2017

High Point University
Summer Research Program in the Sciences (SuRPS)
Final Research Symposium

Thursday, July 27 & Friday, July 28, 2017
Norton 101

SuRPS KEYNOTE SPEAKER

"*Boiling Bugs Break Biomass: An Investigation Into High Temperature, Cellulolytic Microorganisms*"

Laura L. Lee, (HPU Biochemistry / Physics Class of 2012)
Doctoral Candidate, Department of Chemical and Biomolecular Engineering
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ABSTRACT

Extremely thermophilic organisms have a promising, but yet unrealized, role to play in the microbial production of lignocellulosic biofuels and chemicals. Discovery of their potential has been pursued through three complementary approaches: metagenomics, pan-genomics, and genomics. Specifically, extremely thermophilic bacteria belonging to the genus *Caldicellulosiruptor* have been investigated for carbohydrate-active enyzmes and their proficient ability to degrade complex biomasses. This seminar will discuss work furthering our understanding of *Caldicellulosiruptor* genomics, as well as shed light on novel proteins in both characterized and novel species which could have important roles in how these microbes degrade and bind to cellulose.

BIO

Laura L. Lee is a doctoral candidate at North Carolina State University in the Department of Chemical and Biomolecular Engineering. She is a graduate of High Point University, earning B.S. and B.A. degrees in Biochemistry and Physics in 2012. She is a National Science Foundation Graduate Research Fellowship Program awardee, and has interned at the Center for Materials Science at James Madison University, NASA Jet Propulsion Laboratory, NASA Ames Research Center, and 3M. Laura's current work investigates the lignocellulosic binding and degradation capabilities of thermophilic bacteria.

SuRPS Final Symposium

(Thursday, July 27, 2017, Norton 101)

Session A: Dr. Heather Miller, Department of Chemistry, Presiding

	8:30 – 9:05		*COFFEE, TEA RECEPTION (Norton 101 Lobby)*
	9:05 - 9:15	Dr. Brian Augustine	Opening Remarks
Th.1	9:15 - 9:30	Taylor Cooley	Determining the efficacy of the antitumor quinone IB-DNQ in BRCA1 mutant breast cancer cells
Th.2	9:30 - 9:45	Jonathan Ware	Phylogenetic relationships between species in the genus *Liatris*
Th.3	9:45 - 10:00	Sarah Forget	Effects of leaf prostration on microclimate and ecophysiology of the evergreen fern, *Polystichum acrostichoides*
Th.4	10:00 - 10:15	Christopher Johnson	Dietary flavonoid fisetin inhibits expression of fatty acid synthase and induces apoptotic cell death in LNCaP prostate cancer cells
Th.5	10:15 - 10:30	Michael Welter	Microfabrication applications of soft lithography
	10:30 - 10:45		*BREAK (Draelos Scholars set up posters)*

Session B: Dr. Jackson Sparks, Department of Biology, Presiding

Th.6	10:45 - 11:00	Carla Yost	Genetic characterization of chemosensation in a terrestrial isopod: evolution of olfaction in woodlice
Th.7	11:00 - 11:15	Brandon Inscoe	Implementation of 3-color single-molecule fluorescence correlation spectroscopy
Th.8	11:15 - 11:30	Juliana O'Brien	Merging copper and photoredox catalysis to improve Chan-Lam cross-coupling reactions
Th.9	11:30 - 11:45	Annie Rexha	Methods for the phylogeny rebuilding of *Liatris*
Th.10	11:45 - 12:00	Robert Glass	Synthesis of acceptor and donor models for the analysis of a conjugated polymer potential in organic photovoltaics
	12:00 - 1:15		*LUNCH BREAK*

(Note: Thursday, July 27 afternoon sessions continued on next page)

SuRPS Final Symposium

(Thursday, July 27, 2017, Norton 101)

Session C: Dr. Keir Fogarty, Department of Chemistry, Presiding

Th.11	1:15 - 1:30	Kellilyn Arnold	Using molecular data to resolve phylogenetic relationships in the *Liatris* genus
Th.12	1:30 - 1:45	Julia Trautman	Investigating Tat-SF1 interactions with HIV RNA
Th.13	1:45 - 2:00	Amanda Smith	Using single chemical exposures to de-orphanize odorant receptors in *Drosophila melanogaster*
Th.14	2:00 - 2:15	Hannah Lee Dixon	The mechanism of IB-DNQ-induced cell eeath in NQO1 positive BRCA2-mutant breast cancer cells
Th.15	2:15 - 2:30	Matthew Hendrix	Evaluation of a diverse compound library as MRSA virulence modulators
	2:30 - 3:15		***DRAELOS SCHOLARS POSTER SESSION***

Session D: Dr. Cynthia Vigueira, Department of Biology, Presiding

Th.16	3:15 - 3:30	Nick Cutrona	Halogenated dibenzoxazepines: optimizing antibiotic adjuvant activity
Th.17	3:30 - 3:45	Heather Francis	Blazing star: a molecular phylogeny of the genus *Liatris*
Th.18	3:45 – 4:00	Lauren Pferdmenges	Using fluorescence correlation spectroscopy (FCS) to observe how pH affects green fluorescent protein (GFP) fluorescence emission

SuRPS Final Symposium

(Friday, July 28, 2017, Norton 101)

Session E: Dr. Meghan Blackledge, Department of Chemistry, Presiding

	8:30 – 9:00		*COFFEE, TEA RECEPTION (Norton 101 Lobby)*
Fr.1	9:00 - 9:15	Erin Brady	Teaching physics using quadcopter technology
Fr.2	9:15 - 9:30	Kaylee Campbell	Preparation of surface-grafted P3HT brushes using an easily cleavable self-assembled monolayer
Fr.3	9:30 - 9:45	Emily Hahn	The effect of rosehip extracts on LNCaP prostate cancer cells
Fr.4	9:45 - 10:00	Sarah Jiudice	Formation and characterization of nanoporous poly(methyl methacrylate) thin films via spin casting
Fr.5	10:00 - 10:15	Noah Worley	Using a GPU to compute polarization of a metal block
Fr.6	10:15 - 10:30	Colin Mesa	Tat-SF1's role in HIV RNA stability
Fr.7	10:30 – 10:45	Brooke Willans	Pigment profiles of purple, green, and spotted morphotypes of crane-fly orchid, *Tipularia discolor*
	10:45 - 11:00		*BREAK*

