2017 Fall Research Symposium Abstracts

Ecological Assessment of a Chronosequence of Prairie Restorations

Sarah Anderson, Kylee Brimsek & Amy Kochsiek, Ph.D.

There is less than 2% of native prairie remaining in Minnesota today; thus, attempts to restore this ecosystem are critical. We examined a chronosequence of prairie restorations in comparison to a native site in order to assess the efficacy of restoration efforts in these sites, and how long it may take to function similarly to a native prairie. We measured plant diversity, above and belowground productivity, and soil structure characteristics at three prairie restoration sites and one native site. We found that the Gustavus Arboretum and the native site were significantly ($p < 0.0001$) more diverse that the farm and Ney Center sites. This could be driven by more consistent burning and a more diverse seed mix in initial seeding efforts in the Arboretum compared to the other sites. Above and belowground productivity recovered to native levels rapidly as all sites were fairly similar except for the arboretum. This may be due to the sandy soil at the arboretum site leading to less water availability and thus lower productivity in general. Soil structure properties all showed the native site significantly higher than the others ($p < 0.0001$), but with an increasing trend with restoration age suggesting that the legacy of plowing lasts for many years, but recovery is possible.

KPC cells engineered with GFP to study the T cell response to pancreatic cancer

Katie Aney & Stephanie Dougan, Ph.D.

Many cancer immunotherapies are checkpoint blockade therapies that focus on activating CD8 T cells, which infiltrate the tumor and have been shown to increase the overall survival of patients. Pancreatic cancer, which has an extremely low survival rate in patients, is poorly infiltrated by CD8 T cells, thus immunotherapy at this level has not been successful. To monitor tumor-specific immune cells in pancreatic cancer, we have engineered the KPC pancreatic tumor cell line to express green fluorescent protein (GFP) using lentiviral infection. This will improve microscopy visualization of the tumor microenvironment and make it possible to visualize GFP expressing dendritic cells that take up dead tumor cells. After validation, newly engineered cells can be injected orthotopically into the pancreas of mice to study the dendritic and T cell response. This model can also be used in pancreatic cancer immunotherapy screens to quantify the number and level of dendritic cell activation.

HPLC Flow Rate Modulation

Ester Rose Archer, Thomas Lauer & Dwight Stoll Ph.D.

High Performance Liquid Chromatography (HPLC) is a method by which liquid mixtures are pushed through a column to separate, identify and quantify their components. The resulting chromatogram shows the locations of peaks at different retention times, which helps identify the individual components. There are, however, limitations to HPLC. Often, compounds will have similar properties, causing overlap of peaks in the chromatogram. Two-Dimensional Liquid Chromatography (2D-LC) is a method in which there is a second dimension (column) that the effluent from the first dimension (HPLC column) is pushed through to be further separated. One practical problem that can arise during this transfer is the limited space in the sampling valve for this effluent to be collected and stored before it is analyzed in the second dimension. The remaining

effluent is then discarded, ultimately resulting in loss of valuable data. Changing the flow rate in the first dimension will result in different peak retention times and could help ensure there is enough space between the peaks of interest so they can all be analyzed in the second dimension. In this work, many experiments were carried out to examine the resulting chromatograms after flow modulation was applied. To identify optimal flow rates, several simple calculations must be made, so a piece of software was developed to make this process easier. It was also observed that changing the flow, which influences the pressure inside the column, can have detrimental effects on the lifetime of the column. Future work involve use of flow modulated first dimension separations to a 2D-LC system for further analysis.

Domesticated Atriplex hortensis, Protein Isolation and Quality Assessment

Connor Balfany, Thirumurugan Rathinasabapathy, & Slavko Kormanynsky, Ph.D.

Atriplex hortensis is a halophyte that is resistant to drought and temperature fluctuations. Additionally, Atriplex hortensis has a very high protein concentration and fast growing time, core components for fighting global malnutrition. These lab studies are centered around the extraction of the Atriplex proteins to assess their nutritive and commercial value by creating a sustainable extraction process, and researching Atriplex protein effects on cultured muscle cells.

Correlates of Basal Ganglia Perivascular Spaces in a Population Based Sample: Mayo Clinic Study of Aging

Chandra Bouma, Jonathan Graff-Radford, M.D., Clifford Jack, M.D., Prashanthi Vemuri, Ph.D.

