagement within Families of Children with Disabilities in Rural Communities

Families who have children with disabilities experience unique circumstances (Seltzer, Greenberg, Floyd, Pettee, & Hong, 2001). When such families live in rural communities, additional variables interact with child characteristics, such as access to services (Butera & Maughan, 2001) and less social connectedness (Darling & Gallagher, 2004). Understanding the contexts in which children develop, including distal ecological factors and proximal family influences, is essential for promoting positive outcomes for young children with disabilities or developmental delays. During this presentation, the presenter will provide an overview of a mixed-methods research study designed to understand resources and constraints in rural communities as well as early learning engagement patterns within families of young children who have disabilities or developmental delays. The presenter will descried the study's theoretical underpinnings, methods, results, and implications. The audience will have the opportunity to broaden its perspective of what it is like to raise a child with a disability in a rural community and also glean insights about how practitioners and policy makers might better alleviate barriers to parent involvement in learning activities in rural communities.

1.3 Enrique Valera, Winnie W. Shia, Heather M. Robison and Ryan C. Bailey
(evalerac@illinois.edu)
Department of Chemistry
Multiplexed detection of clinically-relevant biomarker panels using a silicon photonic biosensing platform

In recent years, major advances have been achieved that improve both the sensitivity and specificity of biomarker detection for clinical diagnostic applications. Accordingly, significant effort has been focused on the development of clinical decision-support tools to help physicians to diagnose and monitor the progression of a wide spectrum of diseases and disorders. However, additional improvements related to the accuracy of results obtained, the level of multiplexing, assay time, and sensitivity remain to be achieved. In support of these goals, our group has developed a multiplexed silicon photonic technology that enables the rapid detection (< 60 min) of biomarker panels at low concentrations (few pg mL-1) in human samples. We have applied this platform to the detection of immunoregulatory markers of high clinical interest (cytokines), with applications in several diseases. In particular, we will explain the Sepsis and TB markers panels in this presentation, based on the multiplexed detection of 12 and 7 biomarkers respectively. Although in this work our attention is focus on these two panels, the developed technology is generally applicable to the detection of a wide range of biomarkers. So, new targets can be modularly added to existing biomarker panels (up to 32 targets are accepted in the current generation). Additionally, based on the current status of performance of the assays developed, we consider our platform as a promising technology for the point-of-care detection of clinically-relevant biomarker panels that require moderate levels of multiplexing, good sensitivity, and rapid time-to-result.

1.4 **Hillary Schwarb**, Curtis L. Johnson, Matthew D. J. McGarry, Neal J. Cohen
(schwarb2@illinois.edu)
Beckman Institute

Hippocampal viscoelasticity and relational memory performance

Converging lines of evidence demonstrate the importance of structural and functional hippocampal integrity for successful relational memory performance. However, questions remain regarding how the microstructural organization of hippocampal tissue contributes to memory processing. The introduction of a novel neuroimaging technique – magnetic resonance elastography (MRE) – allows us, for the first time, to explore the mechanical properties of brain tissue health in vivo. Mechanical properties of brain tissue estimated with MRE provide a measure of the integrity of the underlying tissue microstructure and have proven to be sensitive measures of tissue health in neurodegeneration. Until recently, however, MRE methods lacked sufficient resolution necessary to accurately examine specific neuroanatomical structures in the brain, and thus precluded the ability the further explore structural relationships with function. In this study, we took advantage of developments in MRE spatial resolution to measure the viscoelasticity of the human hippocampus, and investigated how these elastic properties contribute to hippocampal function. We acquired structural MRI, DTI, and high-resolution MRE scans from twenty right-handed male (ages 18-33) participants. Participants also completed sensitive experimental measures of relational memory performance. Neither hippocampal volume nor white matter integrity correlated with relational measures of memory. Relative hippocampal elastic/viscous behavior, however,

showed a strong relationship with relational memory measures. In this study we demonstrated, for the first time, that we can extract reliable measures of viscoelasticity in the hippocampus using MRE and importantly, that these measures of relative viscoelasticity map neatly onto memory performance using sensitive behavioral tasks.

1.5 Marian Breuer, Zan Luthey-Schulten (mbreuer@illinois.edu)
Center for the Physics of Living Cells (CPLC)
Towards a whole-cell computational model of a minimal cell

Recently the construction of a “minimal cell” has been achieved in experiment – a cell equipped with the bare minimum of genes necessary to sustain independent cellular life. This cell can serve as a model system for fundamental cellular processes not only in experiment but also in simulation. In this project, we aim to create a complete computational model of this minimal cell, including and connecting all cellular processes in one framework. Ultimately, this should allow us to study and visualize basic cellular processes in a computer simulation. Here the minimal cell's reconstructed network of metabolic reactions is presented, as obtained from its genetic information. This network also allowed us to construct a constraint-based steady-state model of the cell's metabolism, allowing us to study e. g. how different parts of the metabolic network are utilized.

2.1 Sumbul Khan, Rachel Smith-Bolton (sumbuljk@illinois.edu)
Department of Cell and Developmental Biology
Regenerating lost wings: Lessons from an insect model

Regeneration is the remarkable capacity in animals to replace lost or damaged body parts. From the mythical regenerating liver of the Greek God Prometheus to the promise of regenerative medicine, regeneration has fascinated mankind for ages. The degree to which an animal can regenerate varies amongst different species, for example there are animals like Hydra that can regenerate their entire body even if cut into several pieces, or animals like insects, which can just regenerate their limbs, and some, like humans have limited capability to only regenerate damaged tissues. In our lab we study the cellular and molecular mechanism of regeneration in the fruit fly, Drosophila melanogaster, which can regenerate new wings after they have been damaged by cutting or cell death. Our aim is to identify the gene expression changes during regeneration, and to address this we have carried out whole genome RNA sequencing (RNA-seq) of the regenerating blastema cells. This led to the identification of novel regeneration genes. Further, the functional characterization of these genes has uncovered the cellular processes and signaling pathways important for generation. These results provide insight into the fundamental mechanisms of regeneration and will aid in addressing the broader questions of regenerative biology and medicine.

2.2 Ahmed Orabi, Abdelaziz Elsayed, Awatef Abdelrahman (aorabi@illinois.edu)
College of Media
Trends of Egyptian Journalistic Discourse about Political freedom practicing during Mubarak Era

The study aims to identify the different trends posed by the Egyptian journalistic discourse about political freedom practicing during Mubarak Era. It presents thesis, arguments, frames of reference and actors presented by the journalistic discourse of political freedom. The study relies on dialectical analysis and media frame analysis approach as theoretical background. Discourse analysis applies on 5 newspapers Al-Ahram (formal), Al Masry Al Youm (private) Al-Wafd,Al-Ahaly and Aafaq Arabia (partisan) during 2005. The study clears the differences between the political freedom in the Egyptian legal system as shown in the constitutional guarantees and laws restrictions, rather than its actual practicing by the Egyptian people in 2005. The study finds Egyptian Newspapers' agreement regarding the political constraints on top of the factors that impede political freedom in Egypt, but differ in the frequency of these constraints and dealing with other obstacles. They agree the negative assessment of the reality of the necessities of political freedom in Egypt, but they differ in these necessities and its priorities. The results show the diversity of frames of reference that the producers of the discourse rely on. There is significant difference in the order of the most active actors discourse between Al-Ahram and the others.

