Auburn University at Montgomery
Undergraduate Symposium

April 3, 2015

Presented by:
The Auburn University at Montgomery College of Arts and Sciences

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The Auburn Montgomery College of Arts and Sciences

Presents

The 2015 Undergraduate Research Symposium

On behalf of the faculty, staff and students of the College of Arts and Sciences, I'd like to welcome you to the sixth annual Undergraduate Research Symposium. Undergraduate research allows our students the opportunity to go beyond the classroom, and thereby make 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 College of Arts and Sciences
Dr. Michael Burger

Undergraduate Research Committee

Dr. John Hutchison — Chemistry
Dr. Bridgette Harper — Psychology
Dr. Kalu Kalu — Political Science and Public Administration
Dr. Jerome Goddard — Mathematics and Computer Science
Dr. Don Chon — Justice and Public Safety
Dr. Chelsea Ward — Biology

Schedule of Events

8–8:15 a.m.	Registration Goodwyn Hall Lobby (coffee and snacks provided)
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10–11:30 a.m.	Poster Session Goodwyn Hall Lobby
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12:50–1:20 p.m.	Lunch (provided) Goodwyn Hall Lobby
1:20 p.m.	Awards Ceremony and Closing Remarks Goodwyn Hall 109

Oral Presentations I

8:30 a.m. Decreased level of NGF in Alzheimer's disease human brain

Joshua Baker and Jake Sustarich — Mentor: Geetha Thangiah, Department: Chemistry

8:50 a.m. The contribution of pigment production to antibiotic resistance in *Serratia marcescens* Bacteria

Taylor Gregory, Kierra Hardy, Erika Rodgers, and Lauren Stephens — Mentor: Pryce L. Haddix, Department: Biology

9:10 a.m. Video games and the growing social acceptance of rape culture in America

Bobby K. Edwards — Mentor: Silvia Giagnoni, Department: Communication & Theatre

9:30 a.m. Ecological models with U-shaped density-dependent dispersal

Jordan Price* and Jordan Berry — Mentor: Jerome Goddard II, Department: Mathematics & Computer Science

Poster Session

1. The challenges of autobiography: An analysis of Art Spiegelman's *The Complete Maus*
Hannah Twitty — Mentor: Darren Harris-Fain
Department: English and Philosophy

2. DNA-based characterization of sulfate reducing bacteria for bioremoval of heavy metals
Pattrick Thomase, Kelsey Rodgers, and Christiane Ingram — Mentor: Benedict Okeke
Department: Biology

3. DC STAMP Domain: Intercompatibility between SPE-42 and other proteins
Ikenna Okeke*, Luke D. Wilson, and Abigail L. Richie — Mentor: Tim Kroft
Department: Biology

4. Production of mixtures of fungal amylase, cellulase and xylanase in lignocellulose medium amended with starch
Christiane Ingram, Kelsey Rodgers, and Patrick Thomase — Mentor: Benedict Okeke
Department: Biology

5. Obesity
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Department: Communication & Theatre

6. Antimicrobial effects of cranberry juice against common Gram-negative uropathogens *in vitro*
Jessica Thomas — Mentors: Li Qian and J. Kyle Taylor
Department: Medical Laboratory Sciences

7. Production of peroxides under ultrasonic irradiation in aqueous phase
Zachary Wooke — Mentor: Daniel Kim
Department: Chemistry

8. The energy cost of metabolic training – A pilot study
Holly Clarke — Mentors: Michele Olson
Department: Kinesiology

9. Vegetation species diversity in relation to tortoise fecal size
Krista Hagen, Brittany Richardson, Hannah Merren, Jake Sustarich, Jacob Hyder, Gayle Smith, Kyle Lesinger Sarah McLemore, Victoria Mosley, and Jasey Stevenson — Mentors: Michelle Taliaferro, Chelsea Ward, Toni Bruner, and Stephen Blake
Department: Biology

Oral Presentations II

11:30 a.m. A novel look at Confederate women: Perspectives from Augusta Jane Evans' *Macaria*

Kelhi DePace	Mentor: Ben Severance Department: History

11:50 a.m. The effect of ascorbic acid on the antibody response in *Rhinella marina*

Krista Hagen and Mashika Tempero	Mentors: Chelsea Ward Department: Biology

12:10 p.m. Synthesis of biologically interesting butenolide natural product derivatives

Joseph Pearman, Nicholas Pinones, and William Heartsill	Mentors: John M. Hutchison and N. Robert Estes II Departments: Chemistry and Biology

12:30 p.m. Use of chlorhexidine in oral care of ventilated patients to reduce ventilator-associated pneumonia

Stacy Glass, Adley Damron, Shirley Hardy, Elizabeth Phillips, and Jessica-Ann Newton	Mentor: Anita All Department: Nursing

* Denotes not elligible for award.

