



Sigma Xi  
Student Research Day  
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Abstracts

## **Graduate Division**

### **Life Sciences (12)**

**EFFECTS OF INDUCER CONCENTRATION ON THE TRANSCRIPTIONAL ACTIVATION OF THE TOLUENE 2,3-DIOXYGENASE OPERON OF PSEUDOMONAS PUTIDA F1**, Patricia J. Batchelor, Dr. Joseph G. Leahy. Dept. of Biol. Sci., UAH

The toluene 2,3-dioxygenase pathway in *Pseudomonas putida* F1 is encoded by the *todXFC1C2BADEGIH* and *todST* genes, which are responsible for catabolism of toluene. In the present study, the effects of toluene concentration on both *PtodX* promoter activity and expression of genes involved in toluene metabolism were examined using transcriptional fusion and Northern hybridization techniques for both the wild-type *P. putida* F1 and a *todC1* deletion mutant. The results of the transcriptional fusion analyses for the wild-type strain show saturation kinetics at low concentrations of toluene and markedly increased promoter activity at higher concentrations. The promoter activity in the *todC1* deletion mutant, however, is nearly eliminated at low concentrations, but not at high concentrations of toluene. These findings, along with the results of Northern hybridization analyses, suggest possible effects of toluene solubility and/or the activation or expression of the regulatory proteins, which control the expression of the toluene 2,3-dioxygenase pathway.

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**INTERACTIONS INVOLVING UBIQUITIN CONJUGATING ENZYMES (UBCs) AND THE UBIQUITIN CONJUGATING ENZYME VARIANT 2 (UEV-2) OF C.ELEGANS**. Ananth Chandrasekaran, Dr. Lynn Boyd, Dept of Biol Sci., UAH

The ubiquitin pathway plays an active role in the degradation of proteins. The proteins to be degraded are tagged with ubiquitin before being degraded in the 26S proteasome. Three enzymes are involved in ubiquitination: ubiquitin activating enzyme (E1), ubiquitin conjugating enzymes (E2s) and ubiquitin ligases (E3s). Free ubiquitin is activated and gets attached to the E1 via a thiol-ester bond. The E1 interacts with an E2 to transfer the ubiquitin to the E2. The ubiquitin-tagged E2 interacts with an E3 to pass the ubiquitin to the substrate protein to be degraded.

There are 20 ubiquitin conjugating enzymes (E2s) and 4 UEVs that are encoded by the *Caenorhabditis elegans* genome (Jones et al, 2002). UEVs are proteins that have a similar sequence to the E2s but lack the active cysteine residue. They are thought to play a role in interacting with the E2s (Hofmann and Pickart, 1999).

We studied the interactions of an E2, UBC-2 and several E3s using the yeast two-hybrid system. A mutant form of UBC-2 was generated by substituting a serine for the active site cysteine. We found an interaction between the mutant UBC-2 and a RING finger E3, NHL-1. The results show that the mutation is able to stabilize the interaction.

Based on work done in our lab UEV-2 has been shown to possibly play a role in the ubiquitin pathway. *C.elegans* strains have shown lethality to this variant form of UBC. We are doing a yeast two-hybrid study to find possible interaction partners for UEV-2. Li et al have shown E2-E2 interactions. We are exploring E2-E2 interactions in *C.elegans* to see if these interactions are more prevalent than was thought to be.

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**IDENTIFICATION OF PAR-2 AS A POSSIBLE E3 LIGASE**, Todd Frazier, Dr. Lynn Boyd, Dept. of Biol. Sci., University of Alabama at Huntsville

The selective conjugation of ubiquitin (a 76 amino acid protein) to a variety of proteins affects many cellular functions. These functions include but are not limited to cell cycle regulation via protein degradation, signal transduction, transcriptional regulation, and endocytosis. The action of protein ubiquitination requires the activity of three enzymes. The first enzyme, E1 (ubiquitin activating enzyme), forms a high energy thiolester bond with ubiquitin. The ubiquitin is then passed to E2 (ubiquitin conjugating enzyme), which in cooperation with E3 (ubiquitin ligase) transfers the ubiquitin to the substrate. PAR-2 is a protein which has been shown to help establish asymmetric first cell cleavage and partitioning of cellular factors in the early embryo of *Caenorhabditis elegans*. PAR-2 is predicted to have possible E3 ligase activity because it contains a RING motif. In vitro ubiquitination assays have shown monoubiquitination in the presence of PAR-2.

The goal of this project is to determine through western blot analysis if PAR-2 can ubiquitinate a protein substrate using a transgenic nematode system for over-expression of PAR-2. A plasmid which contains a heat

shock promoter with a PAR-2 coding region was developed to generate transgenic strains. These strains can be used to over express PAR-2 upon heat stress. In addition this strain expresses a lysineless derivative of ubiquitin (UbK0), which was inserted into a separate plasmid construct. UbK0 retains the potential for monoubiquitination but lacks the conjugation sites necessary for polyubiquitination. Therefore, if PAR-2 leads to ubiquitination of a substrate, a single ubiquitinated species can be detected on a western blot rather than a polyubiquitin smear. It was found that a protein of ~ 55kdal showed signs of monoubiquitination in the presence of overexpressed PAR-2.