2.3 Sudipta Dutta, N. Bovin and D. Miller (sdutta@illinois.edu)
Department of Animal Science
Binding to Immobilized Oviduct Glycans Prolongs the Lifespan of Bovine Sperm

Females of many species store sperm after mating to allow asynchrony between mating and ovulation. Sperm storage sites may also select a more fertile sperm population. Evidence supports the hypothesis that glycanbinding proteins present on the sperm head membrane adhere to the oviduct glycans, retaining sperm in the oviduct to form the reservoir. To identify glycans that bind bovine sperm, glycans that were directly labeled with fluorescein were tested for their ability to bovine sperm. Of those tested, only 3’-O-sulfated Lewis A trisaccharide (suLeA) bound to a high percentage of sperm. The localization of fluoresceinated suLeA indicates that suLeA receptors are present around the apex of the sperm head, the region that binds oviduct cells. To determine if binding to suLeA could mimic binding to oviduct cells and lengthen sperm lifespan, we attached biotinylated suLeA to Streptavidin-Sepharose beads and incubated sperm with the “glycobeads”. At 4, 8, 12 and 24 hr of incubation, aliquots were stained with SYBR14 and propidium iodide to identify live and dead sperm respectively (n=4). Sperm bound to suLeA had a 2-fold higher viability than free sperm after 24 hr. Thus, like binding to oviduct cells, binding to the oviduct glycan suLeA improves sperm lifespan.

2.4 Matthew Lira (melira42@gmail.com)
Department of Biological Sciences, Purdue University

Students learning to coordinate mathematical and physical models in science education

In science, mathematics facilitates theory building and experimental design. In science education, however, learning with mathematics can degenerate into students memorizing equations and algorithms without connecting the mathematical formalisms to meaningful representations of science concepts. I will present a study that illustrates how students learn to coordinate knowledge of mathematical and physical models of concepts in science education by leveraging the theory of Knowledge-in-Pieces. This theory posits that students encode fragmented elements or bits of knowledge as opposed to theory-like knowledge. The task of learning with mathematics in science, then, involves students coordinating their knowledge elements during disciplinary tasks such as interpreting scientific representations (e.g. graphs). I report on how undergraduate physiology students used a multi-representational learning environment to coordinate their knowledge of mathematical and physical models and how an innovative assessment instrument reveals their learning through a pre- /post- design. Analysis of students' talk and eye-movements provided contrasting cases of success—some students learned to coordinate the physical quantities and others did not. Despite the cases contrasting nature, an analysis of students' performance on the written assessment revealed similar patterns of growth. These finding suggests that multiple pathways to success exist for students. At the same time, the finding calls our attention to the important role that modality plays in assessment.

2.5 Vincent Reverdy (vince.rev@gmail.com)
Department of Astronomy
From cosmology to bit hacks: a story of abstraction

What cosmology and bit hacks have in common? Apparently nothing. Except that manipulating bits at very high speed can make cosmological codes run faster on supercomputers, thus allowing better investigations of theoretical models and larger analyses of observational data sets. In this talk, I will explain how a very theoretical question in astrophysics related to the expansion of the Universe can lead to computer science questions related to programming languages and compilers. I will also explain how large scale cosmological simulations made us investigate abstract tree structures with a wide range of applications, from general physics to machine learning, and from database to web parsers. Finally, I will describe how this work on trees lead to a research on bit manipulation algorithms with, once again, a wide range of applications.

3.1 Fei He, Sergei Maslov (feihe@illinois.edu)
Carl R. Woese Institute for Genomic Biology
Study the developmental plasticity through public gene expression data

Two thousand years ago in China, a person named 'Yanzi' argued that a delicious orange can taste like cardboard if it is grown on the other side of the river. We now know that

the phenotype is caused by the interaction between gene and environment. Given the same genome, different phenotype can be induced under different environments. This developmental plasticity might mainly be caused by the gene expression plasticity. Currently, tens of thousands of gene expression profiling data are available for model species. Using those publicly available data, we inferred the expression plasticity (i.e. gene responsiveness to perturbation) for a model plant, Arabidopsis. Our initial results indicated the expression plasticity is a universal feature for plant genes. Genes involved in critical developmental regulations such as Hox TF show the lowest plasticity while genes interacting with environments such as photosystem show the highest plasticity. We are also analyzing the evolution of this feature using public transcriptome data including yeast, worm, fly, zebrafish, mouse and human. Based on our preliminary observation, we propose that expression plasticity may serve as a driving power for evolution. This is still an ongoing project. I'd like to share my progress with all of you. In short, I am trying to answer some basic biological questions by mining public omics data.

3.2 Silvia Soto (sisoto@illinois.edu)
American Indian Studies
Rebuilding a Mayan World: Awakening, Presence, and Possibilities

In the last two decades, the literary production in Chiapas by Mayan writers has flourished alongside the mobilization created by the uprising of the Zapatista National Liberation Army (EZLN). Two parallel movements that have at their center the importance of presence and recognition of Mayan peoples of Chiapas and Indigenous people of Mexico at large. Orality and written word become their guiding forces in the articulation of this position. In the literary production of Mayan writers of Chiapas, however, the act of speaking and writing unfold within the literature, raising the question of meanings of presence and recognition. The possibilities contained in the literature, I suggest, reveal new visions of a Mayan world in Chiapas. In this presentation I examine the importance of presence and recognition as central themes in the literature Mayan writers of Chiapas are producing. Using selected pieces from this body of literature I raise the following questions: Why is presence and recognition such central themes in their literary production? And how is "orality" and "writing" central to the claiming process of this presence and recognition? As the writers move through this practice, I suggest, they stitch together their foundation of a Mayan World in Chiapas. 14

3.3 Muhammad Rabnawaz (rabnawaz@illinois.edu)
Department of Chemical and Biomolecular Engineering
Flourine-Free Anti-Smudge Polyurethane Coatings

In this presentation I will discuss a new method for the preparation of nanoengineered coatings that carries nanoreservoirs of a grafted liquid polymer and omniphobicity-enabling surface chains (NANOGLIDE). These nanoglides repel water, oil, and other liquids with surface tensions above 20 mN/m. On them ink and paint traces readily

shrink. Moreover, the coatings can be made optically clear at thicknesses up to 100 um and maintain their omniphobicity after extensive surface damage and wear. This anti-fingerprint coatings will be very helpful for handheld electronic devices.

(1) Rabnawaz, M.; Liu, G. Angew. Chem. 2015, 127, 6616 (Cover article).
(2) Rabnawaz, M.; Liu, G.; Hu, H. Angew. Chem. 2015, 127, 12913.
(3) http://cen.acs.org/articles/93/i36/Antismudge-Coating-Free-Fluorine.html

3.4 Ozlem Ece Demir-Lira (ece@uchicago.edu)
Department of Psychology, University of Chicago
Early parental decontextualized language input predicts neural basis of narrative processing at child age 7-9

Early parental language input strongly predicts children's language outcomes. Among different measures of input, parents' decontextualized utterances about abstract topics removed from the here-and-now uniquely predict children's language outcomes, stronger than parental background factors and overall parental input quantity. Little is known about relations between early parental input and the neurobiology of language. In the current study, we assessed parental language input during naturalistic parent-child interactions of 18 dyads at child age 30 months. At child age 7-9, we used functional magnetic resonance imaging (fMRI) to examine the neural networks underlying narrative processing in the same group of children. Results showed that parental decontextualized language input, but not parental socioeconomic status or overall parental input quantity, significantly positively predicted activation in bilateral superior/middle temporal gyri, and negatively predicted activation in bilateral superior/inferior parietal, premotor and angular gyri. Overall, our results highlight the role of early home environment in shaping the neurobiology of language.

