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Virginia Polytechnic Institute and
State University

**THE GRADUATE STUDENT ASSEMBLY
PROUDLY PRESENTS THE**

**19TH ANNUAL
RESEARCH SYMPOSIUM**

“BUILDING RESEARCH CONNECTIONS”



**MARCH 26, 2003
OWENS BANQUET ROOM
VIRGINIA POLYTECHNIC INSTITUTE AND STATE UNIVERSITY**

The 19th Annual Graduate Student Assembly Research Symposium

“Building Research Connections”

The Graduate Student Assembly (GSA) is proud to host this symposium in order to provide graduate and advanced undergraduate students an opportunity to showcase their achievements in research. This book is a compilation of the abstracts submitted by this year's participants.

The GSA is an umbrella organization for the graduate students of Virginia Tech. The Research Symposium is one of the many activities sponsored by the GSA. Other activities include the Graduate Research Development Project, Travel Fund Award Program, the Graduate and Professional School Fair, and many more.

For the third year, the Research Symposium is being held in conjunction with Graduate Education Week sponsored by the Graduate School. The purpose of Graduate Education Week is to recognize the importance of graduate education, increase the university community's awareness of the contributions of graduate students to research and education at Virginia Tech, and to enhance the graduate student experience. The week-long program offers opportunities to all members of the university community to be involved with graduate education. The schedule for GEW is on the following page.

Lastly, the Graduate Student Assembly would like to thank our generous sponsors. They have donated funds which have helped defray the cost of holding this event and which provide funds for the cash prizes.

Our sponsors include: Graduate School, Student Budget Board, College of Architecture & Urban Studies, College of Human Resources and Education, College of Engineering, College of Natural Resources, and Virginia/Maryland College of Veterinary Medicine.

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Graduate Education Week Schedule

Monday, March 24

12:00 Proclamation of Graduate Education Week

12:00 - 4:00 Graduate School Open House

Free tickets for Movie Night; popcorn and coffee; raffle

4:30 - 5:30 State of the Graduate School *

Address by Karen P. DePauw in 113 McBryde

7:00 Movie Night – The Lyric Theater (About Schmidt)

Free tickets available through the Graduate School

Tuesday, March 25

9:00 - 12:00 Preparing the Future Professional: Academic Track *

Donaldson Brown Hotel and Conference Center

1:00 - 4:00 Preparing the Future Professional: Business Track *

Donaldson Brown Hotel and Conference Center

Wednesday, March 26

10:00 - 3:00 19th Annual Research Symposium, GSA

Owens Banquet Hall

6:00 - 7:30 Academic Freedom in a Time of Crisis – Keynote Address by Dr. Robert O’Neil *

Owens Banquet Hall

Thursday, March 27

12:00 - 1:30 Roundtable Discussion on Academic Integrity *

Squires Student Center

6:00 - 8:00 Graduate Student Awards Banquet

Owens Banquet Hall – by invitation only

Friday, March 28

12:00 - 1:30 Research Symposium Winners Luncheon

Donaldson Brown Hotel and Conference Center

4:30 - 8:00 The Big Graduate School Cook Out *

Ag Quad behind Sandy Hall; food, music, games and fun

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19th Annual Graduate Student Assembly Research Symposium: “Building Research Connections”

Agriculture and Animal Sciences

- 1. Immunogenicity and pathogenicity in pigs of chimeric infectious DNA clones between pathogenic type 2 porcine circovirus (PCV2) and non-pathogenic PCV1*

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Abstract: PCV2 causes postweaning multisystemic wasting syndrome (PMWS) in pigs, whereas the genetically related PCV1 is non-pathogenic to pigs. We report here the construction and characterization of two chimeric infectious DNA clones between PCV1 and PCV2. The chimeric PCV1-2 clone contains the immunogenic capsid gene of PCV2 in the genomic backbone of the PCV1 DNA clone. A reciprocal PCV2-1 DNA clone was constructed by placing the PCV1 capsid gene in the genomic backbone of the pathogenic PCV2 DNA clone. The PCV1, PCV2, chimeric PCV1-2 and reciprocal chimeric PCV2-1 DNA clones were shown to be infectious when transfected in vitro into PK-15 cells, and expressed respective antigen as demonstrated by IFA. To evaluate the immunogenicity and pathogenicity of the DNA clones, forty SPF pigs were randomly assigned to 5 groups of 8 pigs each. Pigs in group 1 served as the negative control. Pigs in group 2 were each injected into the superficial iliac lymph node with 200 ug of the PCV2 infectious DNA clone, pigs in group 3 with 200 ug of the PCV1 clone, pigs in group 4 with 200 ug of the chimeric PCV1-2 clone, and pigs in group 5 with 200 ug of the reciprocal chimeric PCV2-1 clone. As expected, seroconversions to PCV2 antibody were detected in pigs inoculated with the PCV2 clone and with the chimeric PCV1-2 clone. Pigs inoculated with the reciprocal chimeric PCV2-1 and the PCV1 clones seroconverted to PCV1 antibody. Gross lesions and microscopic lesions in pigs inoculated with the wild-type PCV2 clone are significantly more severe than those inoculated with the chimeric clones and the PCV1 clone. The data indicated that the chimeric PCV1-2 infectious DNA clone induces a specific antibody response to the pathogenic PCV2 while retaining the non-pathogenic nature of PCV1.

- 2. Effects of varying energy intakes on extracellular matrix (ECM) deposition in the mammary tissue of pre-pubertal heifers.*

Forrest, Jamie, R.M. Akers, R.E. Pearson, E.G. Brown, M.J. VandeHaar, and M.S. Weber
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Abstract: Rapid rearing of dairy heifers impairs mammary development and reduces subsequent milk yield. Our objective was to determine if rate of pre-pubertal gain affects deposition of ECM proteins. At 2 wk of age, Holstein calves were assigned to 1 of 4 treatments (HH, HL, LH, and LL) with 2 levels of energy intake (High or Low) and 2 periods of growth (2 to 8 and 8 to 14 wk). At 14 wk, mammary parenchymal tissue was collected, fixed, and embedded in paraffin. Immunocytochemical staining allowed visualization of type IV collagen (Col IV), fibronectin

(FN), and laminin (LM). Images representing 4 increasing grades (1 to 4) were used to quantify protein deposition. Feeding level did not affect Col IV or LM staining grade. FN staining adjacent to subtending ducts averaged 1.93 for HH and 1.50 for LL heifers ($p=0.03$). FN staining around terminal ductular units was similar, averaging 1.87 for HH and 1.32 for LL heifers ($p=0.001$). A contrast grouping H heifers vs. L heifers in period 2 (HH+LH and HL+LL) confirmed a similar feeding level effect (1.78 vs. 1.43; $p=0.008$). A high rate of gain, in particular a continuous high rate, between 2 and 14 weeks of age increased FN, but not Col IV or LM, deposition throughout mammary parenchyma. Ki67 labeling, which indexes cell proliferation, in epithelium was lower in HH (4.05%) than in LL (6.51) heifers ($p=0.01$). Increased FN corresponds with impaired development, supporting our prior work that showed increased FN deposition in ovarioectomized heifers with stunted mammary development.

3. *Induced Expression of Sarcotoxin IA Enhances Host Resistance Against Egyptian broomrape (*Orobanche aegyptiaca* Pers.)*

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Abstract: Parasitic weeds such as broomrape are difficult to control because they are closely associated with the host root and are concealed underground for most of their life cycle. These parasites are not controlled effectively by traditional cultural or herbicidal methods, and the best long-term strategy for limiting damage by broomrape is the development of resistant crops. Our approach to engineer broomrape resistance is based on parasite-induced expression of a selective toxin. Sarcotoxin IA is a bactericidal peptide from the flesh fly (*Sarcophaga peregrina*). The gene encoding this toxin was fused to a promoter taken from a defense-related isogene of 3-hydroxy-methylglutaryl coenzyme A reductase (HMG2). The HMG2 gene is expressed specifically at the site of parasite ingress, thereby concentrating spatial and temporal accumulation of the toxin to tissues affected by the parasite. The sarcotoxin IA gene construct was used to transform tobacco using Agrobacterium-mediated transformation. Transgene integration into the plant genome was confirmed by PCR, and its expression demonstrated by reverse transcriptase (RT)-PCR, respectively. Host response to parasitism was assayed in polyethylene bags and in soil inoculated with Egyptian broomrape seeds. When challenged with the parasite, transgenic plants exhibited greater biomass accumulation and reduced levels of parasitism as compared to non-transgenic plants. Moreover, the frequency of tubercle necrosis and death was higher on transgenic vs. non-transgenic plants. Sarcotoxin IA expression had no significant effect on host growth and development in the absence of broomrape, as transformed and non-transformed plants attained similar stature and biomass. We hypothesize that sarcotoxin IA is toxic to the parasitic plant, rather than the host, due to accumulation of the toxin immediately around or inside the parasite, which acts as a strong sink on the host.

4. Heterogeneity and Seroprevalence of the Newly Identified Avian Hepatitis E Virus from Chickens in the United States

Huang Fang-Fang, G. Haqshenas, D. K. Guenette, C. T. Larsen, F. W. Pierson, F. Elvinger, T. E. Toth, X. J. Meng

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Abstract: A novel virus, designated avian hepatitis E virus (avian HEV), was identified and characterized from chickens with hepatitis-splenomegaly syndrome (HS syndrome) in the United States. To determine the extent of genetic variation and the seroprevalence of avian HEV infection in chicken flocks of different regions in the United States, we genetically identified and characterized 11 additional avian HEV isolates and assessed the prevalence of avian HEV antibodies from a total of 1,276 chickens from 76 different flocks. With a RT-PCR assay, we tested 21 bile samples from chickens with HS syndrome. Twelve of the 21 bile samples are positive for 30-35 nm HEV-like virus particles by electron microscopy (EM). Eleven of the 12 EM-positive bile samples and 6 of the 9 EM-negative bile samples are positive for avian HEV RNA by RT-PCR. Sequence analyses revealed that the 11 field isolates of avian HEV shared 78-100% nucleotide sequence identities with each other, 79-88% identities with the prototype avian HEV, 76-80% identities with chicken big liver and spleen disease virus (BLSV) and 56-62% identities with other known strains of human and swine HEV. An ELISA assay was developed and used to determine avian HEV seroprevalence. About 71% chicken flocks and 30% chickens tested in the study were positive for antibodies to avian HEV. The data indicated that, like swine and human HEVs, avian HEV isolates from different geographic regions are also genetically heterogeneous, and that avian HEV infection is enzoonotic in chicken flocks in the United States.

5. Development of a heteroduplex mobility assay for the identification of vaccine-like field isolates of porcine reproductive and respiratory syndrome virus

Key, Kijona, D. K. Guenette, K.-J. Yoon, P. G. Halbur, T. E. Toth, and X. J. Meng

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Abstract: Porcine reproductive and respiratory syndrome (PRRS) has been devastating the swine industry since the late 1980s. The disease has been controlled, to some extent, through the use of modified live-attenuated vaccines (MLVs) once available. However, such a practice periodically resulted in isolation or detection of vaccine-like viruses from pigs as determined by a partial genomic sequencing. In this study, we developed a heteroduplex mobility assay (HMA) for quickly identifying PRRSV isolates with significant nucleotide sequence identities (~98%) with the MLVs. The major envelope gene (ORF5) of 51 PRRSV field isolates recovered before and after the introduction of the vaccines was amplified, denatured, and re-annealed with the respective HMA reference vaccine strains, Ingelvac PRRS MLV and Ingelvac PRRS ATP. Nine of the 51 field isolates and the VR2332 parent virus of Ingelvac PRRS MLV, which were all highly related to Ingelvac PRRS MLV with <2% nucleotide sequence divergence as determined by sequence analysis, were all identified by the HMA to form homoduplexes with the reference

Ingelvac PRRS MLV. No homoduplex-forming field isolate was identified when Ingelvac PRRS ATP was used as the HMA reference except for its parent virus JA142. Other field isolates with more than 2% nucleotide sequence divergence with the respective reference vaccine strain resulted in the formation of heteroduplexes with reduced mobility in polyacrylamide gel electrophoresis. The HMA results also correlated well with the results of phylogenetic analyses. The data indicated that the HMA developed in the study may be a rapid and efficient method for large-scale screening of potential vaccine-like PRRSV field isolates for further genetic characterization.