We are in the process of repeating the experiments and devising methods to test if this protein is an authentic substrate for PAR-2 mediated ubiquitination.

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**ROLE OF PROTEIN DEGRADATION IN CELL CYCLE REGULATION**, Uma Hota, Dr. Lynn Boyd, Department of Biological sciences, University of Alabama in Huntsville

Removal of excess or unwanted proteins is essential for the normal functioning of the cell. The cell handles the removal of such proteins through a protein degradation mechanism. Protein degradation involves marking of the proteins to be degraded by polyubiquitination followed by actual degradation by the 26S proteasome complex. Polyubiquitination is a process by which a chain of ubiquitin molecules is attached to the protein destined for degradation. Polyubiquitination is carried out by a series of enzymes, ubiquitin-activating enzymes (E1), ubiquitin-conjugating enzymes (E2), and ubiquitin ligase enzymes (E3).

The ability of a cell to replicate (mitosis) is a major factor effective in the normal functioning of the cell. During mitosis, the sister chromatid cohesion is broken down by degrading several mitotic proteins. The degradation of these proteins is facilitated by a multi-subunit ubiquitin ligase enzyme (E3) known as anaphase-promoting complex (APC). APC-3 is one of the sub-units of the APC complex. The purpose of this research was to analyze the APC-3 (E3) interaction with nine different E2s and discover the E2-E3 combination essential for cell cycle progression. The research was conducted using a nematode, *Caenorhabditis elegans*. RNA interference method (RNAi) was used to switch off the nine different E2s individually. RNAi involves the introduction of double-stranded RNA that causes the destruction of corresponding mRNAs leading to the silencing of the target gene.

The effects of switching off of the nine different E2s by RNAi were analyzed in the wild type (N2) and a mutant strain of *Caenorhabditis elegans*. The mutant strain was reduced in APC-3 activity. Complete loss of function of APC results in 100% embryonic lethality. Our hypothesis was that RNAi of the E2 that interacts with APC would enhance the embryonic lethality of the APC-3 reduction mutant. The results show a 100% lethality of eggs when UBC-2 (E2) was switched off. All the other E2s did not show any effect on the lethality when they were silenced. So, this research shows that for normal cell cycle progression, UBC-2 (E2) is essential for APC-3 when compared to the other eight E2s.

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**DEVELOPMENT OF NEW PCR SYSTEMS USING REPLICATION PROTEINS FROM NOVEL HYPERTHERMOPHILES**. Damien Marsic, Owen K. Garriott and Dr. Joseph D. Ng, Department of Biological Sciences and the Laboratory for Structural Biology, University of Alabama in Huntsville, Huntsville, AL 35899

Polymerase chain reaction (PCR) is one of the most widely used techniques in biological research, and has numerous applications in medicine, forensics, and food and drug industries. Its main component is a thermostable DNA polymerase, several of which are available commercially. Despite its success, there is definitely a potential for improvement of PCR, which is still much less efficient in terms of fidelity, speed and product size than in vivo replication. This improvement can be achieved through the evaluation of new DNA polymerases from novel organisms, as well as through the use of additional proteins involved in the replicative machinery.

We have isolated and partially characterized two novel hyperthermophilic microorganisms from samples collected at the Rainbow hydrothermal vent field (North Atlantic ridge) at a depth of 2300 m. Strain OGL-20 was shown to be an archaeon belonging to the *Thermococcus* genus, while strain OGL-7B was determined to be a bacterium belonging to the *Thermoactinomyces* genus. Our project involves cloning the genes encoding DNA polymerases and accessory proteins from those two microorganisms, characterizing the gene products and evaluating their use as PCR components. The selected organisms are particularly interesting as sources of thermostable DNA polymerases, OGL-20 belonging to a genus in which the known DNA

polymerases show remarkable diversity in their properties, while OGL-7B belongs to a genus in which no DNA polymerase has ever been studied, in addition to being in a phylum where no hyperthermophile has been reported so far.

We have so far successfully cloned (using an original approach involving bioinformatics and PCR-based techniques), sequenced and partially expressed a family A DNA polymerase from OGL-7B, a family B DNA polymerase from OGL-20 and a PCNA (polymerase sliding clamp) from OGL-20.

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**GENETIC ANALYSIS OF THE Phd ANTITOXIN FROM BACTERIOPHAGE P1**, James Estle McKinley, Dr. Roy David Magnuson, Dept. of Biol. Sci., UAH

The Bacteriophage P1 plasmid addiction operon is a Toxin-Antitoxin system that stabilizes the P1 plasmid prophage by killing plasmid-free segregants. The operon encodes a stable toxin (Doc) and an unstable 73 amino acid antitoxin (Phd). In addition to neutralizing the toxin, Phd represses transcription of the operon. The N-terminal three quarters of Phd is required for repressor activity, and the C-terminal half is required for antitoxin activity. Here, site-directed mutagenesis was used to determine which amino acid residues in the C-terminal half of Phd were important for repressor activity and which were important for antitoxin activity. Point mutations at twenty positions had no effect on either activity. Mutations at four positions (A36, V37, I38, F44) affected only repressor activity, and mutations at four other positions (D53, E55, F56, F60) affected only antitoxin activity. No point mutations affected both activities, indicating a distinct separation between the amino acids residues that are important for repression and those that are important for antitoxin activity.

