

PROCEEDINGS

ABSTRACTS OF PAPERS, 82nd Annual Meeting of the Virginia Academy of Science, May 26-28, 2004, Virginia Commonwealth University, Richmond, Virginia

Aeronautical and Aerospace Sciences

SOME EVENTS FROM THE FIRST 100 YEARS OF MANNED POWERED FLIGHT. M.Leroy Spearman, Systems Analysis Branch, NASA-Langley Research Center, Hampton, VA 23681. The means of human transportation took on a new dimension in 1903 when the Wright Brothers achieved manned, powered flight. The advent of the airplane provided an increase in speed and increased utility in the field of transportation. The airplane became a vital part of the commercial air transportation system and was also developed as a major component of military systems. The airplane was progressively modified and improved during the first half of the 20th Century. Near mid-century, a significant design change came about with the introduction of jet and rocket propulsion. Speed that was limited by propeller operation could now be increased. New designs appeared for higher speed flight and with the use of large rocket engines, access to space was attained.

A SURVEY OF AEROSPACE VEHICLE DESIGN TYPES - THE NEXT 100 YEARS. M.Leroy Spearman, Systems Analysis Branch, NASA-Langley Research Center, Hampton, VA 23681. Near the mid-20th Century, a significant design change for aircraft came about with the introduction of jet and rocket propulsion. Speed that was limited by propeller operation could now be increased. New designs appeared for higher speed flight. With the use of large rocket engines, access to space was attained with the prospect of space flight clearly in mind. Research was undertaken by the NASA to develop an airframe and propulsion system suitable for spaceflight. Concepts have been proposed for high-speed flight within the atmosphere as well as for special transatmospheric vehicles that could reenter the atmosphere from space to perform certain missions.

Agriculture, Forestry and Aquaculture Science

CATFISH SPAWNING AND FINGERLING PRODUCTION IN VIRGINIA. David Crosby and Scott H. Newton, Cooperative Extension, PO Box 9081, VSU, Petersburg, VA 23806. Catfish raised in earthen ponds in Virginia spawn from Mid-June through the first week of July. Catfish spawn when pond temperature reaches 75°F. This occurs in ponds during the month of May in the Southern States that produce catfish while in Virginia it is June. The obvious outcome is that catfish producing states have a larger fingerling in one growing season when fry are stocked at 100,000 fry/acre than Virginia. The question was asked how to produce fingerlings similar in size that are found in these states given Virginia's climatic condition and growing season. Catfish fingerling density studies were initiated to solve this problem. Ponds were stocked with fry in late June and early July of 2002. Stocking densities were 20,000 fry/acre and 40,000 fry/acre. The objective of this study was to produce a fingerling by the following year (2003) that was at 60 lbs./1000 fish, which is the typical size of fingerlings found in these catfish producing states. The catfish fingerlings were harvested in 2003 during early April. Catfish fry stocked at 20,000 fry/acre resulted in fingerlings ranging from 62.4 lbs/1000 fish to 97.3 lbs/1000 fish (a fingerling of 6 to 7 inches) and the 40,000 fry/acre was 34.6 lbs./1000 fish (a fingerling about 5 inches). The objective of the study for size of fingerling required was met by stocking 20,000 fry/acre.

WINTER GREENHOUSE PRODUCTION OF RAINBOW TROUT. Brian L. Nerrie, Cooperative Extension, Virginia State University, Petersburg VA 23831. Niche marketing is profitable for greenhouse aquaponic farmers supplying high-value plant and fish products. Aquaponic tilapia culture in greenhouses may be limited to summer production due to high energy costs of maintaining optimum water temperatures. A cold season alternative is to substitute rainbow trout. The objectives of this study were to evaluate the feasibility of winter greenhouse production of high-value rainbow trout and test consumer acceptance. Rainbow trout were stocked at a rate of 250 fish in a 3000 gallon greenhouse fish tank. Water was recirculated by airlift pump through an adjacent 1000 gallon biofilter. Trout were fed daily from December through April with a 38% protein 3 mm floating pellet. Feed was delivered over an eight hour period by belt feeders to limit spikes in low-dissolved oxygen. Supplemental oxygen was provided by agitation. Water was added to replace loss due to evaporation. Dissolved oxygen did not drop lower than 5 ppm. Monthly tank water temperatures (°C) averaged 11.4, 11.7, 12.6, 18.4, and 21.9 for December through April. A taste test of harvested trout (220 g) indicated no difference between cage and tank reared fish. Harvested trout were smoked and found comparable to gourmet smoked trout of similar size marketed at \$8.00 per fish.

SALINITY TOLERANCE EXHIBITED BY RAINBOW TROUT USED FOR BAIT IN RECREATIONAL SPORT FISHING. Scott H. Newton, Cooperative Extension, Virginia State University, Petersburg, VA 23806. A series of trials were conducted during the spring, 2003, to evaluate the ability of small (ranging from 4 to 8 inches) rainbow trout to survive transfer from fresh to saline waters. Previously conducted research has shown the feasibility of holding and handling small caged trout for use as live bait for recreational fishing. Trout transferred from cages (65 to 70 F) to holding tanks (60 to 65 F) survival was 100% after 48 hrs and 75% after 72 hrs at 15 ppt salinity. Under similar conditions, trout transferred from fresh water directly to 20 ppt salinity all died in less than 2 hours. Fish survival when transferred from fresh water to 15 ppt salinity for 24 hr, then to 20 ppt salinity, was less than 20% after 72 hrs. Bait trout may be transferred from cages to holding tanks with fresh water at temperatures ranging from 60 to 70 degrees F. Bait trout may be transferred from fresh water tanks to transport containers with 15 ppt salinity and used for fishing in waters with salinity up to 20 ppt. Bait trout transported and held under carefully managed conditions should live up to 3 days; thereby serving their intended purpose as live fishing bait.

HISTOCHEMICAL STUDIES OF THE LEAF GLANDULAR TRICHOMES FROM *VERNONIA GALAMENSIS* (CASS.) LESS. Francoise Favi, Shaunte Tucker, Rasheda McClee & Mark Kraemer, Agricultural Research Station, Virginia State University, Petersburg VA 23806. Leaves of *Vernonia galamensis ethiopica* are being investigated for discovery of novel molecules applicable in agriculture and human health. Leaves of this plant have a bilobed peltate and a capitate awl shaped glandular trichomes on the lower side and the awl shape on the upper side of the leaf. Clarified leaf tissues (1 cm²) were stained to detect terpenoids (NADI reagent), essential oils (Nile blue & Sudan red 7B), lipid (Sudan black B and Sudan III) and polysaccharides (Toluidine blue O and Ruthenium red). Polysaccharides, essential oils and terpenoids were observed within both glands. Stronger staining for essential oils was observed in the peltate than in the capitate trichomes and suggested that the former contained more essential oils than the capitate gland. Cells adjacent to the capitate gland also reacted to polysaccharide stains. This suggested greater production of sugar and metabolic activity in epidermal cells surrounding the trichomes on the adaxial leaf surface.

SUSTAINABLE MANAGEMENT OF A NATIVE BEE FOR FRUIT POLLINATION IN VIRGINIA. Mark E. Kraemer & Francoise Favi, Agricultural Research Station, Virginia State University, Petersburg, VA 23806. The eastern subspecies of the blue orchard bee (BOB), *Osmia lignaria lignaria* (Say) is similar to the western subspecies that is currently used in western orchards. These "pollen bees" are superior to honey bees as pollinators because of their greater focus on pollen collection, method of transporting pollen, limited foraging range, and activity in cool, cloudy weather. Artificial nest boxes were used to monitor a local BOB population near the Appomattox

River in southern Chesterfield County. Male bees first emerged when temperatures remained above 9°C for 48 hours. Because adult bees were present several weeks before apple trees flower it is important that other sources of nectar and pollen are present early in the year. Over 30 nearby plant species flowered during and prior to the completion of the earliest nest cells. A scanning electron microscope was used to identify 300 pollen grains from 22 of the earliest constructed nest cells from 5 locations. Box elder (*Acer nigra*) and eastern red bud (*Cercis canadensis*) provided 58% and 41% of the pollen found in the samples, respectively. All cells contained some box elder pollen, four with 100%. Nest cell construction peaked about the time of apple blossom and continued for several weeks after.

VERNONIA GALAMENSIS LEAVES INFESTED WITH WHITEFLIES: HISTOCHEMICALS STUDIES OF THE TRICHOMES. Shaunte Tucker, Rashida McClee, Mark Kraemer & Francoise Favi. Agricultural Research Station Virginia State University, Petersburg VA 23806. Leaves of *Vernonia galamensis* have long been used in traditional African medicine and to control pests. We have identified glandular peltate trichomes on the abaxial leaf surface as a source of pesticidal compounds, including toxicity to the greenhouse whitefly (*Trialeurodes vaporarum*). However, this whitefly successfully infests and kills these plants. Previous studies showed that the copious wax produced by these whiteflies coated the glandular trichomes and we hypothesized that the wax may be changing the physical and chemical properties of the peltate glandular trichome. Infested and non-infested leaves tissues of *Vernonia galamensis* subspecies *ethiopica* were stained with dyes specific to terpenoids, carbohydrate and lipid compounds. Trichomes stained for terpenoids, essential oils, and polysaccharides on non-infested leaves but did not stain infested leaf trichomes. The first whiteflies to colonize the plant produced wax that appeared to “mop up” up the toxic compounds and cover the trichomes, thus enabling the next generation of whitefly to better survive. This is the first reported instance of insects using wax as a defense against plant toxins.

RESPONSES OF GLUTATHIONE-S-TRANSFERASE IN TOBACCO LEAF EXPOSED TO OZONE. T. Randolph Saunders, Jr.¹, John L. Hess¹, & Boris Chevone² ¹Dept. of Biochemistry, ²Dept. of Plant Path., Physiol., & Weed Sci., Va. Polytechnic Inst. & State Univ., Blacksburg, VA 24061. Exposure of tissues to ozone generates reactive oxygen species, ROS, including superoxide anion, H₂O₂, and organic hydroperoxides. Among the antioxidant enzymes that regulate concentrations of the ROS, glutathione-S-transferase (GST) catalyzes the conjugation of organic hydroperoxides to glutathione and eliminates their potential unregulated reactivity, particularly with components of cell membranes. GST from tobacco leaf tissue was purified 300-fold to homogeneity and used as a source of antibody production in rabbit. Sequence analysis certified the purified protein was similar to the putative GST (Acc. No Q03666). Constitutive GST activity was routinely greater in leaf tissues of tobacco cultivars, Bel B (O₃-tolerant) than in Bel W3 (O₃-sensitive). Following exposure to 250 ppb O₃ for 4 h, GST protein increased 53% only in cv Bel B. RT-PCR of total RNA isolated from leaf tissue revealed that the transcript for GST 107, increased following exposure to O₃ in Bel B, but decreased in Bel W3. Level of transcript for GST 110, that encodes a second form of GST in tobacco, increased in both cultivars. Responses of GST activity, level of GST protein, and GST transcripts indicate a responsiveness of GST and a role of GST in the tolerance of cv Bel B to O₃ exposure.

COMPARISON OF THREE SEQUENTIAL COBIA *Rachycentron canadum* FRY PRODUCTION RUNS IN A RECIRCULATING AQUACULTURE SYSTEM. Michael H. Schwarz, David Mowry, Ewen McLean, and Steven R. Craig. VSAREC, 102 South King St. Hampton, VA 23666. Three cobia (*Rachycentron canadum*) larval production runs in Recirculating Aquaculture Systems (RAS) are compared and contrasted. In all runs, fish were enumerated and stocked as 2 day post hatch (dph) yolk-sac fry into 580L greenwater larval production tanks. Fry were obtained from the Fisheries and Mariculture Laboratory of the University of Texas at Austin Marine Science Institute Port Aransas, and the Aquaculture Center of the Florida Keys, INC. In the first run, 9,000 sac fry were stocked in the system resulting in a density of 15 larvae/L. From this run, 547 fingerlings

weaned onto dry feed were produced, resulting in an overall survival of 6.1%. In the second run, 8,000 sac fry were stocked, yielding a stocking density of 13.7 larvae/L. From this run, 585 fingerlings weaned onto dry feed were produced, resulting in an overall survival of 7.3%. In the third run, 39,000 sac fry were stocked, yielding a stocking density of 67.3 larvae/L. From this run, 529 fingerlings weaned onto dry feed were produced, resulting in an overall survival of 1.4%. Following are observations and discussion into protocol alterations for runs next year.

BIOCHEMICAL STUDIES ON A PUTATIVE B-GLUCOSIDASE CODED BY THE GENE T3G60130 IN *ARABIDOPSIS THALIANA*. Darchelle Braxton¹, Dennis Harding¹, Ali Mohamed¹, A. Esen², and J. Poulton³, ¹Dept. of Biology, VSU, Petersburg, VA 23806, ²Univ. of Iowa, and ³VPI and SU, Blacksburg, VA 24061. β -glucosidases are a group of enzymes found in *Arabidopsis thaliana* that hydrolyze β -glycosidic bonds between the reducing side of glucose and an aryl or alkyl aglycone or oligosaccharide. These enzymes are important in many biological functions in higher plants including chemical defense against herbivores and pathogens, lignin biosynthesis and plant growth, development, fruit ripening, flower senescence, mobilization of carbohydrate reserves, and galactolipid turnover. In this research, -glucosidase X-33-At3g60130 of the *Arabidopsis thaliana* was purified and characterized using various natural and synthetic substrates. The purified enzyme showed strong specificity toward D (+) Cellobiose, O-Nitrophenyl β -D-glucopyranoside and P-Nitrophenyl β -D-glucopyranoside (β -PNPG). This gene is proposed to have plant senescence capabilities.

EFFECT OF ISOFLAVONES ON LIPOGENESIS AND LIPOLYSIS IN OBESE RATS. Ali Mohamed¹, Kimberly Y. Ferguson¹, Ali A. Ali¹, Sam J. Bhatena², & Emaneul Valesques³, ¹VSU, Petersburg, VA, 23806, ²BHNRC/ARS/USDA, & ³GWU Medical Center. The effect of dietary soy protein was studied in lean F344 rats and obese SHR/N-cp rats. Twenty obese SHR/N-cp rats and twenty lean F344 rats were randomly assigned to a six month intervention of an AIN 93 diet with the protein source being either 20% casein or 20% soy. Liver lipid extracts were analyzed for total lipids; total cholesterol, and fatty acid concentrations. Serum was analyzed for cholesterol, and triglycerides. There was no significant change in either liver total lipids or total cholesterol in lean animals fed soy compared to those fed casein diet. In contrast, liver total lipids and total cholesterol were significantly reduced in obese animals fed the soy compared to those fed casein diet. Rats fed soy diet showed decreased in saturated fatty acids and increase in unsaturated ones in lean animals. The opposite was observed in obese animals fed the same diet. There was no significant difference in the patterns of mono or polyunsaturated fatty acids in lean or obese animals on soy diet.

EFFECT OF FLAX ON LIPID AND CHOLESTEROL METABOLISM IN GENETICALLY OBESE, HYPERCHOLESTEROLEMIC ANIMALS. Ali Mohamed¹, Don A. DuBose¹, Ali A. Ali¹, Sam J. Bhatena², & Emaneul Valesques³, ¹VSU, ²BHNRC/ARS/USDA, & ³GWU Medical Center. The effect of dietary flaxseed meal on metabolic parameters was studied in two animal models, lean Fisher 344 rats with normal lipid levels and obese SHR/N-cp rats with elevated levels of cholesterol and triglyceride. The rats were fed AIN 93 diet differing only in the source of protein. The rats were fed either 20% casein or 20% flaxseed meal as their sole source of protein. Liver tissue was analyzed for total lipids, total cholesterol, and fatty acids. Plasma total cholesterol was also analyzed. In both strains of rats, flaxseed meal significantly decreased liver tissue total lipids and total cholesterol. Flaxseed meal also reduced plasma total cholesterol in both strains of rats. Flaxseed meal caused a slight increase in saturated fatty acids and a decrease in unsaturated fatty acids in both strains of rats. Since cholesterol level and total lipid levels are independent risk factors for cardiovascular disorders, our data suggests that flaxseed meal may have beneficial effects.

THE COMBINATIVE EFFECTS OF ISOFLAVONES AND CAFFEINE ON CHINESE HAMSTER CELLS – POSSIBLE APOPTOSIS. Vernell S. Williamson & Ali Mohamed, Virginia State University, Department of Biology, Petersburg, Va. 23801. Over 6.6 million people die of

cancer in the world every year, and 1.4 million new cases in the United States alone are diagnosed (Pererra, 2000). Incidences of cancers such as malignant melanoma have doubled each decade for the last 50 years (Wang et al., 2002). The study of apoptosis may provide insight into the development of alternative cancer therapies. This project explored apoptosis using Chinese Hamster cells (CHO-K1) as an investigative model. It was proposed that isoflavones would have a greater effect on cell number and viability than caffeine alone or combination treatments. Two diet elements were used to induce apoptosis in healthy cell populations. Cellular responses to each treatment were measured with cell counts, viability tests, and photographs. Nine separate tests on fifty four separate cell cultures were performed. The results demonstrated that a combined treatment of caffeine and isoflavones had the largest effect on cellular viability. Isoflavones did have an effect on morphology, which was reversed with the addition of caffeine. Caffeine combined with isoflavones allowed mitosis but the overall health of the cells was impacted.

PERFORMANCE CHARACTERISTICS OF NILE TILAPIA FOLLOWING DIETARY INCLUSION OF MANNAN OLIGOSACCHARIDES. S.R. Craig¹, M. Schwarz² & E. McLean¹, ¹Virginia Tech Aquaculture Center, Blacksburg, VA., ²Virginia Seafood Research and Extension Center, Hampton, VA., Virginia Polytechnic Institute and State University, Blacksburg, VA 24061, USA. This study examined the impact of mannan oligosaccharides (MOS) upon the performance of Nile tilapia. Mannan oligosaccharides were incorporated into experimental diets (0, 0.25, 0.5, 1.0 and 1.0%) and fed to fish (n = 36 group⁻¹) for 14 wk. Dietary MOS had no significant effects (P > 0.05) upon growth, feed efficiency, condition factor, visceral or hepatosomatic indices. Intra-peritoneal fat, and muscle ratios were similarly unaffected by treatment. In contrast to hepatic lipid levels however, feeding with MOS had significant effects (P < 0.05) upon fillet lipid dynamics, an impact that may have importance to product quality and processing issues. The three highest inclusion levels of MOS increased plasma protein levels (P < 0.05) and MOS positively influenced differential cell counts and respiratory burst activity of splenic cells. Differences (P < 0.02) were also recorded in phagocytosis of splenic cells, with a tendency towards declining activity with increasing dietary supplementation with MOS.

RELATIONSHIP BETWEEN ALKALOIDS IN SEED AND WHITE LUPIN PLANT TISSUE. Kristina Staples, Anwar A. Hamama, & Harbans L. Bhardwaj, Agricultural Research Station, Virginia State University, Petersburg, VA 23806. White lupin (*Lupinus albus* L.) seeds are classified as sweet (low alkaloid content) or bitter (high alkaloid content). Seed from sweet lupins are suitable for food/feed whereas bitter lupin are desirable for green manure since alkaloids are known to have pesticidal properties. Our objectives were to characterize variation among winter-hardy lupin lines for total alkaloids in seed and plant tissue. We used Dragendorff test for assigning an alkaloid score varying from 0 (sweet) to 4 (bitter) in winter-hardy lupin lines. Variation existed among 97 lupin lines for alkaloid content of seed (3 lines with score of 0, 6 lines with score of 1, 19 lines with score of 2, 36 lines with a score of 3, and 33 lines with a score of 4). Variation also existed for alkaloids in leaf and pod-shell tissue over that in the seed. For example, lupin lines with seed alkaloids in the high range of 4, had alkaloid content varying from 1 to 3 in the leaf tissue. Similar observations were also made in lines with seed score of 0, 2, and 3. This study indicated that it may be possible to develop lupin lines with sweet seed and bitter foliage.

CANTALOUPE PRODUCTION WITHOUT USING NITROGEN FERTILIZERS. Brian Wooden, Jr. & Harbans L. Bhardwaj, Agricultural Research Station, Virginia State Univ., Petersburg, VA 23806. Our objective was to determine if winter legume cover crops could meet N needs of cantaloupe. Cantaloupe were grown, following three winter legume cover crops (lupin, hairy vetch, and Austrian winter pea), a control treatment fertilized with 112 kg N/ha, and an unfertilized control treatment, in replicated experiments during 2000, 2001, and 2002. The winter legumes were planted during the fall of the preceding year and plowed under in spring of each year before transplanting of cantaloupes. The highest cantaloupe fruit yields, averaged over three years, of 40.8 and 37.1 Mg/ha were obtained when cantaloupe were planted after lupin or hairy vetch, respectively. In

general, performance of cantaloupe following lupin and hairy vetch was similar. These results demonstrated that winter legume cover crops, especially lupin and hairy vetch, can be excellent alternatives to the use of inorganic N fertilizers for meeting nitrogen needs of cantaloupe.

MINOR BIOACTIVE LIPIDS IN WHITE LUPIN SEED OIL. Anwar A. Hamama & Harbans L. Bhardwaj, Agricultural Research Station, Virginia State University, Petersburg, VA 23806. We evaluated oils from seven white lupin (*Lupinus albus* L.) genotypes, grown in Maine and Virginia, to characterize desmethylsterols, dimethylsterols and phospholipids in seed oil to assess its nutritional potential. Lupin seed contained from 5-8 % oil. The unsaponifiable lipid fraction ranged from 2-3% and contained 20-29% desmethylsterols, and 17-22% dimethylsterols. Phosphatidylcholine (33-46%), phosphatidylethanolamine (22-32 %), and phosphatidylserine (11-18%) were the major phospholipid classes in lupin oil. β -sitosterol and campesterol were the major sterols (52-60% and 23-29% of total desmethylsterols, respectively) in lupin oil. In decreasing order of abundance, the desmethyl sterols present in lupin oil were: β -sitosterol > campesterol > stigmaterol > cholesterol > Δ^5 -Avenasterol > Δ^7 Stigmastanol. Growing location induced significant changes in β -sitosterol (52-59%). The seed grown in Maine had significantly higher contents of β -sitosterol, campesterol, and lupeol as compared to those grown in Virginia. The seed grown in Virginia had significantly higher content of stigmaterol and β -amyirin as compared to those grown in Maine. Growing environment influenced the lupin oil traits more than the genotypes.

CANOLA OIL VS. OLIVE OIL. Jamila Echols, Anwar A. Hamama, & Harbans L. Bhardwaj. Agricultural Research Station, Virginia State University, Petersburg, VA 23806. The consumer demand and consumption of canola oil in the United States are increasing due to its lowest content of saturated fatty acids (5 to 8%) and moderate content of poly-unsaturated fatty acids. Even though research conducted in the mid-Atlantic region has demonstrated that canola can be easily produced in this region and may have an economic advantage over winter wheat, canola has not been adopted by the farmers due to lack of marketing outlets. The objective of our research was to compare canola and olive oil in order to demonstrate canola oil's healthy traits. Quality of canola oil from 11 lines, grown at two locations in Virginia, was compared to the published values for olive oil. The contents of saturated (SFA), unsaturated, mono-unsaturated, and poly-unsaturated fatty acids in canola oil were: 6.9, 93.1, 65.5, and 27.6 whereas those for olive oil were 13.5, 86.5, 73.9, and 10.0 %, respectively. Canola oil contained 51% more SFA and ten times more 18:3 (omega-3) fatty acid, as compared to olive oil. The total phytosterol content in canola oil (800 mg/100 g of oil) was approximately four times that of olive oil (221 mg/100g oil). Based on these observations, canola oil compared well with olive oil.

COMPARISON OF SWEET CORN GROWN WITH COMPOSTED POULTRY MANURE AND NITROGEN FERTILIZER. Michael Combs, Harbans L. Bhardwaj, & M. Rangappa, Agricultural Research Station, Virginia State University, Petersburg, VA 23806. Excessive levels of P and N and concerns about water pollution limit the use of poultry manure (PM) as an agricultural fertilizer. Composting of PM with a carbon source has the potential to reduce P and N to manageable levels. We conducted an experiment during 2003 with seven treatments: control with un-composted PM (T1), four treatments with PM (composted with wheat straw turned weekly (T2), composted with wheat straw turned bi-weekly (T3), composted with clover straw turned weekly (T4), and composted with clover straw turned bi-weekly (T5)), recommended rate of N fertilizer (T6), and a control without any treatment (T7). The ears/ha from T1, T2, T3, T4, T5, T6, and T7 were 23167, 35167, 34333, 39500, 44000, 30000, and 23667, respectively. The highest number of ears, greatest ear fresh weight, and greatest were obtained from T5. Results indicated that composting of poultry manure with an organic amendment such wheat or clover straw helps poultry manure's transformation into a usable fertilizer material for supporting crop production.

CANOLA: A NEW PROFITABLE CROP FOR VIRGINIA FARMERS. Harbans L. Bhardwaj, Agricultural Research Station, Virginia State University, Petersburg, VA 23806. Virginia's agricultural economy is suffering from lower returns from winter wheat, thus, necessitating identification/establishment of alternative crops to enhance farm income. Extensive research with canola (*Brassica napus* L.), over the last ten years, has indicated that it may be adapted to Virginia. Canola oil is healthy for human nutrition due to its lowest content of saturated fatty acids (5 to 8%) and moderate content of poly-unsaturated fatty acids. The current US production of canola meets approximately 10% of domestic demand for canola oil, the rest is imported from Canada. Research conducted in Virginia has developed a production system and has resulted in development of an adapted and high yielding cultivar, tentatively named VSX-1. It has been estimated that per acre returns from canola could be \$330/acre as compared to approximately \$252/acre for winter wheat indicating that canola can be an excellent alternative winter crop for Virginia farmers.

Archaeology

PREHISTORIC NATIVE AMERICANS ON THE RICE CENTER. Anthony Bradley, Virginia Commonwealth University, School of World Studies, Richmond, VA. 23219. The Rice Center is located in close proximity to prehistoric Native American settlements as reflected in the archaeological record. Situated along both banks of the James River, these settlements follow established regional patterns from 8000 years ago to Colonial contact. The geography of the Rice Center would have been conducive to Native American use to include the possibility of a settlement. Excavation revealed evidence of a prehistoric Native American presence with indications of stone tool production. Additional artifacts recovered in the area infer a possible connection with sites across the James River and aid in establishing a time line for Native utilization of the Rice Center. Future research and excavation will broaden our current understanding of prehistoric Native American use and possible occupation of the site.

17th CENTURY ENGLISH SETTLEMENT AND CONTACT AT THE RICE CENTER. Jonathan Henriques, Virginia Commonwealth University, Richmond, VA. 23219. In 1619, English settlers moved into the area immediate to VCU's Rice Center, encountering there local Native Americans. Recent archaeology at the Rice Center has revealed intriguing clues about this early colonial history of the property. This paper describes what the site has revealed and may yet reveal about European and Native American contact on the Virginia frontier in the 17th century. These very different cultures experienced significant opposition in economic practice, social organization, and ideology, the details of which are visible within the archaeological record.

GENERAL GEORGE MCCLELLAN AND THE PENINSULA CAMPAIGN. Brian Andriliunas, Virginia Commonwealth University, Richmond, VA 23219. During his campaign to capture the Confederate capital at Richmond in the summer of 1862, Union General George McClellan and his 100,000 troops occupied land now owned by VCU and Berkeley Plantation. The portion owned by VCU contains vast lengths of Union earthworks, put into place to defend the troops encamped within and to provide a base for McClellan's attack on Richmond. McClellan's campaign failed, and he has gone down in history as a failed leader. His presence at the Rice Center has been one of the most crucial in the property's history. This paper will explore the varied history and reputation of McClellan and his Peninsula Campaign and consider the lasting marks his occupation of the property left on the landscape.

UNION CAMP LIFE AT THE RICE CENTER. Jolene Updike, Virginia Commonwealth University, Richmond, VA 23219. Archaeological investigations at the Rice Center along with a number of documentary sources have identified this site as part of an 1862 Civil War encampment providing residents to around 100,000 Union soldiers under the command of General George McClellan. While the body of the camp most probably lies further inland and down river, visible,

well preserved earthworks signal a significant presence. With further investigation, the Rice Center has the potential to produce important information about the soldiers stationed at this location, their cultural and economic effects on the surrounding area, and the role of the James River in the importance of Harrison's Landing.

BIOLOGICAL AND CHEMICAL CONTRIBUTIONS TO ARCHAEOLOGY AT THE RICE CENTER. Jessica Garber, Virginia Commonwealth University, Richmond, Va. 23219. VCU's Rice Center for the Environmental Sciences has already seen a wide variety of research projects in the Life Sciences. Recent archaeological research on the property has expanded the possibilities for Life Sciences research on the property. This paper will review projects already underway incorporating biological and chemical research into the archaeology program and will discuss research presently underway focusing specifically on the chemical analysis of soils recovered from archaeological contexts. This analysis will provide an in-depth look at past land use patterns and will suggest paths for future excavation at the site.

17TH AND 18TH CENTURY TURNED LEAD FROM SHIRLEY PLANTATION. Kathryn L. Swanson, William and Mary Center for Archaeological Research, Williamsburg VA. 23187. A recent excavation conducted next to the main house at Shirley Plantation yielded 33 pieces of turned lead from casement leaded windows. Twenty-one of these leads were found in good context in the builder's trench with artifacts contemporary to the main house and appear to be from the mansion. Five of the leads were inscribed with initials and dates ranging from 1672 to 1756, a time frame that fits with the regional popularity of casement leaded windows. Prior to this excavation, scholars believed that the present mansion house was built with sash windows similar to the ones it has now. These leads as well as others found in previous excavations, however, indicate that the current house originally had casement leaded windows. In addition, the common presence of leads suggests that at least two of the outbuildings had casement windows matching those of the house. Furthermore, the presence of turned lead fragments found with construction material dating to the late 18th century suggests that these windows were part of the house until at least 1774-1775, when the main house underwent a several major renovations.

Astronomy, Mathematics and Physics (concurrently with Materials Science)

INTERPOLATION OF MAGNETIC FIELDS: FINDING THE FIELD FROM MEASURED DATA. Seth S. Henshaw & Steven Whisnant, Physics Dept., MSC 7702, James Madison Univ. Harrisonburg VA 22807. A superconducting electromagnet is being installed at Brookhaven National Lab in order to sustain the polarization of a HD target being used by the LEGS collaboration to study the scattering of polarized gamma rays from polarized nucleon targets. This magnet will also be used to track the paths of charged particles, which implies that the field must be known at every point in space not just at the target location. This information is found by interpolating the magnetic field from an experimentally measured field map. The interpolation technique will be described, its sensitivity to experimental uncertainties will be discussed, and its overall effectiveness of the chosen interpolation method will be characterized. This work is supported in part by the National Science Foundation Grant number PHY-0242159.