Keynote Address: (Introduction by Dr. Aaron Titus, Department of Physics)

11:00 - 11:50	**Laura L. Lee** (HPU Class of 2012) NCSU	**Boiling Bugs Break Biomass: An investigation into high temperature, cellulolytic microorganisms**
11:50 – 12:00	Dr. Angela Bauer	Closing Remarks
12:15 - 1:45		*GROUP LUNCH (Wanek Center 2nd Floor Farmer's Market)*

2017 SuRPS Faculty Participation and Projects

Department of Biology

Dr. Niky Hughes	"Effects of seasonal leaf angle on physiology, biochemistry, and micrometeorology of the evergreen fern, *Polystichum acrostichoides*"
Dr. Jackson Sparks	"Identifying receptors mediating importantinsect behaviors by measuring changes in sensory gene expression in response to single chemical sensory experiences"
Dr. Kevin Suh	"The possible role of a dietary phytochemical fisetin in inducing LNCaP prostate cancer cell death"
Dr. Cindy Viguiera	"Phylogenetic analysis and breeding for improved cultivars of *Liatris* species"
Dr. Patrick Viguiera	"Breeding and genetic analysis of wild and cultivated varieties of *Veronia* (ironweed)"

Department of Chemistry

Dr. Brian Augustine	"Modification and characterization of the metallization of polymer surfaces with applications in biomedical devices"
Dr. Meghan Blackledge	"Old battle, new weapons: synthesis and evaluation of FDA-approved antidepressants and derivatives "
Dr. Keir Fogarty	"Characterization of retroviral gag-cell membrane binding interactions using fluorescence microscopy and spectroscopy"
Dr. Pamela Lundin	"Development of the Sonogashira catalyst-transfer polycondensation as a method to prepare covalently grafted films with anti-microbial properties"
Dr. Heather Miller	"Investigating human Tat-specific factor 1's role in HIV-1 gene expression"
Dr. Melissa Srougi	"Targeting of BRCA1/2 mutant human breast cancers overexpressing NQO1 using the antitumor quinone β-lapachone"
Dr. Andrew Wommack	"Merging copper and photoredox catalysis to improve Chan-Lam cross-coupling reactions"

Department of Physics

Dr. Aaron Titus	"Creating a simulation and custom-designed apparatus to study torque and angular momentum using quadcopter technology"

Special Thanks:

Dr. Joanne Altman, Director HPU Undergraduate Research and Creative Works Program
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Joint School of Nanoscience and Nanoengineering, Greensboro, NC
Ameritox Corporation, Greensboro, NC

STUDENT ABSTRACTS:

{Note: presenting author is underlined, * denotes faculty advisor(s)}

(Draelos Poster Session) A simplified approach to matching chemicals with olfactory receptors in *Drosophila melanogaster*

Hope Anglesey[1], Jackson Sparks[2,*]
[1]High Point Central High School
[2]Department of Biology
High Point University

Insects use odorant receptor (OR) proteins to identify odors associated with food, threats, mates and egg laying sites. We raised vinegar flies in controlled environments using small plastic and large glass vials. Flies were collected and sexed as they emerged from pupal cases during a 5-hour window. Once males reached two days old we exposed them to a single odor or mineral oil control in a plastic chamber free of other chemical stimuli for specific time courses. We dissected antennae from dehydrated flies to collect RNA. We measured the amount of OR and control gene RNA in each experimental and control group using qPCR. Most of the 60 vinegar fly ORs have known odor profiles, some narrowly tuned to a small number of odors. We hypothesized that the OR exhibiting the greatest expression level deviation in response to a given odor will correlate with the odor sensitivity of the coded protein. If expression changes are predictive of OR function, this model could be used as a simplified approach to matching chemicals with chemosensory receptors in economically important insects.

(Th.11) Using molecular data to resolve phylogenetic relationships in the *Liatris* genus

Kellilyn Arnold, Cynthia Viguiera* and Patrick Viguiera*
Department of Biology
High Point University

The 29 species of the plant genus *Liatris*, which is distributed throughout the United States, Canada, and the Bahamas, have yet to be organized into a molecular phylogenetic tree which provides information regarding species relatedness and evolution. Our research utilizes 17 genetic markers to gain greater insight into the relationships between *Liatris* species. Creating a phylogenetic tree with maximum parsimony based on both observable traits and extensive molecular data which goes beyond morphological characteristics and geographic distribution will provide the best grounds for analysis of evolutionary relationships within the *Liatris* genus. Our phylogeny will be the first attempt to comprehensively resolve the *Liatris* genus; improving upon and greatly expanding upon the information which exists about these plants. Our project has the potential to reform what we currently understand about the *Liatris* genus and reveal the complex evolutionary relationships that underlie the classification of its species. This improved phylogeny will provide systematic biologists with the opportunity to use our findings to revise the existing taxonomy of the group.

(Fr.1) Teaching physics using quadcopter technology

Erin Brady and Aaron Titus*
Department of Physics
High Point University

Drones have become more prevalent in today's world, and we built an instructional apparatus to help students understand the fundamental physics concepts behind them. The goal of this project was to create a lab for introductory physics students that allows them to investigate torque and angular momentum. We used a custom-designed apparatus with quadcopter technology that consists of a single beam, two quadcopter motors, an on-board computer, and a power supply on a gimbal. With a lock system on the gimbal the apparatus cannot pitch, and therefore the simplest scenario of rotation in a plane can be studied. We wrote a web-based application with a visual display to control the motors. Using a high-speed camera and video analysis software, we were able to perform experiments to characterize the motors, measure torque due to friction, find the moment of inertia of the apparatus, and measure torque due to drag. We will discuss the physics of quadcopters, experimental results, and the lab write-up, in addition to demonstrating the apparatus.

