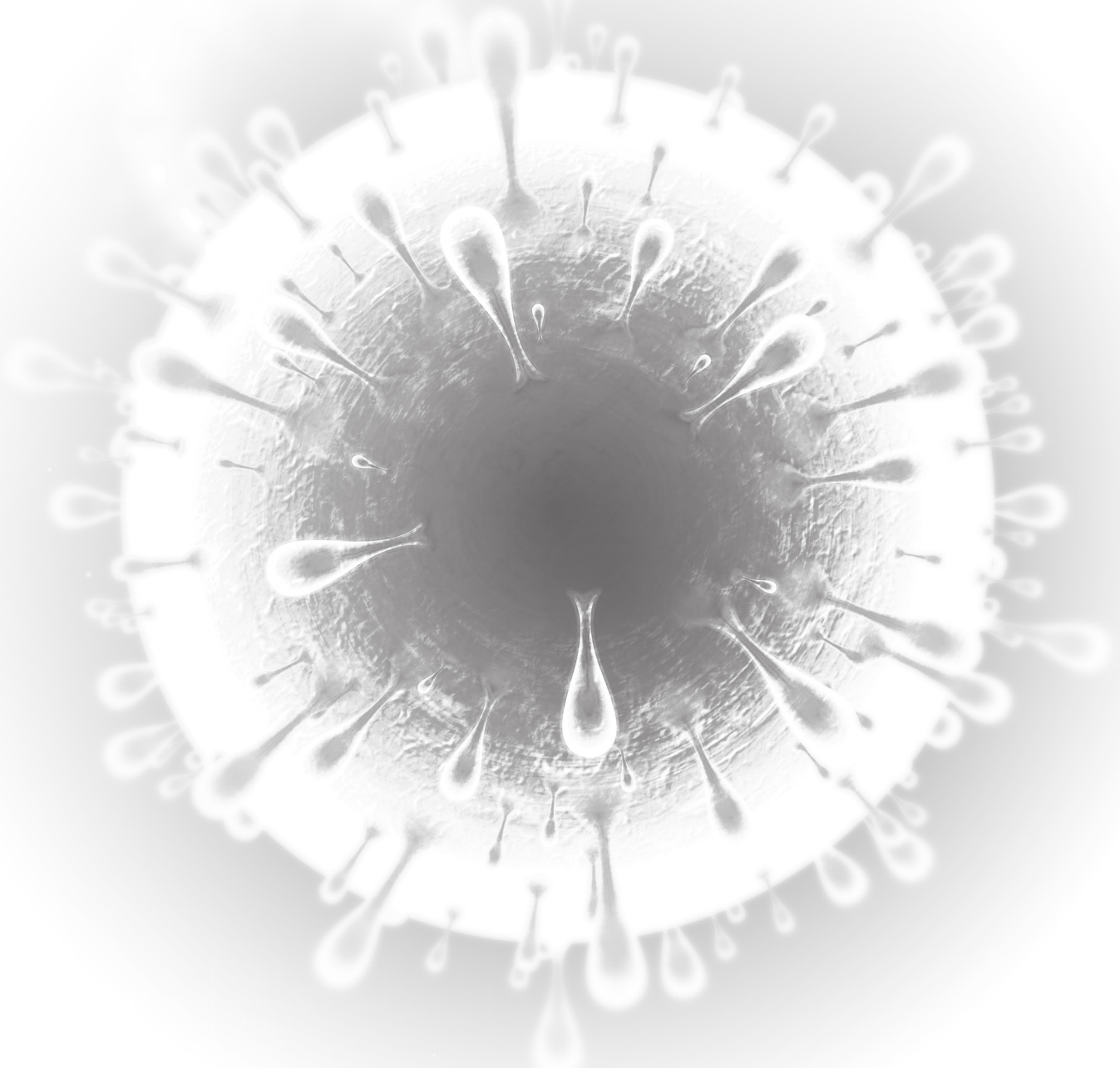


Auburn University at Montgomery

School of Sciences

Undergraduate Research Symposium



April 4, 2014

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The Auburn Montgomery School of Sciences
Presents
The 2014 Undergraduate Research Symposium

On behalf of the faculty, staff and students of the School of Sciences, I'd like to welcome you to the sixth annual Undergraduate Research Symposium. Undergraduate research allows our students the opportunity to go beyond studying science to actually practicing science: forming hypotheses, designing experiments, analyzing data, and thereby making their own contributions to a better understanding of the world. Research is a difficult but rewarding enterprise, and the projects presented here represent a significant commitment of time and energy on the part of both the students and their faculty mentors. I applaud their dedication and invite all of you to enjoy these results of their efforts.