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**TRANSCRIPTIONAL ACTIVATION OF THE GENES ENCODING THE TOLUEN-4-MONOOXYGENASE PATHWAY IN PSEUDOMONAS MENDOCINA KR1**, Shannon L. Moody, Dr. Joe Leahy, Dept. of Biol. Sci., UAH

The toluene-4-monooxygenase pathway in *Pseudomonas mendocina* KR1 is responsible for the catabolism of certain hydrocarbons to TCA cycle intermediates. It is encoded by six different operons: tmoXABCDEF, tmoST, pobA1, pobR1, pcuR, and pcuCAXB. In this study, we reexamined the temporal expression of the genes encoding this pathway using toluene, TCE, and octane as inducers, using Northern hybridization and DNA macroarray analyses to show direct evidence of induction. Expression of the tmoXABCDEF operon was induced by toluene, TCE, and octane, while none of the inducers significantly affected expression of the tmoST operon. Expression of the pcuR and pcuCAXB operons was induced in the presence of toluene, but not by TCE or octane. Taken together, our results show that the regulation of this pathway is not coordinated, which supports genetic evidence that the tmoST and tmoXABCDEF operons have been recently acquired in KR1.

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**PROTEASES FROM NOVEL ALKALIPHILIC SPECIES ISOLATED FROM SODA LAKES OF AFRICA**. Divya Pradhan, Damien Marsic, Owen K. Garriott and Dr. Joseph. D. Ng, Department of Biological Sciences and the Laboratory for Structural Biology, UAH

Alkaliphiles are defined as organisms that have optimal growth rate at pH 9.0 or higher. These organisms can be found in the three domains of life, prokaryotes, eukaryotes, and archaea. They have been isolated from a variety of habitats ranging from normal neutral environments such as garden soil, to soda lakes, ocean floor, sewage plants and thermal springs. The investigations represented here expands our knowledge and understanding of the biodiversity and ecology of alkaliphilic organisms. Alkaliphilic organisms are unique because they have special adaptations that help them maintain a neutral intracellular pH. Thus they have great potential for microbiology and biotechnological exploitations in the industrial world.

Four strains of bacteria, have been isolated and characterized from the soda lakes of Africa. Gene mapping of the 16s rRNA gene of all four isolates shows that they are novel with two species belonging to the genus *Bacillus*, one to *Alkalibacterium* and the other to *Halomonas* sp. All the strains had optimal growth rate at or above pH 9.0 and are thus determined to be obligate alkaliphiles.

The identification and isolation of extra cellular proteases is in progress. Two metalloproteases (of mol. wt. 25 Kda and 30 Kda) from A-11 have been purified and partially characterized. Future works entails finding the gene sequence coding for the targeted extracellular enzymes to make a recombinant overexpression system for further biochemical and structural studies.

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## **BIOLOGICAL ACTIVITY OF RAINFOREST PLANT EXTRACTS FROM FAR NORTH**

**QUEENSLAND, AUSTRALIA**, Mary C. Setzer, Dr. William N. Setzer, Department of Chemistry, UAH

A total of 137 species of trees and three lianas, distributed over 30 families, have been collected from tropical rainforests of north Queensland, Australia. The barks of these plants have been extracted and the extracts screened for cytotoxic activity against Hep G2, MDA-MB-231, Hs578T, MCF7, 5637, PC-3, and SK-MEL-28 human tumor cell lines; for antimicrobial activity against the Gram-positive bacteria *Bacillus cereus* and *Staphylococcus aureus*, the Gram-negative bacteria *Pseudomonas aeruginosa* and *Escherichia coli*, and the fungi *Candida albicans* and *Aspergillus niger*. Brine shrimp (*Artemia salina*) lethality tests have also been carried out on the extracts. Of the 140 species tested, 55 showed remarkable cytotoxic activity against at least one of the cell lines while six species [*Daphnandra repandula* (Monimiaceae), *Melicope rubra* (Rutaceae), *Cryptocarya hypospodia* (Lauraceae), *Carnarvonia araliifolia* (Proteaceae), *Pittosporum venulosum* (Pittosporaceae), and *Calophyllum costatum* (Clusiaceae)] showed pronounced activity against all tumor cell lines tested. Fifteen species showed antibacterial activity against *B. cereus*, seven of which [*Melicope rubra* (Rutaceae), *Xanthostemon whitei* (Myrtaceae), *Grevillea hilliana* (Proteaceae), *Horsfeldia australiana* (Myristicaceae), *Syncarpia hillii* (Myrtaceae), *Clausena brevistyla* (Rutaceae), and *Melicope jonesii* (Rutaceae)] were also active against *S. aureus*.