SPECTROSCOPIC STUDY OF Λ HYPERNUCLEI UP TO MEDIUM-HEAVY MASS REGION THROUGH THE $(e, e' K^+)$ REACTION. Leon D. Cole, Alicia Uzzle, Lulin Yuan, Liguang Tang, Keith Baker, Dept. of Physics, Hampton Univ., Hampton Virginia 23668. The experimental goal is to investigate Λ hypernuclear structure with precision measurements of the mass spectra from light to medium-heavy mass region with the best energy resolution ever achieved. The first $(e, e' K^+)$ hypernuclear spectroscopy experiment was successfully carried out at Jefferson Lab in the spring

of 2000 yielding an energy resolution of 900 MeV. In order to improve this resolution, the high resolution kaon spectrometer (HKS) was designed. HKS features include an increase in the hypernuclear yield by 50 times and the energy resolution to approximately 300 KeV. Also, such an improvement is realized by a new experimental configuration, the “tilt method.” This will allow the use of higher beam currents as well as measure the hypernuclear spectra of higher Z targets. The general aspects of the high precision mass spectroscopy experiment will be presented.

(INVITED PAPER) “EVERYBODY MAKES ERRORS”: A 19TH-CENTURY MATHEMATICAL ATTEMPT TO PROVE THE EXISTENCE OF GOD. Adrian Rice, Dept. of Mathematics, Randolph-Macon College, Ashland VA 23005-5505. Augustus De Morgan (1806-1871) is best remembered today for his work in symbolic logic and algebra, which resulted in the creation of “De Morgan’s Laws”, now commonly used in set theory. Less well known is his work on probability and, more specifically, the use of probabilistic ideas and methods in his logic. De Morgan was one of the first mathematicians to understand and appreciate the work of the French applied mathematician Pierre-Simon Laplace, who wrote ground-breaking (but incomprehensible) treatises on both probability and celestial mechanics. Under his influence, and using his astronomical data, De Morgan attempted to use probabilistic reasoning to answer one of the most profound and tantalizing questions of all time: whether or not a divine creator exists or ever existed. This paper gives the mathematical and historical details of his ill-fated attempt to mathematically prove, or at least determine, the existence of a deity.

NUMERICAL CALCULATION OF THE DIVERGENCE OF A MAGNETIC FIELD. Christopher J. Carlson & C. Steven Whisnant, Physics Dept., MSC 7702, James Madison Univ., Harrisonburg VA 22807. The LEGS collaboration at Brookhaven National Laboratory is pursuing an experimental program with a polarized gamma ray beam and polarized nucleon targets. A superconducting magnet will be installed to maintain target polarization and to assist with particle tracking. Analysis of the experimental data requires a map of the magnetic field. In order to verify that this map is physically meaningful one must show that it satisfies Maxwell’s equations. The numerical calculation of the spatial derivatives at each point in this map and the sensitivity to experimental uncertainty will be discussed. This work is supported in part by the National Science Foundation grant PHY-0242159.

GENERALIZED AND APPROXIMATE DERIVATIVES FOR NONSMOOTH FUNCTIONS. Robert L. Tomlin, NuSoft, Mathematics Study Group. Nonsmooth functions are those that fail to be differentiable at some points in their domain. In recent years, much work has been done in the development of Generalized and Approximate derivatives to give a sense of differentiation for nonsmooth functions. Nonsmooth functions arise naturally in many areas including optimization where, to find extrema, it is necessary to know the zeroes of the derivative, i.e., $f' = 0$. For nonsmooth functions, this is a problem as the extrema may be at a nonsmooth corner point where the function is not differentiable. In this exposition, we will begin by examining the generalized derivative, defined for nonsmooth Lipschitz Continuous functions, developed by F.H. Clarke. His is a set-valued derivative. For optimization, we will be interested in knowing if the set contains zero, i.e., $0 \in \{ \}$. Next we will examine the work to date by the author on a proposed approximate derivative referred to as the ϵ -slope derivative, for nonsmooth ϵ -Lipschitz functions (to be defined). We will compare the ϵ -derivative to Clarke’s generalized derivative. We will restrict ourselves to functions $f : \mathbf{R} \rightarrow \mathbf{R}$ or $f : \mathbf{R} \rightarrow \mathbf{R}^*$ (extended Reals).

THE SCIENTIFIC DIALOGUE BETWEEN LIGHT AND SOUND: SIIR’S PHOTO-ACOUSTIC THEORY. Siir Kilkis, Georgetown Univ., Washington DC 20057. A long time quest to relate light and sound is solved by a seamless mathematical correlation. The ratio of light and sound wavelengths is found to be proportional to the *Photo-Acoustic Number*, which covers the entire

audible and visible range. This correlation is used to create the *Acousto-Chromatic Diagram*, which shows that all octaves of music and shades of spectral colors are superposed. For the first time, the audible range maps over the visible spectrum. The *Visual Orchestration Technology* emerges to show the benefits of the Theory and address human needs. This Technology colorizes compositions at each time increment of music and appeals to the human cognition of light and sound. *Art Composer* is the reverse process and converts the colors in each area increment of an image to music. It is now possible to see the music and hear the colors based on this scientific dialogue.

AXISYMMETRIC FIELDS AND ELLIPTIC INTEGRALS. Joseph W. Rudmin, Dept. of Physics and Astron., James Madison Univ., Harrisonburg VA 22807. Results of studies of calculations of axisymmetric fields are presented. Motivations for the work include improved methods of calculating the fields of solenoids and other fields caused by superposition of rings of current and charge, as well as improved understanding of elliptic integrals and functions with logarithmic singularities. It is shown that the elliptic integral of the first kind can be expressed as a power series plus a power series multiplied by a logarithm. The method of determining these series will be presented.

A LABVIEW INTERFACE FOR A RESIDUAL GAS ANALYZER. Amelia A. Cohen & C. Steven Whisnant, Physics Dept., MSC 7702, James Madison Univ., Harrisonburg VA 22807. This project is part of a collaboration with the LEGS (Laser Electron Gamma Source) group at Brookhaven Laboratory. A highly polarized HD target is one of the main components of this project and its creation requires high purity ($\geq 99.99\%$ pure) gas. Gas with this degree of purity can only be obtained through a careful distillation process, and the distillery at James Madison University is monitored with a residual gas analyzer (RGA). The RGA measures the presence of different masses that pass through the system, where HD is measured as mass 3, H₂ is mass 2 and D₂ is mass 4. To create a Labview interface for this, the masses are read into the computer in the form of currents and must be presented in histogram form. The user can select the length and mass range of the histogram scans performed to learn the presence of different masses. This work is supported in part by the National Science Foundation grant number PHY-0242159.

SEARCHING FOR A NEEDLE IN A HAYSTACK: STRANGE MESON DETECTION IN ELECTRON SCATTERING AT 6 GEV. Erin E. McGrath, James Madison Univ., Harrisonburg VA 22807. My work involves the search for kaon production in conjunction with the Jefferson Lab experiment "Duality in Meson Electroproduction" (Spokespeople: R. Ent, H. Mkrtchyan, G. Niculescu), which investigates quark-hadron duality in the production of pions and kaons. Many runs of this experiment used a hydrogen target, and my work involved identifying these runs and then replaying them while changing the particle mass specifications from the mass of the pion, .13957 GeV/c², to .4936 GeV/c², the mass of the charged kaon. It can then be determined when kaons were produced in the collision of the electron beam with the proton target (this occurrence is relatively rare, hence the title), and this information can be used to further the study of quark-hadron duality.

MODELING LOAD DEPENDENT HYSTERESIS FOR A SIMPLE NiTi ACTUATOR. William S. Galinaitis, Dept. Math. and Comp. Sci., Ferrum College, Ferrum VA. 24088. To accurately position an object with an actuator that exhibits load dependent hysteresis requires a hysteresis model that is capable of adjusting to a change in load. In this paper we investigate the problem of modeling the hysteresis of a simple shape memory alloy wire that is operated under changing tensile loads. A Preisach operator that incorporates load dependent parameters in the Preisach density function is used as the hysteresis model. It is shown that a relationship exists between the Preisach density function and the thermal coefficient of expansion of the wire. It is then shown that the load dependent Austenite-Martensite transition temperatures of the wire can be used to estimate the parameters of the underlying density function. To test this approach, a bivariate density function that

incorporates two load dependent parameters is substituted for the Preisach density function. Two load dependent linear estimators are developed from experimental data and used to estimate the parameters of the density function. These estimators and the load dependent Preisach operator are then used to estimate the length of a SMA wire that is operated under several tensile loads. The estimates are compared to experimental data and a discussion of the effectiveness of this approach is given. (Supported by: NSF RUI 0105190.)

USING FIBER OPTICS AND LIGHT EMITTING DIODES IN THE MULAN DETECTOR CALIBRATION SYSTEM. Chris J. Church & Kevin Giovanetti, Dept. of Physics, James Madison Univ., Harrisonburg VA 22807. The μ Lan project is a collaborative effort to achieve a one part per million (PPM) measurement of the muon lifetime and will be performed at The Paul Scherrer Institut in Villigen, Switzerland. To allow simulations of muon decay as well as testing of the μ Lan Detector a detector calibration system employing light emitting diodes and fiber optics has been developed. The LED's simulate the detection of e^+ from the positive muon decay and the emitted light is delivered to the individual photomultiplier tube detectors by fiber optics. During the development of the system several issues were taken into consideration including limitations of the LED's, pulse widths, light transmission, fiber polishing, and the design of both driver boards and the signal translator boards necessary to utilize the calibration system. The system is now primarily in the production phase in preparation for its installation in July 2004.

FABRICATION OF THE GAS HANDLING SYSTEM FOR USE IN A GAS ELECTRON MULTIPLIER BASED RADIAL TIME PROJECTION CHAMBER. James R. Ferrer, Dept. of Physics, James Madison Univ., Harrisonburg VA 22807. As part of the BONUS collaboration James Madison University will be building a gas handling system to supply the detector with a mixture of DME (dimethylether) and Argon. This system is in the pre-production phases and will begin fabrication this summer. The BONUS detector is used to investigate the quark structure of neutrons. It is also the first cylindrical, GEM based, particle detector. The gas handling system will directly supply the GEM's in the bonus detector.

UPDATE ON THE MUON LIFETIME MEASUREMENT. Michael E. Clemens & Kevin Giovanetti, Dept. of Physics, James Madison Univ., Harrisonburg VA 22807. An overview and update on the Mulan Project: A Precision Measurement of the Positive Muon Lifetime Using a Pulsed Muon Beam and the μ Lan Detector to take place at the Paul Scherrer Institute (PSI) in Villigen, Switzerland. The experiment is a collaborative effort to achieve a 1ppm determination of τ_μ . This will allow for a new determination of G_F , the Fermi constant, a fundamental number in the standard model on which all electroweak processes are dependant. The Detector Development Lab at James Madison University is responsible for development and production of a calibration system for the Mulan detector; our system is currently in production mode. A mock run is scheduled at PSI in July 2004 and a data run is scheduled for the fall of 2004. Current projections foresee all system components in place by 2005.

Biology

DEVELOPMENT OF A RECOMBINANT VACCINE AGAINST PNEUMONIC PLAGUE USING A FUSION PROTEIN EXPRESSION SYSTEM TO CLONE, EXPRESS, AND PURIFY A *VIRG-TYEA* FUSION GENE FROM *YESINIA PESTIS*. Kristina D. Ryden, Dept. of Integrated Science and Technology, James Madison Univ., Harrisonburg, VA 22801. A number of genes coding for outer membrane and virulence proteins of *Yesinia pestis* (pathogenic agent of plague) can be cloned into bacterial and/or yeast vectors for the purpose of over expression. The *TyeA* and *VirG* gene products play important roles in the translocation of *Yesinia pestis* proteins into eukaryotic cells, and because they are both believed to be located on the outer membrane, each of these proteins is

accessible for immune response especially in virulent, non-encapsulated *Y. pestis* strains. A cloning strategy was developed to create an *Intein-VirG-TyeA* fusion gene that can be expressed and purified. The purified Intein-VirG-TyeA tri-fusion protein has been delivered to U. S. Army Medical Research Institute of Infectious Diseases for further testing on animal models. Supported by a Virginia Academy of Science Undergraduate Student Research Award.

POST-CHEMOTHERAPEUTIC ADMINISTRATION OF IL-12 RETARDS TUMOR GROWTH AND ENHANCES IMMUNE CELL FUNCTION: COMBINATION THERAPY USING PACLITAXEL AND IL-12. Jennifer S. Pressley¹, David W. Mullins², & Klaus D. Elgert¹, ¹Dept. of Biology, Microbiology and Immunology Section, Virginia Tech, Blacksburg VA 24061 and ²Human Immune Therapy Center, Univ. of Virginia, Charlottesville VA 22908. A significant consideration in the development of combined chemo/immunotherapy is the mode of action of the chemotherapeutic used. Paclitaxel (TAXOLTM), a potent inhibitor of tumor cell division, also suppresses lymphocyte proliferative responses. To optimize paclitaxel's antitumor effects, its negative immunologic implications must be addressed. We hypothesized that the lymphocyte stimulatory cytokine interleukin-12 (IL-12) could reverse paclitaxel-mediated immune cell suppression. Post-chemotherapeutic (but not simultaneous) IL-12 significantly delayed tumor outgrowth and extended survival. Paclitaxel + delayed IL-12 administration induced nitric oxide and tumor necrosis factor- α secretion in TBH macrophages, and restored tumor-burdened host CD4⁺ T cell function. Collectively, these data suggest paclitaxel can be combined with immunotherapeutic cytokines to achieve enhanced antitumor activity, and we propose this combined therapeutic approach should be considered in a clinical context.

THE USE OF *E. COLI* EXPRESSED PROTEINS OF *YERSINA PESTIS* FOR THE DEVELOPMENT OF VACCINES AGAINST PNEUMONIC PLAGUE. Ronald W. Raab, Robert McKown, & George Coffman, ISAT Dept., James Madison University, Harrisonburg VA 22807. *Yersinia pestis*, the causative agent for bubonic and pneumonic plague, is a leading candidate for use in biological warfare. A collaboration between JMU and the U.S. Army Medical Research Institute of Infectious Diseases (USAMRIID) has been established to utilize recombinant DNA technology to produce a more efficacious vaccine. Recombinant DNA technology has enabled a new approach to vaccine development and production that has been shown to be effective against a number of pathogenic organisms. Our research is focused on the development of complex vaccines made of many protein components that may prove to be more difficult to counter. We have cloned a collection of genes from *Y. pestis* that code for secreted and outer membrane proteins. These proteins have been expressed in *E. coli* and purified by affinity chromatography. The purified proteins will be tested at USAMRIID by injection into animal model systems to induce protective immunity followed by a lethal challenge of aerosolized *Y. pestis*

THE EFFECTS OF PACLITAXEL AND CATECHINS ON RKO CELLS. Adam J. Clarkson & Rosemary Barra. Dept. of Biol. Sci., Mary Washington College, Fredericksburg, VA 22401. Dietary polyphenols are a major mechanism for limiting the proliferation of neoplastic cells. Among the polyphenols, the catechins have demonstrated the greatest anticancer potential. Their cytotoxic effect against human cancer cells suggests they function as telomerase inhibitors. The purpose of this study was to substantiate the toxic potential of catechins (-)-epigallocatechin gallate (EGCG) and (-)-epicatechin gallate (ECG) on telomerase-positive RKO colon carcinoma cells and to determine whether any cytotoxic effects were apoptotic or necrotic in nature. Catechin treatments were compared with treatments of Paclitaxel, an anticancer drug known to induce apoptosis. The MTT cytotoxicity assay indicated that 24 hour incubations with 100 mM Paclitaxel, 200mM EGCG and 200 mM ECG were cytotoxic to RKO cells. Evidence of apoptosis was demonstrated by a subsequent Comet assay, which qualitatively showed DNA damage. A colorimetric assay demonstrated augmented levels of caspase-9 after Paclitaxel (45% increase over control) and EGCG (67%) treatments, suggesting the activation of apoptotic pathways. The experiment also

demonstrated that simultaneous application of Paclitaxel and EGCG (289%) increased cytotoxicity in neoplastic cells.

FIBROSARCOMA-INDUCED DYSREGULATION OF INTERLEUKIN (IL)-1 β AND IL-18 ACTIVITIES AND THEIR MODULATION BY PACLITAXEL. Elizabeth P. Falwell¹, David W. Mullins², & Klaus D. Elgert¹, ¹Dept. of Biol., Virginia Tech, Blacksburg, VA 24061, and ²Human Immunotherapy Center, Univ. of Virginia, Charlottesville, VA 22908. In the present study, we hypothesize that tumors alter M ϕ production of the proinflammatory cytokines IL-1 β and IL-18, both in the tumor microenvironment and systemically. To evaluate this hypothesis, M ϕ s from tumor-proximal (tp) and tumor-distal (td) locations were analyzed for IL-1 β and IL-18 production. While td M ϕ s produced elevated levels of IL-1 β , tp M ϕ levels of IL-1 β were suppressed. Both td and tp M ϕ s produced elevated levels of IL-18. Tumor-derived TGF- β ₁ and IL-10 dysregulated IL-1 β , as antibody blockade of these molecules restored IL-1 β expression. Furthermore, supporting earlier studies showing that paclitaxel up-regulates M ϕ production of tumoricidal and signaling molecules, paclitaxel enhanced tumor-bearing host (TBH) M ϕ IL-1 β production. IL-18 production was enhanced in td M ϕ s when stimulated with paclitaxel. The IL-1 β and IL-18 expression pattern suggest differential regulation of TBH M ϕ NF- κ B translocation. Collectively, these data offer insight into new chemotherapeutic and immunotherapeutic therapies designed to correct cytokine imbalances and restore patient anticancer function.

INTRACELLULAR TRANSPORT DEFECTS MAY UNDERLIE THE SYNAPTIC PATHOLOGY OF ALZHEIMER'S DISEASE. David A. DeWitt,^{1,2} Jennifer Hurd¹, Othman Ghribi,² Nena Fox,³ Kathleen J.S. Griffioen,¹ & John Savory² ¹Dept. of Biol., Liberty Univ., Lynchburg, VA 24502, ²Dept. of Pathol. and ³Dept. of Microbiol., Univ. of Virginia, Charlottesville, VA 22908. Alzheimer's disease (AD) is characterized by senile plaques, neurofibrillary tangles, and severe synaptic and neuronal loss. We have shown that aluminum maltolate treatment triggers pathological changes similar to AD when administered to aged rabbits and aluminum treatment *in vitro* causes human NT2 cells to undergo apoptosis. An early event is the peri-nuclear clustering of mitochondria and endoplasmic reticulum suggesting intracellular transport defects. Staurosporine but not H₂O₂ also induced organelle clustering. Nocodazole treatment redistributed clustered mitochondria suggesting that intact microtubules were required for clustering. Neuronal processes of differentiated NT2 cells appeared either depleted of mitochondria or had mitochondria stuck in axonal swellings consistent with decreased transport. These results with observed axonal transport defects in AD brain suggest axonal transport may play a significant role in synapse loss and thus the pathogenesis of AD. Supported by the Jeffress Memorial Trust and the National Institutes of Health AG-020996.

UNDERSTANDING THE EFFECT OF A DINUCLETIDE POLYMORPHISM ON NITRIC OXIDE SYNTHASE I PROMOTER ACTIVITY IN NEURONAL CELLS. Angela Kelly, Jon Altizer, Linda Guo, Yu Cao, & Terrie Rife. Dept. of Biology, James Madison University, Harrisonburg, VA 22807. The transcriptional induction of the enzyme Nitric Oxide Synthase I (NOS I) following many degenerative diseases such as stroke, nerve injury, or Parkinson's disease is thought to contribute to cell death. Because of this there has been much recent interest in linking increasing size of a dinucleotide polymorphism found in one of the gene's promoter regions with various degenerative diseases. Preliminary evidence suggests that increases in this dinucleotide polymorphism may be linked to Parkinson's disease; however, further work is needed to verify this conclusion. Additionally our lab is attempting to understand better how this dinucleotide polymorphism may effect NOS I expression through the generation of promoter-reporter gene constructs with varying dinucleotide repeat sizes. Our lab has also discovered a new rat NOS I exon called AK that may be involved in translational control of the NOS I gene.

ANALYSIS OF CFTR (CYSTIC FIBROSIS TRANSMEMBRANE CONDUCTANCE REGULATOR) RESIDUES MODIFIED BY PROTEIN PHOSPHORYLATION. L. Daniel Howell, Valerie Chappe, Alexandra Evagelidis & John W. Hanrahan. McGill University, Department of Physiology, Montreal, Quebec (Canada). The Cystic Fibrosis Transmembrane Conductance Regulator (CFTR) is a chloride channel responsible for causing cystic fibrosis (when mutated) and chronic diarrhea (when hyperactivated in the gut). CFTR is regulated by protein phosphorylation in a complex fashion: At least two kinases (PKA and PKC) phosphorylate CFTR on as many as 20 residues. In this study, we determined which CFTR residues are modified by PKC *in vitro* by two-dimensional tryptic peptide mapping of fusion protein and synthetic peptide models, and we examined the functional effects of PKC site mutations on CFTR channel activity. Six of the nine predicted PKC sites were phosphorylated robustly; two (T604 & S686) were essential for CFTR channel activity and two (S641 & T682) were found to be inhibitory. Interestingly, one of the sites (S712) phosphorylated by PKC is a PKA site. The findings from this study will help guide future efforts to manipulate CFTR activity *in vivo*.

TRANSFORMING GROWTH FACTOR B-1 INHIBITS MAST CELL FC- ϵ -RI EXPRESSION. Farnaz Norozian & John J. Ryan, Dept. of Biol. Virginia Commonwealth University, Richmond, VA 23284-2012. Transforming Growth Factor beta-1 (TGF β -1) is a potent regulatory cytokine acting on many immune cells. Given its inhibitory actions, we tested its effects on mast cell function. We find that bone marrow derived mast cells (BMMC) stimulated with TGF β -1 have reduced expression of the high affinity IgE receptor, Fc epsilon RI (Fc ϵ RI). TGF β -1 inhibited Fc ϵ RI expression approximately 60%, with half maximal inhibition requiring 0.3 ng/ml TGF β -1. Reduced Fc ϵ RI expression could be observed within 24 hours of TGF β -1 stimulation, and lasted for at least 7 days. TGF β -1 also inhibited Fc ϵ RI expression on ex vivo-cultured peritoneal mast cells and on cultured human mast cells. Reduced expression of Fc ϵ RI occurred with no change in mRNAs encoding the alpha, beta, or gamma subunits of Fc ϵ RI. However, TGF β -1 reduced protein expression of all three subunits. These data demonstrate the ability of TGF β -1 to inhibit expression of the key mast cell activation receptor, Fc ϵ RI.

THE EFFECTS OF CAFFEINE ON UV-INDUCED APOPTOSIS IN MELANOMA CELLS. Elizabeth A. Sjoberg and Rosemary Barra, Department of Biology, Mary Washington College, Fredericksburg, VA. 22401. This is a preliminary report on research focusing on the possible protective effects of caffeine against UV damage in skin cells. WM-115 human skin cells, CRL-1675 (ATCC), were used in this study. Cell viability was analyzed using the MTT assay after exposure to varying concentrations of caffeine and varying exposure times to UV radiation both separately and in combination. In addition, the activation of apoptosis was analyzed using a Caspase-9 assay. Increasing concentrations of caffeine and UV exposure caused significant decreases in cell viability. At 100 μ g/mL of caffeine, viability was reduced by 50% ($P=0.008$) and at 25 seconds of UV exposure, there was a 60% decrease ($P=0.001$). The cultures treated with both UV radiation and caffeine showed a lower caspase 9 activity when compared to cultures treated with UV alone. This data suggests that caffeine may be exerting a protective effect against UV damage, however additional experiments are needed to confirm this effect and to determine the mechanism involved.

EVALUATION OF THE CYCLOOXYGENASE-2 SPECIFIC NON-STEROIDAL ANTI-INFLAMMATORY DRUG VIOXX (ROFECOXIB) AS AN INHIBITOR OF LIPOPOLYSACCHARIDE-INDUCED PREGNANCY LOSS. Marie Rodgers¹, Carolyn M. Conway², and Arthur F. Conway¹, ¹Dept. of Biology, Randolph-Macon Coll., Ashland, VA 23005 and ²Dept. of Biology, Virginia Commonwealth Univ., Richmond, VA 23284. Lipopolysaccharides (LPS) cause strong inflammatory responses and can cause pregnancy loss at low doses. Since prostaglandin secretion is a major component of inflammatory responses, general non-steroidal anti-

inflammatory drugs (NSAIDs) have been evaluated as inhibitors of LPS-induced pregnancy loss with mixed results. The present study evaluated the specific cyclooxygenase-2 (COX-2) inhibitor rofecoxib (Vioxx), which reduces inflammation in many joint disorders with fewer side effects than general NSAIDs. Three levels of Vioxx (0, 15 mg/kg/day, 30 mg/kg/day) were administered through food on gestation days 7-12 to mice that received one of three levels of LPS injections (0, 2, or 5 µg) in the tail vein on day 9 of gestation. Vioxx treatment resulted in moderate reductions in pregnancy loss in mice receiving 2 µg LPS, but had no apparent effect on pregnancy loss resulting from 5 µg LPS, and the Vioxx effects were not statistically significant (2-way ANOVA).

THE EFFECTS OF ORALLY, SUBCUTANEOUSLY, INTRAPERITONEALLY, AND INTRAVASCULARLY ADMINISTERED LIPOPOLYSACCHARIDE ON PREGNANT FEMALE CD-1 MICE.. Lauren M. Steele¹, Carolyn M. Conway², and Arthur F. Conway¹, ¹Dept. of Biol., Randolph-Macon Coll., Ashland, VA 23005 and ²Dept. of Biol., Virginia Commonwealth Univ., Richmond, VA 23284. Effects of orally administered and injected lipopolysaccharide (LPS) on frequency of pregnancy loss was studied in pregnant CD-1 mice. Oral administration modeled oral infections, intravenous injection modeled sepsis, intraperitoneal injection modeled peritonitis, and subcutaneous injection modeled a localized infection. Orally administered LPS (2000 micrograms per day on days 7-12 of gestation) failed to significantly increase pregnancy loss in CD-1 female mice. Intravenous, intraperitoneal, or subcutaneous injection of 2 or 5 micrograms of LPS on day 9 of gestation significantly increased frequency of pregnancy loss, significantly decreased reproductive tract weight per implantation site, significantly decreased maternal weight gain, and resulted in some increase in maternal spleen weights. Intravenous and intraperitoneal injections were equally effective, while subcutaneous injections were less effective. These results are consistent with dependence of LPS effects on access to macrophages rather than on access to the implantation site.

PROTEASOME INHIBITION BY EGCG IS ACCOMPANIED BY BAX ACCUMULATION AND APOPTOSIS IN T LYMPHOCYTIC LEUKEMIA CELLS. Kimberly Boelte & Rosemary Barra, Dept. of Biol. Sciences, Mary Washington College, Fredericksburg VA 22401. In this study, the effects of EGCG, an ester-bond-containing polyphenol, on proteasome activity in CRL-1990 T lymphocytic leukemia cells were examined. Proteasome inhibition may lead to an accumulation of the pro-apoptotic protein Bax, along with an increase in the occurrence of apoptosis in the cells. Fluorescent proteasome inhibition assays showed that EGCG significantly inhibited proteasome activity in the cells treated with 10 µM EGCG (11.2%) and in the cells treated with 30 µM EGCG (22.5%). Cellular Bax levels increased with an increase in EGCG concentration. Cellular Bcl-2 levels remained steady under the same conditions. In addition, caspase-9 activity increased as the concentration of EGCG increased. The cells were examined for morphological differences with treatment, showing definite difference between control and treated cells. The treated cells showed the morphological characteristics of apoptosis. With EGCG treatment, the CRL-1990 cells demonstrated cellular Bax accumulation accompanied by apoptosis, indicating that EGCG may be useful in a treatment protocol for cancer.

RENAL PROXIMAL TUBULE VDR REGULATION IS CONTROLLED BY COORDINATE EFFECTS OF EXTRACELLULAR CALCIUM AND PTH. Amandeep Bajwa & Matthew J. Beckman, Dept. of Biochemistry, Virginia Commonwealth University, Richmond VA 23298. Renal proximal vitamin D receptor (VDR) gene expression is uniquely regulated in a pattern consistent with the control of negative feedback suppression on 1 α -OHase. Decreased VDR gene expression is influenced by low extracellular calcium (Ca) and high parathyroid hormone (PTH) concentration. The effect of PTH on VDR gene expression was then studied by TaqMan Real-Time RT-PCR. The down-regulation of VDR gene expression in response to PTH was observed as dose-dependent with a maximal response (> 80%) at 200 ng/ml of PTH₁₋₃₄. Furthermore, the down-regulatory effect of

PTH on VDR transcript level was abolished by addition of Ca. To examine if the action of PTH was direct for VDR transcription, cells were transfected with a VDR promoter-luciferase reporter vector. PTH significantly repressed VDR promoter activity. This *in vitro* study mimics a classic *in vivo* model of PTH-mediated renal proximal VDR regulation and identifies a counter-regulatory role for extracellular Ca. In conclusion, PTH negatively modulates HK-2 cell VDR transcription via the cAMP/PKA pathway.

INVESTIGATIONS OF STAT-1 REGULATION OF PLATELET-ACTIVATING FACTOR ACETYLHYDROLASE. Jean Lin & Suzanne E. Barbour, Dept. Biochem., Virginia Commonwealth University, Richmond VA 23298. Platelet-activating factor (PAF) is a proinflammatory phospholipid that is catabolized by platelet-activating factor acetylhydrolase (PAFAH). We are studying localized aggressive periodontitis (LAgP), a chronic inflammatory disease associated with a variety of abnormalities in monocytes, the cells that secrete PAFAH. PAFAH levels are low in monocytes from LAgP patients. The transcription factor STAT1, is also expressed at low levels in monocytes from LAgP patients. We hypothesize that PAFAH expression is induced by STAT1 and is low in LAgP monocytes due to limiting amounts of the transcription factor. To study this hypothesis, a PAFAH promoter in a luciferase reporter construct was transfected into P388D1 macrophages. The cells were treated with cPAF (a PAF analog that activates STAT1) or IL4 (which activates STAT6). PAFAH promoter activity was not induced when cells are stimulated with cPAF. However, IL4 appeared to activate the PAFAH promoter. Together, these data suggest that the putative STAT elements in the PAFAH promoter are functional and may regulate PAFAH expression. This work was supported by a grant from the National Institutes of Dental and Craniofacial Research, DE 13102.