6. Forage species' persistence on a reclaimed mine soil treated with biosolids

Lemus, Rocky, A. O. Abaye, G. K. Evanylo, C. E. Zipper, and S. Hutton

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Abstract: The establishment and maintenance of persistent vegetation to support post-mining land use on mined lands is an important part of the reclamation process. A field study was established in the summer of 1990 on a reclaimed mine site in southwest Virginia to determine forage species' adaptability and survival. The soil was comprised of sandstone and siltstone overburden materials. A composted mixture of sewage sludge and wood chips was applied prior to revegetation at a rate of 112 Mg dry matter ha⁻¹. Sixteen treatments were established, each in four replications, using 12 forage species in pure stands and mixtures. Plant samples were collected annually in the fall, 1996 - 2001, to determine botanical composition and biomass production. Samples were separated by target species (species originally planted), and non-target grasses, forbs, and legumes. Tall fescue (*F. arundinacea*), sericea lespedeza (*L. cuneata*), switchgrass (*P. virgatum*), and switchgrass/AULotan (*Lespedeza* sp.) mix were the most successfully established. The treatments containing alfalfa (*M. sativa*), ladino clover (*T. repens*), and birdsfoot trefoil (*L. corniculatus*) consistently had poor biomass accumulation.

7. Estimating N dynamics under field conditions to improve switchgrass production in Virginia

Lemus, Rocky, D. Parrish, D. Wolf, M. Alley, and C. Anderson-Cook

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Abstract: Biofuels crops may differ in yield because of (among other things) differences in their ability to take up nutrients or differing efficiencies in assimilating nutrients into biomass. Switchgrass (*Panicum virgatum* L.) appears to be rather "thrifty" in its use of N; it produces relatively high yields on soils considered low in N, and it is relatively unresponsive in our hands to higher rates of applied N. The objectives of this study were to look at N use efficiency (NUE) in switchgrass and to begin modeling N fluxes in a switchgrass stand. Experiments were conducted at Orange and Blacksburg, VA in 2001 using well-established stands of Cave-in-Rock switchgrass. The experimental design was a randomized complete block replicated four times and with N application rates of 0, 90, 180, and 270 kg N ha⁻¹. Shoot, root, and soil samples were collected throughout the growing season. Nitrogen content in plant and soil samples was determined using a CN analyzer. There were no significant differences in yield between N

treatments. Nitrogen content in shoot tissue decreased with maturity and there were no differences with N application. Root N content increased with time and N application. No differences in biological NUE [(biomass at N rate X - biomass at N rate 0)/(above-ground plant N at N rate X - above-ground N at N rate 0)] were observed. Partial factor productivity (biomass at N rate X/N applied) was higher at 90 kg N ha⁻¹ and decreased with increasing N application.

8. PESTICIDE MIXTURES POTENTIATE IMMUNOTOXICITY

Olgun, Selen, Hara P. Misra

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Abstract: There is great uncertainty about how complex mixtures of xenobiotics affect human and animal health. Numerous risk assessment studies have been done to evaluate the severity of the threat that each toxic chemical posed; yet the exposure to chemicals is rarely limited to a single compound. We have studied the combined effects of lindane (L), malathion (M), and permethrin (P) on murine (C57Bl/6) immune system, *in vivo*. Animals were randomly divided into groups of six and injected intraperitoneally with three different doses (one-half, one-third, one-fourth, or one-eighth of LD50) of individual pesticide. The vehicle and positive control groups were included. Animals were injected with pesticides on day-1 and day-3, challenged with sheep red blood cells (sRBC) on day-4, and sacrificed on day-8. Exposure to individual pesticides did not alter the thymus/ and spleen/body weight ratios; thymic and splenic cell counts, or CD4/CD8 and CD45/CD90 phenotyping of cells. However, anti-sRBC plaque forming cell (PFC) counts were significantly lowered even at the lowest doses of pesticide exposure. Two other groups of animals were injected with the mixtures (L+M or L+P) of one-third of LD50 of each pesticide. Exposure to pesticide mixtures did not alter the CD4/CD8 and CD45/CD90 cell subpopulations. However, the thymus/ and spleen/body weight ratios, thymic and splenic cell counts, and PFC counts were significantly lowered in pesticide mixture exposures. These data indicate that L, M, and P are potent immunotoxicants and mixtures of these pesticides cause significantly higher toxicity compared to individual exposures.

9. Uranium and Cell Death in the Rat Kidney

Pomeroy, Melinda J. BS Jortner, M Ehrich, D Barber

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Abstract: We investigated the histopathological course of uranium-induced tubular necrosis in adult male Sprague-Dawley rats. Rats were sacrificed 8 hours, 24 hours, and 168 hours following intraperitoneal administration of 0, 1 or 10 mg/kg of uranium as uranyl acetate in saline. Mean uranium concentrations (in ng/ml) in serum were as follows: 1 mg/kg dose- 20.9 at 8 hours, 4.5 at 24 hours; 10 mg/kg dose- 200 at 8 hours, 30.5 at 24 hours. Light microscopic studies revealed brush border loss and necrosis of proximal tubular epithelium, most marked in rats given 10 mg/kg, confirming earlier work documenting the toxic effect of uranium (Sanchez et al., Biol Trace Elem Res 84:139; Lim et al., Yonsei Med J 28:38). This lesion was notable 8

hours post-dosing in the outer stripe of the medulla, and extended through the cortex by 24 hours, best seen in rats given 10 mg/kg. We demonstrate that apoptosis is a feature of cell loss, most prominent at 24 hours post-dosing, using TUNEL assay (1:25) (TUNEL, Roche Diagnostics). By 168 hours, proximal tubular epithelial regeneration was evident in the cortex and outer medullary stripe, more prominent in the 1 mg/kg dosage group. This was characterized by cells having a basophilic cytoplasm and mitotic figures. We demonstrate that apoptotic events occur during uranium-induced renal injury and that regeneration is a prominent sequel to such heavy metal effect. (Supported by U.S. Army Medical Research and Material Command DAMD 17-01-1-0775. This abstract does not reflect the position or policy of the US Government.)

10. Importance of the activity sort level when using pedometry to detect estrus in dairy cows

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Abstract: The objective of this study was to determine how pedometer activity alarm setting, affected pregnancy rate during estrus detection. Four commercial dairy herds (A, B, C, D) recorded activity measurements obtained during the four milking sessions prior to AI. For the milking prior to AI, the increase in activity, relative to a baseline activity determined by the pedometry system, was similar across herds, 2.9 for A (n=167), 3.6 for B (n=84), 3.3 for C (n=166), and 3.8 for D (n=308). Retrospectively, five activity levels (2x, 2.5x, 3x, 3.5x, and 4x baseline) were applied to determine the number of cows and pregnancy rate for cows in each level. Overall pregnancy rates ranged from 33.1% for herd C to 41.6% for herd D. Pregnancy rates increased from 38.4% when activity increase was twice baseline to 41.9% when the activity was 4x, the baseline. Requiring that a cow exhibit a four fold increase in activity decreased the number that would have been inseminated by 58% when compared to cows that qualified at twice the baseline activity. More importantly the number of pregnant cows decreased from 212 when using a two fold increase in activity to 98 when a four fold increase was required for insemination. Pedometer software interface enhances this system as a viably alternative for the detection of estrus.

11. Corticosterone in drinking water altered the time and plasma concentration curve of a single oral dose of corticosterone and levels of plasma sodium, albumin, globulin, and total protein.

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Abstract: Effects of chronic exposure to corticosterone (CORT) in drinking water on CORT kinetics, blood chemistry, and brain catecholamines and esterases were studied in adult male Long Evans rats. Groups of rats (n=8) were given either water, 2.5% ethanol, or 400 mg/ml CORT in 2.5% ethanol for 28 days. On day 28, rats were gavaged either with corn oil or CORT 20 mg/kg (n=4). Blood samples were collected at 0, 15, 30, 60, 120, 240, 480, and 720 min for CORT levels. Day 14 after gavage blood samples were collected for clinical pathology and

brains were dissected into hippocampus (H), cerebral cortex (CC), caudate putamen (CP), and pons for levels of catecholamines, neurotoxic esterase (NTE), carboxylesterase (CbE), and acetylcholinesterase (AChE) activities. Plasma CORT levels of CORT-drinking rats (58 ± 14 ng/ml) were lower than the water (433 ± 40 ng/ml) and the ethanol group (387 ± 25 ng/ml). Plasma CORT was at similar peak levels in 15 min in all rats gavaged with CORT. The change from basal to peak in the CORT-drinking rats was greater than in naïve and vehicle rats. Plasma sodium levels were lower in CORT-drinking rats (137.8 ± 0.8 mEq/dL) than water-drinking rats (141.9 ± 0.8 mEq/dL), suggesting effect of the hormone on the adrenal gland. Plasma albumin, globulin, and total protein were higher in CORT-drinking rats. Brain NTE, CbE, and AChE were not different among the groups except in the CC (NTE lower in CORT-drinking rats). Brain catecholamines levels were similar except the norepinephrine in H was higher in CORT-gavaged rats than the corn oil group.

12. Pharmacological screening of indigenous medicinal plant *termenialia arjuna* for vasodilator activity.

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Abstract: Medicinal plant Terminalia arjuna is attributed with various therapeutic uses on ayurveda hence it was proposed to screen the above plant for pharmacological studies. The objective of this study is to evaluate the hypotensive activity of this medicinal plant. The aqueous and alcoholic extracts were prepared by the method described by Rosenthaler(1930). The percent extractability in solvent like water was found 46.30%. The percent extractability in solvent like alcohol was found 28.00%. The phytochemical analysis revealed the presence of sterols, alcoloids, aminoacids, saponine, glycosides, reducing sugars & resins. Pharmacodynamic studies were carried out by the method suggested by Turner A. R. (1965). The extracts were tried on the carotid blood pressure of anaesthetized dog. The effects of the extracts were recorded with the help of research kymograph maintained at the constant speed throughout this study. The alcoholic extract produced the hypotensive response at the dose rate of 4mg/kg of body weight. The water extract produced the hypotensive response at the dose rate of 5mg/kg of body weight. The hypotensive responses soon regain to normal and were not blocked by atropine. The normal bracket responses of the tetrad were seen to be unaltered after administration of both the extracts. From this study it is concluded that both the extract of the Terminalia arjuna have hypotensive effect on carotid blood pressure of anaesthetized dog and could be used in the conditions of high blood pressure.

13. Pesticide-Induced Reactive Oxygen Species Generation in Murine Splenocytes, In Vitro

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Abstract: Pesticides are used both in agriculture and in public hygiene for protection against undesired pests. Although pesticides are vital in increasing food production and eliminating

diseases, recent reports suggest that over exposure to pesticides poses potential health risks to humans and animals. We have observed earlier that the pesticides, endosulfan and permethrin cause immune cell cytotoxicity mainly via apoptosis. Our hypothesis is that these chemicals induce immunotoxicity through reactive oxygen species (ROS) production. In order to test this hypothesis, we have studied the generation of ROS in endosulfan and permethrin exposed splenocytes of C57Bl/6 adult male mice, *in vitro*. Intracellular generation of hydrogen peroxide (H_2O_2) and superoxide anion was monitored using flow cytometric analysis in combination with dichlorofluorescin diacetate (DCFH-DA) and hydroethidine (HE) dyes, respectively. Splenocytes treated with endosulfan and permethrin showed increases in both H_2O_2 and O_2^- generation in a dose-dependent manner up to 150 mM. Exposure to pesticide mixtures appears to have little or no effect on further generation of either H_2O_2 or O_2^- in murine splenocytes, *in vitro*. These findings suggest that the pesticide-induced immunotoxicity observed earlier may, at least in part, be associated with the generation of ROS.