Dean of the School of Sciences

Dr. Karen E. Stine

Undergraduate Research Committee

Dr. Steve Arnold – Chemistry

Dr. Bridgette Harper – Psychology

Dr. Kalu Kalu – Political Science and Public Administration

Dr. Enoch Lee – Mathematics

Dr. Barr Younker – Justice and Public Safety

Dr. Chelsea Ward – Biology

Schedule of Events

8 - 8:30 a.m.	Registration Goodwyn Hall Lobby - coffee and snacks provided
8:30 – 8:45 a.m.	Opening Remarks Goodwyn Hall 112
8:45 – 9:45 a.m.	Oral Presentations Goodwyn Hall 112
9:45 a.m. – 11:15 p.m.	Poster Session Goodwyn Hall Lobby
11:15 – 11:45 p.m.	Lunch (provided) Goodwyn Hall Lobby
Noon	Awards Ceremony and Closing Remarks Goodwyn Hall 112

Talks

1. Ecological systems with aggregation, grazing, and Sigma-shaped bifurcation curves

Lyndee Bobo, Zach Burnett,
Heather Pierce

Mentor: Jerome Goddard II
Department: Mathematics

2. Effect of *Amblyomma rotundatum* on *Rhinella marina* leukocyte counts

Amanda Wallis

Mentors: Chelsea Ward and N. Robert Estes II
Department: Biology

3. Metal Ion Stimulated Saccharification of Biomass by Cellulolytic-Xylanolytic Enzymes Complex of *Trichoderma* species SG2

Sharla Rafferty, Christiane Ingram,
Andrew Paulk

Mentor: Benedict Okeke
Department: Biology

Poster Session

1. Phenotypic characteristics of common gram-negative uropathogens and preliminary FTIR analysis

Aaron A Hupp

Mentors: Li Qian and J. M. Hou
Department: Biology (Medical Technology)

2. An examination of external political efficacy and its effect on political and campus organizational participation on a southern campus

Elizabeth Jenks

Mentor: Bradley Moody and Pia Knigge
Department: Political Science

3. Comparison of sensitivity rates of antibiotics against common uropathogens in Central Alabama between 2011 and 2012

Jason R. Perez, Bonnie M. Cotton

Mentor: Li Qian and Tracy Camara
Department: Biology (Medical Technology)

4. Antimicrobial activity of 4-alkyl-5-hydroxybutenolides

William T. Heartsill, Jasey Stevenson,
N. Robert Estes II

Mentor: John M. Hutchinson and Adley Damron
Department: Chemistry and Biology

5. Simultaneous production of cellulolytic-xylanolytic-amylolytic enzymes for saccharification of biomass mixtures

Christiane Ingram, Sharla Rafferty,
Andrew Paulk

Mentor: Benedict Okeke
Department: Biology

5. Simultaneous production of cellulolytic-xylanolytic-amylolytic enzymes for saccharification of biomass mixtures

Christiane Ingram, Sharla Rafferty,
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Department: Biology

6. Nerve growth factor overlaps with insulin signaling

Maryum Qayum* and Troi Bateman

Mentor: Geetha Thangiah
Department: Chemistry

7. The effects of stigma on HIV/AIDS

H. Chuck Cofty

Mentor: Clarissa Arms-Chavez
Department: Psychology

8. Leadership perceptions of racial bias in law enforcement

Kanesia K. Wallace

Mentor: Lisa Zanglin
Department: Organizational Leadership

9. Functionality and TSP NTD Stability Mutants

Shelby Nunnelee

Mentor: Robert Villafane
Alabama State University, STEM Scholar

ABSTRACTS



Ecological systems with aggregation, grazing, and Sigma-shaped bifurcation curves

Lyndee Bobo, Zach Burnett, Heather Pierce

Mentor: Jerome Goddard II

Mathematics

Population models built upon the reaction diffusion framework have provided important biological insight into the patch-level consequences of various assumptions made on individual behavior in ecological systems. Such models have seen enormous success both in their empirical validation with actual spatio-temporal distribution data and their ability to yield general conclusions about an ecosystem based on the analytical results of theoretical models. Even with these great successes, the varied dynamics of theoretical reaction diffusion models are still not fully understood. In this talk, we will explore the dynamics of a logistic population model on a one-dimensional domain with hostile boundary, aggregation modeled by modifying the diffusion term, and grazing, i.e. a form of natural predation, via study of the model's positive steady state solutions. We obtain results through use of the quadrature method and Mathematica computations. Specifically, we computationally ascertain the existence of Sigma-shaped bifurcation curves and will briefly explore their biological implications.