THE EFFECTS OF FLAVONOIDS ON P-GLYCOPROTEINS IN COLON CARCINOMA CELLS. Ashley E. Jones and Dr. Rosemary Barra, Dept of Biol., Mary Washington College, Fredericksburg, VA.22405. Drug resistance is a process by which cancer cells fail to respond or stop responding to treatment. One type of drug resistance involves the presence of p-glycoprotein, a channel protein that allows an efflux of drugs from cancer cells. Although this protein is present in most cells, it is present in higher concentration in cancer cells. Even though there are drugs currently on the market that inhibit p-glycoprotein's activity, recent studies have found alternatives to these existing treatments. One such treatment uses flavonoids, which are found naturally in fruits and vegetables. This study investigated the effects of flavonoids on p-glycoprotein in colorectal adenocarcinoma cells. The cells were treated with various concentrations of flavonoids, Verapamil, and the combination of the two to determine their effects on p-glycoprotein. P-glycoprotein activity was determined using a fluorescence assay, Vybrant Multidrug Resistance Assay Kit. The results indicate that flavonoids, as well as the currently available drug Verapamil, inhibited P-glycoprotein activity in the colorectal adenocarcinoma cells.

EVALUATION OF INHIBITION OF PROGESTERONE AND ESTROGEN SECRETION AS A POSSIBLE MECHANISM INVOLVED IN LIPOPOLYSACCHARIDE-INDUCED PREGNANCY LOSS. Danielle Kocubinski¹, Carolyn M. Conway², and Arthur F. Conway¹, ¹Dept. of Biol., Randolph-Macon Coll., Ashland, VA 23005 and ²Dept. of Biol., Virginia Commonwealth Univ., Richmond, VA 23284. Lipopolysaccharide (LPS) from Gram-negative bacteria causes pregnancy loss when injected into mice. We tested the effects of LPS treatment on progesterone and estradiol secretion in CD-1 mice. Mice were injected intravenously with 5 µg LPS or PBS (as a control) on day 9 of gestation and sacrificed 6 or 24 hours later. LPS caused maternal weight loss at 6 and 24 hours after treatment and decreased implantation site width and reproductive tract weight 24 hours after treatment, indicating a maternal inflammatory response to LPS beginning prior to 6 hours after treatment, minimal or no damage to the 6 hour samples, and measurable damage to the implantation site in the 24 hour samples. LPS treatment decreased maternal serum progesterone levels at both 6 and 24 hours after treatment, but caused no significant alteration in progesterone or estradiol levels

in the placenta or in maternal serum estradiol levels at 6 hours after treatment. This is consistent with LPS causing pregnancy loss by interfering with progesterone secretion by the corpora lutea in the ovary.

LOCALIZATION AND ANTIGENICITY OF MOUSE SPERM TPX-1, A MEMBER OF THE CYSTEINE-RICH SECRETORY PROTEIN (CRISP) FAMILY. Stacey S. Harrison, Arthur F. Conway & James A. Foster, Dept. of Biol., Randolph-Macon Coll., Ashland VA 23005. Although safe and effective contraceptive methods are available, new contraceptives that can be used more effectively are needed. Sperm-based contraceptive vaccines immunize females against sperm antigens. We studied Tpx-1, a mouse testis-specific protein in the CRISP family as a target antigen. We tried to determine the localization of Tpx-1 in mature mouse sperm and to determine the potential for use of Tpx-1 as an antigen in a contraceptive vaccine. Immunofluorescence microscopy using antisera against recombinant rat Tpx-1 and a synthetic mouse Tpx-1 peptide showed that Tpx-1 is located primarily in the acrosome of mature mouse sperm. The antigenicity of a synthetic Tpx-1 peptide complexed with hemocyanin was tested in female CD-1 mice. No significant increase in oviductal, uterine, or blood serum IgG, IgA, or IgM was observed at three weeks following a single injection, or fourteen weeks following an initial injection plus a booster injection at three weeks. Although the Tpx-1 peptide used in this study did not appear to induce a significant immune response in female mice, the Tpx-1 protein was shown to be located in the acrosome, an important location for sperm-egg interactions.

A PRELIMINARY PROTEOMIC ANALYSIS OF THE ACROSOMAL MEMBRANES OF GUINEA PIG SPERMATOZOA. Sara S. Hirsch & James A. Foster, Dept. of Biol., Randolph-Macon Coll., Ashland VA 23005. The interaction of sperm with the zona pellucida of the egg is an important process during fertilization. The membranes over the sperm acrosome are key components in this process, but only a few of the proteins of these membranes have been characterized. This study was a preliminary proteomic analysis of the acrosomal membranes in guinea pig sperm. We prepared acrosomal apical segments that contained the membranes over the acrosome, and performed Triton X-114 phase separation to isolate membrane-associated proteins. Proteins were analyzed by 1D SDS-PAGE, Western blot, zymogen gel, and 2D NEPHGE. Microsequence data indicated at least one of the acrosomal membrane proteins (~58 kDa.) is not present in current protein sequence databases and is a novel protein. Western blot analyses of acrosomal matrix proteins showed that AM50 (a pentraxin family member) is associated with the acrosomal membranes, while AM67 (orthologue of a mouse ZP-binding protein sp56) is not membrane-associated. Acrosin (the activated form of proacrosin – a trypsin-like protease) was active when associated with the acrosomal membranes. A high-resolution 2D NEPHGE showed a relatively small number of major acrosomal membrane proteins.

MUTATIONAL ANALYSIS OF RECOMBINANT LACRITIN, A NOVEL SECRETION ENHANCING FACTOR FROM THE HUMAN LACRIMAL GLAND. R. L. McKown¹, S. J. Aherne¹, L. Stehling¹, R. W. Raab¹, G. L. Coffman¹, & G. W. Laurie². ¹Department of Integrated Science and Technology, James Madison University, Harrisonburg VA 22807 and ²Department of Cell Biology, University of Virginia, Charlottesville VA 22908. A recently discovered human gene that codes for a protein called lacritin has been shown to promote ductal cell proliferation and stimulate cell signaling. This protein has potential as a new therapeutic to treat Dry Eye Syndrome. A series of Carboxyl (C) terminal deletions were genetically engineered to create variants of the lacritin protein. The recombinant genes were cloned into *E. coli* expression vectors, expressed in culture, and purified. The purified variant proteins were analyzed for mitogenic activity in the proliferation of ductal cell growth. Recombinant lacritin proteins with 5 and 10 amino acid residues removed from the C-terminus were mitogenic while proteins with deletions of 15, 20, 25, and 59 amino acid residues from the C-terminus were not mitogenic. An amphipathic alpha helical region

has been identified in the C-terminal region of lacritin and a potential structure-function relationship is presented.

ANTIBIOTIC RESISTANCE ASSAY: CAN THIS PROCEDURE WORK USING *ESCHERICHIA COLI* AS THE STANDARD? Felicia Clark and Carolyn L. Thomas, Dept. of Biology, Ferrum College, Ferrum, VA 24088. The standard bacteria species used in the Antibiotic Resistance Analysis is fecal streptococcus or enterococci. Currently the Virginia bacterial standard for swimmable/fishable and potable water is changing to use *Escherichia coli*. The purpose of this research was to develop a new procedure for the Antibiotic Resistance Analysis (ARA) using *E. coli* as the bacteria evaluated for resistance. During the first phase of research, a "pure" *Escherichia coli* culture was purchased and evaluated for resistance patterns. When the pure culture of *E. coli* was tested for confirmation of species the expected results were observed from the first trial, but the same results were not observed in the following two trials. The second phase of research was designed to test different variables in the analysis to determine the cause of species identification variations. The results from two of the three variables (pH, age of culture and other field *E. coli* culture) tested showed no signs of influence. However, when compared to a trial conducted using a sample of lake water bacteria that tested positive to contain *Escherichia coli*, the expected identification results were observed.

AN EXAMINATION OF SEASONAL GROWTH RATES AND SURVIVORSHIP OF THE 'HISPID COTTON RAT' IN SOUTHEASTERN VIRGINIA. Heather A. Green & Robert K. Rose, Dept. of Biol., Old Dominion Univ., Norfolk, VA. 23529-0047. A reexamination of specific population dynamic aspects of the hispid cotton rat is necessary in order to gain additional knowledge and perspective of this species in its northernmost distribution on the east coast of the United States. Previous studies have provided evidence of negative growth of males and females over the winter months. An in-depth study of the rates of growth in males and females throughout the seasons in Virginia will provide a basis for comparison with those of the other geographic populations. By comparing growth rates within each season in Virginian populations, patterns should emerge demonstrating higher and lower rates of survival during different times of the year. Newly collected data associated with winter growth rates may also reveal new insight concerning winter survivorship of cotton rats. Some populations of cotton rats are located at the same northern latitude, but they exhibit differences in their body size. The larger question is to understand both why geographic populations differ in body size and the relevant forces of selection promoting these patterns.

PROBLEMS ASSOCIATED WITH THE USE OF SECONDARY SEXUAL CHARACTERISTICS IN THE TAXONOMY OF AMETABOLA INSECTS: NEW GENUS ALLOCATION FOR PARTICULAR CUBAN NICOLETIIDS (ZYGENTOMA: INSECTA). Benjamin Carlson & Luis Espinasa, Department of Natural Sciences, Shenandoah University, Winchester, VA. 22601. Genus *Anelpistina* is differentiated only from *Cubacubana* by the presence of a characteristic that develops late in male development; articulated appendages in urosternum IV. While reviewing new samples of allegedly *Cubacubana negreai*, it was found that adult males had such appendages, and therefore the species should receive a new allocation: *Anelpistina negreai*. Caution is stressed on the fact that juvenile *Anelpistina* can wrongly be assigned to *Cubacubana*. The use of secondary sexual characteristics in the taxonomy of ametabola insects should be prevented whenever possible.

BIODIVERSITY ESTIMATES ALONG ALTITUDINAL CLINES IN POPOCATEPETL, THE FIFTH HIGHEST MOUNTAIN IN NORTH AMERICA. Jennifer S. Roberts, Joycelyn Cespedes, & Luis Espinasa, Department of Natural Sciences, Shenandoah University, Winchester, VA. 22601. As part of a general ecological study on Popocatepetl, it was decided to do a pilot study of its biodiversity to see if it behaved as predicted by models. There appears to be a correlation between altitude and plant biodiversity along the slopes of the Mexican volcano of Popocatepetl. The higher

the altitude, the lower the biodiversity. Biomass and species richness are not necessarily correlated with altitude. All our results corroborate that in Popocatepetl, the factors that control biodiversity, species richness, and biomass along altitudinal clines, mirror those of latitudinal clines.

THE DISTRIBUTION AND STATUS OF THE SOUTHERN BOG LEMMING IN EASTERN VIRGINIA. Robert K Rose, Dept. of Biological Sciences, Old Dominion Univ., Norfolk, Virginia 23529-0266. The southern bog lemming, *Synaptomys cooperi*, is a small short-tailed, short-eared rodent in the subfamily Microtinae. Since the end of the Wisconsinan glaciation 10,000 years ago, this boreal mammal receded northward, leaving isolated populations stranded in a few locations, including the Dismal Swamp of Virginia. Discovered there in 1895 during the first surveys of the Swamp, it was not seen again until collected by pitfall traps in 1980 in the northern section of the Great Dismal Swamp National Wildlife Refuge. Lemmings live in early successional habitats such as oldfields, under powerlines, and in early seral stages such as young pine plantations. Males and females are similar in length and weight; breeding is year-round and begins at lower body weights than for lemmings from populations from Illinois and Kansas. Litter sizes appear to be smaller than in populations from the Midwest. This lemming is patchily distributed over several thousand km² throughout southeastern Virginia, including 45 locations east and west of the Refuge and six locations in Isle of Wight County. I judge its status to be secure at present. Supported by the Office of Endangered Species, US Fish and Wildlife Service and the Virginia Department of Game and Inland Fisheries.

DESCRIPTION OF NEW SPECIES OF SQUAMIGERA (INSECTA: ZYGENTOMA: NICOLETIIDAE). Bethany B. Burnham & Luis Espinasa, Department of Natural Sciences, Shenandoah University, Winchester, VA. 22601. The genus *Squamigeria* was established in 1999 with a single male individual. Understanding of the genus was therefore limited. Several attempts were made to find more samples of the species but they all failed. In 2001, an expedition was successful in finding new material for the *Squamigeria* species. Also, new materials of related *Squamigeria* species were found while reviewing museum collections. With these materials two new species will be described.

A COMPARISON OF MITOCHONDRIAL DNA MARKERS FOR PHYLOGENETIC ASSESSMENT OF MID-ATLANTIC POPULATIONS IN THE HAIRY-NECKED TIGER BEETLE (*Cicindela hirticollis hirticollis*). Ryan M. Woodcock, James A. Foster, & C. Barry Knisley, Department of Biology, Randolph-Macon College, Ashland VA 23005-5505. Coastal populations of hairy-necked tiger beetle, *Cicindela (Cicindela) hirticollis*, in Maryland are known to be morphologically distinct from Chesapeake Bay populations. It was hypothesized that populations from Assateague Island would exhibit genetic divergence from mainland populations of *C. hirticollis hirticollis* in Virginia and Maryland. Genetic analysis was conducted by sequencing the cytochrome b gene marker on the mitochondrion and the results were used to construct a phylogeny. Two sequences, *C. hirticollis hirticollis* from Indiana, and *C. hirticollis siushawensis* from Wyoming, were used as out-groups. *Cicindela hirticollis* from Smith Point VA and Calvert County MD showed Parsimony of mitochondrial haplotypes indicated that mainland populations form a cohesive and contiguous group. However, *C. hirticollis* from Assateague Island appear as a distinct clade from the mainland *C. hirticollis*. Taxonomic reassessment between these separate gene pools is warranted. This study was funded by a Summer Undergraduate Research Fellowship from Randolph-Macon College.

FEEDING HABITS IN THE NORTHERNMOST CAVE-ADAPTED FISH IN THE WORLD. Gregory N. F. Spangler, Judith C. Wilcox, & Luis Espinasa, Department of Natural Sciences, Shenandoah University, Winchester, VA. 22601. The objective of this study was to establish if there is, apart from the cave fish, a whole unique cave adapted biological community underneath the Nippenose valley. Since the only access to the aquifer is just a single small cave, we could not

properly collect samples directly. As a solution, we studied the stomach contents of the cave fish since they are predatory fish. Specimens of *Gammarus minus* with reduced eyes and a stygobiont isopod were found, leading us to conclude that the underground cave system of the Nippenose valley is host not only to the northernmost cave adapted fish in the world, but to a whole unique cave adapted biological community. Conservation of this underground system should be a priority.

EXPRESSION AND FUNCTIONAL ANALYSIS OF MUTANTS OF THE *ARABIDOPSIS* HEXOSE TRANSPORTER, STP1, IN A HEXOSE-TRANSPORT DEFICIENT YEAST. Douglas Wilson, Matthew Seward & Janet Daniel, Dept. of Biol., James Madison Univ., Harrisonburg, VA 22807. We studied conserved amino acid sequences in the STP1 hexose transporter gene of *Arabidopsis thaliana*. Amino acid sequence comparisons between *Arabidopsis* hexose transporters (STPs) and human glucose transporters (GLUTs) have revealed common amino acid sequences and plant-specific sequences. An arginine (R) residue in transmembrane domain 6 (TM6) is thought to be the proton-binding site for the proton-dependent hexose transporters of plants. In TM7, the amino acid sequence QLS is present in GLUTs that exclusively transport glucose, whereas the non-specific hexose transporters, *At*STPs, have a conserved PFF sequence at the same position. Site directed mutagenesis changed plant sequences to human sequences in TM6 and TM7 in STP1 to produce a mutant STP1 expected to transport hexoses in a manner similar to GLUTs. We describe expression constructs containing wild-type and mutant STP1s and the optimization of a yeast transformation protocol to transfer the expression constructs into a hexose-transport deficient strain of *Saccharomyces cerevisiae* (EBY.VW4000) and results of preliminary growth experiments using the yeast transformants.

THE EFFECTS OF MALATHION ON THE DEVELOPMENT OF ZEBRAFISH (*DANIO RERIO*) EMBRYOS. Elise M. Branch & Rebecca L. Beach, Department of Biology, Hollins University, Roanoke, VA 24020. The popularity of the pesticide malathion is largely due to its relatively low toxicity and short half-life compared to other insecticides. When handled correctly, malathion toxicity is low for birds and mammals, moderate for aquatic life, and high for nontarget insects. Problems arise when it is stored improperly and when applications are repeated frequently with inadequate time intervals to allow for degradation. Although malathion levels occurring in surface and ground waters do not remain constant, they have been monitored at levels far exceeding those cited by the EPA as potentially damaging to nontarget organisms. In this study, zebrafish (*Danio rerio*) embryos were exposed to concentrations of a consumer grade malathion at and above national recommended water quality levels, and effects on embryos were examined and analyzed. Exposure to consumer grade malathion produced significant increases in mortality in 5.0 and 10.0 parts per billion, and significant increases in incidences of deformity in concentrations as low as 0.5 ppb. These results suggest that exposure to low concentrations of consumer grade malathion can be especially detrimental in early stages of development, which emphasizes the need for tougher safety standards for this chemical.

ANTIPREDATOR BEHAVIOR OF GOLDEN SHINERS, *NOTEMIGONUS CRYSOLEUCAS* AND FATHEAD MINNOWS, *PIMEPHALES PROMELAS* IN THE PRESENCE OF LARGEMOUTH BASS, *MICROPTERUS SALMOIDES*. Anne K. Durbin¹, Renée Godard¹ & Bonnie B. Bowers², Hollins University, Dept. of Biology¹ and Psychology², Roanoke Va 24020. Fathead minnows (*Pimephales promelas*) have been used as a model for the study of antipredator responses but have poor survivorship in lakes with introduced predators. Though studied less frequently, golden shiner minnows (*Notemigonous crysoleucas*) survive and even thrive in lakes after the introduction of predators. We examined the behavior of both species of minnows in the presence of largemouth bass (*Micropterus salmoides*). Fathead minnows spent more time swimming before and during exposure to a predator as well as when exposed to bass odor cues. Under direct predation, fathead minnows showed more escape behaviors while golden shiner minnows showed more inspection behavior. Although not statistically significant, bass were more successful in capturing fathead minnows than golden shiner minnows during their first 2 h. together in the tank as well as after 24

hours. These data suggest that antipredator strategies used by fathead minnows may not be as successful as those employed by golden shiner minnows and may contribute to the poor survivorship of fathead minnows in the wild.

IMMUNOHISTOCHEMICAL STUDY OF THE NERVOUS SYSTEM DURING REGENERATION IN *LUMBRICULUS VARIEGATUS*. Meghna Das Thakur & Rebecca L. Beach, Department of Biology, Hollins University, Roanoke, VA 24020. *Lumbriculus variegatus* is a small aquatic oligochaete that reproduces asexually by fragmentation and regeneration. In this study a whole-mount immunostaining procedure was developed as a molecular approach to the study of regeneration in this worm. Using the antibodies 22C10 and BP 104 anti-neuroglian, the structure of the regenerating nervous system following transections was visualized. During regeneration, nerve fibers were observed to grow out from the remaining ventral nerve chord and gradually form networks in the anterior regenerating blastema. Throughout the 8 day period of head regeneration, fibers progressively extended into the prostomium (a sensory organ) at the anterior tip prior to connecting to the presumptive brain rudiment. A neural network first appeared around the blastema at day 4 and rapidly expanded through day 6. Growth at the posterior end was suspended during the period of head regeneration. These results suggest that the nervous system plays an important role in head regeneration of *L. variegatus*.

DURATION OF THE ADRENOCORTICAL RESPONSE TO STRESS IN CAPTIVE HOUSE SPARROWS, *PASSER DOMESTICUS*. Christina E. Wheeler & C. Morgan Wilson. Dept. of Biol., Hollins University, Roanoke, VA 24020. Corticosterone, the primary avian hormone of stress and energy regulation, is secreted rapidly from adrenocortical tissue in response to perturbation. While acute corticosterone secretion has been shown to be adaptive, chronically elevated corticosterone has negative physiological and behavioral consequences. To determine the time necessary to return to baseline corticosterone following acute perturbation, we measured the adrenocortical response of House Sparrows in the field and laboratory. Field-captured birds exhibited low initial corticosterone followed by a rapid increase that reached a maximum within 30-60 min. Laboratory-held birds demonstrated a similar response, but had significantly higher baseline and lower 60 min corticosterone concentrations. Laboratory-held birds sampled again 1-3 h following the end of the original perturbation showed no significant change in either baseline or 60 min levels. These data suggest laboratory conditions elicit chronic elevation in baseline corticosterone and that individuals show hormonal recovery during a perturbation that is not ultimately life-threatening. Experiments measuring the adrenocortical responses of captive and free-living birds should be designed with these data in mind.

TRACKING HETEROCYST AND AKINETE CELL DIFFERENTIATION IN THE CYANOBACTERIUM, *ANABAENA*, USING FLUORESCENT MICROSCOPY. Jeremy Rosen¹, Robert Fisher¹, and Rosita Pitts², ¹Dept. of Biol., Virginia Commonwealth Univ., Richmond, VA 23284 and ²J. Sargeant Reynolds Comm. Coll., Richmond, VA 23285. Filamentous cyanobacteria of the genus *Anabaena* can develop into two cell types: Heterocysts are nitrogen fixing cells that develop in non-random distributions within the colony. Low levels of combined nitrogen trigger their differentiation from vegetative cells. Akinetes can be induced by a lack of sufficient phosphate. Akinetes are cold and desiccation tolerant and act as survival units for the bacterial genome. Developmental progress can be monitored using two simple laboratory tools. Chlorophyll α concentration (as calculated by spectrophotometry) and fluorescent microscopy can be used to track cell differentiation and growth. Using these techniques, we compare the growth patterns of cyanobacteria cultured in media that favors heterocyst or akinete formation. Cultures made up primarily of vegetative cells and heterocysts display a significantly different growth pattern from cultures made up of developing akinetes. Heterocysts lost fluorescence as they developed. Akinete cell fluorescence decreased during development but was never lost completely.

THE IDENTIFICATION OF AN AKINETE MARKER GENE IN THE CYANOBACTERIUM *ANABAENA AZOLLAE* USING PCR AMPLIFICATION. Sharmella Anderson and Jonathan Heekin, VCU–J. Sargeant Reynolds Community College Research Partnership, Dept. of Biol., VCU, Richmond, VA 23284-2012. The purpose of this project was to use PCR to look for an akinete marker gene. We used two types of culture media (SSM and AA/8). The SSM lacked phosphate. The SSM PCR products were compared to those from the AA/8 cultures. The AA/8 medium lacked nitrogen and induced heterocyst differentiation. Weekly, 2 ml of the AA/8 culture were extracted and placed in the 125 ml flasks containing the AA/8 medium to continue the culture growth, and 10 ml of the AA/8 culture were extracted and placed in the 125 ml flasks containing the SSM medium.

Biweekly, the cyanobacteria were extracted using a revised DNA extraction protocol. After obtaining the DNA, it was then amplified using a PCR machine to look for the akinete gene from the DNA. There were several PCR programs used but the one that we found to give the most promising results was the Noak51 program. Electrophoresis was used to actually see the PCR results. We observed the results from the PCR of the AA/8 cultures and compared it with the SSM cultures to see if our findings were positive or negative in finding the akinete marker gene. We were able to find the gene in both media types.

THE EFFECTS OF FIXED NITROGEN COMPOUNDS ON THE GROWTH AND DEVELOPMENT OF THE CYANOBACTERIUM *ANABAENA*. Janice Clanton, Virginia Commonwealth University – J. Sargeant Reynolds Community College Research Partnership, Dept. of Biol., VCU, Richmond, VA 23284-2012. Our objectives were to evaluate the effects of nitrogen compounds on the growth and differentiation of the cyanobacterium *Anabaena azollae*. To do this we studied the effects of sodium nitrate and how it would effect heterocyst development. Cyanobacteria differentiate heterocysts to fix atmospheric nitrogen. Cell differentiation and its effect on a larger system were studied. Cultures were grown in 75ml of AA/8 medium contained in 125ml flasks. Two milliliters of subculture were transferred weekly into new flasks to maintain stocks. All experiments were done in triplicate and repeated three times. The count for heterocysts was taken in both control and sodium nitrate treated cultures. Heterocysts declined in the sodium nitrate treatment. The percentages declined over a 7 day time period. Heterocysts continued to increase over the 7 days in the control . These results showed a direct correlation between medium type and cell differentiation.

THE EFFECTS OF NaCl AND KCl ON THE GROWTH OF THE CYANOBACTERIUM, *ANABAENA*, AS MEASURED BY CHANGES IN CHLOROPHYLL A CONCENTRATIONS. Reana Muhammad, Gail Senatore, & Jason Smith, Virginia Commonwealth University – J. Sargeant Reynolds Community College Research Partnership, Dept. of Biol., VCU, Richmond, VA 23284-2012. The purpose of this study was to examine the growth of the cyanobacterium, *Anabaena*, as it was exposed to NaCl and KCl in a controlled environment. During this study, Chlorophyll *a* (as $\mu\text{g chl } a / \text{ml}$ of culture) served as the dependent variable and concentrations of salts were the independent variables (0mM, 25mM, 50mM, 75mM, 100mM of NaCl, and KCl). All cultures were grown in 75ml of AA/8 medium contained in 125ml flasks. Two milliliters of sub-culture were transferred weekly into a new flask to maintain stocks. All experiments were done in triplicate and repeated three times. Higher concentrations of both the NaCl and KCl showed more inhibition than the lower concentrations. As mM of each salt increased, *Anabaena* growth slowly decreased. The data gathered suggests that *Anabaena* is able to survive in environments where concentrations of NaCl are high, but it will show signs of more severe inhibition in Kcl.

THE EFFECTS OF TUMOR NECROSIS FACTOR α AND INTERLEUKIN 10 ON DENDRITIC CELL (DC) MATURATION. Emily A. Edelman & Rosemary Barra, Dept. of Biol., Mary Washington College, Fredericksburg, VA 22401. DCs play an important role in presenting antigens to T cells and mounting an immune response against an antigen. In order to prime T cells, DCs must first be activated in the lymph system. The purpose of this experiment was to determine the effects

that Tumor necrosis factor alpha (TNF- α) and Interleukin 10 (IL-10) have on DC maturation. TNF- α is effective in inducing DC maturation while IL-10 prolongs the immature stage of the DC life cycle. This experiment used slide photographs and Western Blots as qualitative standards of the effects of TNF- α and IL-10 on DC maturation. Through comparing IL-10 and TNF- α treated cells (10, 15, 20, and 25 ng/ml), both cytokines were shown to influence DC maturation in higher doses (20 and 25 ng/ml). IL-10 inhibits maturation, as seen in the photographs and Western Blot using CD80 as the protein of interest. CD80 is present on mature DCs in higher concentrations and present on immature DCs in lower concentrations. Pictures show that TNF- α enhances maturation but the Western Blots did not show a conclusive increase or decrease in CD80 concentration. The results of this experiment can be used as the foundation for future studies on the effects of TNF- α stimulated DCs on cancer cells.

THE KINETICS OF THE WATER PERMEABILITY PATHWAY OF MAMMALIAN RED CELLS. Karen Sugahara & Stephen Gallik, Ph. D. Dept of Biol. Sci., Mary Washington College, Fredericksburg, VA. 22401. Previous studies have firmly established the relationship between amount of hemolysis and the salt concentrations of hypotonic solutions. The specific objective of this study is to describe the kinetics of the osmotically-induced hemolysis process in normal anuclear mammalian red cells. The time-dependent process of hemolysis of normal sheep red blood cells was tracked across a series of hypotonic phosphate-buffered saline solutions ranging from ionic strengths equivalent to 0.35% - 0.60% NaCl. The percent transmittance of 625nm light (%T₆₂₅), used as a measure of the amount of hemolysis, was recorded continuously over a period of three minutes. Our results show that the time-dependent process of osmotically-induced hemolysis can be described by the equation for a rectangular hyperbola of the form $y = (ax) / (b+x)$. The results show that the initial instantaneous velocity of osmotically-induced hemolysis (the instantaneous velocity at 1 sec.; V_i) falls within a range of approximately 22 %T/sec to approximately 1 %T/sec. The relationship between V_i and the salt concentration is sigmoidal, with the transition region between near-maximum and near-minimum V_i occurring between hypotonic PBS solutions equivalent to the ionic strengths of 0.45% and 0.55% NaCl.

PRELIMINARY SCREENING OF *ACINETOBACTER* SP. BD413 FOR GENES INVOLVED IN THE REGULATION OF NATURAL COMPETENCE. Wendy C. Satterwhite, Jessamine L. Newer & Margaret K. Pope, Dept. of Biol., Randolph-Macon Woman's College, Lynchburg, VA 24503. Natural competence is the physiological state that enables a bacterium to undergo the process of natural transformation. The decision to enter the competent state is highly regulated in most bacteria that are capable of these processes, and usually occurs during stationary phase. In *Acinetobacter* sp. BD413, however, maximal competence has been observed during exponential growth. As this bacterium is a UV-mutagenized derivative of an environmental isolate, we question these findings. Thus we have performed Southern hybridizations against *Acinetobacter* sp. BD413 genomic DNA using as probes two genes, *pilR* and *pilS*, which code for proteins that comprise a two-component regulatory system involved in the regulation of natural competence in *Pseudomonas stutzeri*. Preliminary results suggest that a similar regulatory system may be present in *Acinetobacter*, though it is not known at this time if it is functional. Efforts to clone and characterize these homologous genes from a bacteriophage genomic library of *Acinetobacter* sp. BD413 are currently underway.

PURIFICATION AND CHARACTERIZATION OF A RECOMBINANT HEMIN BINDING PROTEIN FROM *PORPHYROMONAS GINGIVALIS*. Tomeka Liggans, Kevin Jones, Janina Lewis, and Frank Macrina. The Philips Institute, School of Dentistry, Virginia Commonwealth University, Richmond, VA 23298 & Dept. of Biology, J. Sargeant Reynolds Community College, Richmond, VA 23285. *Porphyromonas gingivalis* (*P. gingivalis*) is an anaerobic bacterium, meaning that the bacteria can thrive in the absence of oxygen. It is recognized as an etiological

agent of adult periodontal disease that requires hemin for growth. Periodontal disease affects the majority of adults to some degree, which may be associated with dental infection and loss of teeth. *P. gingivalis* is implicated as an important periodontal pathogen by its high incidence levels in human disease. This project evaluated the binding and utilization of hemoglobin and hemin growth demonstrated in *P. gingivalis*. *P. gingivalis* has been shown to be an organism in the mouths of people with periodontal disease. It produces many protease enzymes that can destroy tissues. I am studying one of the proteins that allow *P. gingivalis* to acquire iron (from hemoglobin), which is necessary for protease production.