Abstracts

Decreased level of NGF in Alzheimer's diseased human brain

Joshua Baker and Jake Sustarich
Mentor: Geetha Thangiah
Chemistry

Nerve Growth Factor (NGF) regulates cell survival and differentiation of neurons. Pro-NGF, a precursor of NGF, has been shown to function in a biologically opposite manner like inducing apoptosis. The inactive pro-NGF is proteolytically cleaved into active NGF by the matrix metalloproteinase 7 (MMP-7). Our goal is to find if there is a variance in the levels of NGF and Pro-NGF in control hippocampus versus Alzheimer's disease brain. Six human postmortem Alzheimer's disease hippocampus and six control age-matched hippocampus brains were used for this study. The hippocampus tissue was homogenized in triton lysis buffer and the protein concentration was determined. To detect the concentration of NGF, Pro-NGF, and MMP-7 the samples were subjected to western blotting. The samples were separated by molecular weight via sodium dodecyl-polyacrylamide gel electrophoresis (SDS-PAGE) and transferred to a polyvinylidene fluoride (PVDF) membrane where specific proteins could be detected by western blotting. From our results we found that levels of NGF were decreased and pro-NGF was increased in patients with Alzheimer's disease hippocampus compared to control. The level of MMP-7, which cleaves the pro-NGF into NGF, was decreased in Alzheimer's disease hippocampus. This may lead to the accumulation of pro-NGF and decrease in NGF level in Alzheimer's disease hippocampus which may contribute to neuronal death. Supported by AUM new faculty grant-in-aid.

A novel look at Confederate women: Perspectives from Augusta Jane Evans' *Macaria*

Kelhi DePace
Mentor: Ben Severance
History, Language and World Cultures

Augusta Jane Evans of Mobile, Alabama, was a popular nineteenth century author of sentimental fiction. In her Civil War novel, *Macaria*; or *Altars of Sacrifice* (1864), Evans emphasizes the urgent need for southern white women to be more involved in the war effort. Moreover, she gives these women hope for the future by creating a theology of single womanhood; the war's rising death toll meant that untold numbers of Confederate women might never marry and Evans wanted southern women and southern society to be prepared for this reality. Although the war did not end as Evans and her Confederate sisters envisioned, *Macaria* offers a plethora of historical insights into the lives and roles of Confederate women during wartime.

The energy cost of metabolic training: A pilot study

Holly Clarke
Mentor: Michele Olson
Kinesiology

This study determined the energy cost of three, 30-minute metabolic training workouts. A secondary aim was to identify whether this form of exercise prompted increased energy expenditure post-exercise. METHODS: Five apparently healthy women (mean ± SD age = 33.4 ± 9.6 years) provided informed consent in writing and were randomly assigned to the perform one of the workouts. Systemic muscular oxygen consumption (VO2) was measured continuously during each workout via spirometric calorimetry using a metabolic cart. VO2 was recorded every 30 seconds; resulting in 60 VO2 values per participant. Post exercise VO2 was recorded continuously for 30 minutes immediately after each workout. Mean VO2 values were used to determine the energy cost (kcals), intensity, and the post exercise energy cost as follows: 1 L O2 consumed is equivalent to 5 kcals of energy expenditure. Further, 1 MET = 3.5 ml/kg/min of O2 consumed. RESULTS: The mean VO2 was 32.2 ml/kg/min (VO2 of 2.3 L/min). The mean kcal cost was 11.3 kcals per minute based on the standardized body weight of 70 kg, resulting in a total kcal expenditure of 340 for the workouts. Expressed in metabolic equivalents (METS; where "rest" = 1 MET, which is a VO2 of 3.5 ml/kg/min), the exercise intensity was 8.6 METs or, required an 8-fold increase in metabolic rate. Last, the post exercise VO2 was 5.9 ml/kg/min (0.41 L/min), which is approximately 62 kcals. In contrast, a 1 MET resting VO2 is only 36.6 in 30 minutes. Thus, the intensity of these shorter metabolic training workouts produced a "high intensity" exercise stimulus that further yielded a 69% increased metabolic rate after exercise. CONCLUSION: At 8.6 METs, with a kcal expenditure of 11.3 kcals per minute, this shorter intense form of exercise exceeds the criteria for increasing fitness and was of sufficient intensity to elevated the resting metabolic rate by 69% for a gross energy cost of 402 kcal.