(Fr.2) Preparation of surface-grafted P3HT brushes using an easily cleavable self-assembled monolayer

Kaylee Campbell and Pamela Lundin*
Department of Chemistry
High Point University

Surface-initiated catalyst transfer polycondensation (SI-CTP) is a chain growth polymerization of conjugated polymers that, using an initiator, are attached to the surface via a self-assembled monolayer (SAM). Monomers are added to the chain one at a time, making the chain length easier to control. However, removing the polymer from a silica-containing surface like glass proves difficult, as it uses the toxic acid HF. We have designed a new silane for the SAM that contains an amide bond and is cleavable under milder conditions. The silane was synthesized by coupling (3-aminopropyl)triethoxysilane (APTES) and 4-bromobenzoic acid. The silane was attached to a glass slide and silica nanospheres creating a SAM. Nickel was inserted into the aryl halide, creating a Ni-functionalized SAM. The Ni-functionalized SAMs were reacted with the monomer to produce surface-grafted poly(3-hexylthiophene) (P3HT). All steps of this sequence were characterized using contact angle measurement, AFM, and SEM/EDX. The results showed that both the nanoparticles and the silicon oxide glass slide were successfully functionalized with the SAM and P3HT. The cleavage of P3HT from the rest of the silane is done with use of $Li(NH_2BH_3)$ to produce the polymer terminated with a benzyl alcohol.

(Th.1) Determining the efficacy of the antitumor quinone IB-DNQ in BRCA1 mutant breast cancer cells

Taylor Cooley and Melissa Srougi*
Department of Chemistry
High Point University

Approximately 5-10% of women diagnosed with breast cancer have mutations in the BRCA1/2 gene. BRCA functions as a tumor suppressor preventing cells from growing and dividing too rapidly. Currently, there are no targeted therapeutics for BRCA1 mutant breast cancers. Isobutyl-deoxynyboquinone (IB-DNQ) is a unique quinone that is bioactivated in tumors expressing NAD(P)H:quinone oxidoreductase-1 (NQO1). NQO1 is overexpressed in a number of cancerous tissues such as breast, lung, pancreas and prostate. NQO1 normally acts to detoxify quinone xenobiotics. However, in the presence of certain quinones, such as IB-DNQ it is reduced to an unstable hydroquinone that rapidly undergoes a two-electron oxidoreduction back to the parent compound resulting in reactive oxygen species formation and redox cycling. However, the efficacy of the NQO1 bioactivatable quinone IB-DNQ has not been tested in BRCA1 mutant cancers. Therefore, we hypothesize that IB-DNQ treatment in NQO1-expressing BRCA1 mutant breast cancer cells will cause DNA damage leading to cell death. To test this hypothesis, HCC1937 BRCA1 mutant breast cancer cells were treated with various doses of IB-DNQ for various times and assessed for cellular viability. DNA damage was determined in cell lysates using western blot analysis probing for γ-H2AX phosphorylation and p53 Ser15 phosphorylation. The data from our research will further our understanding of how NQO1-bioactivatable quinones can effectively target BRCA1 mutant breast cancers.

(Th.16) Halogenated dibenzoxazepines: optimizing antibiotic adjuvant activity

Nicholas Cutrona, Kyra Gillard and Meghan Blackledge*
Department of Chemistry
High Point University

Antibiotic resistant bacteria represent a significant threat to human health in the developed world. The current arsenal of antibiotics are becoming less effective against these resistant bacteria, necessitating novel strategies to combat this alarming trend. Methicillin-resistant *Staphylococcus aureus* (MRSA), is an opportunistic pathogen associated with soft tissue and systemic infections in humans. In 2005 alone, deaths from MRSA outnumbered those from AIDS, Parkinson's disease, emphysema, and homicide, combined. Clearly, novel therapeutics to treat MRSA and other resistant bacteria are urgently needed. Unfortunately, the rate of antibiotic discovery has slowed considerably in the last thirty years due to lack of novel drug targets and scaffolds and the poor return on investment for pharmaceutical companies. Alternative approaches to combatting bacterial infections are necessary to effectively stem the growing resistance crisis. Our group has recently identified halogenated dibenzoxazepines as a class of molecules capable of disarming β-lactam resistance in MRSA. A series of analogs designed to probe the structure-activity relationship (SAR) of the aromatic halogen was synthesized and evaluated for biological activity as antibiotics, antibiotic adjuvants, and antibiofilm compounds. Based on the observed activities of these compounds, a preliminary structure-activity map has been generated. Synthetic and biological data will be presented along with our SAR analyses.

(Draelos Poster Session) Synthesis and characterization of a covalently-linked dimer of the fluorescent dye, rhodamine b

Caroline Dau[1], Lauren Pferdmenges[2] and Keir Fogarty[2,*]
[1]High Point Central High School
[2]Department of Chemistry
High Point University

Our goal is to generate a novel fluorescent molecule; a dimer of the fluorescent molecule rhodamine b, which will have unique fluorescent properties. The dimer's unique properties can then be taken advantage of in fluorescence correlation spectroscopy (FCS) experiments. FCS measures temporal fluorescence fluctuations caused by single fluorescent molecules moving through a diffraction limited laser excitation volume (~10^{-15} L). The amplitude, duration, and frequency of these fluorescence fluctuations can yield information concerning the fluorescent molecules' brightness, mobility (diffusion rate), and concentration. The proposed dimer of rhodamine b should exhibit double brightness and slower diffusion rate when compared to a rhodamine b monomer. These fluorescent properties will allow the rhodamine b dimer to be used as a calibration standard in more complex FCS experiments. In the synthesis, a condensation reaction was used to form amide bonds between the carboxylic acid moieties of two rhodamine b molecules and the amines of the trans-1,4-cyclohexanediamine. The putative dimers were then purified using an acid-base extraction, and characterized by NMR. Once the successful synthesis of the dimer has been confirmed, the fluorescence properties of the dimer will be investigated using both FCS and fluorimetry.

(Th.14) The mechanism of IB-DNQ-induced cell death in NQO1 positive BRCA2-mutant breast cancer cells

Hannah Lee Dixon, Taylor Cooley, Lindsay Palmquist and Melissa Srougi*
Department of Chemistry
High Point University