HORMONAL AND MICROBIOLOGICAL INVESTIGATION OF THE UNBALANCED SEX RATIO OF WINTERING AMERICAN GOLDFINCHES, *CARDUELIS TRISTIS*. Sally L. Beazlie & C. Morgan Wilson. Dept. of Biol., Hollins University, Roanoke, VA 24020. Late summer breeding, migration, and over-wintering may impact female birds more than males, and this may help explain the unbalanced sex ratio documented in American Goldfinches (1.6♂:1♀ during breeding). Because corticosterone, the major avian hormone of stress and energy regulation, can be immunosuppressive, high bacterial load may occur in birds exhibiting chronically elevated corticosterone. To investigate factors that may contribute to the unbalanced sex ratio of goldfinches, we measured the adrenocortical response and the cloacal bacterial load of goldfinches wintering in southwestern Virginia. Most birds demonstrated a significant increase in corticosterone secretion with handling time, but there were no sex-related differences in energetic condition, the adrenocortical response to stress, or density of cloacal bacterial. When data from the sexes were combined, the magnitude of the adrenocortical response and the proportion of different cloacal bacteria present appeared to change by sampling month. However, because birds were not sampled repeatedly, these data are intriguing but do not provide clear explanation for the unbalanced sex ratio seen in American Goldfinches.

CROSS-SPECIES AMPLIFICATION USING MICROSATELLITE MARKERS IN AMERICAN GOLDFINCHES (*CARDUELIS TRISTIS*) AND YELLOW WARBLERS (*DENDROICA PETECHIA*). Alisha N. Tucker, Rebecca L. Beach & C. Morgan Wilson, Department of Biology, Hollins University, Roanoke, VA 24020. Molecular analysis of genetic variation can provide clarity in cases where species are divided into multiple subspecies and where species designations are not widely agreed upon. The American Goldfinch (*C. tristis*) is currently divided into at least two subspecies, and the Yellow Warbler (*D. petechia*) has been divided into three groups composed of 43 subspecies. Microsatellites have become widely used as genetic markers in studies of natural populations since they often show a high degree of polymorphism. Using polymerase chain reaction, cross-species amplification of two passerine loci, FhU2 and HrU5, were investigated in separate populations of American Goldfinches and Yellow Warblers. Results suggested that individuals were homozygous for both of these loci in each of the two species investigated. While these results do not provide specific answers about the two avian populations studied, the techniques employed here may be further refined in order to better answer questions raised by current subspecies designations in these two species.

Biomedical and General Engineering

A MULTIMODAL INFANT HEARING AID, B. May and D. Richards, Dept of Biomedical Engineering, VCU. This paper outlines the preliminary research and prototype development of a multimodal hearing aid for infants with conductive or sensorineural hearing loss. The unit is unique in that it presents information to the user through both vibrotactile and bone conduction channels, while being self contained in a durable, lightweight head-mounted apparatus. This provides a means of treatment of treatment for infants too young for implantable devices and for cases where it is too early to determine the exact type of hearing loss the individual suffers from. Early treatment

is vital in helping to develop normal communication skills and patterns, and the end goal of this research is to create a device that can provide the hearing assistance these children require.

MOLECULARLY ENGINEERED HYDROGELS FOR IMPLANT BIOCOMPATIBILITY, Sheena Abraham¹, Sean Brahim¹, Anthony Guiseppi-Elie^{1, 2*} ¹Center for Bioelectronics, Biosensors and Biochips (C3B), Virginia Commonwealth University, Richmond, VA 23284-3038, USA ²Departments of Chemical Engineering and Emergency Medicine, Virginia Commonwealth University, Richmond, VA 23284-3038, USA. The biocompatibility of biosmart polymer membranes synthesized from cross-linkable (2-hydroxyethyl methacrylate) (HEMA) and tetraethylene glycol diacrylate and containing different mole-percent polyethylene glycol methacrylate (PEGMA) and methacryloyloxyethyl phosphoryl choline (MPC), a phosphoryl choline-containing co-monomer, was investigated. Cytotoxic effects of the polymer gels (cell viability and proliferation) was investigated by cultivating human skeletal muscle fibroblasts onto the gels. The compositions containing MPC and PEGMA concentrations greater than 1.0 and 0.05 mole% respectively demonstrated good protein adhesion and cell viability (>90%) of human muscle fibroblast cells. It is well known that the adsorption of proteins onto biomaterial surfaces modulates the cellular interaction with these surfaces. The extent of adsorption of fluorescein labeled proteins (laminin, collagen, and fibronectin) onto these polymer membrane surfaces was evaluated by measuring the resultant fluorescence intensity using a confocal fluorescence scanner.

DESIGN, FABRICATION AND PERFORMANCE EVALUATION OF AN IMPEDIMETRIC UREASE BIOSENSOR FOR UREA, Vandana Gupta & Anthony Guiseppi-Elie, Dept. of Chemical Engineering and Center for Bioelectronics, Biosensors and Biochips (C3B), Virginia Commonwealth University, Richmond VA 23284. A biosensor system for urea, based on the principle of impedimetry and consisting of a 1 kHz, 100mVpp interrogator and a microfabricated 3-element array biochip, is being developed. The biorecognition layer is formed in two formats: PEGylated urease that is physically entrapped within a spun-applied poly(hydroxyethylmethacrylate) hydrogel and urease entrapped in bovine serum albumin and glutaraldehyde. The transducer, a microlithographically fabricated interdigitated microsensor electrode (IME) array, comprises of an analytically sensitive element, a reference element, and a control element of gold on borosilicate glass. The enzymatic hydrolysis of urea produces ammonium and bicarbonate ions that decrease the impedance of the hydrogel layer proximal to the electrodes of the IME. The hydrogel is affixed to the IME transducer via organosilane chemistry performed on the borosilicate glass within the interdigit space of the IME. The response of the biotransducer was investigated in urea solutions prepared in 10mM Tris buffer, with concentrations ranging from 10 μ M to 5 mM.

IMPEDIMETRIC ELECTRONIC NOSE (E-NOSE), Jerome D. Edmonson, Arvind K. Srivastava, Anthony Guiseppi-Elie, Center for Bioelectronics, Biosensors and Biochips, Virginia Commonwealth University, Richmond VA 23284. This project deals with the development of an electronic model of biological olfactory system, so called 'Electronic nose (E-NOSE)'. An E-NOSE is an instrument that consists of an array of chemical sensors, signal processing and pattern classification. Aim of this work is to design an advanced and sophisticated E-NOSE system based on impedimetric response of an array of chemical sensors for the real time monitoring of volatile organic compounds (VOC). For the measurement of impedimetric response of chemical sensor upon gas exposure a pair of demodulating logarithmic amplifier is used to calculate change in phase and amplitude as chemical fingerprints. A software written in LABVIEW allows the user to the operate each of the sensors in the array at different frequency and temperature for enhanced sensitivity and selectivity. To study the behavior of sensors in actual field testing, a simulated experiment can be performed by generating the artificial environment by mixing as many as eight different VOCs at various concentrations and flow rates. Impedimetric E-NOSE system developed at C3B promises applications in many areas such as in medical diagnostics (breath analysis), environmental monitoring (detection of chemical and biological warfare agents) and space science (monitoring of air quality in international space station).

DEVELOPMENT OF A COMBINATION CELL DELIVERY/BIOSENSOR CATHETER FOR THE MONITORING OF DOPAMINE FROM DIFFERENTIATED NEURONAL CELLS, Shirley Gay¹, George Gillies² and Helen Fillmore³, ¹Dept of Biomedical Engineering, Virginia Commonwealth University, ²Engineering Mech/Aero Engineering Dept, UVa, ³Division of Neurosurgery, VCU. There is a significant loss of dopamine producing cells in Parkinson's Disease. Current therapies to replace these cells with new dopamine producing cells have encountered several obstacles and recent research show that many of implanted cells undergo apoptosis. Our general hypothesis is that the method and technique of cell delivery will affect cell viability. The goal of this project is to design a cell delivery catheter that includes a biosensor to measure catecholamine levels in the microenvironment. An in vitro 'brain like' gel is used as the experimental system into which differentiated NT2, known to be dopamine producing cells are infused. The cell delivery catheter and a MicroC electrode will be inserted into the "brain gel". Electrode readings will be conducted everyday and changes in dopamine levels are recorded. Following 'proof of principle' experiments, we will prepare for trials in an in vivo rodent model.

CONTACT AND BULK RESISTANCE OF POLYPYRROLE-BASED CHEMICAL SENSORS, Shruti A. Manek, Arvind Srivastava and Anthony Guiseppi-Elie, Dept of Chemical Engineering and Center for Bioelectronics, Biosensors and Biochips (C3B), Virginia Commonwealth University, Richmond, VA. The purpose of this work was to investigate the difference in contact and bulk resistances of Polypyrrole on 4 sets of Independently Addressable Microelectrodes (IAME's) modified in different ways to determine the method of modification resulting in the least resistance. The glass substrate of all 4 of the IAME's was salinized with N-(3-trimethoxysilylpropyl) pyrrole for adhesion of the polypyrrole on to the device. The gold surfaces of 2 of the sets of IAME's were modified with 2 different kinds of thiol groups: 2-aminoethanethiol and Amino-1-undecanethiol, Hydrochloride. The platinum and the remaining gold IAME were left unmodified. Polypyrrole was then electrodeposited on the electrodes to form the resistive Polypyrrole-based chemical sensors. 4-point probing (for bulk resistance) and 2-point probing (for contact resistance) were performed on these sensors. In both cases, the unmodified gold electrodes resulted in the least resistance. These sensors were then exposed to Butanol and MIAK and their responses were observed. Once again, the unmodified gold electrode demonstrated the least resistance and most sensitivity; however this sensor took the longest to refresh itself in the presence of nitrogen.

CARTILAGE BENEATH A PROTECTIVE LAYER: IMPLICATIONS FOR TISSUE ENGINEERING, John R. Owen¹, & Jennifer S. Wayne^{1,2} ¹Department of Orthopaedic Surgery, and ²Department of Biomedical Engineering, Virginia Commonwealth University, Richmond, VA 23298. Tissue engineered constructs with normal zonal characteristics and material properties of articular cartilage throughout its thickness have yet to be produced for repair of defects on articular surfaces. Such transplanted scaffolds in vivo may be doomed mechanically from the outset without material properties of sufficient quality. The importance of the superficial tangential zone (STZ) in supporting axial loads and retaining fluids has been shown. This study models the STZ with a preferred direction parallel to the articulating surface, thereby simulating a "split-line" direction. Normal and repairing defects are modeled with the importance of the STZ emphasized. Compared to normal cartilage, repaired defects without a normal STZ experienced a 228% increase in axial deformation and a 194% increase in the rate of fluid loss, whereas inclusion of a normal STZ over the repair area resulted in only a 57% increase in both parameters. These findings support the hypothesis that transplanted material with a quality STZ may be critical in providing a suitable mechanical environment needed in the repairing region to achieve the long-term survival of repairing cartilage.

PROXIMAL HUMERAL FRACTURES: COMPARISON OF FIXATION METHODS, J.M. Iaquinto¹, J.S. Wayne^{1,2} & N.D. Boardman² ¹Department of Biomedical Engineering and ²Department of Orthopaedic Surgery, Virginia Commonwealth University, Richmond VA 23298. Proximal humeral fractures account for 4-5% of all fractures and are treated in a variety of ways

including sutures, k-wires, percutaneous pinning, fixation plates, and intramedullary rods. The goals of this study were to examine the mechanical environment within two fractured humerus/fixation plate constructs under load and to compare the stress/strain results between the two fixation plates and to clinical failure modes. Three-dimensional solid models of the constructs were created with SolidWorks 2004 and finite element analysis performed in COSMOS 2004. Two common fixation plates were evaluated - the Blade Plate and the Locking Compression Plate (LCP). The Blade Plate, which clinically tends to loosen or cut out of the humeral head, showed above failure stress around the blade and screws. This indicates that after some degree of loosening the blade is in danger of cutting out. The LCP, which has been known to break as well as loosen, was supported in these failure modes by stress generated in the plate at the humeral fracture site as well as around the screws. The theoretical support via these finite element analyses for clinical findings provide a methodology which to base design improvement.

DETECTION, IDENTIFICATION AND CLASSIFICATION OF SUCK, SWALLOW AND BREATHING ACTIVITY IN PREMATURE INFANTS DURING BOTTLE-FEEDING, Fedra Adnani, P.A. Wetzel and R.H. Pickler, ¹Dept. of Biomedical Engineering, ²School of Nursing, Virginia Commonwealth University. Prematurity, especially if extreme, is one of the leading causes of problems and/or death after delivery. The various systems and organs of the premature infant's body are not yet fully developed, as a result the premature infant will often require specialized care in a nursery. Among all the problems encountered by premature infants, feeding difficulties are very common. Many premature infants are fed intravenously at first, and they progress to milk feedings provided by a tube passed into the stomach. At around 34 weeks of gestation, premature infants should be able to breastfeed or take a bottle. At the same time such premature infants are usually faced with difficulty making the transition from tube-feeding to full oral feeding. The goal of this study is to develop a set of algorithms to detect, identify and classify five physiological measures; heart rate, respiratory rate, oxygen saturation, sucking and swallowing activities. The results of this study will be used to predict the readiness of a premature infant for introduction to oral feeding. In this study, several signal processing approaches (neural networks, wavelet analysis, expert systems and genetic algorithms) are used as complementary elements of a general data processing system, taking advantage of the synergy between them such that quality of one method compensates for the disadvantages of another.

DEEP BRAIN STIMULATION IN PATIENTS WITH PARKINSON'S DISEASE, H.J.Green^{1,4}; M.S.Baron^{2,4}; P.A.Wetzel^{1,4}; K.Holloway^{3,4}.¹Department of Biomedical Engineering, VCU; ²Adult Neurology, VCU Medical Center; ³Neurosurgery, VCU Medical Center; ⁴ Parkinson's Disease Research, Education, and Clinical Center (PADRECC), McGuire VA Medical Center. With the incidence of Parkinson's disease increasing, a more extensive range of treatment options are available, including medication and surgical treatment. Medication therapy may produce debilitating side effects or wear off as time progresses. One surgical therapy is Deep Brain Stimulation (DBS) where stimulators are placed in the Sub-Thalamic nucleus (STN) or the internal segment of the Globus Pallidus (GPi). After surgery programming of the stimulators takes months. There are several parameters which can independently be adjusted. Training personnel to fine tune these settings is imperative to patient training. An examination of the programmer that is currently in use shows some strengths and some areas for improvement.

EFFECT OF PARKINSON'S DISEASE AND TREATMENT ON HEAD AND EYE MOVEMENTS IN PATIENTS, Myo Thwin Myint¹, P. A. Wetzel¹ & V. P. Calabrese², ¹Department of Biomedical Engineering and ²Division of Adult Neurology, Virginia Commonwealth University, Richmond, VA. Parkinson's disease (PD) is a progressive neurological movement disorder caused by loss of dopamine in the brain resulting in tremor, rigidity of movements, and reduced motor control. The disease also appears to influence the control of eye and head movements, which can impact quality of life. To investigate the progressive effects of PD, head and eye movements were recorded at 120 times per second following the clinical examinations. A total of 15 patients and 9

aged matched controls participated in this study. The participants were asked to perform tasks in eye fixation, smooth pursuit with eye, and head and eye movement compensation. The analyzed data were also correlated against Unified Parkinson's Disease Rating Scale Motor Section score. The early analysis showed that eye tremor appeared to precede head tremor and episodes of tremor were observed in both horizontal and vertical eye movements. The head and eye movements of PD patients appeared less stable than the control group. This study was funded in part by Emerging Technologies Research Grant by Virginia Commonwealth University.

ON THE USE OF THE LEAST MEAN SQUARE (LMS) ALGORITHM FOR SPEECH PROCESSING APPLICATIONS, Mary Evans & Gihan Mandour, Department of Physics, Computer Science and Engineering, Christopher Newport University, Newport News, VA 23606. Speech is the most natural and efficient manner of communication today. However, there are problems when speech is being transferred from one person to another person. The problems can be static existing in a cellular phone or background noise in a crowded room, recognizing single- or multi speakers, or speakers with different accents of speech problems. The goal of any speech recognition technology is to be robust to environmental noise, intelligent, and a fluently conversant machine. The objective of this research is to use the Least Mean Square (LMS) algorithm adaptive filtering technique to reduce noise in speech signals. This research will investigate the effect of single tone noise (sinusoidal noise signal) and random noise on speech signal enhancement. The LMS algorithm is widely used because of its simplicity, ease of computation and its ability not to use any off-line gradient estimations or repetitions of data. Results show the effect of noise frequency and amplitude on the output speech signal for the sinusoidal noise case and the effect of random noise on the output speech signal frequency spectrum.

ON THE USE OF QUASI-OPTIMAL BOUNDING ELLIPSOID (QOBE) ALGORITHM IN CLASSIFICATION PROBLEMS, Timothy Kraus and Gihan Mandour, Department of Physics, Computer Science and Engineering, Christopher Newport University, Newport News, VA 23606. Many digital signal processing (DSP) applications require parametric signal models. Linear-in-parameters systems form a broad class of models that has been extensively investigated. The quasi-optimal bounding ellipsoid (QOBE) algorithm is a member of the set membership (SM) algorithms that are used to identify linear-in-parameters system models. QOBE algorithms are distinguishable by their ability to selectively use the incoming data to minimize an ellipsoid that bounds the solution set. They have emerged as potential candidates in many digital signal processing applications for their efficiency in estimating the parameter set of an unknown system. In general, no knowledge of the statistics of either the model or the observations is assumed. However, the uncertainty is constrained with some bounded energy or bounded magnitude. In this work we investigate the use of QOBE in classification of speech vowels based on the formant resonance frequencies that characterizes them. The database consists of vowels sounds spoken by different speakers and by using an autoregressive (AR) model we classify frames of speech data into one of the vowel sounds.

CHANGES IN DOMINANT FREQUENCY DOMAINS PRIOR TO SPONTANEOUS TERMINATION OF VENTRICULAR FIBRILLATION, S.E. Joel and P.W. Hsia, Department of Biomedical Engineering, Virginia Commonwealth University. Unlike in larger and older animals ventricular fibrillation (VF) in smaller, younger animals spontaneously terminates. Study of spontaneous termination of VF (STVF) might throw light on maintenance of VF, which is under much debate. Zero-padded fast Fourier transform was used to extract high precision dominant frequency (HPDF) maps from optical maps of STVF in isolated rabbit hearts (100x100 pixels per frame, 256 frames/s, n=5). 187 non-overlap 1-second VF segments and 25 HPDF videos were analyzed in terms of spatial and temporal distributions of the dominant frequency (DF) domains on several epicardial regions. LV apex (LVA) had the highest DF values (8.18 ± 0.93 Hz, $p < 0.001$) compared to other regions. The high DF domain in the LVA vanished prior to spontaneous termination of VF ($p < 0.001$). LVA mean DF dropped significantly ($p < 0.001$) prior to termination while other regions of the heart showed small or no significant change in DF. ZPFFT based HPDF

maps analysis in this model showed the disappearance of the highest frequency DF domain as the primary mechanism of STVF. The vanishing highest DF domain prior to STVF is consistent with the mother rotor hypothesis.

RAPID AND ACCURATE ASSESSMENT OF AORTIC STIFFNESS, Xianzhi Shao¹, Dingyu Fei¹ and Kenneth A. Kraft², ¹Dept of Biomedical Engineering and ²Dept. of Radiology, Virginia Commonwealth Univ., Richmond VA 23298. Aortic stiffening has substantial clinical significance and has recently been assessed non-invasively via pulse wave velocity (PWV) using MR. To improve accuracy and efficiency, a novel MR method with high temporal resolution (2 ms) and shorter total measurement time (140 ms) is presented. This is accomplished by applying a single RF comb excitation to the descending thoracic aorta to tag multiple sites, followed by an oscillating frequency encoding gradient to track fluid motion. A PC-based software package facilitates data analysis by constructing position-versus-time flow images, which show curvilinear flow trajectories corresponding to fluid motion at each of the tagged positions. The PWV can be reliably calculated by curve-fitting these trajectories to a model. Validation experiments in compliant latex tubes were carried out to verify accuracy of derived PWV. Compared to another MR method previously developed in our laboratory, *in vivo* experiments show the new method to have improved temporal resolution and enhanced ability to extract PWV from subjects exhibiting low peak flow velocity such as the elderly or those with impaired cardiac function.

Botany

ISOLATION AND INITIAL CHARACTERIZATION OF HEXOSE TRANSPORTER T-DNA INSERTION MUTANTS OF *ARABIDOPSIS THALIANA*. Angela Whetzel & Janet Daniel, Dept. of Biol., James Madison Univ., Harrisonburg, VA 22807. The purpose of our study is to isolate homozygous knockout mutants in *Arabidopsis thaliana*, for two highly related sugar transport proteins, STP1 and STP12. DNA was harvested from two T-DNA insertion mutants for STP1 and STP12 and genotyped by PCR. Of the plants that produced seeds, four were heterozygous for the STP1 gene deletion and five were heterozygous for the STP12 gene deletion. Seeds from the heterozygote plants were collected and planted. In contrast to what is published, we have observed qualitative differences in the germination and survival rates between the STP1 knockout and wild-type plants. In order to better characterize the differences between genotypes, stem height, leaf length and shoot height and genotype were assessed on the seedlings from the heterozygote plants. Two homozygous knockout STP1 plants have been identified through PCR. Results will be presented describing the phenotypic characteristics of each genotype. We are continuing to screen and identify homozygous knockouts for STP1 and STP12. Our preliminary observations suggest that STP1 may play an as of yet undetermined role in germination and early plant growth.

THE GENETIC EXPRESSION OF THE CHLOROPLAST MATURASE GENE, *matK*. Michelle M. Barthelet & Khidir W. Hilu, Dept of Biol., Va Polytechnic Inst. & State Univ., Blacksburg VA 24061. The *matK* gene is localized within the group II intron of *trnK* in the chloroplast genome of most land plants. *matK* is approximately 1500 bp in length and has high sequence variability, except for a strongly conserved region (domain X) at its 3' end. Information from *matK* has produced more robust phylogenies than any other single gene and is only comparable to 5-11 genes combined. This has rendered *matK* as the preferred gene in plant phylogenetics. However, high variability has suggested to some that *matK* is a pseudogene, a gene lacking transcription or translation into a functional protein. Pseudogenes accumulate mutations at a different tempo from functional genes, and thus are less reliable in phylogenetics. We demonstrated that *matK* transcription occurs across plant lineages, rejecting the hypothesis that *matK* is a pseudogene by lack of transcription. We have also elucidated the size of this transcript and its pattern of transcription throughout development. This work supports *matK* as a functional gene and a reliable tool for plant systematics. (Supported by: The Virginia Academy of Science, Sigma Xi Grant-in-Aid of Research, and the Graduate Research Development Project [GRDP], Va Polytechnic Inst. & State Univ.).

AFRICAN VIOLET (*SAINTPAULIA RUPICOLA*) SHOOT PRIMORDIA ENCAPSULATION. Clara Jo Elder, Dept. of Biol., James Madison Univ., Harrisonburg VA 22807. The production of synthetic seeds by means of encapsulating shoot primordia is a promising method for mass propagation of plant species. Leaf explants of African violet (*Saintpaulia rupicola*) were cultured on a caulogenesis medium, and the shoots produced were excised and used in the production of synthetic seeds. Shoots were encapsulated in either 2% sodium alginate or 2% sodium alginate to which half-strength Murashige and Skoog macronutrients, micronutrients, and vitamins had been added. Encapsulated shoots were then planted immediately or stored for seven days before being planted. The shoots were planted on one of three different media, which were medium-grade vermiculite, Promix BX, and sterile Bacto agar-gelled basal media. The results of the study indicate that including nutrients in the encapsulation matrix and planting shoots immediately after encapsulation are beneficial for shoot growth. The agar medium resulted in better emergence, survival, and rooting than the vermiculite medium, however vermiculite produced more usable plants than agar. These results suggest that the best conditions for making synseeds that will produce usable and healthy plants are to encapsulate in alginate containing nutrients and plant onto vermiculite immediately after encapsulation.

ANTIOXIDANT CONTENT IN FRESH AND PROCESSED TOMATO FRUITS. Michael H. Renfro & Jessica R. Montgomery, Dept. Biol., James Madison Univ., Harrisonburg VA 22807. Dietary antioxidants are important for disease prevention in humans. We investigated the antioxidant content of tomatoes, both fresh and processed, to determine if variations in antioxidant content were present. Antioxidants were measured using a hydrophilic antioxidant assay based on enzymatically generated ABTS (2,2'-azino-bis-(3-ethylbenzthiazonline-6-sulfonic acid)) radicals and their decoloration in the presence of antioxidants. Buffered extracts were prepared from fresh, frozen and processed tomatoes. Liquid drained from thawed tomatoes and from canned tomatoes was also analyzed for antioxidant content. Finally, tomato paste was extracted and analyzed for antioxidant content. Significant differences in antioxidant content were found between tomato cultivars and among the various processed states. Tomato paste contained the greatest concentration of antioxidants. Grape tomatoes had a significantly greater concentration of antioxidants than canned whole tomatoes, which were no different than fresh or frozen Roma tomatoes. Freezing and thawing did not significantly change the antioxidant concentration in the tissue. These results should help our understanding of the dietary and health implications of various food preparation techniques.

PRELIMINARY PHYLOGENETIC ANALYSIS OF *BERLANDIERA* (ASTERACEAE) BASED ON ITS AND ETS SEQUENCE DATA. Jennifer A. Clevinger, Curtis C. Clevinger & Michael J. Surace, Department of Biology, James Madison University, Harrisonburg, VA 22807. *Berlandiera*, commonly known as green-eyes, belongs to the sunflower family (Asteraceae) and is found throughout the southern United States and northern Mexico. Of particular interest is *Berlandiera pumila* which is a disjunct found in the southeastern and the southwestern United States. The southeastern populations overlap with *Berlandiera subcaulis* which is purported to hybridize with *Berlandiera pumila*. Phylogenetic relationships were examined using DNA sequence data from the internal transcribed spacer (ITS) region and the external transcribed spacer (ETS) region. Preliminary phylogenetic analysis suggests that the disjunct populations of *Berlandiera pumila* form a monophyletic group together with *Berlandiera subcaulis*. Analysis also indicates that the southwestern *Berlandiera lyrata* is basal to the other members of the genus. A chloroplast marker will be added to this data set in the future to further resolve the relationships.

THE *FLORA OF VIRGINIA* PROJECT: A 2003-2004 UPDATE. Marion B. Lobstein, Dept. of Biology, Northern Virginia C.C., Manassas, VA 22205. Virginia, for its landmass, has the most diversity of species of vascular plant of any state in the United States. It had the first flora, the *Flora Virginica* in 1739 yet does not have a modern flora. The Virginia Academy of Science for over fifty years has supported efforts to produce a modern *Flora of Virginia*. In 2001 the Foundation of the Flora of Virginia, Inc. (FFVP) was formed in 2001 and in May 2002 received 501(c)(3) status.

Additional members of FFVP Board of Directors have been added to broaden the base of support for this Project. Alan Weakley, who will be the first author of the *Flora* is under contract and work on the first dichotomous keys modified for Virginia species is moving forward. Progress continues to be made on the efforts to develop a Flora of Virginia including fund-raising and public outreach efforts. Work on the content of the Flora of Virginia including the first 300 illustrations have been commissioned, completed, and funded by VAS funds. Preliminary work on species descriptions has begun with involvement of the Flora Advisory Board and other interested individuals. Efforts of the FFVP to develop a modern *Flora of Virginia* by 2010 have taken root and continue to make substantial progress.

A PRELIMINARY TREATMENT OF THE GREENBRIARS (SMILAX: SMILACEAE) IN VIRGINIA. Robert A. S. Wright, Wetland Studies and Solutions, Inc., 14088 Sullyfield Circle, Chantilly, VA 20151. As a contribution to the Flora of Virginia Project, a preliminary treatment has been initiated and is planned to be completed by winter 2004. Traditionally, *Smilax* has been segregated into two subgenera (sections), correlative to anatomical and morphological differences (herbaceous versus woody tissue). In addition to personal field and herbarium investigations in *Smilax* since 1988, using 21 collective references (manuals, floras, graduate studies, and specialty documents), the treatment presented recognizes four, possibly five taxa in the herbaceous Section *Coprosmanthus* (*Nemexia*), and seven taxa in the woody Section *China* (*Smilax/Eusmilax*). Some taxonomic and distributional problems exist, primarily due to recent clarification/interpretations in both Sections. Other problems are related to the uncertain historical and present status of one rare entity (Sereno Watson's *S. ecirhata*), three taxa which are not conclusively verified, but are reported/mapped in the literature for VA (*S. biltmoreana*, *S. lasioneura*, *S. hugeri*), and one taxa (*S. smallii*), that may be extirpated. Additional problems, related to future field, herbarium, and distribution mapping work, are presented for future planning, discussion, and ultimate resolution.

CHARLIE DEAM, PIONEER HOOSIER BOTANIST. R. Dean Decker, Dept. of Biol. (retired), Univ. Richmond. Charles Clemon Deam (1864-1953) was born in Wells County, Indiana where he spent his entire life. At age 28, C. Deam became part owner of a drug store in Bluffton. To relieve stress, Charlie and his wife, Stella, began collecting plants, eventually amassing a personal herbarium of more than 73,300 specimens which are now housed at Indiana University. He modified a car into a truck to facilitate his collecting needs. His botanical work led him to become the first "state forester". In this position he began the establishment of state parks and forest preserves on farms. His work also moved him into the academic world of botanist of Indiana, Michigan, and Harvard among others. He was a prominent member of the Indiana Academy of Science. He wrote the Trees of Indiana, Shrubs of Indiana, and Grasses of Indiana but his greatest achievement was the Flora of Indiana (1940) completed when he was in his 70's. At the time of publication, Flora of Indiana was the most extensive state flora to date and it found use throughout the Midwest for many years. It became a model for other state floras. Late in life he received two honorary doctorates, one from Depauw University where he spent two years, and the other from Indiana University. Despite his many accomplishments, Charlie Deam considered himself as "Plain Old Charlie Deam."

SECONDARY XYLEM OF *DALECHAMPIA* (EUPHORBIACEAE). T. Kostadinov, S. M. Hayden, & W. J. Hayden, Dept. of Biol., Univ. Richmond, Richmond, VA 23173. The genus *Dalechampia* consists of ca 100 species of slender-stemmed lianas or decumbent to erect subshrubs with distinctive bibracteate pseudanthial inflorescences. The genus is poorly represented in xylaria and its wood is little known. We studied greenhouse-grown stem samples of seven species. Although primary bundles are bicollateral, secondary xylem is continuous and lacks anomalous structure except for furrowed xylem and interxylary phloem in *D. volubilis*. Lianous species produce a ring of fiber-dominated tissue in earliest stages of secondary growth. Vessel pattern is mostly solitary or clustered and fibriform vessels are frequent within vessel clusters. Perforations are simple. Intervessel and vessel-ray pits are circular to elliptical and alternate. Tyloses are

present, sometimes with druses or prismatic crystals. Moderately thick-walled, non-septate libriform wood fibers constitute the groundmass. Axial parenchyma includes paratracheal and banded patterns. Rays are mostly uniseriate but some 2- or 3-seriate rays are present in most species and larger rays, up to ten cells wide, occur intermixed with narrow rays in *D. stipulacea*. Rays are dominated by square and upright cells. No laticifers were observed in any tissue of any species studied. Earlier reports of laticifers in *Dalechampia* derive from a single mis-identified xylarium specimen.