MRI-visible perivascular spaces (PVS or Virchow-Robinson spaces) are thought to occur when the potential space within the wall of a cerebral blood vessel becomes enlarged and filled with interstitial fluid. Impaired interstitial drainage (caused by arteriosclerosis in the basal ganglia or amyloid accumulation in the centrum semiovale) could contribute to their formation. Previous studies have found a correlation with PVS and several neurovascular and neurodegenerative diseases. With the development and standardization of PVS analysis techniques, PVS could be used as a biomarker to differentiate between patients with vascular dementia and Alzheimers disease. The objectives of this study are to: 1) Expand upon investigation of the associations between PVS within the basal ganglia and midlife risk factors as well as imaging surrogates of Alzheimers disease and cerebrovascular disease, and 2) Evaluate the practicality and reliability of basal ganglia PVS assessments. PVS located in the basal ganglia were correlated with surrogates of small vessel disease and not correlated with Alzheimers disease. However, the analysis technique tested in this study was unreliable, likely due to poor image acquisition quality or differences in scanners used across the participants. We must work to improve scan acquisition and develop a reliable analysis technique before PVS assessment will be usable in a clinical setting.

Using computer simulations to investigate the effects of Active Solvent Modulation on resolution and sensitivity in the second dimension of 2D-LC

Tyler Brau, Eli Larson, & Dwight Stoll, Ph.D.

One major barrier to wider use of two-dimensional liquid chromatography (2D-LC) is the inability to couple "incompatible" methods of separation due to solvent mismatch. Solvent mismatch occurs when the injected sample solvent composition differs from that of the mobile phase used for the separation. This mismatch becomes a problem when the sample solvent composition is 'stronger'

than the mobile phase meaning that it causes faster elution of compounds, which leads to distorted peak shapes and a loss in both resolution and sensitivity during separations. One proposed method of mitigating the negative effects of solvent mismatch is to use Active Solvent Modulation (ASM). ASM allows for the dilution of a sample when transferred from the first to the second dimension, reducing the amount of mismatch. Preliminary data shows that dilutions can increase resolution and sensitivity with both small molecules and peptides. There are other proposed solutions to the problem of solvent mismatch, such as using either a longer column or a column with a larger diameter. Other factors may also affect the benefit of ASM, such as analyte size, analyte polarity, dilution factor, and co-current vs. counter-current operation of the interface valve that connects to the two dimensions of a 2D-LC system. Assessing the effects of these variables experimentally is prohibitively expensive and time consuming. Thus, we have been developing a program capable of simulating separations to aid in understanding how these conditions affect the benefit of ASM and the overall resolution and sensitivity that can be achieved in 2D-LC separations.

Steps Toward a Framework for the Determination of Solute Parameters using the Hydrophobic Subtraction Model of Selectivity in Liquid Chromatography

Linh Chu, Kelson Oram, & Dwight Stoll, Ph.D.

Hydrophobic Subtraction (HS) model was formulated in the early 2000s to understand and characterize the selectivity of reversed-phase columns used in liquid chromatography. The model describes column selectivity as the sum of five solute ‰ÛÒ column interactions: 1) hydrophobic interaction; 2) steric resistance; 3,4) hydrogen bonding; and 5) cation exchange. With a given column, the HS model yields quantitative values of five column parameters that relate to the chemistry of this particular stationary phase.
In this project we focused on determining solute parameters for the HS Model. The ultimate goal is to find an effective tool to limit the guesswork involved in column selection, enable predictions of retention time as a means optimizing separations. In order to determine solute parameters, a UV absorbance spectral library of test compounds was created to serve as the database for compounds when analyzed as mixtures. Then, retention data (about 4000 measurements) were obtained using different mixtures of acetonitrile/water mobile phases. Future work will involve analysis of the resulting solute retention factors for many different columns having different stationary phases to determine how accurately retention time can be predicted using the solute parameters determined in this way.

Determination of the Kinetic Expression of the Photodegradation of the Herbicide Dicamba in Aqueous Solutions

Brittany Courteau & Amanda Nienow, Ph.D.