14. EXOGENOUS γ -GLUTAMYL CYCLE COMPOUND SUPPLEMENTATION TO IN VITRO MATURATION MEDIUM AND EFFECTS ON SUBSEQUENT IN VITRO FERTILIZATION, CULTURE, AND VIABILITY OF PORCINE OOCYTES AND EMBRYOS

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Abstract: High concentrations of intracellular glutathione (GSH) enhance *in vitro* production of porcine embryos. Objectives were 1) to study the effects of γ -glutamyl cycle compound supplements to the *in vitro* maturation (IVM) medium on *in vitro* fertilization (IVF) and *in vitro* culture (IVC) and 2) to evaluate embryo viability. Porcine oocytes were matured in NCSU 23 medium supplemented with either L-cysteine (3.3 mM), L-cysteamine (150 mM), L-cysteine and L-cysteamine, L-glycine (1, 2.5, or 5 mM), L-glutamate (1, 2.5, or 5 mM), L-a-aminobutyrate (3.3 mM), b-mercaptoproethanol (25 mM), L-cysteine and b-mercaptoproethanol, or L-a-aminobutyrate and b-mercaptoproethanol. After IVM, concentrations of intracellular GSH were determined using a colorimetric assay. Significant ($P < 0.05$) increases in GSH concentrations were observed using L-cysteine, 1.0 mM L-glutamate, L-a-aminobutyrate, and L-a-aminobutyrate with b-mercaptoproethanol. Oocytes matured with L-a-aminobutyrate and b-mercaptoproethanol had a lower ($P < 0.05$) occurrence of polyspermy during IVF compared to controls and a greater percentage ($P < 0.05$) of embryos reaching the blastocyst stage compared to other treatment groups. For objective 2, oocytes were matured in NCSU 23 or NCSU 23 supplemented with L-a-aminobutyrate with b-mercaptoproethanol. Supplementation had no effect on the time of cell death. The times at which embryo mortality was greatest ($P < 0.05$) were between 24 to 42 h post-IVF with the greatest occurrence around 36 h. In conclusion, supplementing 3.3 mM L-a-aminobutyrate and 25 mM b-mercaptoproethanol into the IVM medium increases the intracellular GSH concentrations, decreases the occurrence of polyspermy during IVF, and increases embryo development parameters during IVC but does not have an effect on cell death during embryo development.

15. Expression of Cystic Fibrosis Transmembrane Conductance Regulator (CFTR) in Tobacco

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Abstract: The cystic fibrosis transmembrane conductance regulator (CFTR) is one of the most studied membrane protein models because of its clear clinical significance. Mutations within the CFTR gene lead to cystic fibrosis (CF), the most common autosomal recessive genetic disorder in the Caucasian population. CFTR is a putative chloride ion channel in the ATP binding cassette (ABC) class of transporter proteins. It is a large 160 kDa glycoprotein that contains the classic “2x6” transmembrane domains. Due to the low abundance of CFTR and difficulties producing sufficient amounts in heterologous systems, the exact function/structure relationship of the protein is unknown. Expression of CFTR in *E. coli* is lethal and mammalian culture systems are expensive and low yielding. However, successful bioproduction of many complex human proteins has been shown in transgenic plants. Our research objective is to develop tobacco as a model system for expressing large quantities of human CFTR. Plasmids containing the full-length CFTR fused to the 35s double enhanced promoter could not be propagated in *E. coli*, suggesting that the CFTR product generated by “leaky” expression was detrimental to bacteria. Two strategies were undertaken to address the problem: 1) a plant intron was introduced into the CFTR sequence and 2) a more tightly regulated wound inducible promoter MeGATM derived from the defense regulated tomato hmg 2 gene encoding 3-hydroxy-3-methylglutaryl coenzyme A reductase (HMGR). Plant tissues were transformed with all constructs. CFTR presence was determined by PCR. Expression and intron splicing was analyzed by RT-PCR. Protein expression was determined by western analysis.

16. Comparison of prophylactic or therapeutic dietary administration of capsaicin for resistance to *Salmonella* or coccidia in broiler chickens.

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Abstract: Studies show prophylactic dietary administration of capsaicin significantly reduces the incidence of *Salmonella enteritidis* (SE) positive organs or cecal tonsils in broilers. The following experiments compared prophylactic vs. therapeutic efficacy of capsaicin for resistance to *Salmonella* or coccidia in broilers. EXP 1 evaluated capsaicin, 0 (control) or 10ppm, in the starter ration of chicks challenged with either SE or *Emieria acervulina* (EA) on day 0 or 10 respectively. Therapeutic inclusion of 10ppm capsaicin with SE increased ($P<0.05$) liver/spleen (L/S) and cecal positives. No difference was observed in EA lesions. In EXP 2, spice grade capsicum oleoresin (CO), was included in the finisher diet at 0, 5, or 20ppm. Inclusion of 5ppm CO in the finisher diet increased ($P<0.05$) L/S and cecal SE positives. No difference in SE colonization or invasion was observed with 20ppm CO or either CO level for ET lesions or colony forming units (CFU) SE in the ceca. EXP 3 evaluated prophylactic CO at 0, 5, or 20ppm in starter, grower, and finisher diets for resistance to SE or *Salmonella typhimurium* (ST) challenge on day 14 or 29. With challenge on day 14, 5ppm CO reduced L/S ($P<0.05$) positives for SE. Prophylactic or therapeutic capsaicin differentially affects susceptibility to *Salmonella*.

and indicate that prophylactic administration provides a non-antibiotic means to reduce *Salmonella* in broilers.

17. Experimental and field evidence of subclinical spread of avian hepatitis E virus in chicken flocks

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Abstract: Avian hepatitis E virus (avian HEV) is a novel virus recently isolated from chickens with Hepatitis-Splenomegaly (HS) syndrome in the U.S. However, our recent study indicated that avian HEV antibody is also prevalent in healthy chicken flocks. To understand the nature of avian HEV transmission, we first conducted a prospective study in a known seropositive but healthy commercial chicken farm. Fourteen chickens of 12 weeks of age were randomly selected from this farm, tagged and monitored weekly under natural conditions for 19 weeks for evidence of avian HEV infection. All 14 chickens were seronegative at 12 weeks of age. By 30 weeks of age, all of the selected chickens had seroconverted to avian HEV antibody and avian HEV RNA was also detected in the fecal and serum samples of at least one chicken. None of the infected chickens had signs of HS syndrome. To confirm our field observation, we subsequently conducted an experimental infection of chickens with avian HEV under laboratory conditions. An infectious stock of avian HEV prepared in 10% fecal suspension was 10-fold serially diluted from 10^{-2} to 10^{-6} in PBS buffer. Each of the 5 dilutions was inoculated into two young SPF chickens (200 μ l per chicken). Each inoculated chicken was housed in a separate isolator together with two uninoculated contact control SPF chickens. All chickens inoculated with 10^{-2} to 10^{-4} dilutions and one of the two chickens inoculated with the 10^{-5} dilution seroconverted to avian HEV antibody at 4 weeks postinoculation, whereas the two chickens inoculated with 10^{-6} dilution remained seronegative. The two uninoculated contact control chickens housed in the same isolator with the 10^{-2} -inoculated one also became infected through direct contact, and seroconversion in these two contact control chickens occurred at 8 weeks postinoculation. All other contact control chickens housed in the isolators with 10^{-3} to 10^{-6} -inoculated chickens remained seronegative. The data suggested that avian HEV is enzoonotic in chicken flocks, and that avian HEV infection is dose-dependent.

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18. Ectomycorrhizal colonization of *Pinus* species on a mine site revegetation project in southwest Virginia

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Landscape destruction due to mining activity is of great concern, as the methods employed result in habitat loss, decreases in biodiversity, and soil pollution. Revegetation and reclamation of these sites is important; however, accomplishing this task has been difficult. Low pH and high trace metal concentrations in the soil are

phytotoxic, resulting in high seedling mortality. Inoculation with ectomycorrhizal fungi has shown to confer greater success to outplanted seedlings in the past; however, questions remain as to which fungi naturally exist and colonize host plants on these sites. We examined the mycorrhizal colonization of *Pinus strobus* and *Pinus virginiana* trees planted as part of a coal mine reclamation project in Wise County, VA. The seedlings had not been inoculated with any ECM fungi before outplanting. Four subsites at different recovery ages—1, 8, 13, and 25 years—were chosen for study. Percent colonization counts, morphological examination, and DNA sequencing were performed for each sampled seedling. The 25-year recovery site revealed the highest amount of mycorrhizal colonization and the 1 and 8 year sites had the lowest amount of colonization, as expected. The species identification data included specialist species, suggesting that intrinsic host-mycobiont relationships may need to play a greater role in choosing inoculum for revegetation efforts.

19. Nesting of the Red-cockaded woodpecker

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Abstract: We are studying cavity-nesting birds and their relation to the federally endangered red-cockaded woodpecker (RCW) in the longleaf pine forests of Eglin Air Force Base, Florida. As the only excavator of cavities in living pines, the RCW plays a vital role in the longleaf cavity-nesting community. Twenty-seven vertebrate species use RCW cavities. Our objective is to examine the role of the RCW in this community using a nest web approach. A nest web, based on food-web theory, is a modified interaction web with cavities as the central resource and bird species as members of the hierarchy. We relate the abundance of cavity-nesting birds to numbers of RCWs, RCW cavities and snags. These data are incorporated into a nest-web and used to determine which species may be potentially impacted by RCW cavity management. Resulting nest webs identify two groups of cavity-nesting birds at Eglin and suggest that five cavity-nesting species have the potential to be impacted by RCW cavity management. Of particular importance is the southeastern American kestrel, which has a strong, positive and significant correlation with RCW cavity trees. The kestrel is a secondary cavity nester that depends on other cavity-excavating birds to provide nesting cavities. Their need for enlarged cavities makes them susceptible to negative impacts from restrictor plates, commonly used to protect RCW cavities. The southeastern American kestrel has declined by 82% since 1940 and is listed as threatened in Florida. These results suggest that understanding potential impacts of RCW cavity management on other cavity-nesting birds is warranted.

20. A Bioinformatic approach to the discovery of Non-LTR retrotransposons in the African malaria mosquito, *Anopheles gambiae*: unprecedented diversity and evidence of recent activity

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Abstract: Over a hundred families of non-LTR retrotransposons (non-LTRs) were found in the newly released *Anopheles gambiae* genome assembly during a reiterative and comprehensive search using the conserved reverse transcriptase (RT) domains of known non-LTRs as the starting queries. These families, which are defined by at least 20% amino acid sequence divergence in their RT domains, range from a few to approximately 2000 copies and occupy at least 3% of the genome. In addition to having an unprecedented number of diverse families, *A. gambiae* non-LTRs represent 8 of the 15 previously defined clades plus two novel clades Loner and Outcast, more than what has been reported for any genome. Five families were found belonging to the L1 clade, which had no invertebrate representatives to date. One unique family named Sponge contains only a complete open reading frame (ORF) for the Gag-like protein and appears to have been mobilized by a family of the CR1 clade. All clades except R4 have one or more families with characteristics suggesting recent transposition activity such as multiple full-length copies with over 99% nucleotide identity, target site duplications (TSDs), intact ORFs, and corresponding expressed sequence tags (ESTs). The incredible diversity and the maintenance of multiple recently active lineages within different clades indicate a complex evolutionary scenario. *A. gambiae* non-LTRs have the potential to be developed as powerful tools for population genetic studies and genetic manipulations of this primary vector of the devastating disease malaria. The semi-automated reiterative search approach described here may be used to systematically survey and characterize non-LTRs in any genome assembly.

21. *Spatially explicit watershed zone of influence based on runoff travel time hydrologic modeling using GIS*

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Abstract: Overland flow patterns influence watershed erosion, ultimately reducing stream health. Recently, hydrologic models have been incorporated with GIS making spatially explicit prediction of overland flow possible. Our research uses spatial explicit hydrologic models to predict overland flow patterns and examines the utility of these predictions as a method to define the watershed portion most likely to contribute sediment to stream channels, the Ôzone of influence. Identification of an ecologically relevant stream channel zone is useful for all persons interested in conserving aquatic resources. Travel time for each 100 m² cell in twelve North Carolina research watersheds was estimated using surface runoff velocity equations, 10-m Digital Elevation Models and ArcInfo 8.2ñ. Velocity equations included terms accounting for surface roughness, as determined by land cover, slope and flow direction. These were combined to calculate travel time (s) for each cell by inverting velocity estimates (s/m) and multiplying by a cells distance (m) from the stream channel. We defined zones at several maximum travel time thresholds and compared land cover percentages in each. Percent land cover varied with threshold definition although differences decreased with proximity to channels. Zone threshold standardization may allow definition of ecologically relevant ÔriparianÕ areas for sedimentation study and management.