Video games and the growing social acceptance of rape culture in America

Bobby K. Edwards
Mentor: Silvia Giagnoni
Communication & Theatre

Video games have become one of the fastest-growing platforms for American media consumption. With the highly engaging and visual nature of the media, however, negative portrayals of women and violent images can have repercussions: including the promoted social acceptance of rape culture.

Media scholars and academics have not yet done much research to address this phenomenon. In my presentation, I will offer an exploratory approach to understanding our knowledge of video games influencing rape culture and some of the concerns that this phenomenon may bring.

The issue is important because this media phenomenon is relatively new, and the lack of research done in this field underscores how little we as academics know about the influence that video games have on consumers and how that influence may shape societal outlooks, attitudes, and behaviors towards rape and rape victims in America.

The research I undertook was a purely qualitative exploration into previous studies and data. After I found this previous research, I discussed common trends and differences in the findings, and what may have yielded those differences. I also discuss the changing nature of the phenomenon.

The results of my research reflect little being done to study the shift in societal attitudes (and the public discourse about rape) due to video games. Ultimately, studies have found positive evidence of violent video games yielding negative rape attitudes, rape culture, and victim blaming. They have also found that this has worsened through prolonged exposure to video games and that this phenomenon has compounded over the last 20 years.

My presentation stresses the need for more research to be done in regards to video games and rape acceptance and it emphasizes the importance of video game developers being held accountable for violent and sexually objectifying content. It also emphasizes the importance of media literacy for consumers of video games.

Use of chlorhexidine in oral care of ventilated patients to reduce ventilator-associated pneumonia

Stacy Glass, Adley Damron, Shirley Hardy, Elizabeth Phillips, and Jessica-Ann Newton
Mentor: Anita All
Nursing

Rationale: Ventilator-associated pneumonia (VAP) is a nosocomial infection that can occur in patients receiving mechanical ventilation.

Objective: This project will examine research to determine if the addition of Chlorhexidine to regular oral care reduces the incidence of VAP.

Methods: A review of articles met the inclusion criteria and focused on the comparison of using chlorhexidine as a component of oral care as opposed not using chlorhexidine and how that inclusion affected the rate of ventilator acquired pneumonia.

Results: The articles we reviewed were research-based. The research shows a clear reduction in incidence of ventilator-associated pneumonias in mechanically-ventilated patients who received the addition of chlorhexidine to their regular oral care. Research also shows a decrease in the number of days of hospital stay in patients who received chlorhexidine treatment.

Conclusion: A review of the literature clearly demonstrates that incorporating use of chlorhexidine in the oral care regimen for ventilator patients significantly reduces the occurrence of ventilator associated pneumonias.

The contribution of pigment production to antibiotic resistance in *Serratia marcescens* bacteria

Taylor Gregory, Kierra Hardy, Erika Rodgers, and Lauren Stephens
Mentors: Pryce L. Haddix
Biology

Antibiotic resistance is a growing problem throughout the healthcare field. The ability of pathogenic bacteria to mutate, or genetically change, and develop resistance to the killing effects of antibiotics is making disease processes much harder to treat clinically. Mutation rate is defined as the probability that a bacterial population will produce mutant cells as the population increases. In this study, the mutation rates of two strains of *Serratia marcescens* bacteria to nalidixic acid resistance were measured. Both pigmented and non-pigmented S. *marcescens* strains were grown at 26oC and at the human body temperature of 37oC. Initial results have shown an increase in mutation rate of approximately 60% in non-pigmented bacteria, regardless of the incubation temperature. If confirmed by further experimentation, these results will provide evidence for a genome-protective role of the pigment during *Serratia marcescens* population growth.

The effect of ascorbic acid on the antibody response in *Rhinella marina*

Krista Hagen
Mentor: Chelsea Ward and Mashika Tempero
Biology

In the 1700s, ascorbic acid (vitamin C) was discovered to be an essential nutrient to the human diet for several metabolic functions and for collagen formation. Currently, several studies and a host of anecdotal evidence, suggest that vitamin C is an immune-stimulant and can strengthen the immune system response to pathogens. Our study investigates a direct relationship between administration of vitamin C and an increase in circulating antibodies. Twenty Cane Toads (*Rhinella marina*) were immunized weekly with a novel antigen, sheep red blood cells (SRBC), to produce a primary immune response. Ten of these toads were then fed liquid vitamin C weekly at a dosage/weight suggested by the manufacturer for humans. Hemagglutination titration assays were then performed weekly to measure changes in circulating antibody titer. Preliminary results indicated that vitamin C causes a significant increase in circulating antibodies (2 fold). An increase in circulating antibodies could significantly decrease the length of an illness, may indicate an increase in memory cells created during the infection, which would have implications on the potential to be sickened by reinfection.