Dicamba, 3,6-dichloro-2-methoxybenzoic acid, is a post emergent herbicide, typically sprayed on corn and soybean crops across the U.S under the commercial name Diablo. This research project explored the kinetics of the photodegradation of dicamba in aqueous solutions of different water quality, including differences in pH, natural organic matter (NOM concentrations), and dissolved oxygen concentrations. The overall rate was determined to be first order. Addition of the NOM had the largest impact on the rate of the reaction, showing decreasing rates with increasing NOM concentrations. The pH only had a moderate impact, with a higher rate at neutral pH, while the concentration of dissolved oxygen did not have an impact on the rate. Photoproducts were analyzed using UV-VIS and GC-MS. Through UV-VIS analysis two products may be present in solution after

irradiation due to the presence of an isosbestic point. GC-MS data supports the theory of two photoproducts present in solution, dichlorophenol and dichloromethoxybenzene.

Predictive signatures during acute *Campylobacter* enteritis for post-infection irritable bowel syndrome.

Sara Graves, Shoko Edogawa, Staphanie Peters, Terra Wiens, Melanie Orth, Kirk Smith, David Boxrud, & Madhusudan Grover, Ph.D.

Irritable bowel syndrome (IBS) is a chronic disorder of the colon. Patients with IBS suffer from abdominal pain, bloating, diarrhea, and/or constipation. Post-infection IBS (PI-IBS) is the development of IBS after infectious enteritis; this is most common after food-borne illness caused by the bacterium, *Campylobacter jejuni*. Previous studies have shown that patients with PI-IBS differ from patients without PI-IBS in clinical symptom severity, gut microbial composition, and intestinal barrier function, during the post-infection stage. We aimed to identify any specific markers in patients during the acute stage of *C. jejuni* infection that associate with later PI-IBS development. We hypothesized that unique signatures in clinical symptoms, gut microbiota, and intestinal barrier function during acute enteritis associate with development of PI-IBS. To test this, we analyzed clinical symptoms and bio-specimens from patients taken during acute *C. jejuni* enteritis and compared patients who later developed PI-IBS to patients who did not. Findings suggest that certain clinical symptoms and higher gut protease activity during acute enteritis associate with PI-IBS development. The results from this study in combination with further characterization of gut microbial differences and the effects of higher gut protease activity on intestinal barrier function will allow clinicians to accurately predict which patients with *C. jejuni* enteritis are most likely to develop PI-IBS. Identifying high risk patients for PI-IBS development during the acute infection stage could allow clinicians to offer preventative therapeutics to a targeted subset of patients and reduce PI-IBS incidence.

Behavioral Changes in Early Visual Areas due to Perceptual Learning

Kathryn Hagen, Elisabeth Moore, & Geoffrey Ghose, Ph.D.

We are able to quickly recognize familiar shapes and objects even if they are obscured, but how the brain does this is still unclear. We approached this issue by constructing a task in which subjects were required to detect briefly presented (<1 s) degraded circles. Circles were presented at random times within a dynamic noise background. Two analyses of behavior were performed. First, we analyzed false alarm responses to reveal shape detection strategies. This showed that the subject preferentially relied on particular parts of the circle to make judgments. We also examined the subjects perceptual improvement with training. Performance was measured as a function of coherence, the degree to which the circle was degraded, on a daily basis for sessions lasting approximately 30 minutes. After ten days of training, performance on intermediate coherences (50%-90%) increased from about 30% to 60% correct. These results show that a detection task using stimuli well suited to activating neurons in early visual areas can reveal the strategy and learning of rapid shape detection. In the future, fMRI in humans and electrophysiology in monkeys will be used to obtain physiological information concerning the changes in early visual areas responsible for this learning.

Evidence of Less Flexible Cognitive Resource Reallocation In Individuals With Multiple Sclerosis

Brian Hastings & Pierfilippo De Sanctis, Ph.D.

How do individuals with mobility limitations leverage their cognitive resources to most effectively organize their behavior as they ambulate through a complex and ever-changing environment? Difficulties with walking are among the most common mobility limitations in Multiple Sclerosis (MS). Approximately 41% of individuals with MS report difficulties with walking. Recent advances have allowed for simultaneous recording of high-density electro-cortical activity while in motion, called Mobile Brain/Body Imaging (MoBI). In our present study, we utilized MoBI to explore the underlying cognitive, motor and behavioral differences between healthy participants and the MS patient population and provide evidence of differing brain activity.

Simulating Elution Profiles in Two-Dimensional Liquid Chromatography: Developing an Analytical Toolbox

Eli Larson, Carston Damann, Tyler Brau, Hayley Lhotka, Ray Sajulga, Lena Jeong, Sarah Rutan, Peter Carr, & Dwight Stoll, Ph.D.