22. Understanding signal termination in the phosphatidylinositol signaling pathway: a difference FT-IR study of inositol-5-phosphatase catalysis

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Abstract: Signal transduction pathways permit organisms to respond to their environment in order to adapt and survive. Found in all eukaryotes, the phosphatidylinositol (PI) signaling pathway is critical in the generation of inositol second messenger signals. Inositol-5-phosphatases terminate the second messenger signals in this pathway. When cellular second messengers are not terminated or regulated appropriately, organisms lose the ability to control cellular growth and differentiation, resulting in cancer and other diseases. We are investigating the catalytic mechanism of inositol-5-phosphatases in the presence of caged IP₃, using difference infrared techniques. We have obtained difference FT-IR data on the photolysis of caged IP₃; tentative assignment of vibrational modes is based on model compound spectra of IP₃ and IP₂. We also observe structural changes in a purified inositol-5-phosphatase upon binding of IP₃ and conversion to IP₂. These structural changes in the enzyme are consistent with modifications of amino acid residues in the active site of these proteins. This novel approach in investigating the mechanism of inositol-5-phosphatases will provide insights in treating human diseases, such as type II diabetes, and Lowe oculocerebrorenal syndrome, which involve aberrant PI signal transduction. Funded by ASPIRES (S.K. and G.G.).

23. The SCF ubiquitin ligase Slmb regulates centrosome duplication in Drosophila

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Abstract: It has been over a hundred years since Boveri first described the centrosome (Boveri, 1901), yet there is much about this enigmatic structure that remains a mystery. In animal cells, the centrosome serves as the organizational center for elements of the cytoskeleton during interphase and is key to the organization of the mitotic spindle and the correct segregation of chromosomes during cell division (Kellogg et al. 1994). Centrosome replication is one of the crucial events of the cell cycle; abnormal duplication is thought to contribute to genetic instability and has been associated with many forms of human cancer (Salisbury, et. al. 1999; Brinkley, et. al. 2001). However, the mechanisms and regulation of centrosome duplication are only now beginning to be understood. Recently, we proposed that the SCF ubiquitin ligase protein Supernumerary limbs (Slmb) functions as a targeting factor for a SCF mediated proteolytic event required to prevent centrosomes from replicating more than once per round of cell division (Wojcik et al. 2000). Here, we report the evidence that implicates Slmb as one of the regulatory factors involved in regulating centrosome duplication in Drosophila.

24. Automation of Iterative Guided Spectral Class Rejection

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Abstract: Iterative Guided Spectral Class Rejection (IGSCR) is a satellite image classification method which has been shown to be rapid, accurate, and repeatable across users, regions and time. However, the implementation of the IGSCR algorithm up to this point has been tedious and prone to user error because the algorithm requires repeated performance of a number of completely objective and complicated processes. To facilitate the completion of research projects involving the IGSCR algorithm, and for the analyst time savings that it will offer to large scale image classification initiatives, we automated the IGSCR algorithm. The ERDAS C Toolkit and ERDAS Macro Language were used to automate the algorithm. The program produces a classified image or images, spectral signatures, and data obtained during the classification process. The program was used to classify into forest and nonforest 4 Landsat ETM+ (Enhanced Thematic Mapper Plus) images (of Virginia and Minnesota), f! or use in forest area estimation. The resulting classified images were filtered using five different methods in an attempt to improve the agreement of the classification with the land use on the ground. Finally, the validation data sets were refined to make them more representative of the predominant land use in the area surrounding their point locations (since a pixel represents land use information in a 30m² area, not at a point). Although there was a wide range in the resulting classification accuracies (81.9-95.4% overall), there were no consistently significant differences in accuracy between the various filters and validation sets across all images.

25. Ground-based Lidar for Forest Measurement

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Abstract: Airborne light detection and ranging (lidar) devices have become important tools for the gathering of landscape level data in both applied and research forestry. Three dimensional (3-D) lidar data provide insight into forest processes at the landscape level that would be difficult or impossible to obtain with any other means. Recent technological advances have allowed for the creation of portable ground-based lidar devices to gather a similar type of 3-D data. Ground-based lidar gather data at a finer scale, with greater resolution and accuracy than is possible with current airborne lidar. We investigated the feasibility of using a portable 3-D laser imaging sensor to measure various attributes of forest trees and canopies. The applications for this 3-D data can range from the estimation of individual tree measurements such as stem diameter and height, to whole-canopy parameters such as leaf area index, to the development of 3-D virtual environments for use in research and teaching. By developing and testing the accuracy of several methods for measuring tree and canopy attributes with the ground-based laser scanner, we hope to determine the potential of this tool for use in forest measurements.

26. Infrared Spectroscopic Studies of DNA Damage and Repair

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Abstract: When living cells are exposed to sunlight, ultraviolet light can cause damage to the genetic material in the organisms; errors in DNA can result in cell lethality and mutation in daughter cells. The majority of this DNA damage is in the form of cyclobutane pyrimidine dimers (CPD). Photolyase is a light-activated enzyme that catalytically repairs these CPD lesions in DNA. Although its basic steps in DNA repair are mapped, details of its mechanism are still under debate in the literature. Towards the end of examining structural changes in the enzyme and in the DNA lesion upon substrate binding and repair, our overall research goal is to examine the catalytic repair process of CPD by photolyase using difference FT-IR spectroscopy. We have synthesized and purified a cis-syn cyclobutane dimer in vitro to create a paradigm for the study of damaged DNA. We report the first infrared spectra of thymidylyl-(3'-5')-thymidine, a 2-mer of DNA. Assignment of vibrational modes is based on model compound data in the literature. Difference FT-IR data of these two molecules indicate a strong change in the bending frequencies of the C5 methyl group, consistent with the structure of CPDs.

27. Tardigrades - understanding desiccation tolerance

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Abstract: Only a few living organisms have the capacity to survive long periods of complete dryness. One example is the so-called water bear (Tardigrade). During desiccation this organism loses all of its free water. It assumes a physiological state known as 'tun'. In this stage the Tardigrade shows particular resistance to diverse extreme environmental conditions, like temperature (-195°C to 110°C), radiation, vacuum and pressure (6000 times atmospheric) and long periods of dryness (up to two years). It is thought that no reactions can take place in this dry system. This is a stage we would call dead. But under favorable conditions (adding water), this organism can gain normal vitality again, with apparently no damage. Transmitted electron microscopy revealed intact organelles during the desiccated period. Therefore the question is, how can proteins, DNA, lipids, sugars, etc. 'survive' this water loss, without precipitating or denaturating. "Water replacement" is the hypothesis that describes how disaccharides like, trehalose and sucrose, replace the hydrating water molecules during desiccation. To this hypothesis was added recently the "glassy state theory" and the role of other molecules in maintenance of cell integrity.

Due to the complex morphology of Tardigrades compared with other desiccation tolerant organisms (e.g. 8 legs, a nerve system with ganglia, differentiated cells and organs, photoreceptors) the system opens a lot of questions to this topic. This project will analyze desiccation at genomic, protein and carbohydrate levels.

28. Improved Properties of Natamycin Upon Formation of Cyclodextrin Inclusion Complexes

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Abstract: One of the greatest challenges that shredded cheese manufacturers face is product return due to mold growth. Natamycin is an antimycotic with very low water solubility (30 mg/L) and extremely high photosensitivity, which is used to extend the shelf life of shredded cheese products. However, degradation of natamycin and its deficient delivery as an aqueous suspension limits its antifungal effectiveness and decreases product shelf life. The objectives of this research are: (a) to find a new delivery system for natamycin that increases its aqueous solubility and (b) to increase the chemical stability of natamycin so that it has a prolonged antifungal effect on the surface of the shredded cheese. Molecular inclusion complexes of natamycin were formed with b-, hydroxypropyl b-, and g-cyclodextrins (CDs) which allowed large increases in aqueous solubility. The water solubility of natamycin was increased 16-fold, 73-fold, and 152-fold with b-CD, g-CD, and hydroxypropyl b-CD, respectively. The natamycin:CD inclusion complexes resulted in nearly equivalent in vitro antifungal activity as natamycin in its free state. Nuclear magnetic resonance (NMR) spectroscopy was utilized to prove the formation of true inclusion complexes. ¹H NMR shift titrations of N-(3'-N-dimethylaminosuccimido) natamycin with b- and g-CDs enabled determination of the stoichiometry of both complexes as 1:1. Aqueous solutions of natamycin:b-CD complex and natamycin:g-CD complex were significantly more stable ($p < 0.05$) than natamycin in its free state when stored in darkness at 4 °C. These significant increases in water solubility and stability will enable natamycin to function as a more effective antimycotic in the food industry.

29. Human transforming growth factor-beta signaling cross-talk in the malaria vector *Anopheles stephensi*

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Abstract: The mosquito *Anopheles stephensi* limits malaria parasite (*Plasmodium* spp.) development with inducible synthesis of nitric oxide (NO) catalyzed by *A. stephensi* NO synthase (AsNOS). Transforming growth factor-beta1 (TGF-beta1), a prototypic TGF-beta superfamily member, regulates mammalian iNOS activity and immunity to *Plasmodium*. We have determined that active mammalian TGF-beta1 is present in the mosquito midgut to 48h post-bloodfeeding. Cytoplasmic proteins known as Smads mediate signaling by TGF-beta. Because human TGF-beta can activate *Drosophila* Smads, we hypothesized that *Anopheles* cells could respond to human TGF-beta1 (hTGF-beta1) and that this response could influence Smad signaling, AsNOS expression, and parasite development in *A. stephensi*. After treatment with hTGF-beta1, *A. stephensi* cell morphology was characterized by a decrease in the percentage of round cells and an increase in the mean spread cell length. In addition, hTGF-beta1 inhibited DNA

synthesis and induced AsNOS expression in *A. stephensi* cells in vitro. In other experiments, *A. stephensi* were fed on *P. falciparum*-infected blood supplemented with hTGF-beta1 or PBS. Parasite intensity of infection was determined by counting oocysts at 7 days post-blood feeding. Our data showed significantly decreased numbers of oocysts in hTGF-beta1-treated mosquitoes

compared to controls. The *A. stephensi* genome encodes a TGF-beta homolog, As60A, whose expression in the midgut epithelium is modulated in response to parasite infection. We have identified *A. stephensi* Smad homologs of *Drosophila* Mad, Medea, and dSmad2. We speculate that hTGF-beta1 and As60A signals are transduced through intersecting Smad pathways that regulate expression of target genes such as AsNOS and influence *Plasmodium* development.

30. Examination of 2-Oxoglutarate Dependent Dioxygenases in the Central Flavonoid Biosynthetic Pathway of *Arabidopsis thaliana*

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Abstract: Flavonoids are a diverse group of natural products found in all higher plants. The flavonols are the most abundant sub-class of flavonoids, and have been associated with essential physiological functions in planta as well as pharmacological activities in animals. Flavonols are represented by two major aglycone structures that result from variations in the flux through the central flavonoid biosynthetic pathway. The enzymatic activities of flavonol synthase (FLS) and flavanone 3-hydroxylase (F3H) are essential in the synthesis of flavonols. FLS and F3H are classified as 2-oxoglutarate-dependant dioxygenases based on their requirement for ascorbate, 2-oxoglutarate, and Fe²⁺ for optimum activity levels.

Six putative FLS genes (FLS 1-6) have been identified in the *Arabidopsis* genome, while F3H and all the other enzymes of the central flavonoid pathway are encoded by a single gene. Evidence suggests FLS 6 is a pseudogene. The role of the remaining FLS genes in *Arabidopsis* is still unknown. We hypothesize that differences in the accumulation of flavonols in different tissues may be the result of differential expression of FLS isozymes with varying substrate specificities. As one approach to testing this hypothesis, the functional isozymes are being expressed in *E. coli* and utilized to develop an enzymatic assay using HPLC as a detection system. An assay for F3H has been achieved and is currently being refined. The assay will ultimately be utilized to biochemically characterize the recombinant enzyme. The F3H system is also being used as a model on which to generate a reliable FLS assay.

31. Manipulation of ascorbic acid levels in *A. thaliana* using gulono-lactone oxidase

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Abstract: Vitamin C (ascorbate, ascorbic acid) serves many critical functions in the human body as well as in plants. In both systems, it works as a cofactor in the production of hydroxyproline-rich molecules and helps protect molecules such as proteins, lipids and fatty acids from oxidation by free radicals and reactive oxygen species. Although the biochemical pathway in animals has been known since the 1950's, the exact process by which ascorbate is made in plants remains unknown. It was shown in 1963 that the inversion of the hexose carbon chain, which occurs in the animal pathway, is not a possible mode of synthesis in plants. Alternatively, a non-inversion pathway was described, which achieves ascorbate using D-mannose and L-galactose as intermediates. It was shown that transforming lettuce and tobacco with the terminal enzyme in

the animal biosynthetic pathway (GLO; L-gulono-lactone oxidase) increases the ascorbic acid content. It was also shown through feeding studies, that the wild type tobacco plants had elevated ascorbate levels when fed the animal precursor. This data suggests that at least part of the animal pathway could possibly be present in plants, along with the Wheeler (1998) pathway. In this study, wild type and ascorbic acid-deficient *Arabidopsis thaliana* (supplied by Dr. Patricia Conklin) will be transformed with the GLO gene. Homozygous lines of these transformants will be generated and the ascorbic acid levels will be compared to the untransformed wild type and mutant plants. Ascorbic acid levels will be assayed by a spectrophotometric assay and an NBT color assay.