GENOMIC RELATIONS IN *ARACHIS* SECTION *ARACHIS* (FABACEAE). Sheena A. Friend¹, Khidir W. Hilu¹, Dietmar Quandt¹, Shyamalyrau P. Tallury² & Harold T. Stalker,² ¹Department of Biology, Virginia Tech, Blacksburg, VA, 24060, and ²North Carolina State University, Raleigh, NC 27695. Section *Arachis* contains the largest number of wild species in *Arachis* as well as the economically important peanut crop. The species in section *Arachis* have been assigned genomes based on cytogenetic studies. However, the genomic relationships of the three genomes in section *Arachis*, A, B and D, are not fully understood. Ten recently identified species were also tested to identify their genomic identity by creating hybrids with tester species for the A and B genomes. From chromosomal association *A. herzogii*, *A. kempff-mercadoi* and *A. kuhlmanni* are A genome species and *A. cruziana* and *A. hoeheni* are B genome species. From the *trnT-F* sequence information, a phylogenetic tree showed the A genome was more distantly related to the B and D genomes. In the AFLP analysis, the genotypes of *A. hypogaea* formed a tight cluster, indicating the low genetic diversity in the peanut crop. (Sources of funding: Virginia Academy of Science, American Peanut Research and Education Society, and Virginia Agricultural Experiment Station, Hatch Project)

A REAPPRAISAL OF THE NEUSTON COMMUNITY IN FRESHWATER AND MARINE HABITATS. Harold G. Marshall¹ & Lubomira Burchardt², ¹Dept. Biological Sciences, Old Dominion University, Norfolk, VA, 23529-0266, and ²Dept. Hydrobiology, Adam Mickiewicz University, Poznan, Poland. The neuston includes organisms associated with the surface layer of aquatic habitats, and is divided into the epineuston and hyponeuston categories that include algal and faunal taxa. Controversy has developed regarding the hyponeuston composition and its depth in the water column. Pre-determined depths *a priori* according to collection devices used are questionable and not applicable to composition changes that occur diurnally and seasonally at a site. The authors support the neuston definition, and that the epineuston refers to those organisms living upon the surface film, including transient species that can move across its surface, but we define the hyponeuston as organisms living directly below the surface film, to a depth where a statistically significant different representation (composition and abundance) of biota would occur with increasing depth. This community may contain transient species coming from the plankton or benthos (e.g. phytoplankton, zooplankton, etc.). Results from a series of vertical measurements of these populations would indicate the range and variable location and separation of hyponeuston components from the plankton biota.

EVOLUTION OF CHLOROPLAST *matK* PSEUDOGENES IN THE SUBTRIBE AERIDINAE (ORCHIDACEAE). Bridget A. Robinson & David C. Jarrell, Dept. of Biol. Sci., Mary Washington College, Fredericksburg, VA 22401. The chloroplast *matK* gene putatively encodes a RNA maturase which functions to remove specific group II introns prior to translation. Aeridinae pseudogenes were previously identified in a monophyletic group of four genera. Non-triplet deletions apparently eliminate production of a functional MATK protein. Increased sampling has identified new pseudogene-containing taxa. Preliminary phylogenetic analysis suggested a polyphyletic origin of the pseudogenes. Future scoring of deletions as binary characters may establish pseudogene monophyly. Several pseudogene origin hypotheses will be discussed. We have begun by testing for the loss of MATK-dependent introns using PCR. Intron loss would result in a significantly shorter PCR product. To date, the two tested introns are present in all taxa. Continued testing will determine the status of the remaining introns. Forthcoming results from researchers at

Virginia Tech studying the expression of *matK* in a wide range of plants including several taxa with *matK* pseudogenes may enable assessment of other hypotheses. This work was supported by undergraduate research grants from the Virginia Academy of Sciences and Mary Washington College and the MWC Summer Science Program.

PHYLOGENY OF *PHALAENOPSIS* (ORCHIDACEAE) USING MULTIPLE CHLOROPLAST GENES. Brian M. Janelsins & David C. Jarrell, Dept. of Biol. Sci., Mary Washington College, Fredericksburg, VA 22401. The approximately 63 species of *Phalaenopsis* are found from southeast Asia to northern Australia. *Phalaenopsis* classification based largely upon floral characteristics divides the genus into five subgenera. However, floral characters are subject to pollinator selection and, consequently, parallel evolution. Thus, the current classification scheme may not reflect underlying evolutionary patterns. This study hopes to clarify relationships with DNA sequences, a source of information less likely to suffer from pollinator selection. The chloroplast DNA sequences of the *matK* gene, *accD-psal* spacer, and *rps16* intron were obtained from 31, 17, and 19 *Phalaenopsis* species, respectively, and analyzed using parsimony. Phylogenetic analysis shows little support for the current subgenera but numerous sections appear to be monophyletic. Further species sampling, increasing the length of sequence for each region, and a combined analysis may improve resolution and provide a framework for altering the classification scheme to better reflect evolution. This work was supported by undergraduate research grants from the Virginia Academy of Sciences and Mary Washington College and the MWC Summer Science Program.

COMPARISON OF SCANNING ELECTRON MICROSCOPIC PREPARATIONS USED IN THE EXAMINATION OF PFIESTERIA-LIKE DINOFLAGELLATES. Slawomir Cerbin & Harold G. Marshall, Department of Biological Sciences, Old Dominion University, Norfolk Virginia 23529-0266. Early identification of the presence of *Pfiesteria*-like organisms (PLO) would be beneficial to management awareness and early response to their presence. The identification based on morphology can only be confirmed by using scanning electron microscopy (SEM) protocol. The most common SEM method is the suture swelling technique. However, this method in many cases does not give satisfactory results, especially when used for other than *Pfiesteria* sp. organisms. The other commonly used technique is the ethanol-p-formaldehyde procedure, which strips outer membrane of dinoflagellates. This study compares the results of those two methods with different PLO's and also presents results when specific steps within each are combined. The swelling technique was most successful for Bigelow strains 1833 and 1838 while the combined method was best for Bigelow 1882 and ODU 01VDH034. Using the stripping method was not successful in all cases. Within the PLO group different protocols should be used as the results vary among different strains. This is one of several studies on this topic supported by the Virginia Department of Health and the CDC.

EFFECTS OF BREACHING THE EMBREY DAM IN FREDERICKSBURG, VIRGINIA ON EPIPELIC AND EPILITHIC PERIPHYTON COMMUNITIES IN THE RAPPAHANNOCK RIVER. Tracy E. Hamm, Allison M. Lockwood, & Stephen W. Fuller, Dept. of Biol., Mary Washington College, Fredericksburg VA 22401. The Embrey Dam in Fredericksburg, Virginia was breached in February 2004, causing the lake that had formed behind it to drain. We examined sites both above and below the dam before the breaching then added a third site where the lake had drained after the breaching. Our main objective was to observe any succession that might occur on the newly exposed substrata previously submerged under the lake. Once a month at each site, samples of both epipelic and epilithic periphyton communities were suspended in water and examined using Sedgewick-Rafter slides. Periphyton were observed and their biovolume per area (mm^3/cm^2) calculated. In the case of both epipelic and epilithic communities, the biovolume of periphyton observed at the site formerly under the lake was similar to the biovolumes of the above- and below-dam sites. This indicates that if that site was indeed bare before breaching the dam lowered the water levels, then the two weeks between that and our sampling date was sufficient time for a periphyton community to become established.

INTROGRESSIVE HYBRIDIZATION BETWEEN *RHODODENDRON ATLANTICUM* AND *R. PERICLYMENOIDES*: II. VEGETATIVE CHARACTERS. Monica Harris Nicholson & Bruce L. King. Department of Biology, Randolph-Macon College, Ashland, VA 23005. Natural hybridization between *Rhododendron atlanticum* and *R. periclymenoides* was investigated using 10 vegetative characters and discriminant analysis. The two species have overlapping geographic ranges and flowering times. Experimental hybrids are known to be fertile. Two putative hybrid populations (PHP1 and PHP2) were studied. PHP1 showed no evidence of natural hybridization. PHP2 showed convincing evidence of bi-directional introgressive hybridization. The results and conclusions were congruent with previous micromolecular and floral analyses of population samples from the same study sites. Habitat disturbance alone does not ensure that natural hybridization will occur.

Chemistry

CAPILLARY ELECTROPHORETIC METHOD FOR ANALYSIS OF SULFATED FLAVANOIDS. Mandakini Dantuluri & Umesh R. Desai, Department of Medicinal Chemistry, Virginia Commonwealth University, Richmond Virginia 23298. Our previous research on mimicking heparin pentasaccharide structure led to the rational design of sulfated flavanoids. An efficient method was needed for rapid analysis of these designed sulfated flavanoids. This work presents our research on the use of capillary electrophoresis for analysis of sulfated flavanoids. A characteristic feature of our designed sulfated flavanoids is extremely high charge resident on small size. To better understand their electrophoretic behavior numerous conditions including forward and reverse polarity, pH, pressure, voltage, ionic strength, buffer nature, etc. were studied. Optimal resolution was obtained in 20 mM sodium phosphate buffer, pH 3.5, using reverse polarity at 10 kV. A mixture of enantiomeric sulfated flavanoid was resolved into its components using 15% (w/v) β -cyclodextrin in 150 mM sodium phosphate at pH 3.5 and 10 kV under reverse polarity. Yet, a mixture of diastereomeric sulfated flavanoids could not be resolved under the conditions studied, suggesting the difficulty of analyzing such highly polyanionic small molecules.

SYNTHETIC, NON-SULFATED POLYMERS AS HEPARINOIDS: ANTITHROMBIN BINDING AND ACTIVATION STUDIES. Bernhard H. Monien & Umesh R. Desai, Dept. of Medicinal Chemistry and Inst. for structural Biology and Drug Discovery, VCU. Heparin and heparin-based anticoagulants are extremely important pharmaceutical agents. Intensive efforts to design heparin mimics with a sulfated, polysaccharide backbone to eliminate complications from heparin therapy are in progress. The function of heparin, antithrombin activation for accelerated factor Xa and/or thrombin inhibition may be mimicked with *non-sulfated, non-polysaccharide* molecules. The free energy of binding (21–35 kJ/mol) when linear polyacrylic acids with differing chain lengths interact with human plasma antithrombin compares favorably with a specific heparin trisaccharide (24–33 kJ/mol) and pentasaccharide (51–59 kJ/mol). Further, the longest polyacrylic acid studied accelerates the antithrombin inhibition of factor Xa and thrombin 284-fold and 1,109-fold, respectively, which compares well with the ~600-fold and ~4,000-fold acceleration achieved with full-length heparin. Our work demonstrates that non-sulfated, nonsaccharidic molecules can bind and activate antithrombin for accelerated inhibition of two critical enzymes of the coagulation cascade and establishes the proof-of-principle on which rational design of anticoagulants, especially orally active molecules, may be based.

ACTIVE SITE LABELING OF THE CAP METHYLTRANSFERASE. T. A. Linkous & T. O. Sitz, Dept. of Biochem., Virginia Tech, Blacksburg, VA 24061. The 5'-cap structure of eucaryotic mRNAs are methylated in the 7-position of the guanine by the guanine-7-methyltransferase (cap methyltransferase). Without this important methylation the mRNA is not translated into protein. The active site of the cap methyltransferase can be labeled by binding ^{32}P -labeled non-methylated capped RNA and covalently linking it in the active site by exposing it to short wavelength UV light for one hour on ice. When the cap methyltransferase was isolated from mouse tumor tissue, the active site labeling was inhibited by Mg^{+2} at a concentration of 10 mM. This concentration of Mg^{+2}

also inhibited its enzyme activity. However, when the human cap methyltransferase was expressed as a His-tag protein in *E. coli* and isolated, the active site labeling was not inhibited by Mg^{+2} . Actually, 10 mM Mg^{+2} stimulated the active site labeling of the cloned enzyme! However, 10 mM Mg^{+2} inhibited the enzyme activity. When 120 amino acids were deleted from the N-terminal of the cloned human enzyme, it still showed this unusual result, i.e. stimulation of active site labeling by 10 mM but the enzyme activity was inhibited. It is not clear if this difference is due to the cloned expression of the enzyme or due to some variation in the human and mouse sequence.

SUBUNIT STRUCTURE OF THE CLONED HUMAN CAP METHYLTRANSFERASE. J. M. Brooks, M. J. Rothenberg, & T. O. Sitz, Dept. of Biochem., Blacksburg, VA 24061. Without the methylation of the guanine-7-position in the mRNA cap structure, the mRNA is not efficiently translated. Previous research has demonstrated that this enzyme is found in its native form as a homodimer. We have proposed a model of the interaction where the N-terminal region of the subunits interacts with the core enzyme to form this dimer structure. Two different forms of this human methyltransferase have been cloned in a pET16B expression system in *E. coli*: A full length enzyme 476 amino acids in length and a deletion mutation with 120 amino acids deleted from its N-terminal. We were able to express high levels of enzyme activity of both forms of methyltransferase as His-tag proteins and were able to purify both the full-length and deletion mutation enzymes while maintaining activity. If our model is correct the full-length enzyme should form a dimer while the deletion mutation should be found only as monomer. Gel exclusion column chromatography on an FPLC-Superose 6 gel exclusion column was used to determine size. The full length enzyme was only found as a dimer while the deletion mutation was found as monomer and dimer. These results show that while the N-terminal regions play a role in dimer formation there are also some interactions in the core enzyme.

ASSAY FOR HYPOMETHYLATED CAP STRUCTURES IN MRNA. C. M. MacCarthy & T.O. Sitz, Dept. of Biochem., Virginia Tech, Blacksburg, VA 24061. Eucaryotic mRNA contains a 5'-cap structure which is highly modified. The most important of these modifications is the methylation of the N-7-position of the guanine base. Without this modification the mRNA is not translated into protein. Messenger RNA isolated from tumor cells is undermethylated at this important N-7 guanine position. We can assay for this modification by using cloned human guanine-7-methyltransferase (cap methyltransferase) and $H^3(CH_3)$ -S-adenosylmethionine (H^3 -SAM) to methylate this hypomethylated mRNA. The RNA is then isolated, hydrolyzed with base, and the resultant oligonucleotides separated on a DEAE-Sephadex column. While this method works well it is very time consuming. We have developed a fast DEAE-filter binding method that allows us to analyze many samples quickly. Different amino acid analogs (ethionine and cycloleucine) that inhibit methylation were used to treat mice and Normal Rat Kidney (NRK) cells in culture. The RNA was isolated, incubated with cloned human cap methyltransferase and H^3 -SAM, and spotted on small 1.5cm square pieces of DEAE-filter paper. These papers were washed and the radioactivity determined. This rapid filter binding method gives hypomethylation values comparable to those obtained from DEAE-Sephadex columns.

MAGNETIC CIRCULAR DICHROISM STUDIES OF 3-SUBSTITUTED INDOLES. Paula Klonowski & D. D. Shillady, Dept. of Chemistry, Virginia Commonwealth Univ., Richmond VA 23284-2006. The characteristic sharp positive magnetic circular dichroism (MCD) band of indole at 290 nm is compared to the MCD spectra of five other indoles with substituents in the 3-position. The compounds studied are: indole-3-carboxaldehyde, 3-indole acetonitrile, trans-3-indoleacrylic acid, indole-3-acetamide and 3-indoylacetate. It was found that a 3-substituent with a $-CH_2-$ between the indole ring and the other chromophore maintained the positive MCD band near 290 nm, while a 3-substituent pi-conjugated to the indole ring substantially changed the MCD spectrum. Ab

initio molecular orbital calculations using a STO-4G basis set and single-excitation configuration interaction (CIS) are in good agreement with the signs and magnitudes of the MCD bands of these compounds. Thus 3-substituents that are pi-conjugated to the indole ring will not have the large positive 290 nm MCD peak observed for indole and tryptophan.

INFRARED REFLECTANCE ABSORBANCE SPECTROSCOPY OF THE TEMPERATURE DEPENDENCE OF LIQUID CRYSTAL ADSORPTION ON GRAPHITE. Elizabeth M Griffiths & Leanna C Giancarlo, Dept. of Chem., Mary Washington College, Fredericksburg, VA 22401. A series of 4'-alkyl-4-cyanobiphenyls (pentyl through octyl) liquid crystals adsorbed on graphite were the focus of Infrared Reflectance Absorbance Spectroscopy (IRRAS) studies. These studies aim to determine molecular alignment and orientation at varying temperatures. IRRAS was utilized to examine the changes in the liquid crystals as they progressed from the solid to the smectic, nematic, and the isotropic phases. The phases of the adlayer were controlled by varying the surface temperature. Changes in IR peak position and intensity provided information concerning the liquid crystal orientation. In particular, it was found that as the temperature of the system increases, the cyanobiphenyl moiety moves from a parallel to tilted orientation on the graphite. Furthermore, the C-H bonds rotate about the C-C axis as the temperature increases, and the extent to which the C-H atoms interact with the pi orbitals of the graphite increases.

ORGANOSELIUM. Joshua A. Ritchey¹, Craig A. Bayse¹, and Patricia A. Pleban². (1) Department of Chemistry and Biochemistry, Old Dominion University, 4541 Hampton Blvd., Norfolk, VA 23529-0126, Fax: 757-683-4628, jaritche@odu.edu, Selenoproteins play an important biological role as antioxidants. In an effort to understand these oxidation processes completely, oxidation products must be identified. Using ⁷⁷Se NMR, oxidation of selenomethionine (SeMet) gives a signal at 708 ppm and another at 844 ppm (relative to MeSeMe, pD 5, 0.10M, T=20°C). The 844 ppm signal is reported as the selenoxide and the 708 ppm signal has been tentatively assigned as a selenurane. The assignment was made by comparing with theoretical shifts and synthesizing the SeMet methyl ester to eliminate the carboxyl group interaction. This agrees with the Se coupling constants, 10.4Hz for the selenurane and 12.0 for the selenoxide. The oxidation products of the SeMet methyl ester show a decrease in signal intensity of the Se-O selenurane (708 ppm) and a new peak formed at 586 ppm. This new peak is tentatively assigned as the Se-N selenurane.

SYNTHESIS OF OPEN-FRAMEWORK MATERIALS USING SUBSTITUTED BENZYL PHOSPHONATES. Christine L. Heinecke & Barbara A. Reisner, Dept. of Chem., James Madison Univ., Harrisonburg VA 22801. In an effort to synthesize extended structures with large and interesting pore topologies, phosphonate ligands were used to coordinate divalent transition metals. Several new transition metal phosphonates were synthesized from both hydrothermal and biphasic solvent systems. Using diethyl-4-aminobenzyl phosphonate as a ligand, two layered phases containing Co(II) and Ni(II) were synthesized: Co[O₃PCH₂C₆H₅NH₂] \cdot H₂O and Ni[O₃PCH₂C₆H₅NH₂] \cdot H₂O. All products were characterized using powder X-ray diffraction and thermal gravimetric analysis.

COMPLEXES OF Co(II), Ni(II), Cu(II), AND Zn(II) WITH N-CYCLOHEXYL-SUBSTITUTED PHTHALAMIC ACID LIGANDS AS MODELS FOR METAL-DOPED POLYIMIDES. C.M. Davis, with D.L. Polo and L.M. Vallarino, Department of Chemistry, Virginia Commonwealth University, Richmond, VA 23284-2006. Polyimides are low-density organic polymers that have become important as construction materials for industrial applications because of their high thermal stability and excellent mechanical properties. Most polyimides contain an appreciable percentage of (non-imidated) amic-acid sites. It has been suggested that these amic-acid sites can act as ligands for metal ions, resulting in the formation of materials which would combine the original properties of the host polymer with the specific properties of the guest metal ions. As part of an ongoing project, the students of the 2004 *Inorganic Chemistry Laboratory* course have investigated the

coordinating ability of N-cyclohexyl-phthalamic acid toward selected transition metal ions, as a monomeric model for the amic-acid sites of polyimides. The work has involved the synthesis and characterization of the acid, of the sodium salt of the acid, and of the complexes formed by the anionic form of the acid with the cobalt(II), nickel(II), copper(II), and zinc(II) ions.

BLACK GOO AND YOUNG VINE DECLINE. David McGinnis and Roy L. Williams, Old Dominion University Enological Research Facility, Department of Chemistry and Biochemistry, Old Dominion University, Norfolk VA 23529-0126. The young vine disease known as Black Goo is rapidly becoming an international problem for vineyards. Black Goo is believed to be a byproduct of the vine following *Phaeoacremonium chlamydosporum* fungal infection. The research facility has been investigating the chemical nature of infected Virginia Syrah vines. The sectioned Syrah vines were found to contain the dark amber goo, which is associated with the disease. The Black Goo substance is currently being subjected to analytical analysis. We have determined that the substance's chemical constituents include such phytoalexins as trans-resveratrol, cis-resveratrol, e-viniferin, and d-viniferin. Our current hypothesis with regard to possible function of the chemical constituents in infected vines is that their insoluble nature leads to accumulation within the xylem as the disease progresses. This creates an obstruction in the xylem, which inhibits the normal flow of nutrients and fluids within the vine.

SYNTHESES OF FUNCTIONALIZED 1,4-DISUBSTITUTED γ -CARBOLINES. Wayne M. Stalick Department of Chemistry, George Mason University, Fairfax, VA 22030 & James H. Wynne, Chemistry Division, Naval Research Laboratory-Code 6120, Washington DC 20375 and George Mason University, Fairfax, VA 22030. Since a number of reports have shown that γ -carboline are of interest due to their biological activities, a general synthetic path seemed desirable to allow for the examination of a large series of these interesting compounds. In our first approach using N-tosylaldimines as an integral step, the desired products were afforded, but the yields were lower than expected mainly because of the large number of steps required in the reaction sequence. Our second approach significantly reduces the number of steps in the reaction. The sequence begins with the acylation of indole in the 3-position, a reaction we have accomplished without a protecting group. Subsequent reductive amination of the acylated product with a variety of amino acids or derivatives affords the corresponding side chain that easily lends itself to direct cyclization yielding the γ -carboline nucleus. Depending on which amino acid is used, the 3-position can be substituted with a variety of different groups. This second approach affords γ -carboline that can have alkyl, as well as aryl groups in the 1-position, substitution, if desired, in the 3-position and substitution also in the 4-position when necessary.

LASER INDUCED DAMAGE TO MATERIALS AS A METHOD OF DETECTING LASER EYE HAZARDS. Christopher T. Lloyd, James H. Wynne, Samuel D. Jensen & Robert F. Cozzens, Chemistry Division, US Naval Research Laboratory, 4555 Overlook Avenue, SW, Washington, DC 20375. There is a need for an inexpensive, passive device to be used as a laser dosimeter that would indicate whether laser irradiation of a DOD asset had occurred and give an approximate value for the incident laser power. As with ionizing radiation dosimeters, the instrument would be read and interpreted after the lasing has occurred. The dosimeter would be placed on an asset at risk (ie. aircraft, helicopter, border post, front line position). If irradiated, a telltale damage spot would be produced in the sensitive material. Upon later examination, the size and appearance of the damage spot would be an indication of the laser power and evidence of a lasing incident. These damaged-enhanced materials darken when exposed to a laser of sufficient power to damage eyes and optical sensors. Design and testing of an optical system in which these materials can be used is currently underway. The current status of the development and testing of several dosimeter materials and brief descriptions of these optical prototype instruments are discussed.

PREVENTION OF WIND EROSION UTILIZING BIODEGRADABLE POLYMERS. James H.

Wynne, Christopher T. Lloyd, & Samuel D. Jensen, Chemistry Division, US Naval Research Laboratory, 4555 Overlook Avenue, SW, Washington, DC 20375. During Operation Iraqi Freedom, military operations were severely impacted due to the tremendous amounts of airborne sand and dust. Not only does airborne dust affect the operation of equipment but remains a health concern as well. Under conditions such as those found in Iraq and Afghanistan, the prevalence of this problem lead to a renewed effort to address this problem. Employing an affordable, biodegradable, environmentally friendly, water-based, polymer solution, NRL demonstrated the effective treatment of desert surfaces, significantly reducing airborne dust and sand during helicopter approach, taxi and landings. NRL has developed a dust palliative, whereby we are able to solidify the surface of the desert and thus prevent large amounts of dust and sand from becoming airborne upon helicopter approach and landings. This solution was tested on a variety of sand types and was successfully implemented in a recent field test in Yuma, Arizona.

THERMAL DECOMPOSITION OF ALKALI METAL bis OXALATO CUPRATE DIHYDRATES. Adam Taylor and T. C. DeVore, Dept. of Chemistry, JMU. The thermal decomposition the alkali metal bis-oxalato cuprate (II) dihydrate (ALK = Na and K) have been investigated using differential scanning calorimetry (DSC) and thermal gravimetric analysis- mass spectroscopy (TGA-MS) in nitrogen and using evolved gas analysis-FTIR (EGA-FTIR) in vacuum. IR spectroscopy and powder XRD were used to identify the solid residues produced during the decomposition. The decomposition of both compounds occurs in three steps. The first step results from the waters of hydration under all set of conditions tested. The second step results from the loss of CO₂ to form the copper and the alkali metal oxalate in flowing nitrogen. The final step occurs with the loss of CO to form Na₂CO₃. The kinetics for each decomposition step was determined using Kessinger's approximation. The enthalpies of formation for each compound were also determined using the DSC data.

POSTERS:

ADSORPTION OF LEAD IONS BY ORGANO-SILICATE NANOCOMPOSITES. Tarek M. Abdel-Fattah & Larry Isaacs, Dept. of Biology, Chemistry & Environmental Science, Christopher Newport Univ., Newport News VA 23606. The state of Virginia has at least 35 outdoor shooting ranges not counting the military. Alternatives to effectively immobilize lead contaminates in soil and stormwater are needed by small arms range (SAR) managers to comply with environmental regulations and protect the environment. The equilibrium adsorption of aqueous Pb²⁺ by molecular sieves HMS, MCM-41, and MCM-48 were measured by graphite furnace atomic adsorption. Kinetics and isotherm models were prepared, and the effects of pH 2 to pH 12, competing ions, and 25 °C to 45 °C temperature, on performance were investigated. HMS, MCM-41 and MCM-48 reactions with Pb²⁺ were first order, with half-life reaction times of 65, 19 and 107 minutes, respectively. The batch equilibrium study Pb²⁺ data fit the Langmuir and the Freundlich isotherm models. Average percent Pb²⁺ removal at 23°C for HMS, MCM-41, and MCM-48 were 93%, 96%, and 93%, respectively. Ionic competition reduced Pb²⁺ removal by HMS, but enhanced MCM-41 and MCM-48 performance. HMS began to release Pb²⁺ ions below pH = 6 and MCM-41 and 48 began to release Pb²⁺ below pH = 4.

ARSENIC REMOVAL FROM WATER USING IRON MODIFIED ADSORBENTS. Tarek M. Abdel-Fattah & Kelly B. Payne, Dept. of Biology, Chemistry & Environmental Science, Christopher Newport Univ., Newport News VA 23606. This study supports worldwide research efforts to obtain drinking water with arsenic levels below 10 ppb, the current WHO guideline value. Batch adsorption kinetic and isotherm studies evaluated iron treated adsorbents for arsenate (As⁺⁵) and arsenite (As⁺³) removal from water. Adsorption effectiveness was investigated using two iron treatments, varied pH, competing ions, and temperature increases. Iron treated activated carbon and chabazite showed the most promise as low cost arsenic adsorbents; activated carbon removed approximately 60% of arsenate and arsenite while chabazite removed approximately 50% of arsenate and 30% of arsenite. Modeling adsorption using isotherm expressions determined the adsorbents' capacity for arsenic

removal. Arsenate removal by iron treated activated carbon and clinoptilolite best fit the Langmuir model. Arsenate removal by iron treated chabazite and arsenite removal by activated carbon, chabazite, and clinoptilolite best fit the Freundlich model. pH values were determined for effective applications of iron modified adsorbents. Ionic competition and increasing temperature improved adsorption performance.

HINT ANALYSES OF ANTITHROMBIN BINDING TO PENTASACCHARIDES. Chandravel Krishnasamy & Umesh R. Desai, Dept. of Medicinal Chemistry and Inst. for Structural Biology and Drug Discovery, Virginia Commonwealth University, Richmond, VA 23298. Heparin is a highly charged polymer that binds antithrombin and regulates the blood coagulation cascade. Heparin mimics are being developed as new anticoagulants with improved properties. Hydropathic interaction analyses (HINT) was used to assess the nature and degree of interaction between saccharide activators and antithrombin. Minimization studies suggest that a high dielectric constant of 80 is required to accurately simulate the structure of heparin pentasaccharide. This conformation matches the conformation of the pentasaccharide in solution. In contrast, a dielectric constant of 5 is required to simulate the bound-state conformation of the pentasaccharide. Docking studies suggest that a fully automated docking protocol may not accurately predict the best possible binding geometry, thus requiring considerable manual intervention. Finally, a reasonable correlation between HINT score of three critical residues of the pentasaccharide-binding domain and the observed binding energy is obtained suggesting that the protocol developed in this study may be useful for rational design of new heparin mimics.

CAPILLARY ELECTROPHORETIC METHOD OF ANALYSIS OF SULFATED FLAVANOIDS. Mandakini Dantuluri & Umesh R. Desai, Dept. of Medicinal Chemistry, Virginia Commonwealth Univ., Richmond Virginia 23298. Our previous work on mimicking heparin pentasaccharide structure led to the rational design of sulfated flavanoids. An efficient method was needed for rapid analysis of these designed sulfated flavanoids. This work presents our research on the use of capillary electrophoresis for analysis of sulfated flavanoids. A characteristic feature of our designed sulfated flavanoids is high charge resident on small size. To better understand their electrophoretic behavior numerous conditions including forward and reverse polarity, pH, pressure, voltage, ionic strength, buffer nature, etc. were studied. Optimal resolution was obtained in 20 mM sodium phosphate buffer, pH 3.5, using reverse polarity at 10 kV. A mixture of enantiomeric sulfated flavanoid was resolved into its components using 15% (w/v) β -cyclodextrin in 150 mM sodium phosphate at pH 3.5 and 10 kV under reverse polarity. Yet, a mixture of diastereomeric sulfated flavanoid could not be resolved under the many conditions studied, suggesting the difficulty of analyzing such highly polyanionic small molecules.