Vegetation species diversity in relation to tortoise fecal size

Krista Hagen, Brittany Richardson, Hannah Merren, Jake Sustarich, Jacob Hyder, Gayle Smith, Kyle Lesinger, Sarah McLemore, Victoria Mosely, and Jasey Stevenson
Mentor: Michelle Taliaferro , Chelsea Ward, Toni Bruner, and Stephen Blake Biology

Herbivores have long been active seeds dispersers, many times moving seeds hundreds of miles as they migrate. This dispersal process is very important to the processes of succession and the restoration of disturbed habitats. However, the natural habits of herbivores as dispersers have added to the potential of exotic species to spread across habitats. It is likely that the more a herbivore eats the ripe fruit of an invasive plant, the more likely the exotic is an invasive. Tortoises have long been identified as seed dispersers and on the Galapagos as the primary native herbivore on most of the islands they are also a primary disperser. The seeds of eleven species of introduced plants have been identified in tortoise dung and Galapagos tortoises have already been identified as large dispersers of seeds. We hope to identify feeding preference of tortoises by comparing the number of different species in tortoise dung.

Production of mixtures of fungal amylase, cellulase and xylanase in lignocellulose medium amended with starch

Christiane Ingram, Kelsey Rodgers, and Patrick Thomase
Mentor: Benedict Okeke
Biology

Fossil oil is non-renewable and reserves are diminishing. Lignocelluloses are the most abundant renewable feedstock. Industrial activities give rise to waste materials that contain high concentrations of starch. These feedstocks can be converted to saccharides, fuels and chemicals. Simultaneous production of lignocellulose and starch hydrolyzing enzymes will support low cost saccharification of lignocelluloses in conjunction with carbohydrate wastes. A thermotolerant mold (CS4) and a *Trichoderma* species SG2 efficiently co-produce cellulolytic-xylanolytic-amylolytic enzymes. This study presents the influence of starch on simultaneous production of cellulolytic-xylanolytic-amylolytic enzymes complex of CS4 and SG2 for saccharification of switchgrass in conjunction with expired bread. Overall, starch addition was not necessary to induce significant co-production of amylase with cellulase and xylanase in lignocellulose medium. However, an inverse relationship between amylase and xylanase production was observed with 0.2% starch in lignocellulose medium and was dependent on starch concentration. CS4 and SG2 displayed significant yield of sugar from saccharification of switchgrass, expired bread, and their combinations suggesting potential application of carbohydrate wastes in biomass conversion to fuels and chemicals.

DC STAMP domain: Intercompatibility between spe-42 and other proteins

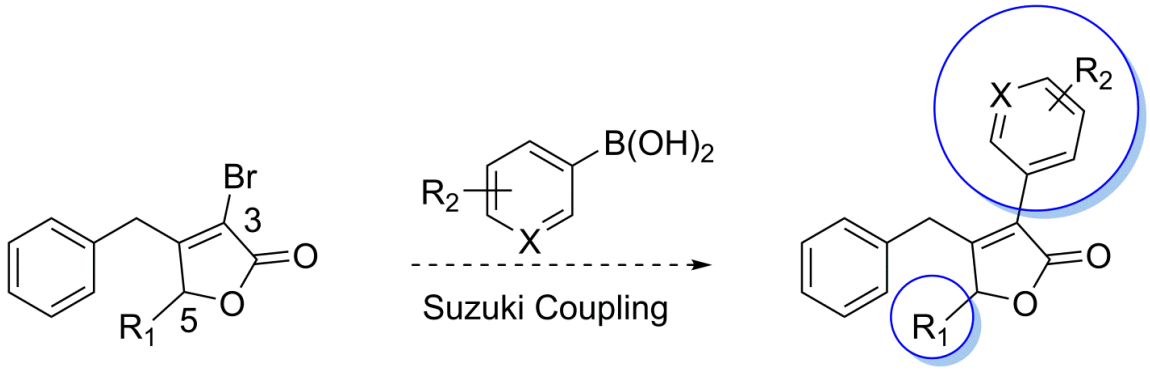
Ikenna Okeke*, Luke D. Wilson, and Abigail L. Richie
Mentor: Tim Kroft
Biology