32. Comparison of nuclear and plastid non-coding regions in the phylogeny of *Iliamna* (Malvaceae).

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Abstract: Sequences from the internal transcribed spacer (ITS) of the nuclear ribosomal genes and the trn L-F spacers of the chloroplast genome were used to resolve relationships in *Iliamna* Greene (Malvaceae). The eight species of *Iliamna* were included as well as representatives from *Malacothamnus*, and *Phymosia*. *Iliamna*, *Malacothamnus*, and *Phymosia* are thought to comprise the Malacothamnus Alliance based on chromosome numbers and morphological similarities. In the past, species of *Iliamna* and *Phymosia* were placed in the genus *Sphaeralcea*, and members of *Malacothamnus* were once included in the genus *Malvastrum*. Preliminary results in the present study indicate a strong affinity between *Iliamna*, *Malacothamnus*, and *Phymosia*. Sequences from the ITS region of *Iliamna* contained several insertion/deletion events preventing direct sequencing; whereas, in *Malacothamnus* and *Phymosia*, these events were not detected. This finding supports the hypothesis that *Iliamna*, with a base chromosome number of $n=33$, is a polyploid possibly derived from either *Malacothamnus* or *Phymosia*, in which $n=17$. The ITS region contained 12% parsimony informative sites, 120 of 678 basepairs sequenced, and the trn L-F spacers 1.3%, 13 of 1178 basepairs. A partition homogeneity test indicated the data sets to be incongruent. Topology of the phylogenies was examined and a few rearrangements of clades were found. It appears that *Iliamna* may not be monophyletic, and that a few species may belong in another genus. Additional sampling from a wider variety of potential relatives is required before a clear picture of the evolutionary history of the genus can be developed.

33. Genes from *Arabidopsis* involved in iron-sulfur cluster biogenesis

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Abstract: Proteins that use iron-sulfur [Fe-S] clusters as prosthetic groups contribute key activities in primary metabolism, hormone biosynthesis, energy production, and the stress response in plants. However very little is known about the assembly of [Fe-S] clusters in plants, despite the progress that has been made toward understanding this process in bacteria, yeast, and

mammals. *Arabidopsis thaliana* contains two counterparts of the *Azotobacter vinelandii* *IscS* gene (designated *AtNFS1* and *AtNFS2*) and three counterparts of *IscU* (*AtISU1*, *AtISU2*, and *AtISU3*). The significance of the redundancy of these genes in *Arabidopsis* is unknown. Transgenic plants have been generated to determine the biological function of these genes using suppression studies. Further, transgenic plants have been generated with the goal of defining the subcellular localization of the proteins using fusions of *AtNSF1* and *AtISU* proteins with GFP. The *AtNSF1* and *AtISU1* genes have been expressed in *Escherichia coli* and in vitro biochemical characterization of the recombinant proteins has confirmed the ability of the gene products to assemble [Fe-S] clusters. Promoter fusions are being constructed to determine if transcription of these genes is inducible or involved in [Fe-S] assembly processes that are tissue or organelle-specific. Gene-specific antibodies are being developed to enable analysis of expression at the protein level.

Humanities and Social Sciences

34. Thalamic Syndrome: Lateralized Multimodal Hallucinations

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Abstract: A sparsity of research exists on thalamic syndromes resulting from altered thalamic activation. The thalamus has been described as a "relay station" with sensory information from most sensory modalities projecting to the thalamus on their way to cortical projection areas. Thus, thalamic insult may result in multimodal sensory and motor deficits. In the present study a 46-year-old woman suffered a right thalamic CVA (as evidenced by CT scan). Secondary to this incident, she complained of altered sensations across multiple sensory modalities, including olfactory, visual, auditory, tactile, temperature, and pain sensation. Interestingly, during recovery from the thalamic CVA, the patient reported hallucinations in olfactory, visual, auditory, tactile, temperature, and pain modalities. Multimodal dysaesthesia and hallucinations showed reliable laterality in the affective valence across modalities with positive associations within the right hemispace and negative associations within the left hemispace. Overall, the results support multimodal effects of the thalamus and provide evidence that consistent affective tone exists across modalities within each hemisphere.

35. Age-related changes in respiratory parameters: Implications for measurement of heart rate variability

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Abstract: Despite common perception that heart rate is a relatively steady process (e.g., normal sinus rhythm), growing bodies of psychological and medical research have related patterns of variability in heart rate to psychological and medical wellbeing. In particular, variations in heart rate linked to respiration, called respiratory sinus arrhythmia (RSA), has proven to be predictive of a host of psychopathologies, such as major depressive and generalized anxiety disorders, as

well as risk for coronary heart disease and likelihood of mortality following myocardial infarct. Many techniques are available for the quantification of RSA, however widespread use has been accompanied by a call for greater methodological control. In particular, the effects of parameters such as respiratory frequency (RF) and volume (RV) may confound the measurement and interpretation of RSA. Because RSA is commonly examined across age groups, the purpose of the present report is to examine potential age related changes in respiratory parameters that may adversely effect RSA assessment. Participants were 100 healthy women (age 21-50). The procedure consisted of four commonly used three-minute tasks and respiratory parameters were recorded using a strain gauge placed around the chest. Correlational analysis revealed a significant negative relationship between age and RV in each of the experimental tasks (all p's<0.04) but no significant relationship between age and RR (p's>0.19). Findings suggest RV may be of particular performance in studies addressed age related differences or groups with large age ranges. Furthermore, efforts to control for respiratory confounds (e.g., paced breathing) may not account for these age-related effects.

36. That Was So Funny You Can Even See It On My Brain

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Abstract: Positive emotions have been associated with increased left frontal and right temporal activation. Research has also found that as the intensity of emotional arousal increases so too does cerebral activation. Interestingly, investigations of the relationship between intensity of emotions and changes in cerebral activation have used negative emotions. Thus, the purpose of the present investigation was to determine if a similar relationship exists for positive emotions. It was hypothesized that significant positive correlations would be found between intensity of mirthful memories and changes in both low beta (13 - 21 Hz) and high beta (21 - 32 Hz) magnitude at the left frontal and right temporal regions. A total of 16 women with an age range of 18 to 22 years ($M = 19.9$, $SD = 1.24$) were initially asked to sit quietly while quantitative electroencephalography (QEEG) was measured (baseline condition). Approximately 5 to 6 minutes later they were instructed to recollect a mirthful memory while QEEG was measured. Afterwards they were asked to rate the intensity of the mirthful memory on a scale of 1 (low intensity) to 7 (high intensity). Correlational analyses between changes in cerebral activation resulting from recollecting the mirthful memory and intensity ratings indicated that changes in high beta magnitude were positively correlated with intensity ratings at the left frontal ($r = .435$) and right temporal ($r = .438$) regions. Thus, the present investigation indicates that the intensity of positive emotions, like that of negative emotions, is related positively to changes in cerebral activation.

37. Diagnostic and Neuropsychological Correlates of Proactive and Reactive Aggression in Children

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Abstract: The purpose of the current study was to explore the relationships between reactive and proactive subtypes of aggression and neuropsychological and diagnostic variables. Children and

their parents completed diagnostic interviews, self-reports, and neuropsychological measures. Results suggest greater impairment in the reactive subtype, suggesting that neuropsychological and diagnostic distinctions may exist between these aggressive subtypes. Consequently, there may be some utility to distinguishing between proactive and reactive aggression in children, and there may be identifiable neuropsychological distinctions, especially in reference to frontal lobe functioning. Such distinctions may allow for a more detailed understanding of the mechanisms underlying such behavior and may lead to more effective interventions specifically targeting deficiencies associated with each form of aggression.

38. Exploring Collaboration between Regional Planning and Public Health Planning in Southwest Virginia

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Abstract: Research on collaboration between regional planning and public health promises project cost sharing while achieving the mission of the respective organizations. The objective of this research is to apply theoretical frameworks (transaction cost, resource dependency, and critical contingencies) for collaboration to assess the current level of interorganizational relationships between planning district commissions (PDC) and health districts (HD) in the area. Using a case study approach, I collected data through in-depth, semi-structured interviews with the eight directors of the four PDCs and four HDs identified in southwest Virginia. After conducting a content analysis of the data, the results from the research area reveals that planning district commissions and health districts collaborate in three areas: physical/environmental health, access to health care, and economic development.

However, collaboration is not consistent across the four districts. In districts with minimal collaboration, directors cite conflicting missions and a lack of understanding about the other organization. In districts with the highest number of common projects, the directors attribute collaboration to a dependency on technical and professional resources, the need for legitimacy and authority, and the ability to achieve internal objectives. All directors claim that limited time and human resources are obstacles to collaboration. Findings from this research show that the directors' views on resource constraints (time) and organizational philosophy corroborate the general findings of the collaboration literature.

Future research should address means of enhancing collaboration between planners and health districts through improved communication about programs and actual, not perceived, skills, resources, and mission of the complementary organization.

39. Cultural Background and Housing Satisfaction

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Abstract: Diversity of culture is a big issue for most societies. Cultural diversity, however, has been neglected in housing research. Few studies have been conducted to find relationships between cultural difference and housing satisfaction, preference, or needs. The purpose of this study was to examine the relationship between residents' cultural background and housing satisfaction. National origin was assumed as an indicator of cultural background. An on-line

questionnaire was administrated for Virginia Tech graduate students who live living in Blacksburg apartment communities. Respondents were grouped according to their national origin, and there were 169 responses from students who were originally from the United States, Korea, India, China and European countries. Respondents were asked to rate satisfaction with 22 housing factors related to size, layout, interior and other features, and overall housing satisfaction. Correlation analysis, analysis of variance, and stepwise regression were used for data analysis. Findings were as follows: (1) National origin showed significant correlation with satisfaction with 11 different housing factors and overall housing satisfaction; (2) Differences were found among the satisfaction of the respondents of the various national groups with of 16 of the factors and overall housing satisfaction. Koreans showed significantly lower satisfaction with most housing factors; (3) Each group had different factors affecting their overall housing satisfaction. In conclusion, it was suggested that various factors should be considered carefully to meet diverse housing needs and preferences of students with different cultural backgrounds in future housing developments in Blacksburg.

40. TOWARD A RESOLUTION OF THE COST OF EQUITY CONUNDRUM IN THE HOSPITALITY INDUSTRY : A CONCEPTUAL FRAMEWORK

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Abstract: The firm value estimate is derived from accounting and finance practices that focus on physical assets as opposed to intangible assets (Cline and Blatt, 1998). The cost of equity estimation models used in firm valuation and capital investment decisions fall short of tapping important constructs to firm value, especially the intangible ones. The purpose of this study is to assess the present cost of equity capital determination models and provide a view of their relevancy for the hospitality industry while simultaneously attempting to propose new options to meet the valuation and capital budgeting needs of the hospitality industry. Achieving a better estimate for the cost of equity in project investment decisions, firm valuation, and industry analysis will enable hospitality companies to achieve a healthy bottom line, and to attract more investors in the future. In order to attain this level of achievement, both academe and the industry should unite their financial and intellectual resources to spur the development of publicly available transparent accounting and financial measures that will assist in quantifying and assessing the variables proposed in this study.

41. Frontal Lobe Dysfunction in Anxious-Depressed Boys

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Abstract: The neurocognitive effects of anxious depression was tested in two groups of 9-11 year old boys. Groups were classified as either high or low in anxiety and depression based on scores from the Trait scale of the State-Trait Anxiety Inventory for Children and the Child Depression Inventory. Performance on Trails A and B, a neuropsychological measure of alternation and

sequencing capacities, and the concept formation subtest of the Woodcock Johnson, was compared between the groups to determine what effects anxious depression has on these frontal executive functions. As predicted, anxious-depressed boys demonstrated patterns similar to those found in previous research using depressed adult participants. The high anxious-depressed boys were less adept at measures of alternation and concept formation relative to the low anxious-depressed boys. However, the groups performed similarly on measures of sequencing. These results indicate that anxious depression may occur with frontal lobe dysfunction.