ISOTHERM STUDY OF SURFACTANT MODIFIED ADSORBENTS FOR REMOVAL OF 2,4-DICHLOROPHENOL FROM AQUEOUS SOLUTIONS. Valerie Johansen, Sandy Han & Tarek M. Abdel-Fattah, Dept. of Bio. Chem. & Environ. Sci., Christopher Newport Univ., Newport News VA 23606. Dichlorophenols are used in wood preservation treatments and the production of herbicides and antiseptics. An experiment was conducted in order to study the effectiveness of various inexpensive adsorbent materials for the removal of 2,4-Dichlorophenol (DCP) from aqueous solutions. The adsorbents used included synthetic molecular sieves, 5A and 13X, naturally occurring zeolites, Clinoptilolite and Chabazite, as well as activated carbon, aluminum oxide and silica gel. Each adsorbent was modified with dodecylamine (DDA) surfactant to increase adsorbent capabilities. The study was done using 50mL of 2,4-DCP (50 ppm) with varying amounts of each modified adsorbent. Absorbance values obtained from a UV-Visible Spectrophotometer to determine the percentage of 2,4-DCP removal from each sample over a total period of 48 hours. All modified adsorbents were successful in removing all or part of the 2,4-DCP. Activated carbon fit both the Langmuir and Freundlich isotherm models and Chabazite fit the Freundlich model. No other adsorbents fit either model. The results of this study could be applied to develop methods for the removal of 2,4-DCP from water.

TEMPERATURE EFFECT ON ADSORBANCE CAPABILITIES FOR CHLORINATED PHENOLS OF NANOCOMPOSITE MATERIALS. Sandy Han, Valerie Johansen, Brian Bishop & Tarek M. Abdel-Fattah, Dept. of Bio. Chem. & Environ. Sci., Christopher Newport Univ., Newport News VA 23606. Chlorinated phenols are used for wood preservation, herbicides, antiseptics, and wood pulp bleaching. They enter into the environment from paper mill discharge and water chlorination processes. Exposure from ingestion or dermal absorption can lead to liver and kidney disease, and significant quantities can cause death. This study investigated the effect of temperature on the adsorption capabilities of nanocomposite materials to remove 2,4-dichlorophenol (DCP) from an aqueous media. The materials investigated are the nanocomposites of HMS, MCM-41, MCM-48, and MCM-50. These materials were prepared by ionic (cetyltrimethylammonium) or neutral (dodecylamine) surfactants as structure directing agents with tetraethylorthosilicate (TEOS) as a silica source. Results and calculations show that HMS, MCM-41, and MCM-50 displayed endothermic adsorption; MCM-48 was the only material to be exothermic. All adsorbents successfully removed over 75 percent of 2, 4-DCP. Organo-silicate nanocomposite materials demonstrate great capability for the removal of organic pollutants from aqueous media due to their significant adsorption capacity.

Computer Science

MULTI-MODAL PERVASIVE COMPUTING. Moses C. Allotey-Pappoe, Dept. of Computer Science, Norfolk State University, Norfolk, VA 23504. As new communications technology keeps evolving into smaller and mobile devices the need to process information to them becomes very important. Pervasive computing simply helps users of these devices access information at anytime and anywhere. However, this way of computing has some shortcomings. Screens are too small making it hard to read text no matter how good the resolutions. In addition, the input mode of using keyboard or handwriting recognition is painfully slow and hard to master. We propose to solve these shortcomings by using other modes of communication, thus creating a multi-modal application. We created a system in which a PDA user will be able to access a web page with embedded voice interaction code so that it will prompt the user for a voice input. The user will then provide a voice input for the database query. The voice input will be converted to text and sent back to the web server. The web server executes the query to retrieve the required data in XML and XSL then transforms these documents into a web page with voice interaction code and sends it back to the PDA. The PDA displays the web page and also renders it in voice to the user. This research was made possible by using open-source products such as Jakarta Tomcat, Apache Cocoon, IBM Multimodal Toolkit, MySQL, and a pervasive computer, the PDA.

GENDER GAP IN COMPUTER TECHNOLOGY. Sunita Luthar & Jeff Zadeh, Department of Mathematics and Computer Science, Virginia State University, Petersburg, VA 23806. The purpose of this paper is to investigate the causes and effects of gender difference in computer technology at secondary level. Also find the answers to questions like; "Why are there fewer females in computer field?" "What are the reasons behind it?" "Are we as a society somehow discouraging females from going into this field?" A questionnaire was developed to find out the attitudes of high school students towards computers. The questions were related to see students' interest in computers and how they use them. It was also meant to find out their future career goals regarding computer science. We found that male students spend more time on the computers per week and feel more comfortable with computer hardware. Many of male students want to choose computer science as a career compare to female students.

Education

EVALUATION OF PHYSICAL SCIENCE OUTREACH PROGRAM. Alison Baski¹, Jacqueline McDonnough² & Susan McKelvey², ¹Physics Department, Virginia Commonwealth University, Richmond, VA 23284, and ²School of Education, Virginia Commonwealth University, Richmond, VA 23284. This evaluation is a part of the Hands-On Physical Science for In-Service Teachers program, designed to improve the physical science teaching of upper-level elementary teachers in the City of Richmond. The course is based on ten hands-on activities related to the Virginia SOL's in physical science. During the school year, physics faculty and undergraduate assistants deliver these lessons to the teachers' classes. In the evaluation of this program, the Self-Efficacy Teaching and Knowledge Instrument for Science Teachers (SETAKIST), developed by Roberts and Henson (2000) was used, as well as an open-ended feedback questionnaire. The SETAKIST revealed that teachers experienced anxiety when teaching new concepts. From the open-ended questions, teachers expressed the importance of hands-on activities, and that they attribute to the program higher levels of confidence when teaching science.

BOREDOM PRONENESS AND TASK EFFECTIVENESS AMONG FEMALE COLLEGE STUDENTS. Michael Gentry¹ & James McCrory², ¹Dept. of Mathematics & ²Dept. of Education, Mary Baldwin College, Staunton, Virginia, 24401. Past research has found that boredom is not simply in the nature of a task but in each person's perception of the task. Boredom is usually associated with specific classes such as English, History, and Mathematics. This study examined the relationship between boredom proneness and task effectiveness for 123 female college students. Subjects were administered a Likert version of the Boredom Proneness Scale (Farmer and Sundberg, 1986). Measures of task effectiveness, e.g., the student's final course grade, were recorded for each subject. Methods of exploratory data analysis were used to analyze the data, and a nonlinear regression model was fit to the data after omitting outliers. A statistically discernible relationship between a student's BP score and her final course grade was detected; the correlation coefficient was $r = .369$. Further data analysis suggested that individuals who require a lot of change and variety and higher levels of stimulation than others are prone to boredom, but are perceived by others as being creative and imaginative. There is no well-developed theory of boredom. Studies need to be conducted to determine if boredom is due to over stimulation rather than under stimulation. Parents, administrators, and teachers need to work together to identify ways to counteract or reduce boredom.

DEVELOPING EXHIBITIONS AND PROGRAMS FOR THE BELMONT BAY SCIENCE CENTER. Eugene G. Maurakis¹ & Astrid Haryati², ¹Belmont Bay Science Center c/o Science Museum of Virginia, 2500 W. Broad St., Richmond, VA 23220 and ²TENG and Associates, 205 N. Michigan Ave. Chicago, IL 60601. Objectives are to conduct and analyze results of internet based surveys for use in the development of exhibitions and programs for Belmont Bay Science Center, a new 200,000 sq. ft. hands-on science center in northern Virginia. Internet based surveys are composed of unique questions (e.g. demographics, interest level in various science and technology subjects, preferences for types of interactive experiences, day and evening programming expectations, required degree of integrating informal and formal education methods, technology integration, science center amenities) differentially targeted to seven different kinds of survey groups (general public, museum operators, educators, advisors, and elementary, middle, and high school students). Funded by US Small Business Administration Grant No. SBAHQ-03-I-0022, Belmont Bay Science Center Foundation, and Science Museum of Virginia.

VIRGINIA'S SCIENCE EDUCATION UPDATES. Eric M. Rhoads, Office of Secondary Instruction, Virginia Department of Education, P.O. Box 2120, Richmond, VA 23218-2120. A description of the Department's efforts regarding implementation of the Virginia Science Standards of Learning, engaging teachers in professional development activities, utilizing standards-based resources effectively, and scientifically-based research strategies for improving student achievement.

HOW DISTANCE EDUCATION CAN BE USED IN THE CLASSROOM. Benjamin D. Swecker, Supervisor of Media Production Services for Prince William County Public Schools and Executive Director of Prince William Network, P. O. Box 389, Manassas VA 20108 & Dr. Beverly M. Thurston, specialist in history, social sciences, and international education for the Virginia Department of Education, P. O. Box 2120, Richmond VA 23218. Distance education refers to instruction that is presented from a remote location using telecommunications or the Internet. Live, electronic field trips enable students to virtually visit places distant places, talk directly with experts. These broadcasts bring the excitement of discovery and learning into classrooms across the nation. WorldNet Virginia provides opportunities for a select group of teachers or students to participate in study seminars. Students have attended the International Space Olympics in Russia and shared their experiences on the Web. In addition, the Internet has brought a wealth of resources to the fingertips of teachers and students across Virginia through the creation of web sites that address the Virginia Standards of Learning (SOL). Lastly, in partnership with DOE and Old Dominion University, Prince William Network has offered a number of professional development courses for teachers.

BRINGING VIRGINIA AGRICULTURE AND NATURAL RESOURCES TO THE CLASSROOM. Elizabeth D. Alford, Virginia Foundation for Agriculture in the Classroom, 12580 West Creek Parkway, Richmond, VA 23238. Virginia Agriculture in the Classroom (AITC) is a statewide educational program for teachers. Its goal is to help students gain a greater awareness of the role of agriculture in our economy and society by providing quality training and resources to their teachers. With less than two percent of the American population residing on farms today, the general population is far removed from its source of food, fiber and shelter. The Virginia AITC program was designed to address this lack of awareness of Virginia's agriculture industry. The program uses agriculture as a medium to teach science, social studies, language arts and math. All program information, hands-on activities, and resources are aligned to state standards, most closely supporting the natural resources strand of the elementary science standards. Virginia AITC is fully-funded by Virginia's agricultural community and thus provides this program to the schools at no cost.

SCIENCE FAIR JUDGING: WHAT ARE THE STANDARDS?. Ronald S. Mollick, Dept. of Biol., Chem. & Environ. Sci., Christopher Newport Univ., Newport News, VA. 23606. Science fairs have been part of the educational landscape especially since the acceleration of science education that took place near the end of the 1950's. Standards for judging have always included the use of forms requiring numerical ratings that must be calculated in several major and minor areas. The problems in using numerical rankings are that 1) judges use of the rating scale varies with each judge, and 2) the number of judges seeing each project is not always the same which increases the variation of the summary scores. My experience is that judges tend to avoid using rating sheets and instead use a general evaluation system that examines 1) student understanding of the background that led to their project, 2) the use of standard scientific methods including controls and replicates, 3) how they present and evaluate data and ideas, and 4) how well they interpret their results and relate them to their original hypothesis. Judges tend not to reduce their evaluations to numbers but they convert their impressions of the projects into a ranking which is discussed with other judges prior to establishing a group consensus. This method works very well and is easy to use. However, data indicates that the number of science fair participants in some parts of Virginia is decreasing as the Standards of Learning are emphasized. It may be that the issue of judging techniques will become insignificant.

A RESPONSIVE RESOURCE: THE SCIENCE MUSEUM OF VIRGINIA. David B. Hagan & Patricia D. Fishback, Science Museum of Virginia, 2500 West Broad Street, Richmond, VA 23220. The Science Museum of Virginia is a remarkable institution in its ability to respond to the needs of the community. A staff of talented educators and scientists are oriented toward service under the flag of science education. The presentation includes many examples of programs from the diverse

array of educational offerings that have been designed to meet the needs of specific groups including university centered courses, in-school enrichment for teachers and students, mentoring for at-risk teens, service learning and special teacher programs.

ACTION RESEARCH: PUTTING THEORY INTO PRACTICE AND PRACTICE INTO THEORY. Dr. Kelly A. Decker, Fairfax County Public Schools and George Mason University. With a national focus upon teacher professional development, action research is one way to contribute to the professional development of teachers and the professionalization of teaching. The *National Science Education Standards* (National Research Council, 1996) proposes standards for the professional development of science teachers. Support for teachers as researchers is evident in the standards. Standard B---Learning to Teach Science recommends that “teachers use inquiry, reflection, interpretation of research papers, modeling, and guided practice to build understanding and skill in science teaching” (p. III-12-13). Standard C---Learning to Learn suggests that “opportunities are provided to learn and use the skills of research to generate new knowledge about science and the teaching and learning of science” (p. III-18). Therefore, this paper recognizes the essential role of elementary science lead teachers in school reform and the need for enabling conditions for these types of teachers to engage in action research and to critically examine their practice and the practice of others. Discussion will also focus on a professional development course that is designed to develop, support, and sustain teachers in effective leadership roles within their school environments.

TEACHING ENHANCED BY TECHNOLOGY: ONE NOVICE TEACHER’S EXPERIENCE WITH INTEGRATING TECHNOLOGY INTO SCIENCE. ¹Jackie McDonough & ²Ryan Templeton. ¹Department of Teaching and Learning, VCU, ²Chesterfield County Science and Mathematics High School at Clover Hill. The changes brought about in education by instructional technology have the potential to inextricably alter instruction within the next generation. These changes though far-reaching cannot be fully realized unless the gatekeeper of education, the classroom teacher, is willing to embrace these transformations. The field of science is continuously changing and instructional technology can be used as a valuable tool in assisting teachers to stay abreast of new findings. This paper will document one novice science teacher’s use of technology for instructional and classroom management. Teaching Enhanced by Technology (TET) offers the novice educational technology user ways to begin the process of change necessary to integrate technology into their instruction.

LEARNING BIOLOGY: A GENDER STUDY. J. Orion Rogers & Trinity S. Breedlove, Dept. of Biol., Radford Univ., Radford, VA 24142. Literature surveys reveal that biological differences exist between male and female brains, more kindergarten boys than girls wanted to be scientists, and more males than females pursue science majors. A biology test, the Lips Academic Self-view Survey (LASS) and five self-assessment, short-answer questions were administered to 23 tenth grade students, eight males and fifteen females, at Patrick Henry High School. Both authors obtained NIH certification to conduct research with human subjects, the Radford University IRB Committee on Human Subjects Research approved this research, and informed consent was obtained from students and parents. Results reveal that although the means for the biology test scores and final grades were higher for females than males, there were no significant differences between the biology test means and final grades of males and females. To the LASS question “Poor in Science”, 0% of males and females answered “Definitely Me”, but more males (25%) than females (7.1%) answered “Mostly Me”, and more females (21.4%) than males (12.5%) answered “Not Me”. To the question “Enjoy Learning Science”, 12.5% of males answered “Definitely Me” compared to 0% of females. To the question “Pursuing Studies in Life Sciences” 12.5% of males answered “Definitely Me” compared to 6.7% of females.

Environmental Science

FISH CONSUMPTION PATTERNS OF POPULATIONS IN VICINITIES OF LAKE KASTORIA AND LAKE PAMVOTIS, GREECE. Eugene G. Maurakis^{1,2} and David V. Grimes^{2,3} ¹Science Museum of Virginia, 2500 W. Broad St., Richmond, VA 24542, ²School of Continuing Studies, University of Richmond, VA 23173, and ³Virginia Department of Transportation, Environmental Division, 1200 E. Broad St., Richmond, VA 23219. Objectives are to establish fish consumption patterns of populations in vicinities of two lakes (Kastoria and Pamvotis) in Greece for use in assessing risks associated with consumption of fishes in these agri-chemically impaired lakes. Results are discussed for four gender-age groups (134 adult and youth males and females) relative to survey questions: demographics [i.e., gender, age, weight, education level, occupation, residency, freshwater fish eating frequency, fishes consumed (species and sizes), fish consumption habits [i.e., quantity, parts, and preparation method. Selection of fish species was based on freshwater fish eating preference, species availability per lake, and ecological feeding type: food chain position (predator, prey); feeding type (i.e., carnivore, herbivore, omnivore), and feeding position (e.g. bottom) Funded by the Thomas F. Jeffress and Kate Miller Jeffress Memorial Trust, Science Museum of Virginia, and University of Richmond.

ASSESSMENT OF HUMAN HEALTH RISKS FROM CHEMICALLY CONTAMINATED LAKE FISHES IN GREECE. David V. Grimes^{1,2} and Eugene G. Maurakis^{2,3}, ¹Virginia Department of Transportation, Environmental Division, 1200 E. Broad St., Richmond, VA 23219, ²School of Continuing Studies, University of Richmond, VA 23173 and ³Science Museum of Virginia, 2500 W. Broad St., Richmond, VA 24542. Objective is to conduct a screening level survey of locally consumed fish tissues in vicinities of two lakes (Kastoria and Pamvotis) in Greece to determine the presence of halogenated organic compounds and determine carcinogenic and non-carcinogenic human health risks associated with the consumption of sampled fish tissues. Results estimate the Incremental Lifetime Cancer Risks (ILCR) and Health Index (HI) values for the two local populations using site-specific population data. These results were compared to analyses conducted using U.S. Environmental Protection Agency default values in an effort to determine their applicability to assessments of risks in non U.S. populations. Funded by the Thomas F. Jeffress and Kate Miller Jeffress Memorial Trust, Science Museum of Virginia, and University of Richmond.

CHARACTERIZATION OF BACTERIA FROM A SOLAR SALTERN IN PUGLIA, ITALY. C.L. Milstead, K. Ku, C.D. Litchfield. Dept. Environmental Sciences and Policy, George Mason Univ., and Oakton High School. Many halophilic organisms are known to thrive in high saline environments, aiding in the evaporation of the water by their natural metabolic activities. This study examined the diversity and characterization of the halophilic microorganisms that were isolated from four different salt concentrations (5.1, 15.7, 20.2, and 28) in the Salina Margherita di Savoia in Italy. Serial dilutions were performed for each sample and were plated on four different media with four different salt concentrations (16 different media per sample). Growth was recorded as the total colony forming units (TCFU) as well as the colony size and color; reactions to gram stain, motility, catalase and Kovac's oxidase, and whether the organisms had the ability to reduce nitrate to nitrite. Oxidative or fermentative metabolism was noted according to the Hugh Liefson test on glucose, lactose, fructose, sucrose, and mannose. Cultures were also tested for their sensitivity to penicillin, chloramphenicol, rifampicin, streptomycin, nalidixic acid, erythromycin, kanamycin, and ampicillin. Lipids were extracted for thin-layer chromatography to distinguish Bacteria from Archaea. The resulting data were analyzed using the Simple Matching Similarity Coefficient to separate the different clades in the almost 100 strains studied.

IMPACT OF LAND USE ON FECAL COLIFORM LEVELS IN SURFACE WATERS OF FAIRFAX COUNTY, VIRGINIA. Judith A. Buchino, Department of Environmental Science and Policy, George Mason University, Fairfax, VA 22030-4444. The purpose of this research is to

investigate the problem of elevated fecal coliform levels in surface waters of Fairfax County and to investigate the role of land use in explaining the problem. The objectives of this project are to provide an in depth analysis of the Fairfax County Health Department monitoring data, both the fecal coliform data and the chemical parameter data and relate them to land use. This significant body of data may be used in research to further investigate the relationships among other environmental data sets, particularly land use, precipitation, and imperviousness. This data set has been underutilized as a source of information about water quality beyond the immediate public health concerns. Making full use of this data set presents an opportunity for groundbreaking research with practical applications. The methodological approach is to develop a statistical model for each watershed. Multiple regression models are used to explain fecal coliform levels using water quality and environmental variables as explanatory variables. The results of this research can be used to enlighten the community on the importance of land use and its impact on water quality and to provide guidance to watershed managers, urban planners, and other government officials for water quality implementation plans and land use management.

DETERMINING POPULATION STRUCTURE OF ESTUARINE BOTTLENOSE DOLPHINS IN SOUTHEASTERN VIRGINIA Kevin M Foss & James R Reed, BCES Dept., Christopher Newport University, Newport News, VA 23606. The Elizabeth and Lower James Rivers represent a unique habitat for bottlenose dolphins (*Tursiops truncatus*). This species is migratory in this area, appearing in late spring through fall. Our studies were undertaken from May to August 2000, January through December 2001 and May through November 2003. Photoidentification allowed for population estimates to be made. In addition to manual matching of individuals, the program FinScan was used to increase the efficiency of the matching process. Many of the animals identified have been matched with catalogs from North Carolina and are seen in winter there. Our population estimates show a population of approximately 700 animals, which use the area in small groups for short periods only. The sighting probability peaks in mid to late summer. The size of the groups is larger than seen along the oceanic waters, and significantly larger than those found in the southern resident stocks. The group size varies over the season, with a single or pairs of animals seen in the first two months, and a peak of 40 in July. The annual mean group size is 25.11. The percentage of neonates sighted falls within the species mean, indicating a reproductive capacity similar to other stocks.

EVALUATION OF A CONSTRUCTED WETLAND MITIGATION AREA IN SPOTSYLVANIA COUNTY, VIRGINIA. Catherine R. Otey, Michael L. Bass, and Laura R. Winter, Department of Environmental Science and Geology, Mary Washington College, Fredericksburg, VA. As part of a wetland mitigation performance review required in permits issued by the Virginia Department of Environmental Quality (VDEQ) and the U.S. Army Corp of Engineers (USACE) for site work disturbance of wetland areas associated with the construction of a large business and commercial park, a woody stem count was completed in the Summer of 2002 and 2003. Comparison of the number of trees in each section and the total trees per acre showed a dramatic increase in 2003 over trees counted in 2002. The entire 2.07 acres was grided-off into 20x20 ft sections and the trees in each grid were counted and identified. Damage to parts of the wetland from ATV activity prior to Summer 2002 was obvious. The tree count per acre in 2002 did not meet the required 400 trees per acre. In 2003 the count had risen to 695 trees per acre putting the wetland area in compliance. Herbaceous wetland species in 2002 was listed at 23 and in 2003 increased to 50 species. Water quality data indicated pH ranged from 6.2 to 6.7 and DO near saturation. Performance evaluation continues.

IMPACT OF ROAD CONSTRUCTION ON WATER QUALITY PARAMETERS IN TWO SMALL STREAM TRIBUTARIES OF THE RAPPAHANNOCK RIVER. Michael L. Bass, Timothy A. Jordan, Department of Environmental Science & Geology, Mary Washington College and Mary Lou Daniel, Occoquan Water Quality Monitoring Lab of Va. Tech. As part of a continuing water quality monitoring program evaluating the impact of the construction of a large commercial and business development on small stream tributaries to the Rappahannock River, water quality

parameters were tested seasonally. This report compares the results found in the Summer 2001, prior to construction with those found in Summer 2003 after construction activity has been occurring over a year. During the Summer 2001 the area had been in an extended drought condition, however the next year saw frequent heavy rainfall beginning in late Spring 2002 and continuing thru the present. Because the rainfall was up and the water temperatures were lower than in Summer 2001, the DO levels were higher and continued to be above 70% saturation. Total Suspended Solids were consistently higher in the upstream stations 1, 2, 3, and 4 that were most directly impacted by road construction Phosphates were higher while nitrates were constant. Fecal coliforms were higher at stations impacted by domestic animals with direct stream access. Evaluation and comparisons continue.

EFFECT OF NEW ROAD CONSTRUCTION ON THE MACROBENTHIC COMMUNITIES IN TWO SMALL STREAM TRIBUTARIES OF THE RAPPAHANOCK RIVER. Timothy A. Jordan, Michael L. Bass, Emma B. Law and Robert H. Strickler, Dept. Environmental Science & Geology, Mary Washington Coll., Fredericksburg, VA. This study assessed the ecological damage inflicted on England Run and the Unnamed Tributary influenced by construction of the Celebrate Virginia project in Stafford County, VA. Research conducted included the study of macrobenthic communities and water chemistry analysis on eight stations located on England Run and the Unnamed Tributary based upon a baseline study in Summer 2001 versus current construction in Summer 2003. Metrics of analysis included the Hilsenhoff Family Biotic Index (HBI), the percent EPT, trophic relationships, and population distribution. The HBI illustrates the amount of organic pollution present, where all stations except station 4 and 6 showed a decrease in water quality. Similarly, percent EPT as a measure of ephemeroptera, plecoptera, and trichoptera present found significant decreases at all stations. Trophic analysis provided that all trophic groups were present at all stations. However, population distribution among all stations reveals an overall thirty percent decrease in number of organisms collected. Ecological damage has occurred and is evident at all stations where only time and better management of the watershed can mend the damage inflicted.

Geography & Geology

(Meeting together)

No Abstracts Submitted

Materials Science

(concurrently with Astronomy, Mathematics & Physics)

MORPHOLOGY OF SILICIDE NANOWIRES STUDIED BY ATOMIC FORCE MICROSCOPY. L. Hussey, M. Sievert & A. A. Baski, Dept. of Physics, Virginia Commonwealth Univ., Richmond VA 23284-2000. In this study, we use Atomic Force Microscopy (AFM) to study gadolinium (Gd) induced nanowires on a silicon surface. Gd is a rare earth metal that has been shown to produce nanowires on silicon surfaces. Nanowires are nanoscale structures with a width of approximately 4 nanometers and lengths ranging from 30-400 nanometers. In our work, Gd is deposited on a special Si crystal orientation, Si(113), in an ultra-high vacuum chamber. The metal is evaporated from a filament to the Si surface then annealed at a high temperature (600°C). Samples are removed from vacuum for AFM study. AFM produces topographical images of surfaces by measuring the forces between a cantilever and sample. Once nanowires are located on the surface, a series of images (2-100 μm) are taken to determine nanowire size and density as a function of Gd coverage and temperature. (Supported by: National Science Foundation).

ATOMISTIC SIMULATION OF HYSTERESIS BEHAVIOR OF NI-TI SHAPE-MEMORY ALLOY. Robert E. Major¹, William S. Galinaitis² & Jason D. Powell¹, Life Sciences Division (Department of Chemistry)¹ and Dept. of Mathematics², Ferrum College, Ferrum VA 24088. Shape memory alloy actuators exhibit positioning errors due to the hysteresis effect. In NiTi, the hysteresis is attributed to a martensitic phase change in the material that affects its total energy. Our research developed an atomic-level model for the thermodynamic processes related to the hysteresis behavior of NiTi actuators. Using Accelrys MS Model, we constructed molecular models of the twinned martensite, strained martensite and austenite polymorphs of NiTi. After running energy calculations on each structure using the DMol3 force field, we found that the energy of the strained martensite (2587 kJ/mol) was greater than that of the twinned martensite (2486 kJ/mol). We also found that the austenite structure (2878 kJ/mol) had the greatest energy as expected. Future work involves the development of phase transition energy profiles for each transformation to determine activation barriers. This study was funded in part by NSF, VAS, and Ferrum College.

NONLINEAR OPTICAL PROPERTIES OF SILICA NANO AEROGELS. K. Lee¹, J. T. Seo¹, S. Ma¹, P. Muhoro¹, B. Tabibi¹, S. Kim², & K. Yoo², ¹Dept. of Physics, Hampton Univ., Hampton VA 23668, ²Dept. of Chemical Engineering, Sogang University, Seoul Korea. Recently, Silica nanoaerogels (SNAs) have drawn considerable attention in nonlinear optical applications of battlefield enhancement and homeland security for eye and sensor protections. Transparent, hydrophilic, low-density nanostructure SNAs were synthesized through two-step sol-gel process and low temperature supercritical fluid dry. The average pore size, specific surface area and apparent density of SNAs were ~ 40 nm (mesopores), ~ 780 m²/g, and ~ 0.07 g/cm³, respectively. The colloidal particle in polymer-like SNAs chain was estimated to be ~ 4 nm. The nonlinear refraction coefficient of the third-order susceptibility of SNAs was estimated to be $\sim -1.5 \times 10^{-15}$ m²/W ($\sim -3.67 \times 10^{-9}$ esu) by a single-beam z-scan spectroscopy with ~ 1 ps Ti:Sapphire laser at ~ 800 nm wavelength. The third-order nonlinear refraction coefficient of nanostructure SNAs is almost five orders larger than the nonlinear (χ^3) refraction of bulk material. The large nonlinear refraction with high nonlinear figure of merit (≥ 187) of SNAs is an ideal materials property for nonlinear optical applications of ultrafast optical power limiting. (Supported by: Army Research Laboratory, Army Research Office, and National Science Foundation).

CALCULATION FOR A NANOPARTICLE DIELECTRIC, THIN-FILM CAPACITOR. Gregory A. Topasna, Dept. of Physics and Astronomy, Virginia Military Institute, Lexington VA 24450. A capacitor device with close-packed dielectric spheres is modeled. One conducting electrode is deposited onto the upper-half of the dielectric spheres and the other is a flat conductor touching the spheres. Capacitance density expressions for the cases of single and multiple layers show an increase above that of the parallel plate capacitor that has the same dielectric thickness. The largest increase is $\sim 23\%$ for a single layer of spheres. The capacitance density decreases as the number of sphere layers increases, eventually approaching the capacitance density of a parallel plate capacitor for a large number of spheres. The ratio of the capacitance density of the spherical dielectric device to that of the parallel plate capacitor is independent of the average diameter of the spheres used in the device.

SYNTHESIS AND OPTICAL SPECTROSCOPY OF CdSe NANOCRYSTALS. S. Ma¹, J. T. Seo¹, K. Lee¹, P. Muhoro¹, B. Tabibi¹, and W. Yu², ¹Dept. of Physics, Hampton Univ., Hampton VA 23668 and ²Department of Chemistry, Rice Univ., Houston TX 77251. Cadmium Selenide (CdSe) semiconductor nanocrystals (NCs) are of great interest in optical applications of optical power limiters, flexible full color displays, and stimulated emission devices. The bandgap and emission tunability of CdSe NCs can be determined by simply changing the size of NCs. High optical quality CdSe semiconductor NCs were synthesized with chemical colloidal reactions for nonlinear optical applications. The typical average of TOPO-passivated colloidal CdSe NCs was from 2 to 4.6 nm. Because of the narrow NCs size distribution, the absorption spectra had a strong blue-shift, and exhibited discrete features because of transitions coupling electron quantized states. The nonlinear

absorption and nonlinear refraction of an extreme low concentration ($\sim 3.2 \times 10^{-7}$ mol/L) of CdSe NCs in toluene were evaluated to be $\sim 4.6 \times 10^{-15}$ W/cm, and $\sim 2 \times 10^{-15}$ cm²/W. The nonlinear figure of merit of CdSe in toluene was estimated to be ~ 0.58 at ~ 775 nm. The possible physical origins of optical nonlinearity of CdSe NCs are two-photon resonant electronic process, one-photon resonant electronic process, and photoexcitation of free carriers. (Supported by: Army Research Laboratory, Army Research Office, and National Science Foundation).

MECHANISTIC SIMULATION OF POLYOXOMETALATE ADSORPTION ON SILVER (AG(111)) SURFACES. Jason D. Powell, Life Sciences Division (Dept. of Chemistry), Ferrum College, Ferrum VA 24088. Polyoxometalates are well known to adhere to metal surfaces from acidic aqueous solution. The amorphous surface phase α -PVT/Ag is formed by the essentially irreversible adsorption of α -PVW₁₁O₄₀⁵⁻ (PVT(5-)) molecules on the Ag(111) surface. This process was modeled as a random sequential adsorption process (RSA) simulated using the Monte Carlo technique. Adsorption sites were chosen randomly, and simple nearest-neighbor exclusion was applied to determine whether adsorption occurred at a site. When a molecule was placed on the lattice, the orientation of the next molecule determines the closest allowed distance of approach. By applying periodic boundary conditions on a 128×128 hexagonal lattice, the saturation coverage of PVT molecules was determined for several different iterations. The resulting saturation coverage for a PVT/Ag was 2.6×10^{13} molecules/cm². The average saturation coverage obtained was $(4.29 \pm 0.04) \times 10^{13}$ molecules/cm². The theoretical coverage was significantly larger (by a factor of 1.7) than the experimental saturation coverage. Presumably, the lower coverage observed by STM can be explained by electrostatic repulsion. This study was funded in part by DOE and Ferrum College.