4.1 Hui Fang (fangh05@gmail.com)
Materials Research Laboratory
Chronically Stable, Flexible Bio-Electronics for Brain and Heart Activity Mapping

Advanced capabilities in electrical recording and stimulation are essential to clinical treatment of neurological disorders and heart rhythm diseases, and to progress in fundamental neuroscience and cardiac science. The most sophisticated technologies for this purpose utilize geometrically conformal electronics that achieve high speed, high resolution electrophysiological mapping through direct interfaces between arrays of thin metal pads and the contacting tissue. Although such systems can be effective, the measurement interfaces pose significant risks due to electrical leakage currents that arise from penetration of bio fluids through the metal and into an underlying platform of electronics that provides amplification and multiplexing. Here we present a solution to this challenge that exploits the use of an ultra thin, biocompatible dielectric layer that completely seals an integrated layer of flexible electronics, where electrophysiology

occurs via direct capacitive coupling to the channel regions of an array of interconnected silicon nanomembrane transistors, without any direct metal contact. Systematic studies of the materials and the electronic characteristics highlight the advantages of such systems. High resolution mapping in normal, paced, and arrhythmic conditions in Langendorff hearts demonstrates the capabilities, with quantitative validation against control measurements performed using optical techniques. The results suggest a realistic pathway towards flexible, biocompatible electronic implants for research and clinical use.

4.2 Gianluigi Rossi, R. Smith, S. Pongolini, S. Natalini, L. Bolzoni (grossi@illinois.edu)
Department of Pathobiology
The importance of being clean: biosecurity measures in farm operations

Many diseases typical of livestocks, such as foot-and-mouth disease (FMD), bovine viral diarrhea, and influenza A, can be transmitted through fomites: objects or substances able to carry infectious organism and, thus, spread an infection. The between-farm spread of these fomites, or indirect contacts, is mostly due to operators on-farm visits (veterinarian, trucks, etc.), that can carry these their clothes, equipments, or vehicles. However, the effectiveness of this transmission route can be reduced by biosecurity measures, defined as strategies able to prevent the spread of infectious diseases. The main goal of this work was to quantitatively evaluate the effect of fomites transmission on a potential epidemic, through the use of an epidemic stochastic model. The system studied was the dairy cattle system of the Parma Province (Emilia-Romagna, Italy). Indirect contacts data were obtained from a list of on-farm veterinarian visits among the dairy cattle in the year 2013; for the same set of farms, cattle movements (i.e. direct contacts) data were considered as a comparison. We tested the contribution to spread of indirect and direct contacts, both separately and combined. We also performed a sensitivity analysis on key parameters, in particular on the probability of infection by indirect contacts. The importance of this parameter lies in the fact that it could be "controlled" by implementing biosecurity measures. The model was simulated to represent the spread of highly contagious infectious diseases in the dairy farms system. We then used the FMD simulation to evaluate the role of each individual farm in a potential epidemic. Our results showed how indirect contacts due to fomites transmission might have a major role in the spread of highly contagious infectious diseases. Thus practices able to reduce the effectiveness of these contacts, such as biosecurity measures, can be crucial for the prevention of serious outbreaks.

4.3 Yue Zhuo, Ji Sun Choi, Thibault Marin, Hojeong Yu, Brendan A. Harley, Brian T. Cunningham (yuezhuo2@illinois.edu)
Department of Bioengineering
Quantitative Measurement of Cell Adhesion with PCEM

Adhesion is a critical cellular process that contributes to migration, apoptosis, differentiation, and division. It is followed by the redistribution of cellular materials at the cell membrane or at the cell- surface interface for cells interacting with surfaces, such as basement membranes. Dynamic and quantitative tracking of changes in cell adhesion mass redistribution is challenging because cells are rapidly moving, inhomogeneous, and nonequilibrium objects, whose physical and mechanical properties are difficult to measure or predict. Here, we report a novel biosensor based microscopy approach termed Photonic Crystal Enhanced Microscopy (PCEM) that enables the movement of cellular materials at the plasma membrane of individual live cells to be dynamically monitored and quantitatively imaged. PCEM utilizes a photonic crystal biosensor surface, which can be coated with extracellular matrix materials to facilitate cellular interactions, within a modified brightfield microscope with a low intensity non-coherent light source. Benefiting from the high sensitivity, narrow resonance peak, and tight spatial confinement of the evanescent field atop the photonic crystal biosensor, PCEM enables label-free live cell imaging with high sensitivity and high lateral and axial spatial-resolution, thereby allowing dynamic adhesion phenotyping of single cells without the use of fluorescent tags or stains. We apply PCEM to investigate adhesion and the early stage migration of dental epithelial stem cells (mHAT9a). By applying image processing algorithms to analyze the complex spatiotemporal information generated by PCEM, we offer insight into how the plasma membrane of anchorage dependent cells is dynamically organized during cell adhesion. The imaging and analysis results presented here provide a new tool for biologists to gain a deeper understanding of the fundamental mechanisms involved with cell adhesion and concurrent or subsequent migration events.

4.4 Adam Brandt, Amy C. Kelly, Michelle L. Green, Paul Shelton, Jan Novakofski, Nohra E. Mateus-Pinilla (abrandt2@illinois.edu)
Illinois Natural History Survey
Prion protein gene sequence and chronic wasting disease susceptibility in white-tailed deer (Odocoileus virginianus)

The sequence of the prion protein gene (PRNP) affects susceptibility to spongiform encephalopathies in many species. In white-tailed deer, individual coding and non-coding single nucleotide polymorphisms have been identified that correlate to chronic wasting disease (CWD) susceptibility. Here we examine all nucleotide polymorphisms and their combined effects on CWD. A 626 bp region of PRNP was examined from 703 free-ranging white-tailed deer sampled by hunter harvest or government culling in Illinois and Wisconsin. Fourteen variable nucleotide positions were identified (4 novel). We identified 68 diplotypes comprised of 24 predicted haplotypes. Diplotypes that were found exclusively among positive or negative animals were rare, each occurring in less than 1% of the deer studied. Only one haplotype and two diplotypes has significant associations with CWD resistance. Each contains mutations (one synonymous and one nonsynonymous) at positions reported to be significantly associated with reduced CWD

susceptibility. Results suggest that deer populations with higher frequencies of the resistant haplotype or diplotypes might have a reduced risk for CWD infection – while populations with lower frequencies may have higher risk for infection. Understanding the genetic basis of CWD has improved our ability to assess herd susceptibility and direct management efforts within CWD infected areas.

POSTER ABSTRACTS

5.1 Karie Brown-Tess (brown.karie@gmail.com)
College of Education
Correlations in the language of math rigor and student empowerment

How is student power connected to pedagogy in the math classroom?" To answer this question, this study analyzes the widely-accepted descriptions of mathematical rigor, provided by NCTM's Principles and Standards for School Mathematics (2000) and NRC's Adding It Up (2001), and words used to describe student empowement. Student power for meaning-making is assessed through Povey et al's, Learners as authors in the mathematics classroom (1999). Student power can be a tool for emancipatory learning (Bruce & Pecore, 2013; Dewey, 2004; Freire, 2000; Mukhopadhyay, 2009; Povey, et al, 1999; Skovsmose, 1990). Implementing democratic structures, specifically by positioning students as joint meaning-makers with the teacher can be an important form of student empowerment for equity in math education.