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## **COMPOSITION AND BIOACTIVITY OF THE LEAF OIL OF AMYRIS ELEMIFERA FROM**

**ABACO ISLAND, BAHAMAS**, Jennifer Schmidt Werka, Dr. William N. Setzer, Department of Chemistry, UAH

The leaf essential oil of *Amyris elemifera* L. (Rutaceae) was obtained by hydrodistillation and analyzed by GC-MS. The most abundant leaf oil components were limonene (45.0%), linalool (20.8%), beta-caryophyllene (5.6%), 3-hexadecanone (5.3%), caryophyllene oxide (3.9%), and beta-sesquiphellandrene (3.6%). The reported biological activities of the major constituents of *A. elemifera* leaf oil are consistent with the ethnopharmacological uses of the plant in the Bahamas to reduce fever, treat symptoms of flu, treat sores and wounds, and its use as a general tonic and bath.

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## **THE IMPACT OF NURSES WORKING 'OVERTIME' ON MEDICATION ERRORS IN THE INTENSIVE CARE UNIT**

Brenda Styles, Gennifer Baker, Tracye Christian, Mike Cooper, Audrey Green, Amy Lanz, Alicia Pettis, Dr. Susan R. Lacey, College of Nursing, UAH

**Statement of the Problem:** There is an unprecedented nursing shortage that is leading to an escalation of nurses working overtime in the healthcare industry. Currently there are no regulations that dictate the amount of overtime allowed for nurses to work as in other industries.

**Purpose:** The purpose of this study will be to determine if there is a relationship between nurses who work overtime and medication errors.

**Specific aims of this retrospective, exploratory study** are to 1) determine if this relationship exists and 2) are there other factors impacting this relationship.

**Design:** Medication error data would be reviewed with matching payroll data for errors reported by registered nurses in the first half of 2004 in a large Southeast part of the U.S.

**Analysis:** Contingency tables will be constructed with the dichotomous data (overtime or not). Descriptive statistics will be used to explain the characteristics of the errors.

**Potential Benefits of Study:** If there is a relationship between overtime and errors, a prospective study must be conducted to verify the findings. If verified, policy changes should be strongly considered by hospitals.

## **Physical Sciences (4)**

### **EXPRESSION, PURIFICATION AND BIOPHYSICAL CHARACTERIZATION OF HUMAN CASPASE-9, AN APOPTOSIS-RELATED CYSTEINE PROTEASE**

Jorge Barcena, Dr. Enrico Digiammarino, Dr. Pam Twigg, Dr. Edward Meehan, Laboratory for Structural Biology, UAH

Caspase-9 is a member of the cysteine-aspartic acid protease (caspase) family. Activation of caspase enzymes plays a central role in the execution-phase of cell apoptosis. They exist as inactive proenzymes which undergo proteolytic processing at conserved aspartic residues to produce 2 subunits, large and small, that dimerize to form the active enzyme. We report the expression of a recombinant form of protein procaspase-9 followed by two different purification procedures. We have also determined physical properties of secondary structure and stability and have begun crystallization screening for the purpose of X-ray crystallographic analysis.

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### **SYSTEM ANALYSIS AND DESIGN OF A NOVEL PROPELLANT FEED SYSTEM FOR IN-SPACE PROPULSION SYSTEMS**

David Eddleman, Dr. James B. Blackmon, Dept. of Mechanical & Aerospace Engineering, UAH

Current high performance upper stages rely on either pressure-fed or turbo-pump systems. Typically, in-space liquid propulsion systems use conventional pressure-fed systems. However, conventional pressure-fed systems are relatively heavy. Turbo-pump systems are relatively light, but expensive, and to date are not available for low-thrust (i.e., 1000 to 5000 lb thrust) in-space systems. Similarly, higher thrust in-space propulsion systems, especially those using liquid hydrogen and liquid oxygen, would likely require development of new turbo-pump engine systems. These systems would be relatively costly, and would have a substantial development time. An alternative approach, termed the Reciprocating Feed System (RFS), offers a means of reducing the cost and weight, and improving the performance, of both upper stage and in-space propulsion systems. The RFS uses large, low mass, low-pressure main tanks for the fuel and oxidizer, connected with two or three small, high-pressure propellant tanks. The small tanks alternately expel propellant, vent, and are then refilled and pressurized in sequence, to maintain steady and/or modulated flow to the engine. This system appears to be far cheaper than turbo-pump systems, with about the same total system mass, and much lighter than conventional pressure fed systems. An analysis tool and results are presented for representative upper stage and in-space propulsion systems. Comparisons of storable propellants, liquid oxygen and RP-1, and liquid oxygen and liquid hydrogen systems are provided, for a range of thrust and delta-velocity missions. We find that the RFS provides much greater payload capability than conventional pressure fed systems. It also provides approximately the same, or somewhat greater, payload than turbo-pump systems, but with anticipated hardware and development costs that are substantially less. The RFS also offers additional potential benefits, including a fail-operational and fail-safe mode; in the event a valve in the system fails, one of the three tanks can be isolated, and the flow continued with just two tanks. Also, by restarting the engines from small tanks that are essentially filled with liquid, the propellant acquisition issues are reduced. The RFS offers the capability to rapidly vary the flow rate and pressure; this provides a high degree of throttling for the engine, which increases its versatility for certain missions. We are able to show that the RFS allows a much higher chamber pressure than for conventional pressure fed systems; this allows the expansion ratio of an engine to be substantially higher, which increases the specific impulse and further increases overall system performance