The second dimension (2D) separation of two-dimensional liquid chromatography (2D-LC) presents unique challenges in method development and optimization that are not typically encountered in conventional one-dimensional liquid chromatography (1D-LC). One such challenge is mitigating the dilution of analytes as they are collected from the first dimension (1D) column, injected into the 2D column, and propagated through the 2D column for further separation. The conditions used in the second dimension are often extreme relative to those used in conventional LC. For example, it is not uncommon in 2D-LC to inject fractions of 1D effluent that are larger than the dead volume of the 2D column itself. There would be tremendous value in the ability to rapidly predict optimal conditions for use in these situations. However, we find that the predictions of existing closed form analytical expressions for retention time and peak width are not consistent with experimental results. To address this need we have adapted an implementation of the Craig distribution model developed by Czok and Guiochon. In this presentation we will describe our efforts in this direction to date including work to accurately simulate 2D separations in 2D-LC. We have also adapted the model to predict separations involving separation media having a gradient in stationary phase chemistry over the length of the separation channel. We believe the set of simulation tools and know-how developed in this work will facilitate further creative work to advance the state of the art in both 1D- and 2D-LC.

Performance Studies of the Transition Radiation Tracker at the Large Hadron Collider ATLAS Experiment.

Elise Le Boulicaut, Andrea Bocci, Ph.D., & Mark Kruse, Ph.D.

The Large Hadron Collider, which straddles the border of France and Switzerland, is the largest particle accelerator in the world. With its high energy proton-proton collisions, it provides researchers with the opportunity to learn more about fundamental particles and forces. The ATLAS experiment is one of the detectors used for this purpose. The part of the ATLAS detector on which our research is focused, the Transition Radiation Tracker, provides tracking and particle identification information. Data monitoring during and immediately after a run is essential in order to avoid losses of possible physics results due to detector malfunctions. Our work consists in assisting monitoring by summarizing raw data plots to create a more visual and intuitive

representation. This procedure makes locating and identifying potential defects easier and generally agrees with existing monitoring systems.

Improving the Aqueous Solubility of Thiomuracin GZ
Hayley Lhotka, Graham Hudson, & Douglas Mitchell, Ph.D.

Thiopeptide antibiotics are extremely effective and potent towards many strains of bacteria, including multi-resistant strains of bacteria such as MRSA. Due to the nature of their bulky size and the amount of hydrophobic amino acid residues included in the main scaffold, however, their aqueous solubility is poor, making thiopeptides bad drug leads. To combat the issue of poor aqueous solubility, analogs of a thiopeptide called thiomuracin GZ were designed, using mutagenesis techniques to modify the precursor peptide, and synthesized via in-vitro enzymatic reactions. During the biosynthesis of the thiomuracin class of thiopeptides, the precursor peptide is modified and eventually converted into the main macrocycle of the final scaffold. In total, eight analogs were generated, in which one amino acid residue of the precursor peptide, non-essential for substrate binding, was substituted with one of four water-solubilizing amino acid residues (aspartic acid, glutamic acid, arginine, and lysine). The F5 and Y7 positions of the precursor peptide were chosen to be mutated since these sites have been shown not to be important for maintaining antibiotic activity. Of all the analogs generated, only substitutions of arginine and lysine at the Y7 position of the precursor peptide could be converted into the mature macrocycle. All substitutions at the F5 position of the precursor peptide resulted in incomplete processing and turnover of the precursor peptide. In the future, the successful analogs of thiomuracin GZ will be isolated and tested for antibiotic activity and aqueous solubility improvements.

Analyzing Monoclonal Antibodies and Host Cell Proteins Using Two-Dimensional Liquid Chromatography
Ben Madigan, Carly Miller, Chris Harmes, & Dwight Stoll, Ph.D.
Over the past decade, the drug market has made a dramatic shift away from small molecule pharmaceuticals, finding room for growth in protein and peptide treatments. This in turn has increased the demand for analytical techniques that make protein drug development safer and more precise. Two-dimensional high performance liquid chromatography (2D HPLC) may present a number of pathways toward this brand of analysis. According to previous studies, it has the selectivity and precision necessary for analyzing complex proteinaceous mixtures, making it an attractive option for conquering modern analytical challenges.

This study focuses on the optimization of 2D HPLC techniques to effectively separate and identify monoclonal antibodies (mAbs) and host cell proteins (HCPs) with the intention of improving modern drug development. Ultimately, we would like to execute these separations with enough speed, efficiency, and robustness to drastically advance the practicality of 2D HPLC in this field.