5.2 Xuan Zhou, Zachary T. Gossage, Joaquin Rodriguez-Lopez (xuanzhou@illinois.edu)
Department of Chemistry
Aluminum-based plasmonic enhancments for solar water splitting

Solar water splitting at semiconducting electrodes remains a challenge in need of new reactive strategies. Wide-bandgap semiconductors show promising photoconversion, however, work mainly in ultra-violet (UV) that accounts for less than7% of the solar spectrum. Strategies such as metal co-catalysts,1 -2 dye sensitizing,3-4 ion doping,5 have been reported to modify these semiconducting electrodes, so that water splitting can be performed with visible light. Despite fruitful results obtained, further improvements in the photo-activity of the semiconductors are still of great necessity. Using of plasmonic nanostructures that amplifies the local intensity of optical electromagnetic field attracts much attention. Studies on the photo-activity enhancements of titanates and hematite caused by surface plasmons have been carried out mainly on noble metal nanoparticles (gold and silver).6-12 However, current methods exploiting metal nanoparticle plasmonic effects can be significantly improved by using aluminum nanostructures. Compared with noble metal nanoparticles, aluminum nanoparticles are less expensive structures that display a much larger plasmonic tubability (from 200 nm to 700 nm) without suffering from interband transition in UV. 13-14 We studied the photo-activity of a condensed pattern of Al nanodimers that is covered by atomic layer deposited TiO2 thin film. As is shown in Figure 1, the pattern was characterized via the mapping of oxygen distribution using scanning electrochemical microscope (SECM) collection mode with light on and off, under longitudinal and transverse polarizations, respectively. Not a single structure can be recognized when scanning in darkness. When the UV light is on, it is easy to distinguish the Al-patterned region, showing an enhancement of 1.5X over bare TiO2. Considering a nanoparticle surface coverage of about 3%, this enhancement

is promising. By flipping the incident polarization, different contrasts can be obtained due to the excitation of different plasmonic modes of the Al dimer, indicating different optical near-field distributions and different oxygen concentrations.

5.3 Aaron Schwartz-Duval, Santosh K. Misra, Elyse Johnson, Prabuddha Mukherjee, Rohit Bhargava, Alvin S. Acerbo, Te-Wei Chang, Ayako O. Ohoka, Fatemeh Ostadhossein, Jasleena K. Singh, and Dipanjan Pan (asschwa2@illinois.edu)
Department of Bioengineering
Polyvillic nanostructures for biomedical applications: a snowflake inspired design

Initially for its luster, used as currency and in recent decades gold has been found to have many other applications in electronics and medicine. At the nanoscale, gold has been applied toward drug delivery, diagnostic imaging contrast enhancement, and photothermal ablative therapies. We describe our preliminary findings on a novel synthetic methodology initiating morphological differentiation of highly controlled branched gold nanostructures. The morphological differentiation was fundamentally driven by incubation temperature, time, and environmental pH. Differentiated morphologies varied from dendritic, snowball, to polyvillic. This differentiation approach initiates a myriad of shapes using relatively low temperatures in aqueous solution wherein the branching can be finely tuned. The extent of branching, size of nanostructure and morphology found to be facilitating cellular internalization with significant loading which could be detected by hyperspectral confocal imaging, and Raman spectroscopy. Origin of near infrared absorbance in these nanodifferentaitions enunciate their probable use in broad spectrum of biomedical uses ranging from in vitro diagnostic to tissue penetrating detection agents.

5.4 Josh Gibson, Doug Booher, Andrew Suarez (jcgibso2@illinois.edu)
Department of Entomology
Comparative functional morphology and kinematics of miniature trap-jaw ant (Strumigenys spp.) mandible strikes

High-speed appendages for prey capture or defense are common in nature. In ants, power-amplified trap-jaws have evolved independently at least four times, yet only one radiation of trap-jaw ants has been studied in detail. We examined morphology and kinematics of miniature trap-jaw ants (genus *Strumigenys*). Mandible shape and size vary greatly within this genus, and it remains unclear which species have power-amplified trapjaws and which do not. We measured the kinematics of *S. eggersi* and *S. louisianae* mandible strikes using high speed videography, and investigated the muscle morphology of various Strumigenys species using microCT. We found that S. eggersi and *S. louisianae* have snaps that occur an order of magnitude quicker than other trap-jaw ants. Maximum linear velocity for *S. eggersi* and *S. louisianae* was 69 m/s and 64 m/s, respectively. Both muscle morphology and labrum position show predictive potential for future studies aimed at predicting kinematics from morphology alone.

5.5 Paulina Ng, Dwight Springthorpe, Robert J. Full (qwnpng@gmail.com)
Department of Entomology
Mobile Manipulation: Ghost crab climbing using pincer-like claws

We typically consider arthropod pincher-like appendages or chelae as structures to manipulate objects such as food, predators, competitors and barriers to movement. We discovered a behavior in the ghost crab, *Ocypode quadrata*, where crabs required chelae to manipulate their body over tall, vertical obstacles. Ghost crabs hurdled narrow, vertical walls up to 16 cm high, approximately 8x hip height and greater than their sideways leg span, using both their legs and chelae. To explain this exceptional hurdling behavior, we presented ghost crabs with obstacles ranging from 2 -16 cm high. At low heights, crabs simply raised their hip height and stepped over the obstacle. For obstacles greater than 6cm, however, ghost crabs adopted a different strategy where chelae became critical to the crabs' capability. We tested the ability of crabs to manipulate their body using their chelae by immobilizing the chelae and then challenging crabs to hurdle a 10 cm obstacle. Immobilization reduced the success rate to zero compared to unconstrained controls which all scaled the hurdle. Quasi-static models of mobile manipulation during the hurdling behavior suggest that chelae are critical because they provide the torque necessary to manipulate the animals' body over the complex, three dimensional terrain they encounter on the upper beach and in the supratidal zone. Ghost crab hurdling using pincer-like claws provides biological inspiration for the design of legged robots where graspers could not only be used to move objects, but manipulate the body itself for enhanced mobility.

5.6 Ju Seong (John) Lee (jlee682@illinois.edu)
College of Education
Learning beyond the classroom: Language learning strategy between Monolingual Korean and Multilingual Moroccan Students

South Korea and Morocco share similar histories of colonization, English language policies for their economic development, and English as a foreign language (EFL). The English proficiencies of university students in both countries, however, are surprisingly different. This project will investigate how Language Learning Strategies (LLS) enlisted by Moroccan university students contrast with LLS enlisted by Korean university students. It will also examine how these LLS influences English oral proficiency differences between the two groups. To measure and analyze the differences, English language oral proficiency, mono or multilingual skills, and survey the learning strategies enlisted by research subjects in each group through the Strategy Inventory for Language Learning (Oxford, 1990), Individual Background Questionnaire (HongNam & Leavell, 2007), and semi-structured interviews (Roulston, 2010) are employed. According to the data on the Moroccan side (Dressman, Lee, & Sabaoui, 2015), a majority of Moroccan university students tend to learn English outside of class through the following activities: listening to songs, reading old novels in English online, watching satellite television or English-

language movie channels, playing online video game, and using social media sites such as Facebook. The data indicates that over 50% of their knowledge and skill in speaking English is responsible for informal, autonomous, media-based activities. Also the top proficient group (who are fluent in speaking and listening) responds that 70-85% of their English have been learned and acquired outside the classroom activities. To answer the question on the Korean side, the researcher will collect data from 40 Korean freshmen university students at two Korean universities in fall of 2016. At this stage, I am eager to seek the insights of our Postdoctoral Research Symposium participants about the potential issues and challenges concerning my research project. This comparative approach allows for methodological contributions to LLS studies, pedagogical implications for 750 million mono- and multi-lingual EFL learners, and new insights from interdisciplinary studies of educational policy and curriculum studies.