The effects of stigma on HIV/AIDS

H. Chuck Crofty

Mentor: Clarissa Arms-Chavez

Psychology

Stereotypic prejudicial responses are innate reactions in the recognition-response process in humans. The two-session experiment investigated the impact of subject personalization on individual reaction times towards learned and novel targets diagnosed with either HIV/AIDS or cancer. The theory was tested by assessing each participant's individual reaction time to positive/negative words which were associated with learned/novel targets. During the first session, participants learned individuating information concerning disease diagnosis and acquisition for 16 different targets. Forty-eight hours after the initial session, participants returned to complete session two. The implicit measure of prejudice used was the Lexical Decision Task (LDT), which measures the rate of association between positive/negative words and learned/novel stimuli. It is hypothesized that participants will have a shorter reaction time in response to positive words associated with subjects who are female, have a diagnosis of cancer, and are considered not to be at fault for disease acquisition. However, it is also hypothesized that participants will have a shorter reaction time in response to negative words associated with subjects who are male, have a diagnosis of HIV/AIDS, and are considered to be at fault for disease acquisition.

Antimicrobial activity of 4-alkyl-5-hydroxybutenolides

William T. Heartsill, Jasey Stevenson and Adley Damron

Mentor: John M. Hutchison and N. Robert Estes II

Chemistry and Biology

The butenolide and 5-hydroxybutenolide are common moieties found in a variety of synthetically useful compounds, several natural products, and drugs with diverse biological activities. As part of an on-going project to discover new anti-microbial compounds, several 4-alkyl and 4-aryl-5-hydroxybutenolides have been synthesized and tested against a variety of bacteria strains. This study has revealed key structural features in butenolide-containing compounds necessary for bacterial growth inhibition.

Phenotypic characteristics of common gram-negative uropathogens and preliminary FTIR analysis

Aaron A. Hupp

Mentor: Li Qian and Harvey J. M. Hou

Biology (Medical Technology)

Urinary tract infections (UTIs) are the most common infectious diseases among both inpatients and outpatients. *Escherichia coli*, *Pseudomonas aeruginosa*, *Klebsiella pneumoniae*, *Enterobacter cloacae*, and *Proteus vulgaris* are the leading Gram-negative bacteria to cause UTIs. Rapid identification of them is challenging with traditional methods. FTIR is a quick and inexpensive bacterial identification technique. The purpose of this study was to show phenotypic characteristics of five Gram-negative bacteria and preliminary Fourier Transform Infrared (FTIR) analysis. Gram-stain and biochemical reactions were performed on each of the five bacteria to show their phenotypic characteristics. Acetonitrile, xylenes, acetone, chloroform, cyclohexane, and methanol were used to extract each bacterium for FTIR measurement. Their IR spectra were analyzed by Omnic software. Preliminary data indicates acetone and methanol are the promising solvents for the signature analysis of bacteria using FTIR, especially *Klebsiella pneumoniae*. Future effort will be to increase the quantity of bacterial extraction to enhance the extraction efficiency.

Simultaneous production of cellulolytic-xylanolytic-amylolytic enzymes for saccharification of biomass mixtures

Christiane Ingram, Sharla Rafferty, Andrew Paulk

Mentor: Benedict Okeke

Biology

Plant biomass is the most abundant renewable feedstock for production of biofuel. The natural fungal isolate, *Trichoderma sp.* SG2 is a strong producer of β -glucosidase, xylanase and cellulase. This study explored co-production of cellulolytic-xylanolytic-amylolytic enzymes complex of *Trichoderma sp.* SG2 for biomass saccharification to sugars for biofuel production. Cell-free culture supernatant of *Trichoderma sp.* SG2 grown in lignocellulose medium displayed strong cellulolytic-xylanolytic-amylolytic activities. Assays conducted with 10 times dilution of the cellulolytic-xylanolytic-amylolytic culture supernatant grown in lignocellulose medium revealed as much as 52.54 units/ml/30 min, 405.64 units/ml/30 min and 195.88 units/ml/30 min of cellulase, xylanase and amylase, respectively. The multi-functional cell-free culture supernatant of *Trichoderma sp.* SG2 is under study for co-saccharification of plant biomass mixture to sugars for bioethanol production.