42. The Autonomic Characteristics of Defensive Hostility

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Abstract: Hostility has been established as a risk factor of coronary heart disease. However, prior studies have shown inconsistent relationships between hostility and cardiovascular (CV) responses to stressors. To investigate the hypothesis that defensive hostile subjects show coronary-prone CV patterning, the autonomic characteristics of trait hostility and defensiveness were assessed in a sample of 48 undergraduates selected on the basis of scores obtained via the composite Cook Medley Hostility Scale (Chost) and Marlowe Crowne Social Desirability Scale (MC) to create 4 groups: 12 (6 male) Defensive Hostile (DH; high MC, high Chost), 12 (6 male) High Hostile (HH; low MC, high Chost), 12 (6 male) Defensive (Def; high MC, low Chost) and 12 (6 male) Low Hostile (LH; low MC, low Chost). All subjects engaged in the following 3 minute tasks, during electrocardiogram recording: baseline, video game (VG), recovery, baseline 2, hand cold pressor (CP) and recovery 2. CV response patterns in DH subjects were predicted to show more sympathetic and less vagal control. Repeated measures MANOVAS were conducted on mean task scores by group and gender for the following CV variables: Heart rate (HR), systolic and diastolic blood pressure (SBP, DBP), pre-ejection period (PEP) and mean successive squared differences (MSSD) of HR. All results for HR and MSSD were ns. Gender X Group interactions were observed for PEP, $F(3,40) = 3.477$, $p=.025$, SBP, $F(3,40) = 3.401$, $p=.027$ and DBP $F(3,40) = 4.407$, $p=.009$. These data suggest that defensive hostility may differentially predict CV responses to stress by gender.

43. Developing A New Critical Thinking Test Using Item Response Theory

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Abstract: The Watson-Glaser Critical Thinking Assessment (WGCTA) is a test of critical thinking ability that has been widely used by organizations as part of the employee hiring process for many decades. Unfortunately, in four of its five subtests, the WGCTA uses multiple-choice questions that have only two possible answers, a situation that virtually assures high rates of guessing and lower measurement precision. A new instrument (the Wagner Assessment Test, or WAT) was developed to assess critical thinking ability via the conceptual approach taken by the Watson-Glaser Critical Thinking Assessment (WGCTA), using a less easily faked response format. Item response theory (IRT) analyses showed that the WAT produced higher test information functions and higher internal consistency reliability. Comparisons of WAT versus

WGCTA scores showed that the new instrument produced reduced guessing and improved measurement precision.

44. A Lack of Relationship Between Auditory and Visual Hallucinations in a Rehabilitative Population

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Abstract: In an elderly rehabilitation population ($n = 30$), experiencing head trauma, stroke, neoplasm, and other infarcts to posterior cortical areas including the occipital and temporal regions, reliable effects were found for the lateralization of visual hallucinations (Harrison & Walters, in press). It was predicted that reliable differences in lateralized auditory deficits would be found. However, preliminary findings do not support this prediction. No reliable auditory differences were notable in the sample population reporting visual hallucinations. The results are interpreted within the context of intermodal differences in the percentage of contralateral and ipsilateral projections for tactile, visual, and auditory modalities. The auditory modality provides relatively unique characteristics in comparisons with the visual, tactile, and vestibular modalities. Furthermore, this finding is important to note and use to guide research when taking into account the findings in the population regarding reliable tactile deficits and visual hallucinations.

Physical Sciences and Engineering

45. Quantification of the Binding of Insulin-like Growth Factor-I (IGF-I) and IGF Binding Protein-3 (IGFBP-3) Using Surface Plasmon Resonance

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Abstract: Insulin-like growth factor-I (IGF-I) is a small growth factor known to signal in a variety of mammalian cells through the IGF-I cell surface receptor (IGF-IR). A unique feature of the IGF-I system is the regulation of this binding by soluble IGF binding proteins (IGFBPs). There are six IGFBPs of which several, including IGFBP-3, can associate with the cell surface. Recent studies from our laboratory found that there is a pH dependence in the association of IGF-I with the cell surface in the presence of IGFBP-3 which suggested increased association of IGF-I with IGFBP-3 at low pH. To determine the mechanism by which this occurred, we studied the cell free interaction of IGF-I and IGFBP-3 as a function of pH using surface plasmon resonance. In our studies, we used a planar self-assembled monolayer surface. Under our optimized conditions, we were able to obtain results which could be fit well with a single site binding model. The association rate constant was found to be higher at pH 5.8 than at pH 7.4 which supports our previous results. Accurate determination of the dissociation rate constant in this experiment was not possible due to rebinding of the free analyte with the immobilized ligand. Further experiments are planned to determine the dissociation constant in the absence of rebinding.

46. Tuning IR Reflectivity by Multilayer Dielectrics: Application of Ionically Self Assembled Monolayer (ISAM) technique.

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Abstract: Radio-frequency (RF) transparent appliqués whose infrared (IR) reflectivity can be tuned over the $3 \mu\text{m} - 12 \mu\text{m}$ wavelength range are needed for military applications requiring low IR emissivity. The approach for tuning the reflectivity was based on alternating dielectric layers of material A with dielectric layers of material B in order to create a stratified layer structure (in an ABAB . . . pattern). The number of alternating layers A and B determines the sharpness of the reflectivity peak. Each dielectric layer is made up of a certain number of bilayers deposited by a self-assembly process. In order to peak the reflectivity at any desired wavelength, the number of bilayers in A and B can be chosen such that the optical thickness of each dielectric layer is the same. The thickness of each layer was chosen using the condition $n_1 \cdot d_1 = n_2 \cdot d_2 = \lambda/4$, where d_1 and d_2 are respectively the thickness of each A and B layer, and n_1 and n_2 are the indexes of refraction of each such layer. Since it was difficult to make a direct determination of the index of refraction and thickness separately, the optical thickness $n \cdot d$ was obtained from the Fabry-Perot interference fringes. We report that the fabrication of the first dielectric layer A was successfully completed using the Ionically Self-Assembled Monolayer (ISAM) technique. The optical thickness per bilayer for a dielectric layer A of a PAH/TiO₂ mixture yielded an experimental value of $0.2964 \mu\text{m}$ per bilayer.

47. Numerical Model for the Compression Response of Polystyrene Cups

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High Impact Polystyrene (HIPS) is by itself the product of styrene and raw rubber co-polymerization. One of the larger markets for high impact polystyrene manufactured by the Dow Chemical Company is for thermoformed drink cups. Drink cups made of HIPS are thermoformed by forcing a heated sheet into a mold. Cup manufacturers seek to minimize the amount of material in a cup. However, there are limits on minimum amount of material based on cup rigidity, strength and fracture toughness. Apparently, cup manufacturers use subjective responses to evaluate cup designs; such as how the cup feels when squeezed by hand, and that the cup should not fracture when squeezed too hard. In order to translate customer acceptability on the feel of the cup to some quantitative measures, Dow researchers have developed a mechanical compression test. The cup is supported horizontally in a fixture on the testing machine platen, and a loading nose attached to the actuator is displaced downward into the cup at one-third of the length of the cup from its opening. The finite element analysis (FEA) is used to conduct parametric studies to aid designers in minimizing the amount of material in the cup without sacrificing performance. Thermoforming results in a cup wall of variable thickness and variable orthotropic material properties along the meridian of the shell wall. In addition, the cup wall is not smooth, but consists of smooth shell segments between circumferential ribs, which are modeled as branched shell segments with offset reference

surfaces. Preliminary results from the FEA have been able to match very closely the experimental results provided by DOW.

48. A Discrete Optimization Approach to Solve the Reader Location Problem to Estimate Travel Times

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Traffic incidents routinely impact the flow of vehicles on roadways. These incidents need to be identified, and responded to in a timely fashion in order to keep traffic moving safely and efficiently. One of the main areas of transportation research that remains of contemporary interest is the study of travel times. Travel time information technologies, until very recently, have not been efficient enough to provide instantaneous information for managing traffic flow. This research focuses on devising an efficient methodology to capture as much travel time information as possible, by solving a Reader Location Problem that maximizes the benefit accruing from measuring travel time variability on roadways. This problem is formulated as a quadratic 0-1 optimization problem. The objective function parameters in the optimization problem represent certain benefit factors resulting from the ability to measure travel time variability along various origin-destination paths. A simulation study was performed to derive these benefit factors for various types of freeway sections, and the simulation results are presented as generic look-up tables. Two composite functions that measure benefits for O-D paths that are comprised of several such sections are also presented.

A novel optimization approach is designed to solve the formulated reader location problem. To test the proposed solution methodology, we considered an 8-mile segment of the Interstate-35 North Freeway. The reader location problem was solved for various problem instances on this network, using synthetically generated traffic demands. Several cases, such as the sensitivity of the reader locations to the different traffic demands, benefit factor composite functions, and/or variation in the density of the graph, as well as the marginal benefit that accrues from locating more and more readers were investigated.

Computational results indicated that the proposed methodology was robust and enabled the efficient solution of realistically sized problems.

49. Automated Conversion of Structured FORTRAN 77 code into Object-oriented C++ code

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Abstract: The maintenance of legacy software systems that were developed using a structural design approach is becoming increasingly expensive. The structural approach is often ill suited for complex systems that need to integrate with other codes. Furthermore, these legacy systems are usually written in FORTRAN, for which there is increasingly less personnel available compared to, say, C++. While it would be desirable to convert these legacy systems into object-oriented codes described in C++, such a conversion process is nontrivial. Currently, the structural design must be manually examined, interpreted, and converted into an object-oriented design described in an object-oriented language. Hence, the conversion process is likely to

introduce numerous new inconsistencies and errors, which degrades the software quality and increases its costs. The preferred solution would be to automate this conversion process. Automation would promote consistency by eliminating the manual variations in interpretation and implementation. It would therefore maximize the likelihood that the converted code does not introduce new errors relative to the original code. The work presented here automates the conversion process from structured design described in the FORTRAN77 language into object-oriented design described in the C++ language. It demonstrates the extraction of object-oriented elements using FORTRAN common block structures and FORTRAN subroutine and function calling hierarchies. The result is a consistent, first-cut converted design, described in the contemporary, broadly used computer language C++, and which integrates with adjacent modules that might still remain structured and described in FORTRAN.

50. What Do the Expert's Say? Teaching Introductory Design from an Expert's Perspective

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Abstract: Introductory computer science courses often focus on language specifics as opposed to general design concepts applicable in multiple languages. Oftentimes, design issues are raised and discussed during the last week of a semester long course, or emphasized in tidbits interwoven with discussions and implementation issues. When students are asked to produce design documents, the product is usually a result of reverse-engineering once the coding is complete. If asked to apply similar design concepts later, many students are unable to do so. Within this research, we will use Object-Oriented Programming and Design (OOP&D) patterns as an instruction mechanism to convey commonly used design concepts. This research will attempt to address the question, can we improve a student's chance of success in learning design concepts by using the OOP&D patterns. In an effort to answer this question, we will concentrate on the following challenge, are OOP&D patterns an effective approach to teaching Object-Oriented design? More specifically, will an expert-defined ordering of exposure to patterns enhance learning impacts?

In order to develop an operational definition for the order of patterns, we surveyed a group of design experts using a set of thirty OOP&D patterns. The design experts were exposed to two patterns ordering exercises (1) their perceived view of similarities between the patterns and (2) the relationship and ordering of teaching these patterns. Using Cohen's Kappa inter-rater reliability statistic, cluster analysis, and frequency of occurrence, we found results showing that there was a clear consensus among experts on the order in which fundamental OOP&D should be taught, however, as the level of difficulty of the patterns increased, the strength of rater agreement decreased.

51. The PRIMA System to Support Flexible and Secure Access to Grid Resources

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Abstract: Computational grids are an emerging technology that allows for the combination of heterogeneous, widely distributed compute and data storage resources in a secure, efficient, and

reliable manner. Many usage scenarios involving computational grids will be based on small, dynamic working groups for which the ability to establish transient collaboration with little or no intervention from resource administrators is a key requirement. Current grid security mechanisms support individual users with little support for collaborations. Recent research seeks to provide manageable grid security services for self-regulating, stable grid communities. Our prior work with component-based systems for grid computation demonstrated a need to support spontaneous, limited, short-lived collaborations. Such collaborations most often rely on shared or delegated fine grained access privileges to data and executable files as well as to grid compute resources. The system we are developing PRIMA - focuses on the management and the enforcement of fine grained access rights. PRIMA mechanisms enable the use of fine-grained rights, leverage other work in the grid computing and security communities, reduce administrative costs to resource providers, enable ad-hoc and dynamic collaboration scenarios and can be used to provide improved security service to long-lived grid communities.