MICROSTRUCTURAL CHANGES IN MICROELECTRONIC THIN FILM CONDUCTORS WITH CURRENT FLOW. K. A. Pushee, K. E. Tinklepaugh & S. C. Matts, Dept. of Physics, Mary Washington College, Fredericksburg VA 22401-5358. As thin film metallic conductors in microelectronic devices shrink in size, they are subjected to increasingly large current densities (10^5 to 10^6 A/cm²). A larger number of electrons can dislodge the atoms that line a film's grain boundaries and other surfaces through momentum transfer. We track the subsequent material transfer by monitoring early surface damage and roughening in 40 μ m wide Al conductors in an effort to relate the damage to the material's ionic drift velocity. This requires the use of a unique sample structure, automated electrical testing and extensive digital image analysis of optical micrographs. The analysis of data collected over the past year suggests a polynomial dependence of electromigration damage on current density as well as on time of current application. The former result adds to the body of data suggesting that the drift velocity is not linear with current density as was once thought. The latter result may indicate that metal movement is governed initially by surface diffusion followed by a stronger grain boundary diffusion component. If ways to decrease the drift velocity can be pinpointed, device longevity can be enhanced. The theoretical underpinnings, experimental philosophy and results as well as laboratory facilities available for this task will be presented.

EXPERIMENTAL SYNCHRONIZATION OF CHAOS IN DIODE LASERS WITH POLARIZATION-ROTATED FEEDBACK AND INJECTION. Karen L. Blackburn¹, Allison R. Spain¹, Katherine J. Babcock¹, Jake V. Bennett² & David W. Sukow¹, Dept. of Physics and Engineering, Washington and Lee Univ., Lexington VA 24450 and Dept. of Math, Computer Science, and Physics, Roanoke College, Roanoke VA 24153. We demonstrate experimental chaos synchronization between two semiconductor lasers. The transmitter laser is driven into chaos using time-delayed optical feedback whose linear polarization state has been rotated orthogonal to that of the transmitter's output. Synchronization of the receiver is accomplished by unidirectional optical injection also using a polarization-rotated beam. Due to the insensitivity of this system to the phase of the optical field, we obtain high-quality synchronization even between relatively dissimilar lasers and over a wide range of operating conditions. Time series, rf spectra, and synchronization plots of the data demonstrate the chaos synchronization, confirmed by high correlation coefficients of

0.85. We also find that the time lag of the receiver laser when synchronized is longer than predicted theoretically, leading to a new avenue of investigation. This work is supported by the Virginia Academy of Science, the W. M. Keck Foundation, and the National Science Foundation.

SPECTROSCOPY OF STIMULATED RAMAN SCATTERING AND RAMAN LASER DEVELOPMENT OF BARIUM NITRATE. P. Muhoro,¹ B. Tabibi,¹ C. Rankins,¹ J. T. Seo,¹ S. Ma,¹ K. Lee,¹ and Roopchan Ramdon,² ¹Department of Physics, Hampton Univ., Hampton, VA 23668 and ²Dept. of Physics, Benedict College, Columbia SC. Stimulated Raman scattering (SRS) in solid-state materials has been widely studied to generate new optical frequencies. SRS allows the laser frequency to be changed by a specific frequency shift that is determined by the spontaneous Raman spectra of a nonlinear laser material. Crystalline barium nitrate has a strong Raman vibrational mode at a frequency of $\sim 1047 \text{ cm}^{-1}$ at room temperature. The first and second Stokes of barium nitrate were at $\sim 563 \text{ nm}$ and $\sim 599 \text{ nm}$ by exciting with a frequency-doubled Nd:YAG laser with $\sim 6 \text{ ns}$ pulse width. Laser performance of barium nitrate was carried out using a Plano-concave laser cavity. An uncoated barium nitrate crystal ($10 \times 10 \times 5 \text{ mm}^3$, Crystal Associates) was pumped longitudinally along the 5-mm dimension in a cavity consisting of a curved output mirror ($r = 1 \text{ m}$, $T = 23.3\%$ at 563 nm , $R = 98.5\%$ at 532 nm) and a flat mirror ($R = 99.5\%$ at 563 nm , $T = 12.9\%$ at 532 nm). The slope efficiency and laser threshold of barium nitrate Raman laser at 563 nm were $\sim 13\%$ and $\sim 7 \text{ mJ}$.

MODELING A PIEZOELECTRIC ACTUATOR USING A RATE DEPENDENT HYSTERESIS OPERATOR. Dan D. DeJarnette & William S. Galinaitis, Dept. of Math. and Comp. Sci., Ferrum College, Ferrum VA 24088. This paper presents a rate dependent hysteresis model for a piezoceramic stack actuator. The model uses many of the basic concepts associated with the classical rate independent Preisach operator. However, the new model differs significantly from the classical approach by using an elementary operator that exhibits a rate dependent behavior versus the rate independent response of the standard relay operator. For this work, a resistor-capacitor (RC) circuit model is used for the elementary operator and the capacitive charge is associated with elemental displacement. The time dependent displacement of the actuator is then represented as a function of the total capacitive charge that results from the cumulative effect of charging and discharging a large number of elemental capacitive circuits. The capability of the rate dependent actuator model is investigated by developing a discrete approximation to the continuous operator in a manner similar to the discrete form of the Preisach operator. Experimental data are then used to identify the relay parameters and additional data collected at several input rates are used to test the model's behavior. (Supported by: NSF RUI 0105190).

STIMULATED PHOTON-PHOTON SCATTERING IN VACUUM FOUR-WAVE MIXING. H. Brown, O. Baker, S. Ma & J. T. Seo, Dept. of Physics, Hampton Univ., Hampton VA 23668. Quantum electrodynamics (QED) predicts the existence of a nonlinear interaction between electromagnetic fields in vacuum. The vacuum is, in fact, a polarizable continuum. The nonlinearity effects are caused by the vacuum polarization. Powerful ultrafast (femtosecond) laser pulses provide an opportunity for studying QED phenomena in intense laser beam electromagnetic fields and four-wave nonlinear optical mixing process in vacuum. The third-order nonlinear photon scattering in vacuum by the interaction of three intense ultrafast laser beams is predicted. We have theoretically approached the nonlinear four-wave mixing in vacuum and compared with the nonlinear effects in a medium.

FABRICATION OF POLYMER-BASED MICROFLUIDIC DEVICES. ¹A. C. Bonhivert, ¹B. H. Augustine, ²W. C. Hughes, ¹Dept. of Chemistry, James Madison Univ., ²Dept. of Physics, James Madison Univ., Harrisonburg, VA 22807. The development of microfluidic devices has been of great interest for biomedical devices in recent years. The purpose of this project is to demonstrate a methodology to produce such a device that will be readily manufacturable, portable, and

inexpensive. Many microfluidic devices reported in the literature are fabricated from glass. We have developed a technique to produce them out of optical grade poly methyl methacrylate (PMMA). This has many potential advantages compared to glass in the manufacturing of the device. We have produced devices containing a 100 μ m wide, 50 μ m deep, and 4" long channel that allows approximately 1mm³ of rhodamine fluorescent dye to flow through using capillary action or along with the aid of a pump system. Preliminary electro osmotic flow (EOF) measurements indicate very low EOF due to the hydrophobic surfaces in PMMA. These devices have potential application in DNA separation. We will discuss the possibilities of making a more efficient device and treating the interior surface of the channel so that components of a fluidic sample can be separated. This work partially funded by NSF REU grant DMR-0097449.

Poster Session

UNDERGRADUATE RESEARCH IN LASER OPTICS AND THIN FILMS AT THE VIRGINIA MILITARY INSTITUTE. Daniela Marciu Topasna, Stacey K. Vargas & Gregory A. Topasna, Dept. of Physics and Astronomy, Virginia Military Institute, Lexington VA 24450. The Virginia Military Institute (VMI) is currently in an aggressive movement to enhance and encourage undergraduate research. As a result of this research initiative, VMI has invested significantly to develop a laser optics and a thin films research facility to support undergraduate as well as faculty research in the Department of Physics and Astronomy. In the department, the initiative is also aimed at educating and training cadets with skills and knowledge in the field of optics and thin films that will be applicable and marketable in their future military or civil careers. The equipment in both laboratories includes pulsed Nd:YAG laser with frequency doubling and tripling capabilities, dye laser system and air-cooled argon ion laser, materials microscope, Atomic Force and Scanning Tunneling Microscopes, Thin Film Measuring System, and UV/VIS/NIR spectrophotometer. We have ongoing research projects involving faculty and cadets in the areas of laser spectroscopy of rare earth and transition metal doped garnets, organic thin films applications for optical limiting and electro-optic devices, and thin film electronic devices.

Medical Science

SYNERGISTIC EFFECTS BETWEEN SUBCUTANEOUS CLONIDINE AND YC-30 IN THE TAIL-FLICK ASSAY. S. Young, A. Wesolowska & M. Dukat, Department of Medicinal Chemistry, Virginia Commonwealth University, Richmond VA 23298. Previously we showed that *meta*-chlorophenylguanidine (MD-354) displays equipotent affinities for serotonin 5-HT₃ receptors (K_i=35 nM) and α_{2B} -adrenergic receptors (α_{2B} -AR) (K_i=25 nM), but somewhat lower affinity for α_{2A} - and α_{2C} -ARs. Both 5-HT₃ and α_2 -adrenergic receptors have been implicated as playing a role in pain. Even though (s.c.) MD-354 did not produce antinociception in the mouse tail-flick assay, a combination of an inactive dose of the analgesic agent clonidine (0.25 mg/kg, MPE=13%) with an inactive dose of MD-354 (10 mg/kg, MPE=8%) potentiated (MPE=83%) the antinociceptive effects of clonidine. In order to understand the potentiation mechanism of clonidine by MD-354, an analog with a different binding profile was synthesized and examined. YC-30 (3,4,5-trichlorophenylguanidine) displays 50 times higher affinity for 5-HT₃ receptors than MD-354 and no selectivity among α_2 -adrenergic receptors. In the mouse tail-flick assay, YC-30 (0.003 – 30 mg/kg) failed to produce antinociception but it was 300 times more potent than MD-354 in potentiating the antinociceptive effects of an inactive dose of clonidine. [American Cancer Society IRG-73-001-28]

AGING CAUSES ELEVATED INTRACELLULAR CALCIUM LEVELS AND ALTERED CALCIUM HOMEOSTATIC MECHANISMS IN HIPPOCAMPAL NEURONS. L.S.Deshpande¹, M.Raza², R.E.Blair², S.Sombati² & R.J.DeLorenzo^{1, 2} Depts. of Pharmacology-Toxicology¹, Neurology² Virginia Commonwealth University, Richmond, VA. Aging is associated with increased

vulnerability to neurodegenerative diseases and greater neuronal deficits after stroke and epilepsy. Recent evidence demonstrates increased expression of voltage gated calcium channel proteins and associated Ca^{2+} currents with aging. However, a direct comparison of $[\text{Ca}^{2+}]_i$ levels and Ca^{2+} homeostatic mechanisms in neurons acutely isolated from young and old animals has not been performed. In this study using Fura-2 Ca^{2+} imaging, we demonstrate that in comparison to young neurons, older neurons manifest statistically significant elevations in $[\text{Ca}^{2+}]_i$ levels. There appears to be an apparent shift towards higher $[\text{Ca}^{2+}]_i$ levels in older neurons. When challenged with a $[\text{Ca}^{2+}]_i$ load (50 μM glutamate, 1-min), older neurons took longer to remove the excess $[\text{Ca}^{2+}]_i$, indicative of altered Ca^{2+} homeostatic mechanisms. These results demonstrate that older neurons manifest both increased $[\text{Ca}^{2+}]_i$ and altered Ca^{2+} homeostatic mechanism. These alterations in calcium dynamics may render older neurons more vulnerable to brain injury and neuronal cell death. Support: Milton L. Markel Alzheimer's disease Research Fund to RJD.

LEUKOCYTE RECRUITMENT AND CDNA MACROARRAY ANALYSIS OF INFLAMMATORY GENE EXPRESSION IN INTERLEUKIN-3 DEFICIENT AND WILD-TYPE MICE DURING ACUTE PERITONITIS. Ju-Han Chang & Chris S. Lantz, Dept. of Biol., James Madison Univ., Harrisonburg, VA 22807. Inflammation is a complex protective response to infection or tissue injury involving accumulation of white blood cells (WBCs), plasma proteins, and fluid. Acute peritoneal inflammation can be induced in mice by injection of zymosan, a cell wall component of *Saccharomyces cerevisiae*. Zymosan-induced inflammation is associated with cytokine production, complement activation, and mast cell activation, and is characterized by a rapid influx of WBCs from the circulation into the peritoneal cavity. To investigate the role of interleukin-3 (IL-3) in this model of acute inflammation, IL-3 $-/-$ and $+/+$ mice were injected I.P. with zymosan or with PBS as a control. 4 hrs later, peritoneal cells were collected, total WBC counts performed, and pooled samples of total RNA used for analysis of gene expression by macroarray. We found that several inflammatory genes (CXCR-2, IL-1 β , IL-1R2, MIP-1 α , MIP-1 β , and IP-10) are up-regulated following stimulation with zymosan; however, no differences exist between IL-3 $-/-$ and IL-3 $+/+$ mice. Likewise, IL-3 $-/-$ and $+/+$ mice showed equivalent zymosan-induced elevations in total peritoneal WBC numbers.

A MUTATION INACTIVATING THE MITOCHONDRIAL INNER MEMBRANE FOLATE TRANSPORTER CREATES A GLYCINE REQUIREMENT FOR SURVIVAL OF CHINESE HAMSTER CELLS. E.A. McCarthy, S.M. Taylor, C. Jackson-Cook, and R.G. Moran. Virginia Commonwealth University, Richmond, VA 23298. A mutant Chinese hamster ovary cell line, glyB, which required exogenous glycine for survival and growth, was previously reported by Kao et al (1969). We now report that the defect in glyB cells causative of this phenotype is a point mutation in an inner mitochondrial membrane protein required for transport of folates into mitochondria. The single nucleotide change identified in glyB cDNA introduced a glutamate residue in place of glycine found in wild-type mft at codon 192. Transfection of the wild type hamster cDNA into glyB cells allowed cell survival in the absence of glycine and the accumulation of folates in mitochondria; transfection of the Glu192 cDNA did not. Genomic sequence analysis and fluorescence in-situ hybridization demonstrated a single mutated allele of the *mft* gene in glyB cells. We conclude that we have defined the cause of the glyB auxotrophy and that the glyB mft mutation identified a region of this mitochondrial folate carrier vital to its transport function.

T CELLS EXPOSED TO 2,3,7,8-TETRACHLORODIBENZO-*p*-DIOXIN (TCDD) UNDERGO APOPTOSIS AND FAIL TO REPLICATE FOLLOWING SUPERANTIGEN CHALLENGE. L. Faulconer², I. Camacho¹, M. Nagarkatti¹ & P.S. Nagarkatti², ¹Dept. of Microbiol. & Immunol. and ²Dept. of Pharmacol. & Toxicol., Virginia Commonwealth University, Richmond, VA 23298. The mechanism by which TCDD, an environmental pollutant decreases immune response is not clear. This study investigated division of TCDD-exposed T cells activated with staphylococcal enterotoxin A (SEA) by labeling with 5,6-carboxyfluorescein diacetate succinimidyl ester (CFSE). V β 3/V β 11 expression was used to identify SEA-responsive T cells and TUNEL assay to detect apoptosis. C57BL/6 mice were injected with TCDD i.p. followed by SEA into hind foot pads. Draining lymph

nodes (LN) were harvested on days 1-4 and analyzed following *in vitro* culture. Results showed that TCDD-exposed lymphocytes exhibited reduced cell divisions, even after reactivation *in vitro*. TCDD exposure decreased the percentage and total numbers of V β 3+ and V β 11+ T cells and increased the levels of apoptosis in these cells. These data demonstrate that TCDD-induced apoptosis in SEA-activated T cells *in vivo* may account for decreased cell division and a consequent immunosuppression. (This work was supported in part by grants from NIH AI053703, AI058300, & ES09098)

ANALYZING LOCAL CORN AND SOY CONSUMER FOOD PRODUCTS FOR PREVALENCE OF CRY 1 AND CP4 EPSPS PROTEINS. Consuelo J. Alvarez and Adrienne R. Hampton, Dept. of Nat. Sci., Longwood Univ., Farmville VA, 23909. Genetically modified corn and soy seeds have been approved for food and feed by the USDA in the 1990's. Product labels, however, are not required to inform potential consumers that the food contains genetically modified components. Though no allergic reactions to Cry1 or CP4 EPSPS proteins have been reported, concerns have arisen regarding regulatory measures applied to genetically modified foods and has become the focus of novel investigations. The goal of this research is to begin a data bank of locally available foods exhibiting the genetic modifications conferred by Cry1 gene from *Bacillus thuringiensis* coding for δ -endotoxins with specific pesticidal activity or by the gene encoding CP4 EPSPS protein of *Agrobacterium* with resistance to herbicides. The data bank will serve as a resource for consumer education and future reference should food allergies be reported. Polymerase Chain Reaction, which requires samples of DNA from the foodstuff being analyzed, is used to detect the Cry1 and CP4 EPSPS genes. To date, DNA has been successfully extracted from 15 out of 29 corn and soy samples. Genetic modifications have been found in 2 of the 9 corn samples and in 1 of the 6 soy samples.

THE SYNERGISTIC INTERACTION BETWEEN 5-HT₃ ANTAGONISTS AND CLONIDINE ON SPINALLY-MEDIATED ANALGESIA IN MICE. A. Wesolowska & M. Dukat, Department of Medicinal Chemistry, Virginia Commonwealth University, Richmond, VA 23298. m-Chlorophenylguanidine (MD-354) binds equally well at serotonin 5-HT₃ (K_i=35 nM) and α_{2B} -adrenergic (K_i=25 nM) receptors. Both receptors have been implicated as playing a role in antinociception. Although, MD-354 (s.c.) was inactive as an analgesic in the tail-flick assay in mice, a combination of an inactive dose of the antinociceptive agent clonidine (0.25 mg/kg, MPE=13%) with an inactive dose of MD-354 (10 mg/kg, MPE=8%) produced a supra-additive antinociceptive effect (MPE=83%). In consideration of the 5-HT₃ partial agonist properties of MD-354, it was of interest to determine if the potentiating effect of MD-354 on clonidine is associated with its 5-HT₃ agonist or antagonist activity. Due to a lack of brain-penetrant 5-HT₃ agonists, combinations of an inactive dose of clonidine with available 5-HT₃ antagonists (s.c.) (tropisetron and zacopride) were examined. Tropisetron (0.2 mg/kg, MPE=0%) and zacopride (0.01 mg/kg, MPE=4%) potentiated the antinociceptive effect of clonidine (MPE=71% and 82%, respectively), suggesting that MD-354 potentiates the analgesic actions of clonidine at least in part through a 5-HT₃ antagonist mechanism. [American Cancer Society-IRG-73-001-28]

FUNCTIONAL PLASTICITY OF CANNABINOID RECEPTORS IN THE RAT PILOCARPINE MODEL OF ACQUIRED EPILEPSY. Katherine W. Falenski¹, Robert E. Blair², Laura J. Sim-Selley¹, Billy R. Martin¹, & Robert J. DeLorenzo^{1, 2}, Depts. Of Pharmacology/Toxicology¹ & Neurology², Virginia Commonwealth University, Richmond, VA. Recent studies have shown that the cannabinoid receptor is plastic in a rat model of epilepsy as measured by significant long-term increases in region-specific hippocampal CB₁ receptor protein expression. However, it has not been addressed whether there are subsequent alterations in functional receptor G-protein coupling. Therefore, we utilized WIN55,212-stimulated [³⁵S]GTP γ S autoradiography to assess CB₁-receptor-mediated G-protein activation. Analysis revealed that [³⁵S]GTP γ S binding in whole hippocampus was significantly greater in epileptic rats. It was also shown that [³⁵S]GTP γ S binding decreased in the dentate gyrus molecular layer, while binding in the stratum radiatum of CA1-CA3 increased.

These results indicate that epilepsy causes long-term plasticity changes in both the expression and function of the CB₁ receptor. The plasticity of the CB₁ receptor during epilepsy may play a crucial role in the anticonvulsant nature of cannabinoids and the role of this receptor in the pathophysiology of epilepsy. Support: RO1-NS23350, P50-NS25630, DA05274

MECHANISMS OF IL-2-INDUCED VASCULAR LEAK SYNDROME. Louise Melencio¹, Prakash S. Nagarkatti¹ & Mitzi Nagarkatti^{1,2}, Depts of ¹Pharmacology/Toxicology and ²Micro/Immuno, VCU, Richmond, VA. 23298. IL-2 is used to treat melanomas and metastatic renal cell carcinomas. IL-2 immunotherapy is highly effective in about 25% of patients, while in others, it induces severe toxicity resulting in Vascular Leak Syndrome (VLS), edema and respiratory distress. We wanted to explore why these differential responses occurred by using a murine model. Two strains of mice, Balb/c and C57BL/6, were treated with high doses of IL-2 and their responses were compared. Balb/c mice developed less VLS and exhibited decreased lymphokine activated killer (LAK) cell activity against endothelial cells and YAC-1 tumor cells when compared to C57BL/6 mice. IL-2 treatment led to increased CD8+ and CD4+ T cells in both strains. Also, in Balb/c mice, there was a marked increase in CD4+CD25+ T cells known as T regulatory cells. Furthermore, C57BL/6 had greater upregulation of CD44 expression following IL-2, which has been implicated in endothelial cell injury leading to VLS. Overall, the current study suggests that there are strain specific differences in IL-2 induced toxicity in mice, which may explain the differential response observed in patients (NIH Support: AI053703, AI058300, HL058641).

THE 5-HT₆ ANTAGONIST MS-245 MODULATES THE DISCRIMINATIVE STIMULUS EFFECTS OF (+)AMPHETAMINE. Tatiana S. Bondareva, Manik R. Pullagurla, Richard Young & Richard A. Glennon, Department of Medicinal Chemistry, Virginia Commonwealth University, Richmond, VA 23298. 5-HT₆ serotonin receptors, often found associated with dopaminergic terminals in brain, might play a role in the action of antipsychotics, appetite control, and in cognitive dysfunction. It had been shown in biochemical studies that 5-HT₆ antagonists potentiate the effect of (+)amphetamine, but produce no amphetamine-like effect themselves. In order to determine if such findings could be extended to the stimulus properties of dopaminergic agents, we examined the effect of MS-245 in rats trained to discriminate (+)amphetamine (1.0 mg/kg; ED₅₀ = 0.3 mg/kg) from saline vehicle. MS-245, an agent developed in our laboratories, is one of the few available 5-HT₆ antagonists. MS-245 failed to substitute for (+)amphetamine in stimulus generalization tests. However, MS-245 potentiated the stimulus effects of 0.3 mg/kg (i.e., the ED₅₀ dose) of (+)amphetamine such that the combination resulted in stimulus generalization. 5-HT₆ antagonists in combination with low doses of dopamine releasing agents might be of use in the treatment of Parkinson's disease while at the same time reducing the side effects associated with dopamine agents. [Supported in part by MH 60599]

MAST CELL DEVELOPMENT AND PARASITE IMMUNITY IN MICE WITH A SIMULTANEOUS DISRUPTION OF IL-3 AND IL-4R. James W. Chumley, Robert.P. Stewart, and Chris S. Lantz, Dept. of Biol., James Madison Univ., Harrisonburg, VA 22807. Mice infected with the gastrointestinal nematode *Nippostrongylus brasiliensis* (*N.b.*) elicit a vigorous T cell mediated immune response that is characterized by elevated IgE levels, eosinophilia, and an intestinal mastocytosis. It has been shown that interleukin (IL)-3 ^{-/-} mice express defects in mast cell development, and that IL-4R α ^{-/-} mice display impaired immunity to infection with *N.b.* We examined the individual and synergistic roles of IL-3 and IL-4 during *N.b.* infection using IL-3 ^{-/-}, IL-4R ^{-/-}, and IL-3/ IL-4R α double-deficient mice. All mice were infected with *N.b.* and parasite eggs production was quantified during the length of the infection in order to assess the immune response. As expected, IL-3 ^{-/-} mice expelled the parasites relatively early following infection, whereas IL-4R ^{-/-} mice and IL-3/ IL-4R α double-deficient mice did not expel their parasites and were sacrificed at day 49. No differences in the kinetics of egg expulsion were detected throughout the response. This finding indicates that IL-4 has a much more profound effect on parasite expulsion

than does IL-3, and that IL-3 and IL-4 do not mediate redundant functions.

THE EFFECT OF OVEREXPRESSION OF HEAT SHOCK FACTOR 1 (HSF1) ON TELOMERASE ACTIVITY AND TUMORIGENICITY. Keith Jensen¹, Lynne Elmore² & Shawn Holt^{1,2,3}, Departments of Human Genetics¹ and Pathology², Virginia Commonwealth University, Richmond, VA. It has been shown that the key components of the hsp90 chaperone complex, including hsp90, p23, hsp70, hsp40, and HOP (p60), associate with telomerase; however, their specific role in tumor progression has yet not been defined. HSF1, the primary heat shock protein transcription factor, may affect transformation and tumorigenesis by regulating the expression of several hsp90 chaperone complex proteins in response to stress. In our *in vitro* model of prostate cancer progression, as cells convert from immortal (P69) to tumorigenic (M2182) and eventually metastatic (M12) capabilities, both telomerase activity and global chaperone protein levels increase, while mRNA levels of core telomerase components hTR and hTERT remain constant. We have shown that ectopic overexpression of HSF1 induces increased expression of endogenous hsp90. Furthermore, telomerase activity in the overexpressing HSF1 cell lines is increased as well. However, the increased telomerase activity does not correlate with increased tumorigenicity, as these cell lines fail to grow colonies in soft agar.

THE S(+)-OPTICAL ISOMER OF THE DESIGNER DRUG MDMA AS A DISCRIMINATIVE STIMULUS. A. Wesolowska, R. Young & R. A. Glennon, Department of Medicinal Chemistry, Virginia Commonwealth University, Richmond, VA 23298. The psychoactive drug MDMA ("Ecstasy") has a very complex and still unknown pharmacological mechanism that is not identical to the mechanisms of action of hallucinogens or central stimulants. Its psychoactive effects may also differ from those of its optical isomers. To characterize the actions of designer drugs, rats were trained to discriminate S(+)-MDMA (1.5 mg/kg) from saline. All agents displayed complete generalization to S(+)-MDMA with ED₅₀ doses as follows: S(+)-MDMA (0.55 mg/kg), (±)-MDMA (0.90 mg/kg), R(-)-MDMA (1.41 mg/kg), S(+)-MDA (0.55 mg/kg), R(-)-MDA (1.26 mg/kg), S(+)-PMMA (0.98 mg/kg), R(-)-PMMA (1.95 mg/kg). All tested agents, regardless of what other effects they might produce (MDA: hallucinogen, stimulant), or whether they lack the stimulant action of MDMA (PMMA) share a common stimulus component of actions. Perhaps stimulus differences between MDMA, MDA and PMMA are most notable when the training agent is either "purely stimulant-like" or "purely hallucinogen-like". [DA 01642]

INTERACTIONS OF CANNABINOID AND S1P RECEPTORS AND THEIR LIGANDS. M.P. Cassidy, L.J. Sim-Selley and D.E. Selley, Dept. of Pharmacology & Toxicology, VCU, Richmond VA 23284. The effects of D⁹THC, the psychoactive component of marijuana, are mediated by CB₁ cannabinoid receptors in brain. CB₁ receptors are also activated by the endogenous lysolipid anandamide. Similarly, S1P receptors are activated by the lysolipid S1P. Both receptors produce intracellular responses by activating G_{i/o} type G-proteins. The present studies examined potential interactions between CB₁ and S1P receptors and their ligands in brain. G-protein activation was measured by agonist-stimulated [³⁵S]GTPγS binding. Inhibition of adenylyl cyclase, a downstream effector of G_{i/o}, was measured by agonist inhibition of conversion of [³²P]ATP to [³²P]cAMP. Results in cerebellum show that CB₁ receptors produced less than additive stimulation of [³⁵S]GTPγS binding with S1P receptors, suggesting convergence on the same pool of G-proteins. However, unlike CB₁ receptors, S1P receptors did not inhibit forskolin-stimulated adenylyl cyclase in this region. In the hippocampus of CB₁ KO mice, cannabinoid agonists partially inhibited S1P stimulated [³⁵S]GTPγS binding in a dose-dependent manner, but this effect was not mediated through S1P₁ receptors as determined in a S1P₁ expressing cell line. Conversely, S1P competed for cannabinoid ligand binding in cerebellum, but not in CB₁ or CB₂ expressing cell lines. These results suggest that S1P and endocannabinoids may act in part through a common lysolipid receptor in brain.

INSULIN FEEDBACK ALTERS MITOCHONDRIAL ACTIVITY THROUGH A KATP-CHANNEL-DEPENDENT PATHWAY IN MOUSE ISLETS AND BETA-CELLS. Craig S. Nunemaker, Min Zhang, & Leslie S. Satin, Dept. of Pharm/Tox, VCU Medical Center, Richmond, VA 23298. Recent work suggests that insulin may exert both positive and negative feedback directly on pancreatic beta-cells. To investigate insulin's effects on metabolism, mouse islets and beta-cell clusters were loaded with rh123 to dynamically monitor mitochondrial membrane potential. Acute insulin application (100 nM) increased mitochondrial activity. The KATP channel opener diazoxide or the L-type calcium channel blocker nifedipine mimicked the effect of insulin. Further, treatment with forskolin, which increases endogenous insulin secretion, also mimicked the effect of applied insulin, suggesting physiological feedback. Pretreatment with nifedipine or the KATP channel inhibitor glyburide prevented the insulin effect, suggesting insulin acts along a KATP channel pathway. Together, these data suggest a feedback mechanism whereby insulin receptor activation opens KATP channels to close calcium channels and inhibit further secretion. The resulting reduction in beta-cell calcium increases the energy stored in the mitochondrial gradient that drives ATP production. Insulin feedback onto mitochondria may thus help to calibrate the energy needs of the beta-cell on a minute-to-minute basis.