C. elegans is a microscopic, free living nematode. It has a completely sequenced genome, a short generation period, produces large broods, and it is transparent. All of these features makes *C. elegans* a good model for the research we were conducting. *C. elegans* exists as self-fertile hermaphrodites and males that can fertilize hermaphrodites with their sperm. *C. elegans* hermaphrodites with spe-42 or let-479 mutations are self-sterile because their sperm are incapable of fertilizing oocytes despite being indistinguishable from wild type sperm. When the mutant hermaphrodite is crossed with a male, the male's sperm are able to rescue the oocyte and fertilize it, showing that the mutant phenotype is a sperm cell-specific error. This also opens up several questions about the role of spe-42 in the fertilization of the oocytes. spe-42 and let-479 are not specific to *C. elegans.* Homologs of these genes have been found in all species that use sperm–egg fertilization techniques. In this work, we analyzed the amount of progeny produced when the DC-STAMP domains, which are required for protein function, were swapped from other proteins into SPE-42 or LET-479. By using *C. elegans* as a model for fertilization help us become more knowledgeable about the reproductive systems of other organisms.

Synthesis of biologically interesting butenolide natural product derivatives

Joseph Pearman, Nicolas Pinones, and William Heartsill
Mentors: John M. Hutchison and N. Robert Estes II
Chemistry and Biology

Glycogen synthase kinase (GSK) is multifunctional enzyme that is involved in a variety of physiological processes. Given its role as a key regulator in numerous signaling pathways, aberrant regulation of GSK has been implicated in several pathologies, including Type II diabetes, cancer, and Alzheimer's disease. As a result, inhibitors of GSK are emerging as popular targets for the potential treatment of these diseases. Inspired by a small class of 3,4-substituted butenolide natural products, several natural product derivatives possessing the 3-aryl-4-benzylbutenolide structural motif were synthesized and tested for glycogen synthase kinase inhibitor activity. The focus of this small chemical library was on the influence of the C-3 aryl ring and the presence or absence of oxygen functionality at C-5 on kinase inhibitory activity.



Ecological models with U-shaped density-dependent dispersal

Jordan Price* and Jordan Berry
Mentor: Jerome Goddard II
Mathematics and Computer Science

Dispersal of an animal population is considered to be density dependent when dispersal decisions are made based on the presence of conspecifics. Recently, several ecologists have noted density dependent dispersal in multiple species of animals from insects to birds to bears. In fact, the relationship between population density and dispersal has been shown (empirically) to be U-shaped. In this talk, we will model the effects of U-shaped density dependent dispersal on the patch-level dynamics of a population using one of the most versatile theoretical population frameworks, the reaction diffusion population model. In particular, we will explore the dynamics of a diffusive logistic population model on a one-dimensional domain with nonlinear boundary conditions modeling U-shaped density dependent dispersal via study of the model's positive steady state solutions. We obtain results through use of the quadrature method and Mathematica computations and will briefly explore their biological implications.

Obesity

Brittany Sanders
Mentor: Larry Moore
Communication & Theatre

Obesity has become a major problem in the United States, but especially in the South. Maintaining a poor diet and physical inactivity easily contribute to obesity, diabetes, and other serious illnesses. This information will provide you with facts about obesity. It will also show you how to decrease obesity in adults and children.

Americans contribute to their early demise each day without worry or fear. Fast food, soda, and electronics are some of the reasons why people no longer have to leave the comfort of their own home to experience the dangers of death.....Obesity is a growing problem in America, especially in children.

Some of the reasons for the growing obesity in children are the poor eating habits and the lack of physical activity. In the article, “Teens gaining healthy eating habits, but not enough,” tell us that teens began eating more fruits and vegetables, getting at least 60 minutes of physical activity, and watching less television. While the article, “Signs of progress in childhood obesity fight,” tell us about a slight decrease in obesity and a slight increase in Colorado, Pennsylvania, and Tennessee. It also tells us about the first lady’s Let’s Move! program and how it encourages child care providers to get children to be more active outside and play.