An examination of external political efficacy and its effect on political and campus organizational participation on a southern campus

Elizabeth Jenks

Mentors: Bradley Moody and Pia Knigge

Political Science

In order to examine the relationship between external political efficacy and participation in campus organizations, and the relationship between external political efficacy and participation in political activities, this research will use a survey instrument that will include 10 questions as well as items asking participants about their gender and religious and campus affiliation. Using the data collected, we will examine the influence of parental organizational and political participation on external political efficacy and the organizational and political participation of students. We believe we will find that: individuals who are active in campus organizations will also be more likely to participate in political activities; individuals who are active in campus organizations will report higher levels of external efficacy; individuals whose parents participated in campus organizations will be more likely to participate in campus organizations; and individuals with higher levels of external efficacy will be more likely to have parents who are active in politics and civic organizations. We ultimately hope to find a relationship between expressions of external political efficacy and membership in Greek organizations in order to foster a discussion on the culture perpetuated in, and the benefit obtained by, membership in Greek organizations. We will conclude our study with a discussion of the implications of our findings and the success or lack thereof with our research design.

Comparison of sensitivity rates of antibiotics against common uropathogens in Central Alabama between 2011 and 2012

Jason R Perez and Bonnie M Cotton

Mentor: Li Qian and Tracy Camara

Biology (Medical Technology)

Approximately 40 to 50 percent of women have at least one urinary tract infection (UTI) episode during their lifetime. The treatment of UTIs in both inpatients and outpatients has become more difficult due to increased antimicrobial resistance. The previous reports showed that sensitivity rates had geographic variability. The purpose of this study was to compare sensitivity rates of antimicrobial agents against common uropathogens in Central Alabama between 2011 and 2012. A total of 1466 catheterized urine cultures from inpatients and outpatients were collected - 692 in 2011 and 774 in 2012. Their susceptibility tests were performed according to the Clinical and Laboratory Standards Institute (CLSI) microdilution method. Sixteen antimicrobials were categorized as cephalosporins, other β -lactams, aminoglycosides, fluoroquinolones, and others (Trimeth/Sulfa-TMP/SMX, tetracycline, and nitrofurantoin). The top four uropathogens found in this study were similar in both years. *Escherichia coli* was the predominant organism (about 35 percent); followed by the *Enterococcus faecalis* (about 16 percent), *Klebsiella pneumoniae* (11 percent), and *Pseudomonas aeruginosa* (7 percent). There were no significant changes in the sensitivity rates of the antimicrobial agents between 2011 and 2012 in Central Alabama except for Piperacillin/Tazobactam (Pip/Tazo) and gentamicin; *Escherichia coli* showed an increased susceptibility rate from 92 percent in 2011 to 97 percent in 2012 for Pip/Tazo ($P < 0.05$) and *Pseudomonas aeruginosa* demonstrated an increased susceptibility rate from 56 to 77 percent for gentamicin during the two years ($P < 0.05$). The speculated explanation for the increased sensitivity rates was due to the limited use of the two antibiotics. The findings of this research will help monitoring the trend of antibiotic susceptible rates of the uropathogens and provide evidence for new guidelines of antibiotic selection to treat UTIs in this area.

**Metal ion stimulated saccharification of biomass by
cellulolytic-xylanolytic enzymes complex
of *Trichoderma* species SG2**

Sharla Rafferty, Christiane Ingram, and Andrew Paulk

Mentor: Benedict Okeke

Biology

The natural fungal isolate, *Trichoderma sp.* SG2 is a strong producer of cellulolytic and xylanolytic enzymes that act synergistically in lignocellulose biomass saccharification. This natural fungal isolate also produces amylase and is a better producer of β -glucosidase than the mutant (*Trichoderma* Rut-C30) employed in production of cellulase. This study firstly evaluated the effects of several metal ions on cellulase and xylanase activities. Metal ions that proved to stimulate cellulase and xylanase activities of *Trichoderma sp.* SG2 were selected and studied for biomass saccharification using cellulolytic-xylanolytic cell-free culture filtrate of *Trichoderma sp.* SG2 grown in lignocellulose medium. Analysis of reducing sugars as well as HPLC analysis of glucose and xylose in switchgrass hydrolysate revealed substantial promotion of biomass hydrolysis. Results suggest potential application of *Trichoderma sp.* SG2 in biomass saccharification for biofuel production.