BRCA1 and BRCA2 are tumor suppressor genes that are involved in the processes of DNA repair and gene transcription. When mutated, BRCA1/2 can lead to the development of breast cancer and are the cause of 5-10% of all breast cancer cases. Unfortunately, current treatments for BRCA1/2 mutant cancers are not always successful and cause off-target effects in normal tissues. Previous work has shown that the expression of NAD(P)H:quinone oxidoreductase-1 (NQO1) is higher in breast cancer tissues and cell lines than normal tissues. In the presence of certain quinones, such as isobutyl-deoxynyboquinone (IB-DNQ) NQO1 performs a two-electron oxidoreduction resulting in futile redox cycling and reactive oxygen species (ROS) generation. We hypothesize that treatment of NQO1+ BRCA2-mutant breast cancer cells with IB-DNQ will cause DNA damage, and activation of the repair enzyme poly(ADP-ribose) polymerase-1 (PARP-1). Co-treatment of IB-DNQ with PARP-1 inhibitors, ABT-888 or Olaparib (OLA), will therefore show greater toxicity in BRCA2-mutant cells due to their inability to repair DNA damage. To test this hypothesis, the BRCA2-mutant breast cancer cell line HCC1428 was treated with various doses and times of IB-DNQ with or without the NQO1 inhibitor dicoumarol or co-treated with PARP inhibitors and assessed for viability. To determine whether the NQO1-mediated metabolism of IB-DNQ caused DNA damage, western blot analysis was performed and cell lysates probed with phosphorylated γ-H2AX and phosphorylated p53 antibodies. Results from these experiments suggest that IB-DNQ-induced toxicity in BRCA2-mutant cells is NQO1-dependent and causes DNA damage. Future studies will continue to examine the mechanism of IB-DNQ-induced cell death in BRCA2-mutant breast cancers.

(Th.3) Effects of leaf prostration on microclimate and ecophysiology of the evergreen fern, *Polystichum acrostichoides*

Sarah Forget, Elizabeth Parker and Nicole Hughes*
Department of Biology
High Point University

Fronds of the evergreen fern *Polystichum acrostichoides* are oriented vertically following expansion, and bow gradually through summer and fall until fronds are completely appressed flat against the soil in winter. The objective of the current study was to measure the physiological consequences of forcing fronds into a position counter to their natural seasonal angles. During winter, fronds were forced to remain upright (ca. 50° from horizontal). Diurnal leaf temperatures and microclimate of sample plants were monitored using thermocouples and micrometeorological sensors. Monthly photosynthetic gas exchange and maximum quantum yield of PSII (Fv/Fm) were also measured. During winter the consequences of altered leaf angle were dramatic. Upright leaves exhibited reduced photosynthesis, stomatal conductance, evapotranspiration, and chlorophyll fluorescence relative to naturally-flat fronds, with most dramatic differences occurring during late winter (Feb and March). Because relative humidity was consistently higher beneath flattened fronds relative to ambient air, and *P. acrostichoides'* stomata are abaxially-located, we suspect that flattened fronds benefited from a reduced leaf-to-air vapor pressure deficit and possibly enhanced CO_2 from soil respiration, allowing for enhanced stomatal conductance and photosynthesis during winter relative to upright fronds. Furthermore, the enhanced warming experienced by flat leaves under high-light conditions (up to 15°C) also likely enhanced photosynthesis, bringing frond temperatures closer to those optimal for photosynthesis (10 - 25°C). We conclude that winter leaf prostrations enhance photosynthesis in *P. acrostichoides* by trapping humidity beneath the abaxial surface, and promoting elevated leaf temperatures through boundary layer effects.

(Th.17) Blazing star: a molecular phylogeny of the genus *Liatris*

Heather Francis and Cynthia Vigueira*
Department of Biology
High Point University

The genus *Liatris*, flowering plants also known as blazing stars or gayfeathers, are native to North America and are often cultivated as garden ornamentals. The molecular phylogeny of the genus *Liatris* has, until this study, been unresolved and little is known about the genetic relationships among the 29 species within this genus. Previous taxonomic and systematic efforts have primarily been based on morphological characteristics and biogeographical distributions. Using markers from a database of Asteraceae DNA primers, we were able to amplify 17 regions of genomic DNA sequence through a touchdown PCR technique that employs a series of decreasing annealing temperatures. Using these genetic markers,—significantly more than previous studies—we have defined evolutionary and genetic relationships for 23 species through this genus. We then used these relationships to create a preliminary phylogenetic tree of these species of *Liatris*, which has greater resolution than anything that has been published to date. This phylogeny will be a useful tool for other scientists within the taxonomic field to help with revisions of other trees or scientific texts.

(Th.10) Synthesis of acceptor and donor models for the analysis of a conjugated polymer potential in organic photovoltaics

Robert Glass and Pamela Lundin*
Department of Chemistry
High Point University

As renewable energy sources become increasingly important, organic photovoltaics show capacity in supporting a future not dependent on fossil fuels. Current organic photovoltaic devices are composed of a blend of donor and acceptor materials to induce electron transfer, creating the current that produces electricity for consumer use. The goal of our research is to determine the potential of a conjugated polymer consisting of both the acceptor and donor units covalently bound together, which simplifies the preparation of the active layer in comparison to the blend method. To determine if the polymer shows promise in facilitating the transfer of electrons, models of the donor and acceptor portions of the polymer will be synthesized independently using organic synthesis techniques and their charge states characterized by transient absorption spectroscopy. The acceptor model is a thienopyrrolodione (TPD) coupled to two thiophenes and functionalized with an alkyl sulfonate group. The donor model is a thiophene coupled to two benzothiophenes (BDT). The thiophene is also functionalized with an alkyl sulfonate group. The anticipated acceptor-donor molecule will ultimately be synthesized by linking the acceptor to the donor. The current results of this synthesis will be discussed in the presentation. All of these components will be sent to collaborators at DePaul University for characterization of the charge states for each model.

(Fr.3 & Draelos Poster Session) The effect of rosehip extracts on LNCaP prostate cancer cells

Emily Hahn[1], Kelsey Snelgrove[2], and Kevin Suh[1,*]
[1]Department of Biology
High Point University
[2]High Point Central High School

Rosehip, also known as dog rose and rose haw, is the fruit of *Rosa canina*. Rosehip has traditionally been used to treat disorders such as arthritis. Recent studies have proved that rosehip extract can decrease glioblastoma cell proliferation. In this lab, we tested the effect of rosehip extract on LNCaP prostate cancer cells. LNCaP cells were treated with varied concentrations of rosehip extracts (0, 50 ng/mL, 25 µg/mL, 250 µg/mL, 1 mg/mL, and 1.5 mg/mL) for 24, 48, and 72 hrs. We performed MTT assays to measure the viability of the cells. Metabolically active cells reduce MTT (3-(4,5-Dimethylthiazol-2-yl)-2,5-diphenyltetrazolium bromide) to colored formazan products. This can be dissolved by the addition of dimethyl sulfoxide and quantified by measuring the absorbance at 570 nm. We observed that rosehip extracts decrease the viability of LNCaP cells in a dose-dependent manner. In LNCaP cells, the PI3K (phosphoinositol 3-kinase)/Akt signaling pathway is constitutively active which confers growth advantage to the cells. This is due to a mutation in PTEN (phosphatase and tension homologue) protein, a negative regulator of PI3K signaling pathway. Western blot analysis will be utilized to see the signaling pathways targeted by rosehip extract including PI3K/Akt pathway.