5.7 Lydia Kisley, Mohan-Vivekanandan Poongavanam, Katerina Kourentzi, Richard C Willson, Christy F Landes, Martin Gruebele, Deborah Leckband (lkisley11@gmail.com)
School of Chemical Sciences
Protein adsorption, diffusion, and structure at interfaces

Biomolecules at man-made, material surfaces play an important role in the performance of biosensors, disease diagnostics, biomedical implants, and tissue engineering scaffolds. If the stability of the biomolecule is disrupted at a surface, the device performance degrades. A multifaceted approach to understand proteins at interfaces is presented, including single molecule spectroscopic studies to quantify adsorption and diffusion of single proteins, and a temperature jump technique, Fast Relaxation Imaging (FReI), to understand the folded state, stability, and folding dynamics of proteins. Specifically, the adsorption and diffusion of a model globular protein, α-lactalbumin, was studied by single-molecule microscopy at a silica–aqueous interface at varied pH, a system relevant to pharmaceutical separations. Electrostatic repulsion resulting in free diffusion was observed at pH above the isoelectric point of the protein. In contrast, at low pH strong adsorption and surface diffusion with either no ($D \sim 0.01$ μm2/s) or translational ($D \sim 0.3$ μm2/s) motion was observed where the protein likely interacted with the surface through electrostatic, hydrophobic, and hydrogen bonding forces. Preliminary work to study the folded stability of proteins using FReI at lipid membrane and polymer interfaces is also included. Overall, these new interfacial analytical approaches identify the impact of local protein-material interactions on protein stability. This could direct design rules for the engineering of surfaces, improving the performance, shelf life, and cost of biomedical devices and materials.

5.8 Kimberly A. See, Karena W. Chapman, Lingyang Zhu, Kamila M. Wiaderek, Olaf J. Borkiewicz, Chirstopher J. Barile, Peter J. Chupas, and Andrew A. Gewirth (ksee@illinois.edu)
School of Chemical Sciences

Beyond Li-ion Batteries: A Multitechnique Approach to Understanding Speciation in Advanced Electrolyte Solutions for Mg Batteries

Mg batteries are an attractive alternative to Li-based energy storage due to the high volumetric capacity afforded by the use of Mg metal as an anode. Mg metal deposition is unique in that dendrites are not observed upon deposition resulting in a viable metal battery. The development of Mg batteries is strongly dependent on the development and understanding of the electrolyte component, which are often composed of highly reactive Grignard reagents and exhibit low Coulombic efficiencies and low anodic stabilities. The magnesium aluminum chloride complex (MACC) electrolyte is a promising system that is composed of stable chloride salts and exhibits nearly 100% Coulombic efficiencies with high anodic stability. Interestingly, efficient Mg electrodeposition and stripping behavior is not observed in the electrolyte as-prepared, instead, the MACC must be conditioned before Mg deposition and stripping is supported. In this talk, a combination of characterization techniques will be discussed including Raman spectroscopy, surface enhanced Raman spectroscopy, 27Al NMR, 35Cl NMR, and pair distribution function analysis to determine the complexation of the Mg complexes in the active electrolyte. Relative changes in speciation between the as-prepared and conditioned electrolyte provide vital insights into the speciation necessary to achieve efficient Mg electrodeposition and stripping behavior.

5.9 Bradly Alicea, Stephen Larson, Steve McGrew, Richard Gordon (balicea@illinois.edu)
Department of Crop Sciences
The DevoWorm Project: raising the worm with data

DevoWorm is a distributed collaboration, part of the OpenWorm project, focused on meta-analysis and computational modeling to better understand *C. elegans* embryogenesis by synthesizing and leveraging the existing knowledge-base: 1) Assembly/integration of existing datasets: DevoWorm will use cellular-level data (position, radius, mother and neighboring cells, expressed genes) to build phenomenological, mean-field and dynamic models starting from early embryogenesis. Building developmental emulations from this wealth of community data will have wide-ranging implications. 2) Higher-level data/computational modeling: DevoWorm will derive higher-level descriptions of the *C. elegans* embryo including annotation via higher-level markup languages (SBML, RDF), with biophysical modeling using CompuCell3D. Secondary datasets of new created variables will graphically represent developmental processes, complementing higher-level descriptions in the form of layered data analysis. 3) Theoretical investigations: It may be possible to re-interpret the classic lineage tree view of *C. elegans* development and explain mosaic and regulative development via a unified theory. One way this can be accomplished is through reorganization of the *C. elegans* lineage tree as a differentiation tree. A *C. elegans* differentiation tree may prove useful for understanding developmental mutants, and the evolutionary relationships between various types of developmental systems.

5.10 Zheng Li, Kenneth S. Suslick (zhengli5@illinois.edu)
Department of Chemistry
Sensitive Detection of Trimethylamine with a Colorimetric Sensor Array

Trimethylaminuria, also known as fish malodor syndrome, is an uncommon metabolic disorder characterized by excessive accumulation of the malodorous trimethylamine (TMA) in human body. TMA is also an irritant toxic gas that can cause health issues such as headaches, nausea and skin burns, and the NIOSH/OSHA permissible exposure limit (PEL) of TMA is set at 10 ppm for long term exposure. Therefore, there remains a pressing need for a highly sensitive and selective sensor for the medical diagnosis of trimethylaminuria and regular monitoring of TMA concentrations. In this work, we report a sensitive and rapid detection of trimethylamine both in aqueous and gaseous phases using an inexpensive colorimetric sensor array with reversible chemical interactions. Distinctive color change patterns provide a facile discrimination over a wide range of concentrations for trimethylamine with the accuracy of classification >99%. Calculated limits of detection are well below the diagnostically significant concentration for trimethylaminuria. The sensor array shows good reversibility after multiple uses and is able to accurately discriminate trimethylamine from similar amine odorants. The colorimetric sensing technique promises to be a useful point of care device for rapid, quantitative diagnosis and monitoring of trimethylamine levels for patients with trimethylaminuria.

5.11 Selim Jang, Soohyun Cho (sjang28@illinois.edu)
Department of Psychology
How the different components of mathematics relate to domain specific and general cognitive abilities?

5.12 Yajie Wang, Mark Bartlet, Zachary Litman John F. Hartwig and Huimin Zhao (ywang345@illinois.edu)
School of Chemical Sciences
Exploring the Synergy between Chemical Catalysis and Biocatalysis: Tandem Reactions Combining Biocatalysts and Organometallic Complexes for Selective Synthesis

5.13 Agata Ploska, Jamila Hedhli, Christian Konopka, Lukas LaHood, Iwona T. Dobrucki, Leszek Kalinowski, Lawrence W. Dobrucki (szeffler@illinois.edu)
Beckman Institute
Serial molecular imaging of the receptor for advanced glycation endproducts with multimodal nanoparticle-based targeted probe in preclinical models of hindlimb ischemia

Objectives In this study we assessed the feasibility of serial multimodal imaging of the receptor for advanced glycation end-products (RAGE) in preclinical models of hindlimb ischemia using targeted nanoparticle-based PET-optical probe. Methods For our studies, we used previously synthesized, optimized and chemically characterized G4-PAMAM dendrimer-based nanoparticle. The nanoparticle was functionalized with the specific