Nerve growth factor overlaps with insulin signaling

Maryum Qayum* and Troi Bateman

Mentor: Geetha Thangiah

Chemistry

Nerve growth factor (NGF) is a neurotrophin that regulates survival, differentiation, and maintenance of sensory and sympathetic neurons. NGF can bind to two classes of cell-surface receptors, a high-affinity tyrosine kinase Trk receptor and a low-affinity p75NTR. The Trk receptor consists of three family members, including TrkA, TrkB, and TrkC. NGF causes TrkA autophosphorylation, which thereby recruits downstream signaling proteins and leads to cellular differentiation. Insulin binds to the insulin receptor (INSR) on the cell surface, leading to its autophosphorylation. In this study we report that TrkA has an NPXY motif and kinase regulatory loop similar to insulin receptor. NGF also phosphorylated the INSR at tyrosine 1146 and tyrosine 1150/1151 in the kinase activation loop similar to insulin. These results suggest that NGF might overlap insulin signaling in PC12 cells.

Leadership perceptions of racial bias in law enforcement

Kanesia K. Wallace

Mentor: Lisa Zanglin

Organizational Leadership

Bias-based policing is an important issue which police departments are constantly addressing and the public is routinely scrutinizing. Police officers interact with the public on a daily basis, and the perceptions of interactions can be based on various factors. In a quantitative study of a large metropolitan police department in Alabama, this study seeks to assess bias-based policing. The authors use a survey that measured bias-based policing in a previous study conducted in the Commonwealth of Virginia. The findings of the Alabama study conclude: 1) Caucasian-American and African-American police officers responses are significantly different in their perceptions of racial-biased policing; 2) police officers in management positions have perceptions of racially biased policing that differ considerably from those of officers in non-management positions; and 3) officers in both mid- and upper-level management positions perceive bias-based policing is unofficially supported.

Effect of *Amblyomma rotundatum* on *Rhinella marina* leukocyte counts

Amanda Wallis

Mentors: Chelsea Ward and N. Robert Estes II

Biology

Amblyomma rotundatum is a tick that bites reptiles and amphibians in several parts of the Americas. Many studies have reported that *A. rotundatum* infestation of *Rhinella marina* increases death rate for both wild and captive toads. However, little is known about the effects of *A. rotundatum* on the physiology of the organisms they parasitize. Changes in leukocyte counts would be expected due to the presence of non-self proteins. The aim of this experiment was to determine if varying degrees of infestation showed changes in leukocyte counts among *R. marina*. Twenty toads infested with different numbers of *A. rotundatum* were monitored for four months and leukocyte counts were completed monthly. We found no significant change in the percentage of circulating leukocytes among tick-infested toads. Lymphocyte number, however, showed a steady decrease over time in specimens.

Functionality and TSP NTD Stability Mutants

Shelby Nunnelee

Mentor: Robert Villafane

Alabama State University, STEM Scholar

The bacteriophage P22 tailspike protein (P22 TSP) has been extensively studied and has served as a model protein. It has been a model system for protein folding and protein aggregation, among other things. P22 TSP is also a model system for protein-protein interactions. When the phage assembles inside of the bacterial cell, the last step of its assembly is the attachment of the tailspike to the rest of the tailless virus particle (called the “head”). This is an example of protein-protein interaction. Another example of protein-protein interaction in this system is the ability of the trimeric N-terminal domain (NTD), the first 108 amino acids, to maintain its domelike structure. Protein stability is of major importance in the study of protein structure and function, especially given that most proteins exist on the brink of thermodynamic instability. The tailspike structure consists of a homotrimer of 666 amino acids per chain. The TSP consists of two domains, the NTD (108 amino acids) and the C-terminal domain (558 amino acids). Besides interacting with the rest of the virus structure, the TSP interacts with the bacterial cell surface. It is imperative that we understand what keeps the tailspike stable before we study how it interacts with the rest of the viral structure. Building on our previous research, our most recent studies sought to determine which amino acids were involved in maintaining the stability of the tailspike. The poster reflects the methods used and the outcomes.