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### **LEAF ESSENTIAL OIL COMPOSITION OF FIVE ZANTHOXYLUM SPECIES FROM MONTEVERDE, COSTA RICA**

Joseph A. Noletto, Dr. William N. Setzer, Department of Chemistry, UAH

The leaf essential oils from five species of *Zanthoxylum* (Rutaceae) from Monteverde, Costa Rica, have been obtained by hydrodistillation and analyzed by gas chromatography-mass spectrometry. The species examined include *Z. fagara*, *Z. acuminatum*, *Z. melanostictum*, *Z. monophyllum*, and an undescribed species. The most abundant classes of compounds found in *Zanthoxylum* leaf oils are acyclic and menthane monoterpenoids as well as simple alcohols, aldehydes, and ketones. In terms of molecular diversity, menthane and acyclic monoterpenoids, cadinane and mesocyclic sesquiterpenoids, and simple alcohols, aldehydes, and ketones dominate the essential oils of *Zanthoxylum* species. Monoterpenoids make up the majority of the mass of the leaf oils of *Z. monophyllum*, *Z. acuminatum*, *Z. fagara*, and *Zanthoxylum* sp. nov. Linalool, 4-terpineol, alpha-terpineol, and trans-2-hexenol, are found in all of the *Zanthoxylum* species examined in this study.

**PHYTOCHEMICAL INVESTIGATIONS OF NECTANDRA MEMBRANACEA,**

Xiujun Wu, Dr. William N Setzer, Dept. of Chemistry, UAH

The crude acetone bark extract of *Nectandra Membranacea* from Costa Rica showed in-vitro cytotoxicity against HepG2 and MDA-MB-231. It is antibacterial to *Bacillus cereus* and *Staphylococcus aureus*, and it is also antifungal to *Candida albicans*. Bioactivity-directed chromatographic separation led to isolation a novel sesquiterpene, nectandralactone. The structure of nectandralactone was determined by analysis of NMR data and LC-MS spectrum.

## ***Undergraduate Division***

### **Life Sciences (8)**

**EXPRESSION, PURIFICATION, AND CRYSTALLIZATION OF OPTINEURIN, A HUNTINGTIN-INTERACTING PROTEIN**, Brooke A. Belyea, Dr. Pamela D. Twigg, Laboratory for Structural Biology, UAH

Huntington's Disease is a neurodegenerative disorder characterized by death of cortical and striatal neurons, and caused by the abnormal elongation of a polyglutamine tract in the huntingtin protein. The function of huntingtin is, as yet, unknown but studies have revealed a large array of proteins which bind to huntingtin in the cell.

Optineurin (also known as FIP-2) is a huntingtin-interacting protein whose function has been linked to membrane trafficking and cellular morphogenesis, including the modification of dendritic spines. This suggests a function for huntingtin in the proper maintenance of dendritic cells. More recently, in addition to its importance in the normal function of the huntingtin protein, mutations in the optineurin gene have been observed to give rise to a form of primary open-angle glaucoma. Therefore, structural information on this protein may provide critical clues to the progression of at least two genetic disorders.

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**IDENTIFICATION OF THE AMINO ACIDS INVOLVED IN THE COOPERATIVE INTERACTION OF PHD AND DOC**, Jenifer Ferguson, Dr. Roy Magnuson, Dept. of Biol. Sci., UAH

Transcription of the plasmid addiction operon is negatively regulated by the products of the operon, Phd and Doc. Phd forms homodimers and binds to two adjacent sites in the promoter region and thus represses transcription. Doc binds Phd and mediates cooperative interactions between adjacent Phd binding sites. My research is focused on identifying the amino acids involved in the cooperative interactions between Phd and Doc. Jamie McKinley used site-directed mutagenesis to create thirty-three Phd point mutants in the C-terminal half of Phd. I am measuring the effect of the Phd mutations on the transcription of the promoter, as indicated by a LacZ fusion, in the presence and absence of Doc. Preliminary results indicate that PhdE45A, PhdY47A, and PhdL52A have defects in cooperativity. Results also indicate that PhdA50D, PhdA54D, and PhdD64R have enhanced cooperativity.