RAGE ligand (Ne-carboxymethyl-lysine, CML), and labeled with both copper-64 (64Cu) and high-yield fluorophore (AlexaFluor647) for dual-modality PET-optical imaging. In vivo serial imaging was performed in C57BL6 mice (n=8) at 1, 3, 7 and 14 days after surgical ligation of right femoral artery to induce hindlimb ischemia (HI). To study RAGE expression in animal model of impaired collateral vessel development, we performed in vivo imaging of RAGE in diabetic (n=5) and non-diabetic (n=5) ApoE-/- mice at baseline and 1 week following hindlimb ischemia. All images were analyzed using CT-derived VOIs placed on PET images and specific uptake was expressed as SUV and ischemic-to-nonischemic (I/N) ratio. After last imaging session, mice were euthanized and selected tissues harvested for gamma well counting (GWC) and Western blotting using antibodies for eNOS and RAGE. Results GWC analysis demonstrated increased kidney, liver and lung retention paralleled by relative low uptake of RAGE-targeted nanoparticle in other critical organs. Analysis of PET-CT images and confirmed by GWC analysis in C57BL/6 mice subjected to HI demonstrated gradual increase of RAGEtargeted probe accumulation at 1 day (+9%), 3 days (+51%) and 7 days (+94%) followed by significant reduction in probe's retention at 2 weeks post-HI (+34%). This observation was further supported by the analysis of RAGE expression. Interestingly, the I/N ratio calculated for dimeric eNOS demonstrated highest expression as soon as 1 day post-HI (+292%) which gradually decreased to baseline levels at 2 weeks post-HI. Image analysis in ApoE-/- mice demonstrated that the I/N ratio was significantly higher in non-diabetic (+49%) vs. diabetic (-8%) at 1 week post-HI as compared to the baseline. However, the absolute activity of RAGE-targeted probe in non-ischemic muscles revealed increased baseline RAGE expression in diabetic ApoE-/- mice as compared to non-diabetic controls. These imaging- and molecular biology derived data suggest synergistic effect of both diabetes and apolipoprotein deficiency on RAGE expression, impaired collateral vessel development and possibly decreased peripheral perfusion recovery. Conclusions In this study we successfully assessed both temporal and animal model-specific changes in RAGE expression with PET-optical imaging using newly synthesized molecularly-targeted multimodal nanoparticle. This multimodal imaging strategy may allow optimization and monitoring of therapeutic RAGE-targeted interventions directed at the augmentation of functional recovery in diabetic patients with peripheral arterial disease. Studies were supported by the Ministry of Science and Higher Education Poland ("Mobility Plus" Program, AP), The Foundation for Polish Science (LK, WLD), and American Heart Association (WLD).

5.14 Sung Jun Lim, Daniel R. McDougle, Mohammed U. Zahid, Liang Ma, Aditi Das, Andrew M. Smith (melsj@illinois.edu)
Department of Bioengineering
Lipoprotein Nanoplatelets as Biocompatible 2D Fluorescent Probes with Rapid Cellular Uptake

We introduce a new biocompatible fluorescent nanomaterials named lipoprotein nanoplatelets, which is a hybrid between a sheet-like semiconductor nanocrystal called nanoplatelet (NPL) and an organic nanodisc composed of phospholipids and

lipoproteins. NPLs have been attracting considerable attention due to their unique optical and electrical properties including narrow emission band arising from atomically precise thickness, linearly polarized fluorescence, and highly efficient interparticle energy transfer. We have made these NPLs collidally stable in biological media for the first time by encapsulating individual NPLs with phospholipids and lipoproteins, in which the former adsorbs to flat NPL surfaces while the latter binds to the edges. Lipoprotein NPLs (L-NPLs) are highly fluorescent and show long-term stability in biological buffers and high-salt solutions. Moreover, they exhibit uniquely rapid internalization into living cells. These unique properties suggest that LNPLs are particularly well suited for live-cell single-molecule imaging and multiplexed cellular labeling.

5.15 Santosh K. Misra, Zhe Wu, Mao Ye, Klaus Schulten, Dipanjan Pan (skmisra@illinois.edu)
Deptartment of Bioengineering
A Nitro-furan Antibiotic Turns Oncolytic to Selectively Reduce Breast Cancer Stem Cell via STAT-3 Modulation

Use of known pharmaceutical drugs with different chemotherapeutic character in new area of medicine can be a clever approach to reduce the total time and cost spent on developing a drug molecule from scratch. Nifuroxazide, a nitro-furan anti-biotic has been recently identified as potent anti-cancer agent but physical limitations of low aqueous solubility and lack of targeted delivery reduces the extent of benefit could be achieved against cancer. To address this issue, we synthesized prodrug of nifuroxazide (Pro-nifuroxazide), enzymatically cleavable at Sn-2 site to release the drug, and assembled as significantly stable pro-nifucelle. Pronifuroxazide were found to be better cell membrane interacting molecule than the nifuroxazide and in vitro studies in MDA-MB231, MCF-7 and C32 cells showed better cancer cell inhibition activity with 2-5-fold higher induced apoptosis. Pro-nifucelle was also found to be better by at least 2 fold in reducing CD44+ stem like cell population. It was also established that even after being in form of pro-nifucelle, cancer cell growth inhibition was always followed the STAT-3 inhibition pathway. Studies in nude mice xenografts with MCF-7 revealed the highly efficient calculated % effective growth inhibition to be more than 400 % for pro-nifucelle while H&E analysis showed significantly high nuclear fragmentation and retracted cytoplasm. Immuno-staining on tumor section showed significantly low level of pSTAT-3 by pro-nifucelle treatment establishing the inhibition of STAT-3 post pro-nifucelle by inhibition of STAT-3 phosphorylation. Thus, we could significantly improve the anti-cancer activity of repurposed nitro-furon antibiotic nifuroxazide to many folds with improved IC50, induced apoptosis, reduced CD44+ cell population, STAT-3 inhibition and reduced phosphorylation by using pro-nifucelle.

5.16 Sandip Chorghade, Joseph Seimetz, Stefan M. Bresson, Russel S Emmons, Michael De Lisio, Yang Jing, Nicholas K. Conrad, and Auinash Kalsotra (sandipgc@illinois.edu)
Department of Biochemistry
Poly(A) binding protein C1 is developmentally regulated and controls a post-transcriptional

pathway for cardiac hypertrophy

The poly(A) binding protein C1 (PABPC1) is a highly conserved and ubiquitously expressed cytoplasmic regulatory factor that facilitates mRNA translation by stabilization of a "closed loop structure" between the 5'-cap and the 3'-poly(A) tail. Here we report that PABPC1 protein expression in human and mouse heart is developmentally regulated and is reduced by approximately 800-fold within the first four weeks after birth. Remarkably, the postnatal silencing of PABPC1 protein expression is post-transcriptional, cardiomyocyte specific, and evolutionarily conserved. We demonstrate that silencing of PABPC1 in cardiac myocytes is driven by a decrease in its own poly(A) tail length, which results in reduced polysome association and translation of Pabpc1 transcripts in adult heart. Strikingly, PABPC1 protein levels are up regulated under cardiac hypertrophic conditions and we show that forced expression of PABPC1 in adult hearts of transgenic mice is sufficient to stimulate hypertrophic growth. Furthermore, we demonstrate that PABPC1 depleted mouse neonatal cardiomyocytes are viable; but incapable of undergoing physiologic or pathologic hypertrophy due to their inability to enhance basal protein synthesis. Taken together, our results illustrate a cell-type and developmental stage-specific role for PABPC1 and highlight its importance in controlling cardiac growth during normal development and in hypertrophy.