Ultrasonic Imaging using Refracto-Vibrometry
Matthew Mehrkens, Ben Rorem, & Tom Huber, Ph.D.

By sending sound waves into an object and observing the shape and timing of the wave at various locations, one can begin to determine certain properties of the object. The experiment to utilized refracto-vibrometry imaged ultrasound waves that have interacted with multiple targets. The

collected data gives an elegant and quantitatively descriptive way to show the interactions of sound and the various objects.

Syntectonic Deposition of Plio-Quaternary Sediments in the Santa Rosalia Basin of Baja California Sur, Mexico
Abby Michels, Luke Johnson, & Tina Niemi

Plio-Quaternary sediments of the Tirabuzin, Infierno, and Santa Rosalia formations record syntectonic deposition in the Santa Rosalia basin an oblique-rift-margin basin along the Gulf of California in Baja California Sur, Mexico. These deposits unconformably overlie the upper Miocene, Cu-Zn-Co-Mn-rich Boleo Formation. The Mesa Soledad outcrops, exposed on the Minera Boleo mine property, show interfingering of marine and terrestrial deposits of the three formations along the inland margin of the basin. Faults that cut the Pliocene section of the mesa are mostly steeply-dipping, NW- and NE-striking faults with normal displacement, determined from stratigraphic offset. Two stratigraphic sections were measured on either side of one of these high-angle, NW-striking fault that has a normal throw of 26 m. Our analyses of sediment grain size, fossil assemblages, and sedimentary petrography indicate a mismatch of the stratigraphic units across the fault and suggest a component of strike slip. North of the fault, fluvial gravels from the Pliocene-aged, Tirabuzin Formation unconformably underlie fossiliferous marine deposits from the late-Pliocene to Pleistocene? -aged Infierno Formation. South of the fault, marine deposits of the Tirabuzin Formation grade upward into beach gravel, and finally into non-marine conglomerates. The absence of the Infierno Formation on the southern side of the fault suggests the deposits were either eroded unevenly due to uplift or laterally displaced by strike-slip movement. Fossiliferous sandstones and conglomerates of the Santa Rosalia Formation unconformably cap the entire outcrop and show no tectonic displacement.

The Iron Binding Chemistry of Metalloprotein II and Myohemerythrin
Haley Moran & Brandy Russell, Ph.D.
This project investigates similarities and differences between the behavior and structure of 3 similar metal-binding proteins from marine worms (Nd myohemerythrin, Pg myohemerythrin, and Nd metalloprotein II). The purpose was to explore how differences in the form of the protein determine function. Specifically, kinetics experiments were run that switched the oxidation state of the metal binding sites of each protein. Rates of tranformation were then analyzed in order to compare the each protein's ability to quickly bind oxygen, auto-oxidize, and otherwise alter their metal binding site. The study currently suggests that the proteins function similarly despite their completely different natural functions (myohemerythrin being an iron-binding oxygen transport protein and metalloprotein II being a toxin-binding cadmium transport protein). This suggests there is not a fundamental major change in ligand binding kinetics in these proteins and that these proteins (when prompted) can complete each other's functions. This also leads to further questions about what prompts the difference in functions in the wild.

Inverse Magneto-Caloric Effect at the Spin Reorientation of Fe_2B alloys dopes with Co
Kelly Neubauer, Peter Klavins, Jackson Badger, & Valentin Taufour

The magnetocaloric effect is usually quantified by a negative variation of entropy when applying field at constant temperature. An inverse effect can also be observed near spin reorientations. We describe the synthesis of single crystals of Fe_2B alloys with Co substitutions. We are able to control

the spin reorientation temperature using Co doping. The transition occurs in the range 300-0 K for substitutions in the range 11-13%. We report on an inverse magneto-caloric effect at this transition.

Creation of Reusable, High-Fidelity Heart Model to Simulate Neonatal Extracorporeal Membrane Oxygenation
Meagan Nowariak, Alex Mattson, & Paul Iaizzo, Ph.D.

Extracorporeal Membrane Oxygenation (ECMO) uses a bypass circuit to aid cardiopulmonary function in neonates born with underdeveloped lungs and congenital heart defects. To decrease complications that arise in initial cannulation, simulation models have been constructed to allow hospital staff to practice various ECMO clinical scenarios. The aim of this project, was to create a reusable, high-fidelity heart model to be used to simulate neonatal ECMO initiation for both open chest and jugular-carotid access.