(Th.15) Evaluation of a diverse compound library as MRSA virulence modulators

Matthew Hendrix, Mikaela Seemann, Kyra Gillard, Jennifer Marshall, Juliana O'Brien, Andrew Wommack and Meghan Blackledge*
Department of Chemistry
High Point University

Antibiotic resistance has become a widespread issue in the medical profession. Previously effective antibiotics, such as penicillin, have become less effective as a result of the evolution of different bacterial defense mechanisms that bypass an antibiotic's ability to kill or prevent bacterial growth. Methicillin-resistant *Staphylococcus aureus* (MRSA) is a bacterium that has become highly resistant to β-lactam antibiotics. Development of novel antibiotics has slowed considerably over the last three decades, necessitating novel approaches to combat antibiotic resistant bacterial infections. One new approach is the use of antibiotic adjuvants. Antibiotic adjuvants are non-toxic compounds that, when combined with an antibiotic, enhance the ability of an antibiotic to kill bacteria. In previous work, our group has identified amoxapine, a tetracyclic amine antidepressant, as possessing moderate adjuvant activity against MRSA when combined with β-lactam antibiotics. To identify important structural features responsible for the observed adjuvant activity, we screened 31 structurally-related compounds for their ability to repotentiate MRSA to oxacillin. Through our efforts, we have identified several structural motifs required for adjuvant activity that will inform the syntheses of future derivative libraries.

(Draelos Poster Session) Spectrophotometric quantification of glutathione and glutathione disulfide in healthy volunteers using a novel glutathione formulation

Georgia Howell[1], Brianna Bruggeman[2], James Smoliga[3], Colin Carriker[4], and Andrew Wommack[2,*]
[1]High Point Central High School
[2]Department of Chemistry
[3]Department of Physical Therapy
[4]Department of Exercise Science

High Point University

The aim of this research is to observe the effectiveness of an oral glutathione (GSH supplement by administering the supplement to healthy, young male participants. To study the proprietary GSH supplement, blood is then taken at six time points: pre-supplement and at 5, 10, 30, 60, and 120 minutes post-supplement. Each collection is separated into erythrocyte lysate, protein and plasma fractions. Then, using a spectrophotometric assay for each of these fractions, the amount of GSH is determined by monitoring the reaction of GSH with 5,5'-dithio-bis (2-nitrobenzoic acid) (DTNB) to form 5'-thio-2-nitrobenxoic acid (TNB), which characteristically absorbs at 412 nm. Glutathione disulfide (GSSG) is quantified in a similar manner, where 2-vinylpyridine is used to first covalently react with endogenous GSH, then using glutathione reductase and NADPH, each GSSG is processed into two molecules of GSH. Overall, the assay has two parts: fraction preparations and spectrophotometric quantification. Literature precedent supports our preliminary data, in that the plasma samples have low micromolar concentrations of whole GSH, while the protein and erythrocyte lysate samples both contain high micromolar concentrations of GSH. Our work is ongoing to confirm the efficacy of the current GSH supplement formulation.

(Th.7) Implementation of 3-Color single-molecule fluorescence correlation spectroscopy

Brandon Inscoe, Samuel Mycroft and Keir Fogarty*
Department of Chemistry
High Point University

In our project, we constructed an instrument capable of 3-color single-molecule fluorescence detection. Fluorescence emission of light from a dilute solution of single fluorescence molecules excited by a laser was analyzed using fluorescence correlation spectroscopy (FCS). In FCS, a laser is focused to a diffraction-limited spot (~10^{-15} L). Fluorescence fluctuations caused by single molecules moving through this region are monitored by an avalanche photo-detector (APD), and analyzed in a house-made Python program. In the resulting analysis, fluctuation frequency yields the concentration of the solution, fluctuation duration yields molecular mobility/kinetic information, and the fluctuation amplitude yields the brightness of the fluorescent molecules. The 3-color instrument was tested using 10 nM solutions of fluorescein, rhodamine 6g and rhodamine b dyes, excited by a 488 nm aqua laser, 514 nm green laser and a 568 nm yellow laser, respectively. The autocorrelation function data collected from the three dyes was used to characterize the excitation volumes generated by the three lasers.

(Draelos Poster Session) Development of laboratory experiments for CHM 3111 course on nanomaterials

Yasa Jasim[1], Kaylee Campbell[2], Michael Welter[3], Brian Augustine[2] and Pamela Lundin[2,*]
[1]T. Wingate Andrews High School (High Point, NC)
[2]Department of Chemistry
[3]Department of Physics
High Point University

The goal in this project was to demo laboratory experiments for the upcoming Fall 2017 CHM 3111 course on nanomaterials. One of the experiments included the synthesizing of two amphiphilic molecules (10-2-10, and 12-2-12) and the determination of the critical micelle concentration (CMC) by dye fluorescence and solution conductivity. The outcome of 10-2-10 was that 8.0 mM concentration was enough to create a micelle, and for the 12-2-12, the outcome was 5.0 mM. The second experiment was the development of a laboratory on how polymer coatings, on drug-containing particles affects the release rate of the drug. The desired result is to have a coating that controls the delay time to allow slow release of the drug to maximize its efficacy by minimizing clearance from the body. Another lab that was tested was the synthesis and characterization of perovskite $CsPbBr_3$ quantum dots. These quantum dots were characterized by UV-vis and SEM. Finally, the last experiment that was demoed was the process development of lithography. This experiment specifically included the use of UV light to create a geometric pattern from a photomask to add a light-sensitive chemical, called a photoresist, onto silicon.