5.17 Chaitali Misra, Darren J. Parker, Jamila Hedhli, Cole Lewis, Sandip Gulab Chorghade, Wawrzyniec Lawrence Dobrucki and Auinash Kalsotra (chaitali@illinois.edu)
Department of Biochemistry
Overexpression of a fetal Rbfox2 splice isoform drives cardiac dysfunctions in Myotonic Dystrophy type 1

Myotonic dystrophy type 1 (DM1) is caused by a CTG trinucleotide expansion in 3'-untranslated region of the DM protein kinase (DMPK) gene. DM1 affects multiple tissues, but cardiac dysfunctions are the second leading cause of death, mostly due to arrhythmias. Pathogenesis occurs due to a toxic gain of function of the DMPK mRNA containing expanded CUG repeats (CUGexp RNA). However, the exact mechanisms, which drive cardiac dysfunctions are poorly understood. We have discovered that protein levels of the RNA-binding protein Fox2 (Rbfox2), a master splicing regulator, are drastically up-regulated in DM1 human and mouse heart. This is accompanied by aberrant skipping of the 43bp exon in Rbfox2 transcript, resulting in a selective up-regulation of fetal Rbfox2 splice isoform (Rbfox2Δ43) in adult cardiomyocytes. We demonstrate that CUGexp RNA expression in DM1 affects Rbfox2 in two distinct ways: 1) Reduced expression of miRNA(s) causes de-repression of Rbfox2 protein levels; and 2) CELF1 overexpression promotes sk.

5.18 Mohammad Ali, Tsung-Han Tsai, and Paul V. Braun (mali85@illinois.edu)
Department of Materials Science and Engineering

Autonomic ionic transport through chemical potential gradient for the detection of G-series nerve agents

G-series nerve agents, such as Sarin, Cyclosarin and Soman can cause permanent damage to central nervous system or even lead to death. The most recent terrorist attack employing Sarin was occurred in Tokyo, Japan on March 20, 1995, killing 12 people, severely injuring 50 and causing temporary vision problems for nearly 1,000 others. However, early treatment with proper antidote could prevent serious health damage, thus detection of Sarin is crucial. Current methods to detect Sarin include FET, IMS, GC, MS, enzymatic array, electro-chemistry are limited to either low sensitivity or operational complexity, or non-portability. Off the methods, nanoscale detectors hold great promise for selectively single molecule detection and can be miniature into small handheld device. However, for small size of the sensor, the probability of an analyte reaching the nanosensor is extremely low, especially in a diluted environment. We employ a secondary detection technique for the Sarin. The presence of oxime hydrolyses Sarin to produce hydrogen fluoride (HF). It is expected that migration of small H+ or F+ is much faster than larger Sarin molecule. The H+ or F+ is thus transported to the sensor through a polyacrylamide hydrogel film containing built-in chemical gradient. The chemical gradient is used to direct and accelerate ion transport towards the sensor without help of any external device. Result shows that ions can be directionally transported up to several millimetres within couple of minutes. The chemical potential gradient is expected to lead an accelerated analyte capture by several order of magnitude compared to direct collection without gradient.

5.19 Alexander Brown, Wendy S. Woods and Pablo Perez-Pinera (abro4576@gmail.com)
Department of Bioengineering
Multiplexed, Targeted Genome Engineering using Nuclease-Assisted Vector Integration (NAVI)

The expansion of genome engineering spurred by CRISPR/Cas9 continues to accelerate. While mutagenesis generated via NHEJ remains a highly efficient and effective strategy for select applications, homology directed repair (HDR) based strategies are often necessary for inserting large or complex sequences and to facilitate selection of modified cells. However, HDR-based gene editing is often time consuming, technically challenging, costly, inefficient and difficult to scale. To overcome these limitations we engineered Nuclease-Assisted Vector Integration (NAVI), a unique strategy that bypasses the HDR bottleneck. We demonstrate, through multiplexed insertion of a single plasmid into multiple loci, that NAVI eliminates the need for homologous sequence within donor vectors. Furthermore, by employing a single and universal guide-RNA, multiple vectors were simultaneously integrated into distinct loci, greatly facilitating production of isogenic mammalian cell lines. NAVI enables applications such as genomic integration of heterologous DNA sequences ranging from 3-50 kbp or the generation of double gene knockout cell lines at low cost within ~3 weeks. We conclude that NAVI can be readily adapted for use in a variety of research and therapeutic platforms, due to its greatly

enhanced versatility, ease of use, efficiency, and robust multiplexing capabilities for targeted integration of large sequences within mammalian genomes.

5.20 Andreas P. Kourouklis, Kerim K. Kaylan, Gregory H. Underhill (akourouk@illinois.edu)
Department of Bioengineering
Matrix composition and biophysical characteristics coordinately influence liver progenitor differentiation

Recent efforts have utilized microfabricated platforms such as high-throughput cellular microarrays to examine combinations of microenvironmental signals that determine cell functions. To date, the majority of these approaches have focused on the biochemical properties of extracellular matrix (ECM) or soluble growth factors, and have yet to address the vast number of biophysical cues presented by cellular microenvironments. Here, by integrating a cellular microarray platform with defined substrates of modular stiffness, we sought to systematically investigate the combinatorial effects of ECM composition and mechanical stiffness on the differentiation of liver progenitor cells. Although several pathways have been suggested to regulate liver progenitor fate decisions, a potential role for biophysical signals had not previously been explored. Cellular microarrays were fabricated through the seeding of liver progenitor cells onto defined islands of ECM proteins supported by polyacrylamide gel substrates. Independently presented islands of 5 distinct ECM proteins, including their pair combinations, were created by means of a contact microarrayer. To control the biophysical stimuli, the elastic modulus of the polyacrylamide gels was tuned between 4, 13 and 30 kPa by changing the cross-linking density. Progenitor cells were induced to differentiate within the array of protein islands, and at distinct time points, both hepatocyte (e.g. albumin) and biliary (e.g. osteopontin) markers were quantitatively evaluated using immunostaining and a custom imaging analysis pipeline. The results of these microarray studies suggest that substrate stiffness influences liver progenitor fate decisions in a manner dependent on the protein composition of the ECM. In particular, biliary differentiation, was broadly reduced on 4 kPa substrates compared to stiffer 30 kPa substrates. However, our results demonstrate that in contrast to type I collagen and fibronectin, type IV collagen supports biliary differentiation independent of the elastic modulus of the supporting gel substrate. To further examine the physical interactions associated with 20 this combinatorial ECM signaling, we developed an approach for interfacing traction force microscopy with the cellular microarrays. The systematic assessment of cell-derived traction forces illustrated that the degree of cell traction was consistent with the biliary marker expression data, which indicated that liver progenitor differentiation is forcecorrelated and further modulated by the protein composition of the ECM. By merging traction force microscopy with defined biochemical microenvironments, we have established a unique approach for investigating cell-ECM interactions. Continued efforts focused on the processes guiding liver differentiation would form the foundation for the optimization of stem cell differentiation protocols and

the development of cell-based therapies.

5.21 Zhaleh Ghaemi, Irisbel Guzman, Martin Gruebele, Zaida Luthey-Schulten (ghaemi@illinois.edu)
Department of Chemistry
Kinetic and Thermodynamic Effects of the Electrostatic Interactions of the U1A Protein-RNA complexes

The U1A protein is a component of the U1 small nuclear ribonucleoprotein particle, which forms part of the spliceosome, a crucial cell machinery. Since U1A protein is highly charged, electrostatic interactions have been suggested to be of importance in the association of the protein with RNA and the stability of the complex. To understand this effect, positively charged residues of the protein have been mutated in several positions and changes in the thermodynamics and kinetics of the complex have been measured. We performed molecular dynamics simulations on the mutant complexes to determine the local and global effects of the mutants. Using microsecond-long simulations we shed light on the conformational changes of the complexes with positive charge mutants that are in accordance with experimental data. We then derived an expression based on atomic fluctuations to predict the dissociation constants (Kd). Our theoretically derived Kd values are in good agreement with measured experimental values, suggesting the validity of our approach. The proposed method increases the efficiency of Kd values estimation for mutated proteins; allowing its applicability to protein engineering and drug discovery projects.