Identifying genes involved in *Drosophila* ovulation through genetic screens
Halie Ostberg, Elizabeth Knapp, & Jianjun Sun, Ph.D.

Ovulation is the release of an oocyte from the ovary into the oviduct for fertilization, made possible by the proteolytic degradation of the layer of somatic follicle cells that surround the mature oocyte. In humans, ovulation is closely tied to ovulatory disorders, including polycystic ovary syndrome (PCOS), infertility, and ovarian cancer. To better treat and prevent these disorders, the complex genetic regulation of ovulation must be understood. Though Drosophila melanogaster has been a popular model system for over a century, it has only recently become a tool for better understanding ovulation. Work in our lab demonstrates that the follicle rupture process during ovulation is largely conserved between flies and mammals. In flies, this rupture process is induced by octopamine (OA), a neuromodulator similar to norepinephrine in mammals, which leads to the degradation of posterior follicle cells, the release of the oocyte, and the formation of corpus luteum. Such conserved mechanisms, along with high fecundity and a wealth of available genetic tools, make Drosophila a fitting model to explore ovulation mechanisms. In the present study, we seek to determine which genes are required for follicle rupture, and therefore for successful ovulation. Four genes expressed in the follicle cells of mature egg chambers were investigated for ovulation defects through in vivo and ex vivo ovulation assays. All four genes play a role in ovulation in Drosophila as their knockdown exhibited decreased follicle rupture, egg laying, and calcium-signaling, suggesting these assays serve as an effective way to screen genes for ovulation involvement.

Identifying agricultural land management successes and water quality improvements at the sub-watershed scale: A case study in south-central Minnesota
McKenzie Perry, Jake Westfield, & Laura Triplett, Ph.D.

In agricultural regions with highly-impacted water quality, it can be challenging to generate local motivation for water improvement efforts. Although the problem is daunting, and the magnitude of each individuals efforts may be indistinguishable in a mainstem stream, we may be able to detect incremental improvements earlier within a sub-watershed. In Seven Mile Creek, a small watershed in south-central Minnesota, we monitored at the sub-watershed scale to search for evidence of intermediate improvements during a years-long effort to reduce nutrient and sediment loads. The watershed is 9300 hectares with approximately 95% committed to corn and soybeans. Subwatershed 1 (SW1) is 4030 hectares and subwatershed 2 (SW2) is 3690 hectares (43% and 40% of the watershed area, respectively). In both subwatersheds, ubiquitous subsurface drain tile quickly

drains water from the land, shunting it into tributaries and the mainstem which then have flashy storm responses.
In 2016-2017, the two subwatersheds differed in water quality and storm response, despite nearly identical size, topography, climate, and geology. For example, during large storm events in 2016, total suspended sediment (TSS) concentrations were measured as high as 113 mg L-1 in subwatershed 1 and 79 mg L-1 in subwatershed 2. However, the annual average TSS concentration was 2 mg L-1 in SW1 and 3 mg L-1 in SW2, resulting in a higher loading from SW2. In contrast, the annual average nitrate concentration was higher in SW1 than SW2 (28 mg L-1 and 20 mg L-1, respectively). We determined that the difference is likely due to differences in soil type, cropping practices, or recent best management practice (BMP) implementation.

GOT DRUGS? A summer spent in the Mayo Toxicology lab
Erica Power & Aaron Getchell

The Mayo Clinic in Rochester has over 60 laboratories varying from innovative research to clinical testing laboratories. The Clinical and Forensic Toxicology Lab (CFTL) is a clinical lab in the Department of Laboratory Medicine and Pathology (DLMP) and services Mayo Medical Laboratories which includes all Mayo Clinic Health Systems and other clients nationwide. In the CFTL, there are two main areas of testing conducted. Therapeutic drug monitoring (TDM) is a process where patient samples are tested for prescribed medications at the prescribed dosages over an extended period of time. This helps physicians determine if their patients are being compliant with their medication. Drugs of Abuse testing in the other area of tests conducted and perhaps the more well-known area of a toxicology lab. Drugs of Abuse testing is done in two parts. First, it is screened to rule out the negatives and limit the number of drugs needing to be tested in further confirmation assays. Confirmation assays test for a specific analyte, such as PCP, THC, Ethanol and many others. These tests report a specific concentration of analyte within the matrix tested, such as blood or urine. I will discuss the CFTL methods for determining the concentration of alcohol within a patient's blood sample, and determining THC concentration from a patient urine sample. This includes sample extraction, overview of detection methods (GC-FID or GC-MS) and the reporting to physician process.