52. Flow Management in Hospital Emergency Department

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Abstract: Hospital emergency department (ED) overcrowding is a growing concern for patients and policy planners. Efforts directed at solving the problem of ED overcrowding have gained prominence because of long waiting times, long patient queues, and the deterioration of the overall service offered to the patients. One concern of policy planners is to gain sufficient insight into the service delivery pattern to develop a feasible solution that leads to improved system performance. In our research, the Emergency Severity Index (ESI), a new ED triage system quickly gaining popularity, is used to drive a simulation model that will be used as an analysis tool to drive ED structural decisions, enabling planners to better match capacity with demand to prevent ED overcrowding.

53. Ubiquitous Computing: By the People, For the People

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Abstract: One of the challenges in building and evaluating ubiquitous computing systems emanates from the fact that they generally have been built to showcase technological innovation without considering how to foretell whether and how people will eventually accept them in their lives. As we transcend from desktop-based to ubiquitous computing technology, we are interested in determining some of the factors likely to influence individual adoption and use of this technology. In this study, participants are introduced to the notion of ubiquitous computing via a scenario-centric presentation including basic everyday objects imbued with some computational power to convey information. Through a detailed survey, participants provide feedback relating to their impressions, rating the performance of each interface on a number of metrics and making comparisons between the ubiquitous and desktop interfaces. We inspire them to think of new ways to use existing ubiquitous interfaces to support their current and

possible information needs, as well as better interfaces that can convey this information. The two key findings of this study are that Ubicomp systems can be preferred over desktop interfaces in certain situations and Predicting acceptance of ubicomp systems transcends conventional usability characteristics.

54. Tennessee Rockfall Management System

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Abstract: The proposed poster will describe the Rockfall Management System (RMS) currently being developed for the Tennessee Department of Transportation (TDOT). The system includes several features that pertain to how data are collected, visualized and distributed using modern technologies. Field personnel record geologic data, as well as other characteristics of rock cuts, on a Personal Digital Assistant (PDA) that uses interactive dropdown menus for rapid and consistent input. Hazard ratings, GPS coordinates, and other data are downloaded from the PDA into a centralized database, and are then distributed throughout TDOT using a web-based GIS. Analytical tools found in GIS are used to determine important measures of hazards along routes, such as rockfall hazards per mile, rated rockcuts per mile, and hazards along routes normalized by traffic counts. Additionally, spatial analysis as a means of locating sections of road with potentially hazardous rockcuts is described. An example of spatial analysis is given, in which terrain models are compared with roads, geology, and hazard rating layers to improve the ability to locate potentially hazardous rockcuts along Tennessee's state route system

55. Clustering and Feature Subset Selection Using Rank Order Statistics

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Abstract: A new algorithm is presented that performs supervised clustering and feature discrimination for data that lends itself to being ranked. Current methods rely on a comparison of the absolute values of features across subjects that may not valid. In addition, a method is presented to eliminate those features that do not provide enough discriminatory power. The theoretical underpinnings of the method are discussed and an example given to illustrate the potential of the methods.

56. Quantifying Aquifer Strain and Storage in an Unconsolidated Aquifer

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Abstract: Quantifying aquifer storage is important to characterize aquifer response and optimize aquifer pumping in large well fields located in thick sedimentary basins like those in the arid southwestern America. The majority of this water is released from storage because of aquifer-system compression. Historically this compression is assumed to occur only in the vertical direction. However, aquifer mechanics and field studies show that strain is three-dimensional and

the amount of water released from storage by horizontal strain can be significant. Traditionally, during an aquifer test the drawdown is monitored over time from a monitoring well. Transmissivity is calculated using the Cooper Jacob equation, and then the storage coefficient is estimated. A newer innovation has been to measure the subsidence over time and calculate the skeletal storage by calculating the slope of on a subsidence vs. log time plot. Using subsidence to calculate storage results in a storage coefficient value for the aquifer system that is within 10% of the actual value in numerical simulations. However this method neglects the effects of water expansion when calculating storage. BIOT4 code is used to set up an ideal aquifer model to quantify the role that water expansion plays when an aquifer is being stressed. The modeling program calculates radial and vertical deformation as well as drawdown. The role of water expansion in the aquifer over time and space will be examined using this modeling program.

57. Fiber Optic Sensors for Partial Discharge Monitoring in Power Transformers

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Abstract: Partial discharge(PD) within a power transformer is one of the major reasons that may lead to insulation breakdown and catastrophic failures. It is important that PD activities being monitored and studied to detect incipient insulation problems, to prevent catastrophic failures, and to prevent extensive costs.

Electrical, chemical and acoustic measurements, have been extensively studied for PD detection inside a power transformer. In general, the acoustic measurement has the advantages, over the other two methods, of instantaneous measurement, better noise immunity, and the potential of PD location. However, an externally mounted piezoelectric acoustic sensor may suffer from, in addition to strong EMI noise, multi-paths of the acoustic wave transmission.

Fiber optic extrinsic Fabry-Perot(FP) interferometric sensors have been shown attractive to measure a wide range of physical and chemical parameters because of the small size, light weight, high sensitivity, high frequency response, electrically non-conductive, and immunity to EMI noise. These advantages make optical fiber sensors an excellent candidate for the detection of PD generated acoustic waves.

A diaphragm-based interferometric fiber optic sensor using a low-coherence light source is designed for on-line detection of PDs inside high voltage transformers. The sensor uses a fused silica diaphragm and a single-mode optical fiber encapsulated in a fused silica glass tube to form an extrinsic Fabry-Perot interferometer, which is interrogated by a low-coherence light. Test results from a field test in the Northfleet(London, UK) STG3A 400/275KV transformer indicate that the developed sensors are capable of faithfully detecting the acoustic signals inside transformer oil with high sensitivity and wide bandwidth.

58. Grating-assisted Operating-Point Tuning for Fiber-Optic Fabry-Perot Interferometric Sensors

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Abstract: Accurate and dynamical control of the operating-point of a Fiber-Optic Fabry-Perot interferometer working in its linear region is crucial for practical sensor applications to compensate for manufacturing errors and environment perturbation induced drifts. However, current operating-point stabilizing techniques, such as using a servo system, a tunable light source, a quadrature phase-shifted demodulation or dual wavelength interrogation, or direct spectrum detection, are generally not suitable for dynamic operating-point control and wideband applications.

In this paper, we present an alternative demodulation technique named as a Grating-Assisted Operating Point Tuning (GA-OPT) system. The GA-OPT system uses a diffraction grating and a feedback control, functions as a tunable bandpass optical filter. The wideband lights from a FFPI sensor is first collimated by a collimator, diffracted by a diffraction grating on a motorized rotary stage, and then focused by a second collimator into a large core fiber connected to a photodiode or directly onto a photodiode. The bandwidth of the filter is determined by the size of the receiving fiber (or the diameter of the photodiode active area) and the focal length of the collimator, while the central wavelength is controlled by the position of the rotary stage which is determined by the difference between the dc output of the photodiode and the setting point. The GA-OPT features a dynamic operating-point control, high frequency response, insensitive to light source fluctuation, and real time operation.

Experimental results show that a tunable range of 40 nm with a 1300 nm SLED source (corresponding to a cavity length change of 3.1%) can be easily obtained which is really limited by the light source. The achieved tuning speed of 400 nm/s and a step resolution of 0.4 nm can satisfy most practical FFPI sensor measurements.

59. Theory of local heating in nanoscale conductors

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Abstract: We report on first-principles calculations of local heating in nanoscale junctions formed by a single molecule and a gold point contact. Due to the lower current density and larger heat dissipation, the single molecule heats up less than the gold point contact. We also find that, at zero temperature, a threshold bias V_{onset} of about 6 mV and 11 mV for the molecule and the point contact, respectively, is required to excite the smallest vibrational mode and generate heat. The latter estimate is in very good agreement with recent experimental results on the same system. At a given external bias V below V_{onset} , heating becomes noticeable when the background temperature is on the order of $e(V_{\text{onset}}-V)/k_B$. Above V_{onset} , local heating increases dramatically with increasing bias but is also considerably suppressed by thermal dissipation into the electrodes. The results provide a microscopic picture of current-induced heat generation in atomic-scale structures.

Undergraduate Research

60. The effect of toys on performance and behavior of weanling pigs housed in littermate or mixed groups

Ashby, Michael, T. H. O'Hare, B. Osborne, S. Meder, A. Young, A. Damon, J. Joseph, L. A. Kuehn, and C. M. Wood mijr4@vt.edu

Abstract: Two trials were conducted to determine if toys had any effect on weanling pig behavior and performance. Both trials were conducted in environmentally controlled nursery rooms containing 12 double deck pens each. Each pen (84 cm x 117 cm x 60 cm) housed four pigs. Treatments (toy/no toy and littermate/mixed) were randomly assigned to pens of crossbred pigs in a 2x2 factorial arrangement based on litter, gender, and weight. All pigs received the same diets. Trial 1 lasted two weeks and Trial 2 lasted four weeks. In Trial 1, pig behavior was observed in 13 sessions. In Trial 2, behavior was recorded four times. In Trial 1 (avg. initial wt = 8.5 kg), pigs with toys gained more ($P < 0.06$) than pigs without toys. Pigs with toys also displayed fewer vices ($P < 0.05$), but fought more ($P < 0.05$). Mixing of litters did not affect growth rate, but there was more fighting in mixed pens ($P < 0.05$) than in littermate pens. In Trial 2 (avg. initial wt = 7.5 kg), littermates gained faster the first week ($P < 0.05$), but there was no effect of toy on gain. There were more pig-to-pig interactions among pigs without toys ($P < 0.05$) but there were no other significant behavioral differences. There were few behavioral differences between mixed and littermate pigs. The results suggest that toys can be effective in reducing unwanted behavioral vices in weanling pigs and may help increase growth rate.

61. The Correlation of Anxiety and Depression with Reactive and Proactive Aggression

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Abstract: Correlations of anxiety and depression with reactive and proactive aggression were investigated. Studies suggest that children who display reactive aggression are prone to more anxiety-related problems that predict depression. Reactive aggression is defined as a hostile reaction to a perceived threat. Proactive aggression is an acquired instrumental behavior that is controlled by external rewards. We measured proactive and reactive aggression by child and teacher reports of aggressive behavior. Nineteen subjects, ranging in age from thirteen to eighteen, participated in the study. Each was assessed on proactive and reactive aggression using the Child Behavior Rating Scale. Anxiety was evaluated using the Revised Children's Manifest Anxiety Scale and depression was determined by the Children's Depression Inventory. We predicted that child and teacher report of reactive aggression would positively correlate with child self report of depression and anxiety. We also expected child and teacher report of proactive aggression would not correlate with child self report of depression and anxiety. Spearman rank order non-parametric correlation analysis was used to determine the relationship between our data. The preliminary analysis of pilot data indicated that reactive aggression is positively correlated with depression and anxiety.

62. Infrared Study of Kinesin Eg5 and Monastrol

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Abstract: Eg5 is a homotetrameric kinesin motor protein found in humans. It is implemented in anaphase of mitosis by binding to the microtubules of spindle fibers. Its non-processive movement utilizes ATP to separate sister chromatids to opposite poles of the cell. Previous studies have shown that monastrol is a potent inhibitor of Eg5 by creating monastrol spindles, thus impeding mitosis. Monastrol, however, has not been shown to inhibit the function of any other kinesin motor proteins. Since structural changes of monastrol binding have not been characterized, difference infrared spectroscopy is employed to probe structural changes at binding sites that occur upon interaction in the motor protein with monastrol. IR spectroscopy data will be presented on monastrol and Eg5 individually as well as the structural changes that occur upon contact. These studies yield information on this specific form of mitotic inhibitor. Funded by Fralin Biotechnology Fellowship, Biological Sciences Initiative, OSER/Carilion Biomedical Institute and ASPIRES.

63. The Correlation of Anxiety and Depression with Reactive and Proactive Aggression

Garner, Melissa, Cline, Sarah; Clory, Tiffany; Scarpa, Angela; Van Voorhees, Elizabeth,
mgarner@vt.edu

Abstract: Correlations of anxiety and depression with reactive and proactive aggression were investigated. Studies suggest that children who display reactive aggression are prone to more anxiety-related problems that predict depression. Reactive aggression is defined as a hostile reaction to a perceived threat. Proactive aggression is an acquired instrumental behavior that is controlled by external rewards. We measured proactive and reactive aggression by child and teacher reports of aggressive behavior. Nineteen subjects, ranging in age from thirteen to eighteen, participated in the study. Each was assessed on proactive and reactive aggression using the Child Behavior Rating Scale. Anxiety was evaluated using the Revised Children's Manifest Anxiety Scale and depression was determined by the Children's Depression Inventory. We predicted that child and teacher report of reactive aggression would positively correlate with child self report of depression and anxiety. We also expected child and teacher report of proactive aggression would not correlate with child self report of depression and anxiety. Spearman rank order non-parametric correlation analysis was used to determine the relationship between our data. The preliminary analysis of pilot data indicated that reactive aggression is positively correlated with depression and anxiety.