(Fr.4) Formation and characterization of nanoporous poly(methyl methacrylate) thin films via spin casting

Sarah Jiudice[1], Kaelyn Whetzel[2], Christopher Hughes[2] and Brian Augustine[1,*]
[1]Department of Chemistry
High Point University
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The formation of a multi-layer micro or nanoporous film could be a critical advancement in diverse technologies such as biomedical membranes, water filtration, and high efficiency batteries. With a fabrication technique that is more simple and cost-effective than current techniques, we were able to produce a multilayered nanoporous structure with an average pore diameter of less than 1 μm and a layer thickness of approximately 60 nm. Nanoporous films were produced by spin-casting 996,000 g/mol poly(methyl methacrylate) (PMMA) dissolved in tetrahydrofuran (THF) at a concentration of 15 mg/mL onto cleaned silicon at a spin speed of 800 rpm. In attempts to reproduce this effect on different substrates, namely commercially available commodity PMMA and soda-lime glass, a variety of pre-deposition substrate treatments were examined. The substrates were treated with a standard clean, a Piranha clean (conc. H_2SO_4:20% H_2O_2 in a 3:1 ratio at room temperature), a Piranha clean followed with a self-assembled monolayer coating of silane (4-bromo-N-(3-(triethoxysilyl)propyl)benzamide), and a standard clean with a layer of SiO_2 deposited via electron beam evaporation. The standard clean consisted of a 5 min sonication in acetone, followed by 5 min in isopropyl alcohol, then 5 min in deionized water with compressed N_2 drying between each step. Surface topography was then then imaged using an atomic force microscope (AFM) operating in contact mode. It was found that the desired nanoporous and layered PMMA microstructure could be observed on the standard cleaned silicon, SiO_2 coated silicon, and SiO_2 coated PMMA, but was not observed with standard cleaned PMMA or any soda-lime glass based substrates. In order to understand this phenomena, we have been investigating the effect of the substrate surface hydrophobicity via contact angle measurements on layer formation and more closely examining the surface chemistry behind the layer formation. Ultimately, we would like to be able to suspend this nanoporous film over a more mechanically robust surface in order to utilize as a water filtration device.

(Th.4) Dietary flavonoid fisetin inhibits expression of fatty acid synthase and induces apoptotic cell death in LNCaP prostate cancer cells

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Over the course of a lifetime, approximately one in seven American men will develop prostate cancer. Within the first seven months of 2017, there have been roughly 161,360 newly diagnosed cases of prostate cancer in the U.S. Fisetin (3,3′,4′,7-tetrahydroxyflavone) is a flavonoid derived from plants such as strawberries. It is known that FASN (fatty acid synthase) is overexpressed in many cancers including prostate cancer. FASN provides a key catalytic reaction in the *de novo* synthesis of fatty acid. FASN induces elevated rates of fatty acid synthesis and promotes cancer cell growth by providing an energy source, membrane lipids and signaling lipids. Recent studies suggest that fisetin inhibits growth of prostate cancer cells, both in vitro and in vivo. Previously, we observed that fisetin decreases the energy level in prostate cancer cells. Therefore, FASN could be a potential therapeutic target in prostate cancer. We treated LNCaP prostate cancer cells with various concentrations of fisetin for 24 and 48 hrs. Cell viability assay showed a decreased number of viable cells after fisetin treatment. Using Western blot analysis, we found that fisetin induces apoptotic cell death and inhibits FASN expression. We also detected metabolic stress in LNCaP cells when treated with fisetin. Further analysis will be conducted using RT-PCR and immunocytochemistry to verify the effect of fisetin on FASN. We will also analyze the levels of the key FASN transcription factors after fisetin treatment. Our data show that fisetin could be a useful agent for treatment of prostate cancer.

(Fr.6) Tat-SF1's role in HIV RNA stability

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Tat specific factor 1 (Tat-SF1) is a human protein that is a known host factor for Human Immunodeficiency Virus (HIV). The molecular mechanism of Tat-SF1 in HIV propagation is still unknown, but knockdown of Tat-SF1 in human cell lines was found to decrease the infectivity and alter the relative levels of the different RNA size classes of HIV. Possible roles for Tat-SF1 include nuclear export, splicing and stability of viral RNAs. Current research aims determine the role of Tat-SF1 in the stability of viral RNA within human cell lines. If Tat-SF1 is involved in RNA stability, then knocking down gene expression for Tat-SF1 would cause the viral RNA to degrade at a different rate than control cells. HeLa cells were grown, transfected with enhanced green fluorescent protein (EGFP) and Tat-SF1-specific shRNAs, transfected with HIV-encoding plasmids, and treated with actinomycin D to stop further transcription. Transfection efficiency was estimated through fluorescence microscopy. RNA was purified and reverse transcription was used to synthesize cDNA for qPCR analysis. Transfection efficiency was estimated to be 40-50%. Total RNA was successfully isolated and purified from all samples, as assessed by spectrophotometry and agarose gel electrophoresis. Genomic DNA contamination was effectively removed. Quantification of plasmid DNA contamination and RNA stability is forthcoming. Together, this work will add to the field's knowledge of how Tat-SF1 regulates HIV gene expression.

(Th.8) Merging copper and photoredox catalysis to improve Chan-Lam cross-coupling reactions

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The current study has improved the efficiency of the copper-catalyzed Chan-Lam coupling reaction using a ruthenium-based photoredox cocatalyst. The Chan-Lam reaction traditionally facilitates the oxidative cross-coupling of aryl boronic acids with arylamines with moderate yields. The addition of the Ru-photoredox cocatalyst in our current Chan-Lam coupling reaction expands the substrate scope to both electron-poor and electron-rich boronic acids, and importantly now facilitates the coupling of unactivated alkylamines to electron poor boronic acids. Initial studies using the modified Chan-Lam reaction conditions with the photoredox cocatalyst have provided robust substrate scope with desired efficiency. Although much is known about the copper-based catalytic cycle, our future studies seek to elucidate at which point or points in the cycle that the photoredox catalyst is involved.

(Th.18) Using fluorescence correlation spectroscopy (FCS) to observe how pH affects green fluorescent protein (GFP) fluorescence emission

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Our goal is to investigate the dependence of the fluorescein emission of Green Fluorescent Protein (GFP) on pH by using fluorescence correlation spectroscopy (FCS). FCS measures temporal fluctuations in molecular fluorescence emission by focusing light on a small sample and generating a correlation function that provides an analysis on the kinetics and diffusion time as said particles pass through the excitation volume. The ability of FCS to look at processes that affect fluorescence allows us to investigate the dependence of GFP fluorescence on pH. The hydroxyl group on tyrosine, one of the amino acids responsible for GFP's fluorescent properties, is protonated and not fluorescent at a low pH, while it is deprotonated and fluorescent at a high pH. The rate of reaction, or the rate in which tyrosine's hydroxyl group is protonated and then deprotonated, decreases as pH increases, because there are less hydrogen protons available for protonation. Because this pH-dependent process is constantly fluctuating and FCS provides insight regarding the fluctuation of fluorescent processes, a flickering light can be observed through FCS detection. However, FCS measures the characteristic timescales of both diffusion and protonation kinetics, so we investigated altering solution viscosity to resolve both processes by separating mobility from kinetics, thus making the kinetics easier to observe.