Using Fragment-Based Ligand Design to Inhibit PfGCN5-mediated Gene Expression
Emma Santa, Abby Trouth, & Scott Bur, Ph.D.

Malaria is a protozoan infection caused by Plasmodium falciparum. The GCN5 protein contains a bromodomain that plays an important role in gene expression in many organisms. The GCN5 found in Malaria differs from the protein in humans, making it a good drug target that wouldn‰Ûªt interrupt the human GCN5. Disruption of the protein-protein interactions via the binding of small molecules could kill the parasite. The goal of this experiment is to design, synthesize and test small molecules for binding to the protein using protein-observed fluorine NMR (PrOF NMR).

Weekly Cycle in NEXRAD Rain Rates
Ryan Sullivan & Kenneth Bowman, Ph.D.

NEXRAD (Next-Generation Radar) level-3 rain rate measurements for the summer and spring time months of 2004 - 2013 were found on average to significantly correlate with a weekly cycle, attributable to the rain rate intensification of evening storms produced by the aerosol pollution cycle. A harmonic fit of the NEXRAD rain rate data suggests a sinusoidal weekly pattern with a

maximum peak residing during the middle of the work week throughout Central to Eastern U.S. These findings are in agreement with the results produced by Bell et al. [2008] which found a significant aggrandizement of the TRMM rain rate data for the middle of the work week. Both reports support the theory that aerosol pollution prevents rainstorm precipitation at early stages in cloud formation allowing an increase in convection of water above the freezing isothermic layer; further invigorating storms and increasing overall precipitation [Bell et al., 2008].

Analysis of the effects of fat content on the islet isolation procedure of total pancreatectomy with islet autotransplantation (TP-IAT)

Riley Thoen, Jacob Ricks, Bernhard Herin, M.D. & Joshua Wilhelm, M.S.

Chronic pancreatitis is a disease characterized by extreme abdominal pain which may lead to narcotic abuse and interruption of regular daily activities. A total pancreatectomy may be used to remove the source of pain, but pancreas removal leads to loss of cell function, resulting in a form of type 1 diabetes mellitus. The total pancreatectomy with islet autotransplantation (TP-IAT) serves to remove the cause of pain while still retaining some pancreatic exocrine function. Islet autotransplantation involves isolation of islet cells from the surgically removed pancreas and injection of those islets back into the host's liver. This study aimed to determine how fat levels on removed pancreases impacted the isolation process, and whether protocols need to be installed to account for differing pancreatic fat levels.
Pancreas fat level was grouped and analyzed in four ways: high vs. low fat pancreases, high vs. low fat with pediatric cases removed, pancreas floating upon arrival to the isolation facility vs. low fat and non floating, and pancreases with lipomatosis (>25% fat) and low fat. Each group was analyzed for differences in patient demographics and isolation and transplant outcomes. Few important differences for isolation and transplant outcomes were found between any higher and lower fat groups. However, patients with higher fat pancreases had significantly higher BMIs and were more likely to be have diabetes mellitus or be pre-diabetic before surgery. This indicates that patients with higher BMIs should be asked to lose weight before surgery or the desired metabolic outcome may not be achieved.

Decomposed Cosmic Velocity Field in f(R) Gravity

Xiaoqi Yu, Baoju Li, Liang Gao, Jie Wang

We propose a new method to distinguish modified gravity *f*(R) cosmology from ΛCDM cosmology. N-body simulations are used to produce the density and velocity field of these cosmologies. By decomposing peculiar velocity in the simulations into three eigen-components, an irrotational component completely correlated with the density field V_δ, an irrotational component completely uncorrelated with density field V_S, and a rotational component V_B, the velocity power spectra of these components are compared and contrasted for different cosmology models. A close investigation of the contrast for various components at different scales shows that the V_S component is the most powerful one to indicate *f*(R) cosmology. We find that, even for an *f*(R) model with $|f\{_{R0})| = 10^{-6}$, the power spectrum of V_S component can reach 13 % higher than General Relavity at k=0.2h/Mpc. The statistics for cosmic velocity field therefore have future implications in indicating different cosmologies.