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**CARDIOVASCULAR REACTIVITY TO POSITIVE AUDIO STIMULUS AND THE RELATIONSHIP OF MIBI AND RIAS-B SURVEYS**, Kaye S. George, Dr. Aurora Torres, Dept. of Psychology, University of Alabama in Huntsville

This study examined cardiovascular reactivity to the presentation of a race congruent or incongruent speaker in a White American sample. Students (N=22) were presented surveys used in racial identity assessment. We recorded blood pressure and heart rate in the pretest-posttest scenario. The speaker was presented after the first set of surveys. We compared a control group (congruent race—Zig Ziegler) and an experimental group (noncongruent race—Martin Luther King). We rated mood and obtained blood pressure and heart rate. Second sets of surveys were then given followed by a final measurement of mood and vital signs. We found that heart rate was almost the same for congruent and noncongruent speaker in both groups. However, the noncongruent group had a higher change in systolic blood pressure at test 1 with an average increase of 4.1. The change in blood pressure had great variability across all tests. The mood showed the greatest change for the noncongruent speaker. This supports the hypothesis that an individual may recognize the race of a speaker by hearing them speak however; unless the listener has an emotional investment in the events that surround the speech there is no great change in heart rate and blood pressure.

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**ADOLESCENT COMPETITIVE AGGRESSION**, Laura Hinke, Lauren Bussey, Dr. Lynx Carlton McClellan, Dr. Aurora Torres, College of Nursing and Dept. of Psychology UAH

The purpose of our study was to provide more insight on the relationship between competition and aggression in children. This study aimed to help fill the void of research using soccer as a situation to compare same age-opposite sex children in an organized, physically challenging, aggressive sport. We hypothesized older players would be more aggressive than their younger counterparts, with males more aggressive than females. Also, we

hypothesized winning a game would increase the player's view of his/her performance during the game and, a positive relationship would exist between the level of the opponent and player's reported competitiveness. At each game (a lose and a won), the players completed a behavioral collection form. The coaches completed a different behavioral form. The behavioral data showed all players were similar in their levels of aggression and competition, with no significant results found. In addition, no correlation was found between the two factors of opponent level view and competitiveness. However, winning did show a tendency towards the predicted direction to increase self-reported playing ability. This lack of support for our hypotheses could be attributed to the fact that there was no direct measurement for aggression. For future studies, a better approach would involve video taping the players and coding for aggressive behaviors.

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#### **THE RELATIONSHIP BETWEEN POST-IDENTIFICATION FEEDBACK AND AGE ON**

**PARTICIPANT'S EYEWITNESS EXPERIENCE**, Deah S. Lawson, Dr. Jeffrey S. Neuschatz, Elizabeth L. Preston, Amanda D. Burkett, Michael P. Togliola, James M. Lampinen, Joseph S. Neuschatz

This study examined the relationship between post-identification feedback and age on participant's memory for an event, as depicted by a store surveillance camera. After viewing the video the participants were asked to identify a suspect from a target absent photo line-up. After the participant made their choice, they were given either confirming feedback that they picked the actual suspect or no feedback. Participants who were told that they selected the actual suspect indicated that they were more confident, paid more attention to the video, had a better view, and were also more willing to testify in court than those participants who received no feedback. The effects of post-identification feedback did not vary with age, however older participants were less confident overall as compared to younger participants. These results elucidate the biases inherent in line-up identification as well as the mutable nature of memory.

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#### **RELATIONSHIPS OF THE MIBI AND RIAS'-B TO CARDIOVASCULAR REACTIVITY**, Millicent

Steger, Dr. Aurora Torres, Dept of Psychology, UAH

Cardiovascular disease is prevalent throughout African Americans. Although many factors contribute, psychosocial factors need to be further investigated. The cardiovascular reactivity hypothesis suggests that exaggerated cardiovascular responses result from extended exposure to stress such as discrimination. The purpose of this investigation was to determine if correlations exist between the subscales of the Racial Identity Attitude Survey-B (RIAS-B; Helms) or the Multidimensional Inventory of Black Identity (MIBI; Sellers) and determine if the presentation of the scales induce reactivity. Measures were also taken to determine if the presentation of a positive stimulus (ML King's I Have a Dream speech) would induce reactivity. Blood pressure and heart rate were taken prior to the presentation of the first set of surveys as a baseline. We recorded blood pressure and heart rate in the pretest-posttest scenario with 9 African American students. After the presentation of the first surveys, mood was rated and blood pressure and heart rate were obtained. A 4-minute audio clip of the MLK speech was then presented. Mood and cardiovascular measures were once again recorded. The second set of surveys were presented and a final measurement of mood and vital signs were taken. The most consistent correlation existed between the Encounter subscale of the RIAS-B and the Nationalistic Ideology subscale of the MIBI ( $r=0.93$  pre-test;  $r=0.79$  post-test). Also consistent was the relationship between the Pre-encounter subscale of the RIAS-B and the Private Regard for the MIBI ( $r=-0.72$  pre-test;  $r=-0.89$  post-test). These relationships indicate both subscales may be assessing a common element. Data indicate a significant decrease in SBP from baseline to post-stimulus response,  $t(8)=2.669$ ,  $p=0.028$ , but all other cardiovascular measures were stable. Thus, the presentation of the racial identity surveys did not influence reactivity, although the MLK excerpt appeared to attenuate blood pressure. Negative correlations were found with the Internalization subscale of the RIAS-B and heart rate after the MLK stimulus, which contradicts previous findings in the laboratory when a negative racial stimulus was presented. The data suggests that using multiple measures for assessing racial identity may have its benefits in defining the relationship of this complex psychosocial construct and cardiovascular reactivity.