(Th.9) Methods for the phylogeny rebuilding of *Liatris*

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We worked on identifying the phylogenetic and evolutionary relationships in the genus *Liatris*, a genus of plants in the Asteraceae family. Previous work in this genus has relied on only 1-3 genetic markers which have not been sufficient to identify the genetic relationships between the species. To resolve the phylogenetic tree of *Liatris* we screened universal markers that have been developed for the Asteraceae family for use in the many species that make up *Liatris*. We tested about 90 of the 192 markers for success in the different species of *Liatris*. To test the genes, we performed PCR reactions to amplify the gene regions, used gel electrophoresis to check for proper amplification, and sequenced the resulting DNA fragments. Once the DNA samples were finished with sequencing, Codon Code and BioEdit were used to align and trim the genetic sequences. Of the 90 tested markers, 16 were successfully sequenced and aligned for our phylogenetic analysis. We have produced drastically more genetic information than what was previously available for this genus. With the additional information that was found we will have a better understanding of the relationships between the species in *Liatris* and the genus will have a better resolved phylogenetic tree.

(Th.13) Using single chemical exposures to de-orphanize odorant receptors in *Drosophila melanogaster*

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We raised two-day-old male *Drosophila melanogaster* cohorts in identical light and temperature conditions, exposing each to a single chemical stimulus (or a "no odor" control) for two hours in chambers devoid of other chemical stimuli. We microdissected antennae from desiccated tissue to enrich olfactory transcripts. We used qRT-PCR to measure relative gene abundance associated with the differing olfactory experiences, using primers designed to target several of a family of olfactory receptor (OR) genes. We hypothesized that ORs whose expression are most dramatically affected by intense exposure to a given chemical will correspond to the receptor known to be responsive to that chemical, thus highlighting ligand/receptor pairs. This approach, if validated, would provide a convenient method to de-orphanize insect chemoreceptors and thus sidestep the need for gene knockout or transgenics to confirm receptor function. Once paired with total polyA RNA-sequencing, this approach could highlight genes not currently known to be involved in the chemosensation of economically important chemicals like DEET. These molecular targets could be further screened to identify and develop novel insect behavior-altering chemicals. The neurophysiology underlying our results are discussed.

(Draelos Poster Session) Gastrointestinal barrier permeability and associated inflammatory response during exercise at simulated altitude

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Intense exercise at altitude can reduce blood flow to the gut by >70%. This study tested whether ischemic stress during exercise at altitude also promotes gastrointestinal barrier permeability and a pro-inflammatory response. Subjects (N=5) completed two 60 min treadmill runs at a workload equivalent to 60% VO_{2max}. One was performed at sea level (F_IO_2=21%) and the other at 13,250 ft of simulated altitude (F_IO_2=14%). Blood samples were collected before (PRE), after (POST), 1hr (1-POST), and 4hrs after (4-POST) exercise. From these samples the circulating concentration of I-FABP (indicator of gut permeability/damage) and markers of leukocyte activation (CD14, GM-CSF, ICAM-1, IL-8, MCP-1) as well as inflammatory status (TNFα, IL-1β, IL-6, IL-10) were measured with ELISA. Data were analyzed with Two-Way RM-ANOVAs (Condition*Time) with statistical significance set at $p \leq 0.05$. Newman-Keuls *post hocs* were run where appropriate. I-FABP and IL-8 rose with exercise at simulated altitude but not when exercise was performed under normoxic conditions. IL-6 rose with exercise in both conditions but to a greater degree under simulated altitude. CD14, ICAM-1, and IL-10 were also significantly higher when exercise was performed at simulated altitude. Preliminary data suggest that exercise at altitude increases gastrointestinal barrier permeability. This may contribute to greater leukocyte activation, as indicated by the higher levels of IL-8 which is a known neutrophil chemotactic factor. Elevated circulating concentrations of CD14 and ICAM-1 suggest that TLR4-mediated inflammatory signaling cascades may also be increased. Collectively, these data suggest that gastrointestinal barrier permeability during exercise at altitude may be a previously unrecognized contributor to acute mountain sickness-associated symptomology.

(Th.12) Investigating Tat-SF1 interactions with HIV RNA

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Little is known about the human protein Tat-specific factor 1 (Tat-SF1) and its role in the production and regulation of the Human Immunodeficiency Virus (HIV). Tat-SF1 has been shown by several groups to be an HIV dependency factor and promote HIV infection, but the molecular mechanism behind this is unclear. Possible roles in HIV alternative splicing, stability and/or export of RNA have been proposed. All of these roles would dictate an interaction between the human host factor and the viral RNA, but this has yet to be shown experimentally. Our current research attempts to describe how Tat-SF1 interacts with viral RNA during HIV production by using an *in vitro* approach. First, recombinant DNA was engineered by cloning the coding sequence of Tat-SF1 into a bacterial expression vector that contained a glutathione S-transferase (GST) tag. Individual colonies underwent PCR screening and Sanger sequencing to identify a positive clone. Using isopropyl β-D-1-thiogalactopyranoside (IPTG) to induce transcription, we successfully expressed Tat-SF1 in *E. coli*. Expression levels were optimized and confirmed by western blotting. Affinity purification of GST::Tat-SF1 was also completed. Finally, preliminary data on the creation of HIV RNAs *in vitro* will be presented. Together, this work will add to the field's knowledge of how Tat-SF1 regulates HIV gene expression.

(Th.2) Phylogenetic relationships between species in the genus *Liatris*

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Gayfeathers or blazing stars are perennial plants in the genus *Liatris*. They provide aesthetic value as an ornamental plant and serve as host plants for butterflies and other insects. Discrepancies and a lack of information surrounding previously developed phylogenic trees for the perennial plant has led to our quest to learn more about the evolutionary relationships amongst the 29 species. We used specific genetic markers developed for the Asteraceae family and DNA from the 29 species of *Liatris*, to create a more informative phylogeny. The multitude of markers used will provide a more detailed phylogeny compared to previous phylogenies that used an insufficient number of markers. We will also review the classification, geographic distribution, and biology of *Liatris* to provide more information about this precious species.