64. Biochemical and Genetic Charaterization of a Unique Sulfurtransferase in *Bacillus subtilis*

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Abstract: Sulfurtransferases are present in most living organisms and thus are likely to play

important roles within the cell. The exact functions of many of these proteins are still unknown. The movement of sulfur within the cell by sulfurtransferases may be necessary in the formation of essential sulfur-containing vitamins, cofactors, and tRNAs. A specific type of sulfurtransferase is the rhodanese. A rhodanese is described as a sulfurtransferase that transfers the sulfur from thiosulfate to cyanide during in vitro experimentation. The organism *Bacillus subtilis* contains four predicted rhodanese genes. This project involves the physiological and biochemical characterization of the *B. subtilis* rhodanese YrkF. YrkF is a unique rhodanese protein because it contains two conserved domains. The rhodanese domain is fused to a Ccd1 domain, which is predicted to be a regulator of disulfide bond formation. The Ccd1 domain contains a conserved Cys-Pro-x-Pro motif. The research has involved overexpression and gene disruption in the initial stages of characterization. Overexpression of the gene revealed YrkF to have a relatively high activity. A *yrkF* gene was disrupted using a plasmid DNA intermediate with an erythromycin resistance cassette insertion. The plasmid was then used to transform *B. subtilis* and a mutant knockout strain was isolated. PCR was performed with the mutant and wild-type strain to verify the knockout. Rhodanese activity was determined for the knockout and wild-type strains showing a slight decrease in rhodanese activity for the mutant. The biochemical characterization of an interesting protein such as YrkF could be used as a model protein for rhodanese and other sulfurtransferase proteins.

65. Familial Conflict and Childhood Anxiety

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Abstract: Family conflict was examined in relation to anxiety in 22 children, aged 7-13. Children were recruited through local schools, daycare centers, and medical offices to participate in a study examining the relationship between behavioral and emotional problems and aggression (i.e., reactive and proactive). It was predicted that there would be a positive correlation between family conflict, as measured by the Family Environment Scale (FES), and physiological anxiety, social concerns, and worry, as measured by the Revised-Children's Manifest Anxiety Scale (RCMAS). Based on the results of our statistical analysis, our predictions were supported. The correlation between physiological anxiety and family conflict was .453 ($p = .017$), family conflict and social concerns was .558 ($p = .003$), and family conflict and worry was .369 ($p = .045$). In addition, a regression analysis was performed and suggests that anxiety accounted for 33.9% of the variance in family conflict ($p = .054$). Taken together, the results from this investigation indicate that increased family conflict is correlated with increased levels of anxiety. Specifically, physiological anxiety, social anxiety, and overall worry increased as levels of family conflict increased. Results from this study should improve the understanding of how the familial system impacts a child's level of anxiety.

66. Examination of photoactivation in DNA photolyase using difference infrared spectroscopy

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Abstract: DNA mutations caused by increasing ultraviolet radiation can have lethal effects on all

biological organisms. DNA photolyase is a flavoenzyme that can utilize the energy from visible light to repair UV-damaged DNA, specifically pyrimidine dimers. Two processes are important for dimer repair: photoactivation and photorepair. During photoactivation, the catalytic cofactor FAD[•] is reduced to FADH⁻ by the transfer of an electron through a chain of amino acids in photolyase. Once reduced, FADH⁻ can then transfer an electron to the pyrimidine dimer to carry out photorepair. We propose to map the molecular interactions of photoactivation using difference FTIR spectroscopy. In our difference infrared spectrum, we observe the vibrational modes from both the catalytic cofactor and aromatic amino acids in photolyase. These data allow us to examine the dynamic structural changes that occur within the protein matrix that correspond to the redox changes of FAD.

67. Identification of the activity of rhodanese enzymes in *Bacillus subtilis*: Specifically YtwF

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Abstract: Rhodanese enzymes, a type of sulfurtransferase, are found in almost every living organism. YtwF is one of four rhodanases in *B. subtilis*. It is composed of 68 amino acids. We have shown that even though *ytwF* is a very small enzyme, it is responsible for about 80% of the rhodanese activity in the cell in crude extract when a mutant with a knockout in the *ytwF* gene was compared with a wild-type bacteria. I have made double deletion mutants that knockout two of the rhodanese genes *ytwF*, *yqhL*, and *yrkF*. These double mutants will be used to further test the rhodanese activity of the enzymes. They will also be used to determine if the rhodanese enzymes are necessary for the production of sulfur containing cofactors by using minimal media.

68. FindMITE-BASED SEARCH OF THE CHICKEN GENOME FOR MINIATURE INVERTED-REPEAT TRANSPOSABLE ELEMENTS

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Abstract: As the chicken genome sequencing gets underway, novel bioinformatics tools are needed to help us understand the chicken genome's structure, organization, and function that can be determined from the sequence data. In this undergraduate research project, we were interested in determining the incidence and frequency of the miniature inverted-repeat transposable elements, or MITEs, within the chicken genome. The search involved the use of the novel bioinformatics tool FindMITE developed at Virginia Tech. Chicken DNA sequences deposited by Washington University in the trace database were searched for pre-defined standard characteristics of MITEs. Putative MITES were verified by a BLAST search of NCBI's databases for their incidence in the *Gallus gallus* genome. Based on these analyses, three MITES were identified and verified. The data suggests a low frequency of MITEs relative to other types of transposons that have been described previously including CR1s.

69. Random-primer based genetic analysis of chicken lines divergently selected for immune response to sheep red blood cells

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Abstract: Consumer concerns about antibiotic use in chickens pose a significant challenge for the poultry industry. Genetic resistance therefore remains one of the few viable options open to the industry in meeting this challenge. Identification of DNA markers for immune response will facilitate the use of genetic resistance by breeders in breeding chickens less susceptible to disease causing pathogens. We conducted a random-primer PCR-based genome-wide scan of chicken lines divergently selected for immune response to sheep red blood cells. Using DNA templates from high and low-line birds in the 27th generation of selection for immune response, we screened a total of 28 primers for informativeness in the high and low selected lines. While 22 of the 28 primers amplified fragments, about 20 or 71% amplified polymorphic fragments. The size of the polymorphic fragments has ranged from 400 base pairs to 3500 base pairs. An 800-bp RAPD fragment shown to be low-line specific has been cloned and sequenced. The sequence characterization showed that both ends contain, as expected, the 10-base sequence of the original RAPD primer. Additionally, the sequence was shown to contain an AGC Microsatellite repeat that is non-informative in the selected lines. However, 5 putative SNPs appear to indicate a line-specific segregation. Characterization of these variants and the confirmation of the association of the 800-bp fragment with immune response continue. This fragment will represent the first molecular tool that can be used by chicken producers to directly select for immune response in chickens.

70. Proactive and Reactive Aggressive Behaviors in Children as They Relate to the Construct of Psychopathy

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Abstract: Two forms of childhood aggression have been identified in the literature. Reactive (or emotional) aggression is committed in response to perceived provocation or threat, whereas proactive (or instrumental) aggression is a non-emotional, deliberate attempt to obtain goals or to coerce or intimidate others. Proactive aggression has been hypothesized to be associated with psychopathy, a construct that has long been applied to adults, but has only recently been investigated in children. Specifically, the "callous-unemotional" factor of psychopathy has been associated with antisocial behavior and instrumental aggression in children with conduct problems.

This investigation examined the construct of psychopathy and its relationship to the proactive/reactive aggression distinction in children. Child self-report and teacher report measures of proactive and reactive aggression and of psychopathic behavior were administered to a pilot sample of 24 adolescents between the ages of 13 and 18. It was hypothesized that psychopathy, and especially callous-unemotional traits, would be associated with proactive aggression, but not with reactive aggression. The results demonstrated that while the construct of psychopathy correlated with both reactive and proactive aggression, child reports of callous-

unemotional traits correlated only with proactive aggression. It is suggested that impulsivity is common among reactive and proactive aggression and psychopathic behavior, whereas callous-unemotional traits are unique to proactive aggression and psychopathic behavior. Thus, while the overall construct of psychopathy may not map precisely onto proactive aggression in children, the callous-unemotional factor of psychopathy may be an important link between the adult and the child constructs.

71. Comparative Capture of SIR2 in the Budgie

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Abstract: The goal of this undergraduate research project is the use of a comparative PCR-capture approach to identify and isolate a SIR2-like homologue in the budgerigar, an avian model for aging. Because SIR2 acts in conjunction with many tumor suppressors to halt translation and facilitate DNA repair before resuming the translation process, it is believed to also influence longevity. Its effect on longevity is believed to be through the suppression of oxidative stress, which is very high in the budgie. Since SIR2 has been isolated and sequenced from many organisms including yeast, mouse, and human, bioinformatics tools were used to conduct a comparative analysis of these known SIR2 homologues and a chicken EST with significant match to other SIR2 genes. PCR primers were then designed from areas of high homology using a human as well as a chicken template. The primers were optimized and then used in budgie PCR at the specific temperature. Fragments amplified were isolated and are currently being sequenced and characterized. Amplification of a fragment of the expected size as well as the lack of multiple bands suggests the presence of SIR2-like fragment. The sequencing of one direction of these amplicons, though preliminary, suggests a lack of sequence similarity with the reference chicken SIR2 homologue. The work in further characterizing the amplicons and the relatedness of these to SIR2 continues.

72. Congestive Heart Failure Alters Skeletal Muscle Sarcoplasmic Reticulum Calcium Transport Using Exogenous and Endogenous ATP Sources

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Abstract: Skeletal muscles of heart failure patients display altered sarcoplasmic reticulum function as well as modified metabolic capacity. The Ca²⁺ pump of the sarcoplasmic reticulum (SR) uses ATP to provide energy for Ca²⁺ transport. The SR binds creatine kinase and pyruvate kinase that enables it to use ADP plus phosphocreatine (PC) or phosphoenolpyruvate (PEP) to generate ATP to support uptake. In this investigation, the rat SHHF model of heart failure was utilized. At end-stage failure, SR vesicles were isolated from the gastrocnemius (GAST) and diaphragm (DIA) muscles. SR Ca²⁺ uptake rates (5mM oxalate) were then determined in the presence of exogenous ATP (2mM) as well as ADP (2mM) plus either PC (5mM) or PEP (2mM). In both SHHF and control rats, PC+ADP and PEP+ADP uptake rates were 20-30% of ATP supported. In the GAST, ATP supported uptake was increased in SHHF by 58%. Substrate supported rates were not significantly different between groups. In the DIA, ATP supported

uptake was depressed in SHHF by 48%. PC+ADP and PEP+ADP supported rates were also depressed by 47 and 45%, respectively. Finally, ATP binding, as determined by binding of fluorescein Isothiocyanate (FITC), was depressed in both control and SHHF samples. These data show that heart failure differentially affects GAST and DIA SR Ca²⁺ uptake. In addition, the ability of SR vesicles to utilize PC and PEP as energy substrates is affected.

73. Functional Genomics in *Drosophila* utilizing a GFP Protein Trap Screen

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Abstract: The GFP (Green Fluorescent Protein) protein trap is a system used to identify and observe the localization of previously uncharacterized proteins in *Drosophila*. We are utilizing this technique to look for proteins that have a function in mitosis. The study of mitosis has important biomedical implications, as mitotic defects have been associated with many forms of cancer. The GFP protein trap makes use of a modified P-element, a mobile DNA element unique to *Drosophila*, carrying a coding sequence for GFP. The GFP sequence acts as an artificial exon, which when inserted into the locus of an endogenous gene, may result in the incorporation of the GFP into the structure of protein upon translation. Using this system, we are able to screen through large numbers of larvae looking for GFP expression. Further characterization of trapped proteins is accomplished through imaging actively dividing cell types, such as syncytial embryos and giant larval neuroblasts. The insertion point is then mapped by comparing the sequence obtained by inverse PCR against the *Drosophila* genome database, allowing us to identify the gene that has been tagged.