5.22 Fatemeh Ostadhossein, Santosh K. Misra, Alireza Ostadhossein, Prabuddha Mukherjee, Enrique Daza, Rohit Bhargava, Dipanjan Pan (ostadho2@illinois.edu)
Department of Bioengineering
Next Generation Host-guest Chemistry on NanoCarbon Enhanced Inhibition of Breast Cancer In vitro and In vivo

Signal Transducer and Activator of Transcription Factor 3 (STAT-3) is a known pathway to be overexpressed in cancer stem cells, which are responsible for tumor relapse. Drugs that regulate STAT-3 expression normally lack aqueous solubility hence posing an obstacle on their efficient bioavailability. Herein, a theranostics nanoplatform based on luminescent carbon nanoparticles decorated with cucurbit[6]uril has been introduced for enhancing the solubility of niclosamide, an FDA approved drug which has recently been repositioned as an anticancer drug by exerting STAT-3 inhibition. The host guest chemistry made the delivery of the hydrophobic drug feasible while carbon nanoparticles enhanced the cellular internalization and made the delivery trackable by various imaging modalities . Extensive physicochemical characterizations on the carbon nanoparticles decorated with cucurbit[6]uril revealed the success of synthesis. Subsequently, niclosamide interaction with cucurbit[6]uril was studied by 1H NMR titration accompanied by in silico investigations. In vitro assessment of the prepared

formulation in the human breast cancer cells indicated ca. two fold enhancement in the inhibitory effect of niclosamide delivered by our approach compared to the free drug while increasing the cell apoptosis ~1.5 fold. FT-IR imaging on the cells confirmed the presence of characteristic chemical signatures of the components, thus demonstrating the cellular internalization. Furthermore, the catalytic biodegradation of the nanoplatforms was seen to occur upon exposure to the Human myeloperoxidase in a short time frame. In vivo studies on the athymic nude mice implanted with MCF-7 xenograft indicated the size of the grown tumor in the treatment group was half of the control group after 40 days. Immunohistochemistry corroborated the down regulation of STAT-3 phosphorylation. Overall, the host guest chemistry on nanocarbon can be considered as a novel arsenal for STAT-3 inhibition.

5.23 Ming-Hsu Chen, Michael J. Bowman, Bruce S. Dien, Michael A. Cotta, Kelly S. Swanson, Terence R. Whitehead, George C. Fahey Jr., Alison N. Beloshapka, Loren B. Iten, Laura L. Bauer, Kent D. Rausch, M. E. Tumbleson and Vijay Singh (chen289@illinois.edu)
Agriculutral and Biological Engineering
An integrated biorefinery: functional oligosaccharides production and high ethanol fermentation

Xylooligosaccharides (XOS), which appear during cellulosic material pretreatment, are nondigestible oligosaccharides produced by the partial hydrolysis of xylan. Because of their health promoting benefits and sweet taste, XOS could be used as functional foods and as a sugar substitute. Currently, due to difficulties in refining, XOS are not recovered from the waste stream of the cellulosic ethanol process. The objective of this study was to investigate XOS purification from crude biomass hydrolysate, evaluate the biological function of XOS and connect XOS production with a high ethanol fermentation procedure.

5.24 Keilin Jahnke, Bruce Elliott-Litchfield, Madhu Viswanathan, Tami Bond, Joe Bradley
Institute for Sustainability, Energy, and Environment (ISEE)
Stored Solar Cookstoves Project

We are developing stored solar innovations to address the global cooking problem. Our solution aims to maintain the familiarity of traditional cooking methods but without the use of fuel, flame, or emissions. A key operational feature is that the devices store thermal energy at temperatures of 300-500C (600-900F), providing positive alternatives to both fire-based and traditional solar cooking. The technology closely approximates combustion-based cooking allowing simulation of a wide variety of cooking cultures, and thereby respecting social and cultural preferences and increasing the probability of global adoption. The devices are also flexible energy sources that could be used for space heating, cooling, food drying, lighting, phone charging, etc.

The motivation behind this project is address the global cooking problem in effort to improve respiratory health of women and children. According to the World Health Organization, cooking fires produce key global warming agents, including carbon dioxide,

black carbon, and ozone precursors. Residential solid fuel cooking is responsible for one-third to one-half of global black carbon or about 10% of the global climate forcing, while the CO2 from these fires account for a further 10-20%. Fire cooking wastes energy and can create unsafe conditions resulting in burns and destructive fires. Though individual fires are small, cumulatively the effects are sizable, and the personal, environmental, and health impacts are tragic.

We envision a hybrid business model for scaling up over the next 3-10 years and we hope to begin implementation in Sub-Saharan Africa and India. To achieve greater scale, we envision the potential formation of energy businesses - "solar shops" - that are predominantly owned by women. Solar shops will harvest solar energy using our innovation, and store and deliver the portable energy vessels to customers, e.g., neighbors who pay a fee. The business operators will heat the vessels by adjusting the dishes to follow the sun, place the "charged" vessels into insulated storage, and deliver them to customers by exchanging charged vessels for discharged vessels. Engagement of women, who are normally tasked with fuel collection and cooking, in these businesses is expected to be an effective approach for increased rates of acceptance and adoption.

5.25 Teresa Romano, T. Daglish, E. Fumagalli (teresa.romano@polimi.it)
Politecnico di Milano
The effects of policy uncertainty on technology diffusion: wind power in Italy

European renewable energy policies have been going through a period of changes, often unanticipated, which are likely to influence investors' decisions. By using an original methodological approach, this work aims to disentangle the effect of market environment characteristics on the decision to invest in a wind technology for power generation. Also, we highlight how renewable energy sources (RES) policy changes affect the time at which the technology starts being used. Our dataset consists of all onshore wind plants connected to the grid between 1987 and 2014 in Italy, and is combined with information about institutional setting, investment costs, and presence of RES support schemes. Starting from the assumption that RES policy changes contribute to increase the number of connections to the grid in certain periods and decrease it in others, a Hawkes model is estimated. On one hand, results point to the role played by market environment characteristics (like institutional setting and investment costs) as technology diffusion drivers, while the role of learning effects disappears when we exclude small investors from the sample. On the other hand (independent of the investment size), the decision about the date of first use is significantly affected by RES policy changes.

5.26 Jamila Hedhli, Sarah Schuh, Andrzej Czerwinski, Heather D. Huntsman, Iwona T. Dobrucki, Marni Boppart, Lawrence W. Dobrucki (hedhli2@illinois.edu)
Department of Bioengineering (Graduate Student)
Molecular imaging of stem cell induced angiogenesis at the onset of microvascular

complications in type-1 diabetes

Cardiovascular complications, including peripheral arterial disease (PAD), are among the leading causes of morbidity and mortality in diabetic patients, accounting for over 80% of diabetes-associated deaths. Current therapies for patients suffering from PAD rely on mechanical revascularization through either percutaneous or surgical approaches. Unfortunately, these approaches are frequently unsuccessful in the long term. As an alternative, targeted stem cell-based therapies might provide clinical improvement for these patients through improved perfusion by stimulating increased microvascular density (angiogenesis) and subsequent large vessel remodeling (arteriogenesis). Of the various potential candidate cells that might be used in treating PAD patients, mesenchymal stem cells (MSCs) are being pursued the most actively at both preclinical and clinical levels. In my talk I will present recent work describing the development of a novel αvβ3-integrin targeted PET-CT tracer (64Cu-PEG4-cRGD2), and its use in evaluating the potential use of muscle-derived mesenchymal stem cells in stimulating angiogenesis and potentially improving muscle function in diabetic mice with hind limb ischemia.

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