(Th.5) Microfabrication applications of soft lithography

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In soft lithography, a flexible elastomeric stamp with patterned relief structures on its surface is used to generate patterns with feature sizes ranging from 30 nm to 100 μm. The structures on the stamp's surface are a relief of a chrome-etched, glass master designed in a 3D rendering software. However, the chrome layer is only a few hundred nm thick, which is not tall enough to create a stamp with prominent features. Therefore, we developed the master's image on silicon wafers using a UV light-activated photoresist, whose relief has a thickness of about 10 μm. These wafers could then be cleaved and reserved as reusable and inexpensive masters. Using the silicon masters as a substrate, PDMS was poured on its features and cured, producing a flexible yet durable "stamp" that could be used in soft lithographic techniques such as micromolding in capillaries (MIMIC) and micro-contact printing (μ-CP). MIMIC involves placing the PDMS stamp on a flat substrate, injecting a solution along the edge, allowing the solution to dry and then removing the stamp. This technique relies on capillary force—the ability of a liquid to flow in narrow spaces without the assistance of, or even in opposition to, external forces. μ-CP is a form of microfabrication that uses the relief pattern on the surface of the PDMS stamp to form patterns of self-assembled monolayers (SAMs) on the surfaces of substrates by contact with a molecule that can react with the substrate acting as the ink. We produced stamps from a mask with 5, 10, 15 and 20 μm features for MIMIC and μ-CP. Analyses performed with a scanning electron microscope (SEM) confirmed the successful transfer of mask features to PDMS stamps—5.00 ± 0.70 μm wide features, 10.00 ± 0.25 μm wide features, 15.00 ± 0.40 μm wide features and 19.40 ± 0.20 μm wide features all with heights of ~10 μm. Observation with an optical microscope confirmed successful capillary action through each feature size.

(Fr.7) Pigment profiles of purple, green, and spotted morphotypes of crane-fly orchid, *Tipularia discolor*

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The crane-fly orchid (*Tipularia discolor*) is a perennial, terrestrial orchid native to woodlands of the southeastern United States. In the Piedmont of North Carolina, three different colored morphotypes occur sympatrically in the forest understory during winter, exhibiting leaves with adaxial (upper) surfaces that are either solid green, solid purple, or green with purple spots. It is currently unknown why individuals differ in phenotype, and possible explanations include differential abiotic stress, pathogen infection, and/or genetics. In the current study, we used analytical HPLC techniques to quantify the concentrations of photosynthetic pigments present in the three morphotypes, and to determine which type(s) of anthocyanin were present as well. This data will help us to determine whether the plants differ in relative abiotic stress, since the proportions and ratios of plant pigments are known to vary with such factors as nitrogen deficiency, heavy metal toxicity, high-light, and cold temperatures.

(Fr.5) Using a GPU to compute polarization of a metal block

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The goal of this project is to calculate the polarization of a metal block due to the electric field of an external charged particle using parallel computation on a NVIDIA GPU using CUDA (Compute Unified Device Architecture). When a charged particle is brought near a neutral metal object, the electrons distribute along the surface of the metal in such a way that the net electric field inside the block approaches zero. During this process called the transient, we use the GPU (Graphics Processing Unit) to simultaneously calculate the charge on each piece of the surface of the metal object. To check the accuracy of the calculation and the improvement in performance provided by CUDA, we compare results to a previous program written by Bruce Sherwood in Python. In this presentation, I will present: the physics of polarization, the scientific computing capabilities of the GPU, and the results of our program.

(Th.6) Genetic characterization of chemosensation in a terrestrial isopod: evolution of olfaction in woodlice

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Common pill bugs (*Armadillidium vulgare*) represent one of more than 3600 species of terrestrial isopods, most of which belong to the suborder Oniscidea. Considered an opportunist and scavenger, *A. vulgare* primarily feeds on decaying plant matter. The spatial memory of nutrient rich versus nutrient poor locations in *A. vulgare* suggests these animals have functional olfactory organs. Other species within Oniscidea, like *Porcellio scaber*, demonstrate the ability to detect airborne metabolites from leaf litter. Several species within this suborder are specifically attracted to odors of conspecifics but not to other species. Aldehydes have been shown to stimulate antennal sensory neurons in Oniscidea. It remains uncertain as to when lineages associated with modern *A. vulgare* first became sensitive to chemicals with relatively high vapor pressures. We hope to establish the first antennae of *A. vulgare* as the primary olfactory appendage in adults by demonstrating its necessity in two-choice and radial behavioral assays. Simultaneously, we are conducting *de novo* RNAseq analyses to curate highly expressing antennal specific transcripts. Genes of the terminal two segments of the first antennae of *A. vulgare* represent likely mediators of important olfactory-dependent behaviors like feeding and mating. BLAST queries using these sequences will reveal the genetic underpinnings of olfaction in terrestrial crustaceans. Annotation of olfactory or otherwise chemosensory genes in this species will provide the basis for comparative studies of the independent, yet synonymous origins of olfaction in insects and crustaceans.

More scenes from SuRPS 2017

(A.) BCA assay from Suh lab; (B.) Fluorescence microscopy of breast cancer cells from Srougi Lab; (C.) Laser data from Fogarty Lab ; (D.) Fluorescence microscope in Srougi lab; (E.) Fogarty lab; (F.) Field work in Hughes lab; (G.) Prostate cancer cell images from Suh lab; (H.) Miller lab; (I.) HPLC in Wommack Lab; (J.) SEM Image from Lundin lab; (K.) PCR analysis in Viguiera Lab; (L.) SEM of pill bug antenna from Sparks lab; (M.) Lab prep in Sparks lab; (N.) Dyed beads in Lundin lab; (O.) Plate assay in Blackledge lab; (P.) AFM image from Augustine lab; (Q.) JSNN Cleanroom from Augustine lab. (R.) HPLC trace of plant dyes from Hughes lab; (S.) Columns in Blackledge lab; (T.) Human RNA gel electrophoresis from Miller lab; (U.) Blue LED initiated-reaction in Wommack lab; (V.) Sample prep in Lundin lab.