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**GENE EXPRESSION PROFILING OF PREINFECTION PROCESSES IN AN ARBUSCULAR MYCORRHIZAL FUNGUS IN RESPONSE TO ROOT EXUDATE SIGNALS**, Holly L. White<sup>1</sup>, Michael A. Muratet<sup>1</sup>, Jerry Nagahashi<sup>2</sup>, David D. Douds<sup>2</sup>, Dr. Gopi K. Podila<sup>1</sup>,<sup>1</sup>Dept of Biological Sciences, University of Alabama, Huntsville, AL 35899; <sup>2</sup>USDA-ARS ERRC, Wyndmoor, PA 19038

Arbuscular mycorrhizae are symbiotic relationships between fungi of the order Glomales and terrestrial plant roots. As obligate biotrophs, arbuscular mycorrhizal (AM) fungi cannot grow, develop, or reproduce in the absence of a plant host. The signaling and morphogenetic events in the early interaction stages are critical for the recognition of suitable host and eventual formation of mycorrhizae by these fungi. The exudation of signals from host plant roots causes the increased branching of germ tube hyphae necessary for the fungi to find the root. A *Glomus intraradices*-carrot root model system and an EST-microarray-based approach were used to understand the effect of root exudates on gene expression in germinating spores. A cDNA library was constructed by extracting RNA from spores of *G. intraradices* that were germinating in the presence of carrot root exudates. Over 2500 expressed sequence tags (ESTs) were selected arbitrarily and sequenced to recognize differentially expressed genes induced by the root exudates. Macroarrays that consisted of a unigene set of 810 ESTs from the cDNA library printed in duplicate were used to observe temporal gene expression patterns using probes prepared from RNA from germinated spores induced by water only versus germinated spores induced by root exudates. The up and down regulation pattern of various genes from 3 through 48 hours of exposure to exudate signals shows that the initial response of germinated spores to root exudates occurs in cycles rather than one continuous stretch of expression patterns. Overall, the maximum likelihood analysis indicates there is a distinct pattern of clusters of gene expression. The results showed that there is a clear temporal pattern of expression of signaling, structural, and metabolism-associated genes in succession in the fungus in response to host root exudate signals. The results allowed the clustering of genes into functional groups for which identities do not exist in GenBank. These studies give a better understanding of the preinfection stage signaling/recognition events in the AM symbiosis. This is the first study that has looked at very early stages of AM fungi and root exudate interactions.

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**POST IDENTIFICATION FEEDBACK EFFECTS ON THE WITNESSING EXPERIENCE OVER A THREE WEEK TIME DELAY**: Ráchael Wise, Andrew Fairless, Deah Lawson, Matt Cornwell, Dr. Jeffrey Neuschatz, The University of Alabama in Huntsville

A confident witness makes a convincing witness, however; confidence can be influenced by factors other than accuracy. For example, post-identification feedback may have a large impact on confidence and other factors such as view and attention that are related to the witnessing experience. Post identification feedback occurs when the police inform the witness that she identified the police's suspect. The purpose of this study was to measure the impact that post-identification feedback had on the witnesses' memory of the event and whether these effects will persist over a long retention interval. To this end undergraduate college students watched a grainy video and were told to pay careful attention to the man that appeared in slow motion. Following the video participants made a line up identification. Half of these 'witnesses' were given feedback that they had picked the culprit and half were given no feedback. Participants were then given a questionnaire that asked them about 14 variables related to the witnessing experience (e.g., confidence, view, willingness to testify, and so forth.) The questionnaire was given either immediately, 1 week, or 3 weeks later after the identification. On all measures except distance, those that had received feedback scored higher on all variables related to the witnessing experience. The effect of feedback did not significantly vary with retention interval. This suggests that the effects of post-identification feedback may last until a trial.

## **Physical Sciences (4)**

**HEATING OF SOLAR UPPER TRANSITION REGION BRIGHT POINTS VIA COLLISION AND CANCELLATION OF MAGNETIC FLUX ELEMENTS**, Mikal Burgess, Ross Cortez, Dr. Hakeem M. Oluseyi, Department of Physics, University of Alabama in Huntsville, Huntsville, AL 35899

We are developing a model of the response of the solar upper transition region atmosphere to the interaction of randomly moving photospheric magnetic flux elements. We utilize the model of Longcope and Kankelborg that was originally developed to account for coronal X-ray bright points, small plasma loops at coronal temperatures ( $T_e \approx 1$  MK). In our study we will compare predictions of the model to observations of sub-coronal upper transition region bright points (UBPs) which do not have a coronal analogue. Using high resolution time series magnetogram data obtained by the Michelson Doppler Interferometer (MDI) experiment aboard the Solar and Heliospheric Observatory (SoHO) and extreme ultraviolet data obtained by the Solar Ultraviolet Measurements of Emitted Radiation (SUMER) experiment, we will compare our models to the observed energetics and population statistics of UBPs. In this poster we present the analytical model and examples of the data that will be utilized.