Antimicrobial effects of cranberry juice against common Gram-negative uropathogens *in vitro*

Jessica Thomas
Mentors: Li Qian and J. Kyle Taylor
Medical Laboratory Sciences

The purpose of this study is to evaluate the antimicrobial effects of cranberry juice on five common Gram-negative uropathogens in vitro. A 108 CFU/ml bacterial suspension of each organism was streaked on Mueller Hinton agar. The disc diffusion method was performed on *Escherichia coli* ATCC 25922, *Pseudomonas aeruginosa* ATCC 27853, *Proteus mirabilis* ATCC 12453, *Klebsiella pneumoniae* ATCC 13833, and *Enterobacter cloacae* ATCC 13047 in triplicate. Concentrated cranberry juice, 1:2, 1:4, 1:6, 1:8, 1:10, 1:12 dilutions and saline control were saturated on Whatman discs. The inhibition zones were measured by digital fractional caliper. All results were calculated on SPSS version 19 according to one way ANOVA, the means were compared with Tukey's HSD. Results: significant inhibitory differences between *P. mirabilis* and *E. coli, K. pneumoniae, and E. cloacae* ($P < 0.05$); *P. mirabilis* was the most sensitive to cranberry juice, followed by *P. aeruginosa, E. coli*, and *K. pneumoniae. E. cloacae* has the most resistant to cranberry juice. Cranberry juice showed its antimicrobial effects against all the tested bacteria even after 1:4 dilution, but *P. mirabilis* was inhibited after 1:6 dilution.

DNA-based characterization of sulfate-reducing bacteria for bioremoval of heavy metals

Patrick Thomase, Kelsey Rodgers, and Christiane Ingram
Mentor: Benedict Okeke
Biology

Accumulation of heavy metals such as copper, zinc, lead, and nickel in living systems can cause serious health problems. Water can be polluted by metals through crude oil spill and activities of modern societies including mining, electroplating, leather tanning, power generation, and manufacturing of electronics. Under anaerobic conditions, sulfate reducing bacteria (SRB) produce hydrogen sulfide from oxidation of organic materials using sulfate as the final electron acceptor. H2S can precipitate soluble metal species as insoluble metal sulfides which can be removed. We isolated SRB adapted to sulfate reducing conditions from three year old MPN tubes positive for SRB. The MPN tubes were inoculated with sediment cores from sites polluted by the 2010 gulf oil spill. After repeated evaluation of isolates for sulfate reduction, three stable isolates were selected. Using three universal primers: 27-forward, 519-reverse and 1492-reverse, the isolates were characterized by 16s rRNA gene sequence analysis. Isolates BD1 and BD2 from Bayou Dualac core sediments are related to Citrobacter species; whereas isolate BJ2 from Bay Jimmy core sediments is related to Clostridium species. BD1 and BD2 are capable of aerobic growth. BD1 rapidly reduces sulfate producing H2S in about 24 h. Further studies will explore factors affecting growth of the isolates and their potential application for bioremoval of metals from water and waste streams.

The Challenges of Autobiography: An Analysis of Art Spiegelman's *The Complete Maus*

Hannah Twitty
Mentor: Darren Harris-Fain
English and Philosophy

Art Spiegelman struggled with creating an autobiography. The angst he felt is expressed throughout *The Complete Maus*. However, further analysis is needed to understand the underlying meanings for his anxiety. Analyzing *The Complete Maus* required the accompaniment of Art Spiegelman's book *MetaMaus* and additional academic sources written in response to *The Complete Maus*. In order to gain insight into Art Spiegelman's struggle with creating an autobiographical work, a thorough scrutiny of the text itself is completed as well as side-by-side comparisons with the academic sources. Following this, conclusions are made based off of personal interpretations and scholarly opinions. The conclusions are presented in essay format and then condensed for optimal viewing via poster. The discovery from the analysis is that it is difficult to give an autobiographical work the justice that it deserves, but Art Spiegelman eloquently succeeded in his efforts. Art Spiegelman's apprehension with creating *The Complete Maus* is better understood and appreciated through a viewing of text and images from the graphic novel. Be advised that some of the images presented may be upsetting to the viewer; caution is advised.

Production of peroxides under ultrasonic irradiation in aqueous phase

Zachary Wooke
Mentor: Daniel Kim
Chemistry

Ultrasound devices generate frequencies from 20 kHz up to several gigahertz, with each application requiring specific frequencies. Ultrasonic irradiation to aqueous media with frequencies between 20 to several hundred kHz can cause cavitation which brings dramatic chemical and physical effects, leading to the production of high temperatures and pressures (up to 5,000 K and 1000 atm) with the subsequent production of reactive oxygen species and hydrogen atoms. Also it is well known that cavitation caused by ultrasonic irradiation produces hydrogen peroxide in water. Formation of hydrogen peroxide was determined by fluorometric method to optimize ultrasonic sonicator (20kHz, 400W) by varying power levels.