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**ADVANCED SPACE RADIATOR PROJECT**, Sean Entrekin, Dr. James B. Blackmon, Dept. of Mechanical Aerospace Engineering, Propulsion Research Center, UAH

Low mass, low cost, long life radiators are a critical, enabling technology necessary for advanced space and terrestrial power and thermal management systems. The objective of this project is to evaluate a new type of space and terrestrial radiator based on a novel, super-conducting, solid-state heat pipe (termed the Qu Supertube). We have developed analytical tools for assessing radiator performance, designed and fabricated candidate heat pipe radiators and developed test methods based on the Forbes technique, first used in the 1860s. The Forbes technique appears to be appropriate for these exceptionally high thermal conductivity heat pipes, which are difficult to test with conventional methods using known heat fluxes and temperature gradients. We tested control radiators, one type of conventional heat pipe radiator, and several versions of the new solid-state super-conducting heat pipe and radiator both in vacuum and under ambient conditions. Results show that the solid-state, super-conducting heat pipe provides effective thermal conductivity thousands of times higher than an equivalent solid bar of silver, and is therefore a candidate for a wide variety of thermal management applications.

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**COMPOSITION AND BIOACTIVITY OF THE LEAF ESSENTIAL OIL OF HETEROPYXIS DEHNIAE FROM ZIMBABWE**, Angela Rea Ramsey, Dr. William N. Setzer, Department of Chemistry, UAH

The leaf oil of *Heteropyxis dehniae* Suss. (Heteropyxidaceae) was obtained by hydrodistillation and analyzed by GC/MS. The most abundant essential oil components are linalool (58.3%), 4-terpineol (9.8%), alpha-terpineol (3.6%), and caryophyllene oxide (3.1%). The antimicrobial activity against *Bacillus cereus*, *Staphylococcus aureus*, *Pseudomonas aeruginosa*, *Escherichia coli*, *Candida albicans*, and *Aspergillus niger*, and the in-vitro cytotoxicity of the oil on PC-3, MDA-MB-231, Hs 578T, MCF7, SK-MEL-28, and 5637 human tumor cells were also examined. Caryophyllene oxide shows notable cytotoxic activity with LC-50 values of 147-351  $\mu$ M.

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**THE USE OF POTABLE ETHANOL AND CASTOR OIL TO POWER AN AUTONOMOUS VEHICLE**, C. Chris Stowers, Dr. James Smith, Dept. of Chemical Engineering, UAH

Combustion science is the backbone of the propulsion system used to power this vehicle. A standard RC Hobby car was modified to operate on an ethanol-castor oil fuel instead of the typical nitromethane-synthetic oil fuel. Preliminary solubility and viscosity test were performed in order to design the fuel such that it closely matched the properties of the nitromethane fuel. Preliminary test showed that a 90% mixture of 190 proof ethanol and 10% castor was the best candidate for the fuel. The castor oil and water (from the ethanol mixture) is not burned in the engine, but serves as an engine coolant. Since the castor oil does not burn, it does not produce any fly ash like the other synthetically lubricated combustion reactions. Additionally, since ethanol combust at a much higher temperature than nitromethane, the constituents of the fuel serve as a critical coolant

for the combustion chamber of the engine. All coolants are collected and contained after they pass through the engine compartment.

The propulsion system proved to be reliable, economical, and environmentally friendly. Considering that ethanol and castor oil are produced universally, the fuel constituents can be readily obtained at reasonable prices. Additionally, considering the combustion products of ethanol are mainly CO<sub>2</sub> and H<sub>2</sub>O, the reaction is very environmental friendly as compared to other methods of propulsion. Ethanol fuel also has an extremely high octane providing for high performance and reliability.

Overall, the vehicle is capable of traveling anywhere from 0 to 1000 feet carrying 0 to 500-mL of water using entirely renewable resources.

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## Student Participants

### **Graduate**

Jorge Barcena  
Patricia J. Batchelor  
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David Eddleman  
Todd Frazier  
Uma Hota  
Damien Marsic  
James Estle McKinley  
Shannon L. Moody  
Joseph A. Noletto  
Divya Pradhan  
Namritha Ravinder  
Mary C. Setzer  
Brenda Styles  
Jennifer Schmidt Werka  
Xiujun Wu

### **Undergraduate**

Brooke Belyea  
Mikal Burgess  
Sean Entrekin  
Jennifer Ferguson  
Kaye S. George  
Laura Hinke  
Deah S. Lawson  
Angela Rea Ramsey  
Millicent Steger  
C. Chris Stowers  
Holly White  
Ráchael Wise