APOPTOSIS AS THE PRIMARY MECHANISM OF CANNABINOID-INDUCED IMMUNOSUPPRESSION. Catherine A. Lombard¹, Prakash S. Nagarkatti², & Mitzi Nagarkatti¹, ¹Dept of Microbiology & Immunology, & ² Dept of Pharmacology & Toxicology, VCU Medical Center, Richmond VA 23298. Delta-9-tetrahydrocannabinol (THC) and other cannabinoids have been shown to cause immunomodulation and immunosuppression. Studies from our laboratory have shown that THC causes immunosuppression by triggering apoptosis in immune cells, suggesting its potential use in the treatment of autoimmune diseases. However the use of THC is still controversial due to its psychotropic side effects. In this study, we investigated whether the synthetic CB2-selective agonist JWH015 could be use as an alternative to THC to treat diseases of immune origin without causing psychotropic effects. We found that JWH015 inhibits proliferative response of splenocytes to mitogens *in vitro* via induction of apoptosis. In addition, JWH015 can trigger apoptosis in thymocytes *in vitro* through cross-talk between the death receptor and the mitochondrial pathways of apoptosis. Finally, we found that JWH015 is able to cause immunosuppression *in vivo*. Together this study suggests JWH015 as an ideal candidate in the treatment of autoimmune diseases as it causes immunosuppression without psychotropic side effects (NIH R01 ES09098, R21 DA014885, R01 DA016545).

DEVELOPMENT OF NOVEL 5-HT₆ SEROTONIN ANTAGONISTS. M. Lee, J. B. Rangisetty, M. Dukat & R. A. Glennon, Department of Medicinal Chemistry, Virginia Commonwealth University, Richmond VA 23298. 1-Naphthylpiperazines, which are structurally related to tryptamines, bind nonselectively at several populations of 5-HT receptors. Tryptamines can be made selective for 5-HT₆ receptors by introduction of certain substituents at the indole N₁-position. Several C₄-substituted naphthylpiperazine analogs were synthesized to compare their 5-HT₆ receptor affinities with those of their corresponding N₁-substituted tryptamines. Radioligand binding data showed that naphthylpiperazines bind at 5-HT₆ receptors, and that the 4-benzenesulfonyl substituted compound (K_i = 3.8 nM) had an affinity comparable to the previously reported, highly selective and potent tryptamine-based 5-HT₆ antagonist MS-245 (K_i = 3.1 nM). 4-(benzenesulfonyl)-1-naphthylpiperazine behaved as a 5-HT₆ antagonist (adenylate cyclase assay) and represents an example of a new class of 5-HT₆ antagonists. Unlike MS-245, the piperazine analog lacks a benzenesulfonamide bond and should be less prone to metabolic hydrolysis. [Supported in part by MH 60599]

HSP90 AND P23: A FUNCTIONAL ROLE IN TELOMERASE AND TELOMERES. Sarah A Compton & Shawn E Holt, Medical College of Virginia at VCU, Richmond VA 23228. Telomerase is the novel reverse transcriptase capable of maintaining telomere length by de novo synthesis of telomeric repeats onto chromosome ends. It is not expressed in most somatic cells however, 85%

of cancer cells express telomerase making it an important target for cancer therapies. Chaperone proteins including hsp90 and p23 were the first proteins shown to functionally associate with the telomerase enzyme. Using a cultured metastatic prostate cancer cell line, we have explored the role of these chaperones in telomerase and telomere regulation using both pharmacological and genetic (siRNA) inhibition of chaperone function. We confirm that chaperones are required for telomerase assembly and activity. More importantly, we demonstrate that cells with reduced chaperones undergo gradual telomerase independent telomere shortening resulting in delayed apoptosis due to critically short telomeres. We demonstrate that these cells have high levels of reactive oxygen species (ROS) due to uncoupling of nitric oxide synthase (NOS). And propose a model in which inhibition of hsp90 and/or p23 function uncouples NOS to increase levels of free radicals that attack telomeres and ultimately induce apoptosis as a consequence of prolonged telomere damage.

CANNABINOID RECEPTOR LIGATION TRIGGERS APOPTOSIS: A NOVEL MODALITY TO TREAT MALIGNANCIES OF THE IMMUNE SYSTEM. Jean H. Kim¹, Mitzi Nagarkatti² & Prakash S. Nagarkatti¹, ¹Dept. of Pharmacol. & Toxicol., ²Dept. of Microbiol. & Immunol., Virginia Commonwealth University, Richmond, VA 23298. Currently, treatment of cancer with radiation and/or chemotherapy targets not only cancer cells but also normal cells resulting in unwanted toxicity. A more specific targeting of cancers of the immune system arose with the discovery of CB2 cannabinoid receptors exclusively on such cells. This study examined whether cannabinoid analogs, O-1812 and O-2137, highly specific to CB1 and CB2 receptors, respectively, could induce apoptosis in EL-4 lymphoma cells and be used as anti-cancer agents. Exposure of EL-4 to either analog, *in vitro*, led to a reduction in cell viability as well as an increase in apoptosis in a dose-dependent manner. The apoptosis was induced through death receptor and mitochondrial pathways as evidenced by the cleavage of caspase-8 and 9, and the partial blockage of apoptosis using specific inhibitors. The agonists also dramatically lowered the number of viable EL-4 tumor cells when administered *in vivo*. These data suggest that CB2 agonists that lack psychotropic effects may serve as novel anticancer agents (Supported in part by NIH ES09098, NIHR DA014885, and NIH DA016545).

CONFORMATIONALLY-CONSTRAINED 5-HT₆ SEROTONIN RECEPTOR LIGANDS. R. Kolanos, M. Pullagurla, M. Dukat & R. A. Glennon, Department of Medicinal Chemistry, Virginia Commonwealth University, Richmond, VA 23298. Serotonin 5-HT₆ receptors belong to the GPCR superfamily and are positively coupled to an adenylate cyclase second messenger system. Pharmacological data indicate that 5-HT₆ receptors could play a role in certain central disorders, cognitive dysfunction, convulsive disorders and obesity. Among known antagonists are a series of Roche compounds, and benzenesulfonylindoles developed in our laboratory. N₁-(Benzenesulfonyl)indoles and N₉-(benzenesulfonyl)tetrahydrocarbazoles might be viewed as conformationally-constrained Roche analogs and can be utilized to determine how these two series bind relative to the Roche compounds at 5-HT₆ receptors. Using these analogs, the importance of the multiple amine groups in the Roche compounds are being examined. In this process a novel diamine has been identified as an example of a new class of high-affinity 5-HT₆ antagonists. [Supported by NIMH grant MH 60599]

THE ROLE OF EPO-DEPENDENT PHOSPHORYLATION/DESTRUCTION OF BIM IN THE SURVIVAL OF ERYTHROID CELLS. R.M. Abutin¹, J. Chen¹, K-H. Roh¹, H. Harada², & S.T. Sawyer¹, ¹Departments of Pharmacology/Toxicology and ²Internal Medicine, Virginia Commonwealth University, Richmond VA 23298. Erythropoietin (EPO) is the hormone required for the survival of erythroid progenitors. A central regulator of survival/apoptosis is the BCL-2 family of proteins, which include the pro-apoptotic protein, BIM. Recent reports show that survival factors down-regulate BIM at the posttranscriptional level via MAP kinase-dependent phosphorylation targeting this protein for destruction. We show that BIM protein was significantly increased following EPO withdrawal and that BIM is phosphorylated/degraded through a proteosomal-dependent process upon EPO stimulation in dependent erythroid cells. Additionally

it appears that EPO-dependent phosphorylation of BIM is through a MAP-kinase-dependent pathway. In contrast to studies implicating the PI3-kinase/Akt pathway in the viability of erythroid cells, it does not appear to be involved in BIM suppression following EPO withdrawal. Therefore, the EPO-dependent phosphorylation and subsequent degradation of BIM may play a role in the survival of erythroid cells.

ACTIVE ANAPHYLAXIS IN MICE WITH SINGLE AND SIMULTANEOUS DISRUPTION OF IL-3 AND IL-4R. Joshua A. Morales, Nicole F. Neel, & Chris S. Lantz, Dept. of Biol., James Madison Univ., Harrisonburg, VA 22807. The clinical manifestations of allergic hypersensitivity reactions are related to the biological effects of the mediators released by mast cells. Numerous *in vitro* studies suggest that interleukin-3 (IL-3) and IL-4 can enhance the release of inflammatory mediators from mast cells activated by IgE and antigen. However, little is known about the ability of IL-3 and IL-4 to regulate the function of mast cells in IgE-dependent allergic responses *in vivo*. We therefore examined active systemic anaphylaxis (ASA) reactions in control +/+, IL-3 -/-, IL-4R α -/-, and IL-3/IL-4R α double-deficient mice. Active systemic anaphylaxis, which requires *de novo* synthesis of antigen-specific antibody, was induced by immunizing mice I.P. with chicken ovalbumin plus adjuvant, and challenging the mice on day 17-18 with the same antigen I.V. The ability of mice to undergo anaphylaxis was assessed by monitoring changes in body temperature and the time of death following antigen challenge. Contrary to what has been suggested based on numerous *in vitro* studies, our findings indicate that IL-3 and IL-4 are not required for anaphylactic responses *in vivo* and that IL-3 and IL-4 do not appear to mediate redundant functions *in vivo*.

THE EFFECTS OF THYROID HORMONE ON POSTNATAL RAT CARDIAC α -MHC GENE EXPRESSION. Nicole Maier & Kathryn Loesser, Dept. of Biol., Mary Washington Col. Fredericksburg, VA 22401. Triiodothyronine (T₃) has been shown to have both positive and negative effects on the expression of α and β -myosin heavy chain (MHC) isomers respectively. The purpose of this experiment was to test the effects of the hypothyroid state on this isomer expression in neonatal and postnatal *Rattus norvegicus* cardiac development. It was hypothesized that the hypothyroid animals would develop hypertrophy due to the increased β -MHC expression while demonstrating cardiomyopathy due to the decrease in α -MHC expression. Two female rats were each mated, 1 female was designated as the control, and the other was made hypothyroid with a solution of 0.005% PTU in water. Four pups from each of the control and experimental litters were sacrificed 2 and 4 weeks after birth; their hearts were removed, weighed, sectioned, stained, and measured using a morphometric computer program. It was shown that there was some overall hypertrophy of the hearts themselves in the hypothyroid rats at 4 weeks, with some evidence of possible cardiomyopathy in the same rats at 2 weeks. Immunocytochemistry revealed a seemingly higher prevalence of β -MHC isomers in the experimental animals at both 2 and 4 weeks, indicating that the limited secretion of thyroid hormone did stimulate greater β -MHC isomer formation while limiting α -MHC isomer expression. However, the difference was not statistically significant. More experiments need to be done to further validate these results.

DAMAGE OF THE MYOCARDIUM IN *RATTUS NORVEGICUS* BY HOMOCYSTEINE AND THE PROTECTIVE EFFECTS OF ASCORBIC ACID. Adam Clark & Kathryn Loesser, Dept. of Biol., Mary Washington Col. Fredericksburg, VA 22401. The purpose of this experiment was to observe the damaging effects of homocysteine and the protective effects of ascorbic acid on the myocardium of *Rattus norvegicus*. Inducing hyperhomocysteinemia by supplementing L-methionine in the drinking water would lead to an increased infarct area during ischemic periods caused by an occlusion in the left anterior descending artery. During ischemic periods, antioxidants such as ascorbic acid help protect the myocardium from harmful compounds by interfering with oxidation reactions that activate these compounds. Four groups consisting of four rats each were established and fed supplements in their water for ten weeks. A control group received no additional supplements; another group received water supplemented with ascorbic acid; a third group received water supplemented with L-methionine; the last group received water supplemented with both

ascorbic acid and L-methionine. At the end of the ten weeks, a myocardial infarct was induced in each of the rats and serum homocysteine was measured. Digital photos were taken of heart transects and ImageJ software was used to determine heart areas. A positive relationship was seen between homocysteine levels and total infarcted area. Hyperhomocysteinemia increased the amount of myocardial damage, while ascorbic acid did not show any distinctive protective effects on the myocardium.

THE EFFECTS OF B-6 VITAMINS IN ATHEROSCLEROTIC MICE. Sara Stokes & Kathryn Loesser, Dept. of Biol., Mary Washington Col. Fredericksburg, VA 22401. Elevated homocysteine (Hcy) levels, otherwise known as hyperhomocysteinemia, have been shown to be an independent risk factor for many cardiovascular diseases, such as atherosclerosis. There are many enzymes involved in the metabolism of homocysteine that are dependent upon B-vitamins. We evaluated the effects of B₆ supplementation on atherosclerotic apolipoprotein E-deficient mice following induction of hyperhomocysteinemia. The 20 animals were divided equally into: a control group receiving a high fat diet alone, 1 group supplemented with 3.3% Met in drinking water; another with both 3.3% Met in drinking water and 14 mg B₆ in food; and lastly, 1 group with only 14 mg B₆ in food. The animals were fed their respective diets for 5 months and subsequently their plasma Hcy and hearts were evaluated. Our results showed the high Met with B₆ treated group reduced the plasma Hcy concentration by 48.7% (p= 0.0487) over the plasma Hcy levels in high Met only group. There was also a significant difference in plasma Hcy levels between the control animals and both of the high Met groups. However, we found that there was no correlation between plaque size and Hcy concentration in any of the groups. Our data imply that vitamin B₆ supplementation significantly decreases plasma homocysteine levels but does not protect against plaque development.

DPX TIPS[®] VS. LIQUID-LIQUID EXTRACTION OF TETRAHYDROCANNABINOIDS FROM WHOLE BLOOD OBTAINED FROM VIRGINIA DRIVERS. D. D. Flammia, T. H. Woods, R. P. Edwards, & J. M. Pearson, Division of Forensic Science, Richmond, VA. Delta-9-tetrahydrocannabinol (THC) (a psychoactive compound in marijuana) and 11-nor-9-carboxy-delta-9-tetrahydrocannabinol (THCA) (metabolite) are present in more than a third of the driver's blood arrested for driving under the influence in Virginia. The current methodology for extracting THC and THCA from blood requires acetonitrile precipitation, basifying (aqueous) the acetonitrile layer, and extracting THC with hexane/ethyl acetate. THCA is then extracted similarly after acidifying the above. Both THC and THCA are then derivatized and quantitated using a gas chromatograph coupled to a mass selective detector (GC-MSD). This extraction procedure was compared to a new solid phase technique in which the above acetonitrile layer is aspirated into a plastic tip containing a proprietary sorbent. The acetonitrile is discarded and THC and THCA are eluted simultaneously from the sorbent with hexane/ethyl acetate. Next the THC and THCA are derivatized and quantitated with a GC-MSD. The DPX technology provides rapid extraction of THC and THCA; however the method does not provide enough sensitivity to quantitate the low levels of THC and THCA found in Virginia's drivers.

MECHANISM AND RECOVERY OF CB1 RECEPTORS FOLLOWING THC IN BRAIN. N. S. Schechter, D. E. Selley, & L. J. Sim-Selley, Department of Pharmacology & Toxicology, Virginia Commonwealth University, Richmond, VA 23298. CB1 cannabinoid receptors are G-protein-coupled receptors mediated by cannabinoids, including Δ^9 -tetrahydrocannabinol (THC). Chronic cannabinoid agonist administration causes tolerance to behavioral effects and results in receptor adaptation. This adaptation leads to internalization, desensitization and downregulation of CB1 receptors at a rate and magnitude that is region specific. To produce tolerance, mice were administered increasing doses, from 10 to 160 mg/kg, of THC twice daily (s.c.) for 15 days. [³H]SR and [³⁵S]GTP γ S binding showed prolonged decreases in CB1 receptor binding and receptor-mediated activity. CB1 receptor protein levels did not differ between THC and vehicle by western analysis of brain region homogenates or IHC staining of brain sections. Interestingly, a 50% increase in CB1 mRNA was found in hippocampus. Northern blot analysis of striatum at Day 1 post-

treatment was decreased and recovered by Day 3. These results indicate that CB1 receptor downregulation caused by chronic THC administration is not a result of receptor degradation or decreased synthesis.

MECHANISM OF CB₁ RECEPTOR ADAPTATION. Sylvester, J.L., Sim-Selley, L.J. & Selley, D.E., Dept. of Pharm/Tox., Virginia Commonwealth University, Richmond, VA 23298. Δ^9 -tetrahydrocannabinol (THC), the psychoactive constituent of marijuana, and the synthetic cannabinoid WIN55,212-2 (WIN) act on G-protein coupled CB₁ receptors in the brain. Upon chronic administration, these cannabinoids produce both desensitization and downregulation of the receptor in a regionally specific and time-dependent manner. These effects have been shown *in vitro* in both membrane homogenate binding assays and autoradiographic studies. This study attempted to reproduce these effects in a cell culture model using CHO cells transfected to express the CB₁ receptor. Internalization was illustrated by confocal microscopy of transiently transfected CB₁-CHO cells treated with either THC or WIN. Receptor desensitization was demonstrated in CB₁-CHO cells by measuring the uncoupling of G-proteins (Emax) through a WIN stimulated [³⁵S]GTP γ S binding assay. No significant downregulation could be produced by either WIN or THC treatment, as there was no change in Bmax in the [³H]SR141716A receptor binding assay. These results suggest that chronic treatment of CB1-CHO cells with either THC or WIN produces desensitization of CB1 receptors, but the internalized receptors are recycled to the plasma membrane rather than being degraded.

INVESTIGATION OF UDP-GLUCURONOSYLTRANSFERASES INVOLVED IN THE GLUCURONIDATION OF MPA IN RATS UDP-GLUCURONOSYLTRANSFERASES. K. Miles¹, S. Stern², F. Kessler¹, P. Smith² & J. K. Ritter¹ ¹Dept. of Pharmacol. and Toxicol., Virginia Commonwealth Univ., Richmond VA 23298 ²Dept. of Drug Deliv. and Dispos., Univ. of North Carolina, Chapel Hill NC 25799. The objectives of this study were to evaluate the UGT isoforms that are active in MPA metabolism in rats, and assess the potential roles of these forms in hepatic, renal, and intestinal MPA glucuronidation. Liver microsomes from homozygous Gunn j/j rats exhibited marked decreases in MPA glucuronidating activity. Recombinant rat 1A1, 1A6, and 1A7 but not 1A2, 1A3, 1A5, and 1A8 possessed MPA activity. Apparent Km (mM) values of: 0.446, 0.655, 0.511 and Vmax (mmol MPAG/min/mg) values of: 4.48×10^{-7} , 1.84×10^{-7} , and 1.1×10^{-6} were determined for 1A1, 1A6, and 1A7, respectively. 1A1 levels were highest in liver whereas 1A7 was highest in intestine. In addition, MPA glucuronidating activity was highest in intestine. This study, suggests that multiple isoforms may be involved in modulating MPA-related GI-toxicity in rat. However, 1A7 may be particularly important in intestinal MPA glucuronidation. Supported by NIGMS grant 1R01GM61188.

THE ANTINOCICEPTIVE EFFECT OF THC IN THE ARTHRITIC RAT: INTERACTIONS WITH OPIOIDS. Melinda L. Cox & Sandra P. Welch, Dept. of Pharmacology, VCU, Richmond, VA 23298. We addressed the hypotheses that THC-induced release of endogenous opioids results in antinociception, and that THC enhances morphine in the paw pressure test in arthritic (FAA) and normal (NA) rats. We characterized receptor involvement with the use of antagonists to opioid and CB1 receptors. THC-induced antinociception was shown to have a kappa opioid component in FAA rats, while it seemed to be more mu opioid-mediated in NA rats. Using a spinal cord perfusion technique, we measured levels of endogenous opioids in cerebral spinal fluid (CSF). THC (i.p.) released dynorphin A and leu-enkephalin in CSF of NA rats, but tended to decrease release in FAA rats. Vehicle tended to increase these peptides in FAA rats. Met-enkephalin levels were higher in naïve FAA rats than NA rats. These results further suggest a role for the kappa opioid system in THC-induced antinociception. Using a low dose combination (1:1) of THC and morphine, we found that THC enhances morphine to the same degree in NA and FAA rats. Currently we are examining the effects of chronic morphine, THC, or low dose combination on antinociception, opioid peptide release, and receptor protein levels.

DURATION OF ADMINISTRATION AND DOSE DETERMINANTS OF NICOTINE BEHAVIORAL DEPENDENCE IN RATS. Robert E. Vann & Patrick M. Beardsley, Dept of Pharmacology & Toxicology, VCU, Richmond, VA, 23298. Understanding threshold conditions of inducing or maintaining nicotine (NIC) dependence could facilitate developing guidelines for tobacco usage minimizing its toxicity. Using laboratory animals to demonstrate NIC dependence effects, however, has been difficult using conventional methodologies. The present study used the disruption of a learned behavior (lever pressing reinforced with food pellet delivery) as the dependent measure for inferring dependence in Sprague-Dawley rats. NIC (3, 6, 12 mg/kg/day as the base) was delivered via minipumps for up to 12 days. Initial studies demonstrated that after 7 or 12 days of NIC administration, in doses from 3 to 12 mg/kg/day, conditioned responding was disrupted following challenges with 1 mg/kg of the nicotinic receptor antagonist, mecamylamine, suggesting dependence. Subsequent tests indicated that the threshold for inducing dependence occurred after as little as 4 days of NIC administration at 3 mg/kg/day. These data indicate that using the disruption of learned behavior to detect NIC dependence is a sensitive methodology for characterizing threshold conditions for its induction.

Natural History & Biodiversity

SYSTEMATICS AND LIFE HISTORY OF PULMONATE GASTROPODS IN THE VIRGINIA PIEDMONT AREA (MOLLUSCA: GASTROPODA: PULMONATA.). Corraine A. Scott & Deirdre C. Gonsalves-Jackson. Dept. of Biol., Randolph–Macon Woman’s College, Lynchburg VA 24503. Pulmonate gastropod mollusks include terrestrial slugs, which are commonly considered garden and greenhouse pests because they can cause tremendous damage to cultivated crops. It is therefore important to understand the biology and life history of these mollusks because of the negative impact they have on the environment. The goals of this research were to survey and document the biodiversity and life history of terrestrial slugs in the Virginia Piedmont area with the intent of characterizing the local slug fauna. This was accomplished through fieldwork, laboratory study, and culturing of collected specimens to document embryonic development through hatching. Results of sampling indicate a rich diversity and abundance of terrestrial slugs. Of the seventeen sites sampled, 169 specimens were collected during an eight-week period. Diversity of terrestrial slugs was confirmed as high with 12 species in five genera identified. In addition to biodiversity results, developmental patterns were documented for 25% of collected species.

COMPARISON OF POPULATIONS OF *LEUCISCUS CEPHALUS* IN GREECE. Christina Harview¹ & Eugene G. Maurakis^{2,3}, ¹Henrico High School, Richmond, Virginia 23228, ²Science Museum of Virginia, 2500 W. Broad St., Richmond, VA 23220, ³UR, Richmond, VA 23173. An analysis of 17 external meristic and morphometric characters was used to evaluate the taxonomic status of southern populations of *Leuciscus cephalus* in Peloponnesos, Greece. Seven meristic characters (lateral line scales, scales above and below lateral line, numbers of branched dorsal and anal fin rays, and total pectoral and pelvic fin rays) and 10 morphometric features (standard length, head length, eye diameter, body depth, caudal peduncle depth, dorsal and anal fin shapes) were evaluated in 63 specimens collected from the Arachthos, Evros, Nestos, and Strymon rivers (mainland Greece), and the Alphios and Pamisos rivers in Peloponnesos, Greece. Numbers of lateral line scales and branched anal fin rays, caudal peduncle depth, and shape of anal fin were used to distinguish southern populations in Peloponnesos from those of mainland populations, and support the proposition that populations of *L. cephalus* in Peloponnesos, Greece are recognizable at the subspecific level: *L. cephalus peloponnesis*. Funding was provided by the Jeffress Memorial Foundation, Science Museum of Virginia, and University of Richmond.

CURRENT RESEARCH ON THE ENDANGERED NORTHERN FLYING SQUIRRELS (*GLAUCOMYS SABRINUS*) OF VIRGINIA. James L. Sparks Jr.¹, Cecil Thomas², John F. Pagels¹, & Bonnie L. Brown¹, ¹Dept. of Biology, Virginia Commonwealth University, and ²Mount Rogers NRA, U.S. Forest Service. Relict northern flying squirrel, *Glaucomys sabrinus* populations occur

in high elevation spruce-fir refugia in the southern Appalachia Mountains. Two endangered subspecies are found in Virginia, *G. s. coloratus* in Smyth and Grayson counties and *G. s. fuscus* in Highland County. We used a sodium nitrate fecal float to assay infestation levels of the helminth parasite *Strongyloides robustus* in the Mount Rogers National Recreation Area (MRNRA). *S. robustus* is a parasite whose pathogenicity has been documented in *G. s. coloratus*. We found that the conifer-affiliated red squirrel, *Tamiasciurus hudsonicus*, carried the highest load of *S. robustus* suggesting that seasonal consumption of red spruce, *Picea rubens*, by *G. sabrinus* does not function as a vermifuge as was previously hypothesized. Preliminary results from micro-satellite DNA analysis suggest that *G. sabrinus* from Mt. Rogers (n=4) has greater polymorphism than nearby White Top Mountain (n=4). Our management recommendations for MRNRA include protecting spruce-fir habitat and supporting the restoration of habitat contiguity between Mt. Rogers and White Top Mountain.

PHYLOGENETIC RELATIONSHIPS AND BIOGEOGRAPHY OF *COBITIS (BICANESTRINIA)* SPECIES IN THE SOUTHERN BALKAN PENINSULA. Julia B. Haubenstock, Oberlin College, Oberlin, OH 44074, and Eugene G. Maurakis, Science Museum of Virginia, 2500 W. Broad St., Richmond, VA 23220 and UR, Richmond, VA 23173. Cladistic analyses of thirteen characters from eight species of *Cobitis* (two *Monocanestrinia* and six *Bicanestrinia*) and two species of *Sabanejewia* as out-group taxa in Greece resulted in a cladogram where species of *Cobitis (Bicanestrinia)* form a monophyletic group. Within *Cobitis (Bicanestrinia)*, *Cobitis meridionalis* and *Cobitis trichonica* form a monophyletic group, the sister-group to a clade composed of *Cobitis punctilineata*, and the clade of *Cobitis hellenica* and *Cobitis arachthosensis*. Our hypothesis of *Cobitis (Bicanestrinia)* relationships and resultant distributions of the species are congruent with a cladogram of the historical relationships among river drainages in the southern Balkan Peninsula, where geological vicariant events support the derivation of cobitid distributions in the region. This study was funded in part by the Thomas F. Jeffress and Kate Miller Jeffress Memorial Trust, Science Museum of Virginia, University of Richmond, and Aristotle University, Greece.

CEPHALIC SKIN MORPHOLOGY OF TUBERCULATE MALE *SEMOTILUS ATROMACULATUS*. William R. McGuire¹ and Eugene G. Maurakis^{2,3}, ¹St. Christopher's School, 711 St. Christopher's Road, Richmond, VA 23226, ²Science Museum of Virginia, 2500 W. Broad St., Richmond, VA 23220 and ³Biology Dept., UR, Richmond, VA 23173. Morphology of cephalic skins of tuberculate male *Semotilus atromaculatus* (Cyprinidae) were studied to test the hypothesis that neurons underlie tubercles. Light microscopy reveals that dermal pilli which protrude into cephalic tubercles of breeding males contain neurons. These results support previous hypotheses that male epidermal tubercles play a tactile role in breeding behaviors of *S. atromaculatus* during the spring. Both light and scanning electron micrographs suggest that neural projections in the form of neuromasts relate to a species specific developmental pattern of cephalic tubercle distribution. Funding was provided by Virginia Academy of Science, Science Museum of Virginia, and University of Richmond.

CHARACTERIZATION OF FRESHWATER MUSSEL MICROHABITAT IN THE UPPER CLINCH RIVER, VIRGINIA. Brett J. K. Ostby and Richard J. Neves, Department of Fisheries and Wildlife Sciences, Virginia Polytechnic Institute and State University, Blacksburg, VA 24061-0321. The Tennessee Valley Authority has recently returned 150-200 miles of dam tailwaters to more natural conditions and proposed reintroduction of native freshwater mussels in those reaches. Before translocation of mussels from other locations can proceed, suitable habitat must be defined for each species. During intermittent low flows (200 - 600 cfs) from May to September 2003, a stratified sampling design was employed to determine hydraulic parameters and substrate composition preferred by a suite of species proposed for reintroduction. Flow parameters, including shear stress, mean column velocity, and Reynold's number best distinguish among sites with high and low quality mussel populations and also predict presence and absence of common species within a reach. Substrate is similar among all sites and has no predictive value. Habitat suitability criteria (HSC)

have been developed for the most abundant species and demonstrate transferability among reaches. Habitat use by many species overlap, therefore species can be placed into habitat guilds. HSC will be used to guide translocation efforts and tailwater management.

FINDING BURROWS AND KILLING LARVAE, BEHAVIORS OF THE PASSALID BEETLE *ODONTOTAINIUS DISJUNCTUS*. Andrew J. King & Norman J. Fashing, Dept. of Biol., College of William and Mary, Williamsburg VA 23187-8795. Infanticide, the killing of young by an adult of the same species, is an interesting behavior found in a wide range of animals. Although the mechanism differs with each mating system, the underlying reason behind infanticide is that it serves to increase the fitness or relative reproductive success of an individual with respect to the rest of the members of the population. To date, infanticide has been reported in only one beetle family, the Silphidae or carrion beetles. Here we present experimental evidence for infanticidal behavior in *O. disjunctus*, a member of the subsocial family Passalidae. Additional supporting evidence will be presented on passalid way-finding behaviors in order to assess the possibility of burrow takeovers during the mating season. Results indicate that adults that have not reproduced in a season kill larvae placed in their container. Adults that were raising larva do not kill larvae even if they are not their own. (Supported by a Howard Hughes Medical Institute Summer Research Grant to AJK)

MORPHOLOGICAL ADAPTATIONS FOR PRECOPULATORY MATE GUARDING IN ASTIGMATIC MITES. Norman J. Fashing, Dept. of Biol., College of William and Mary, Williamsburg, VA 23187-8795. Individual male's reproductive success can be advanced by preventing his sexual partners from being inseminated by rival males, a feat often achieved in arachnids by means of precopulatory mate guarding. In males of astigmatic mites, this is often accomplished by guarding an immature female from other males during her penultimate (tritonymphal) instar, and mating with her when she molts to an adult. Although males of some species simply cling to the dorsum of an immature female in an attempt to prevent other males from gaining access, others have evolved specialized morphological adaptations which aid in precopulatory mate guarding behavior. In some genera (e.g., *Sarraceniopus*; Histostomatidae), the second pair of legs are enlarged and used to spar with other males. In others, the male uses either one pair (e.g., *Hericia*; Algophagidae) or two pairs of modified legs (undescribed genus; Histostomatidae) to hold the tritonymphal female off the substrate as he walks about on his remaining legs. In natatorial genera (e.g., *Creutzeria*, *Zwickia*; Histostomatidae), the front pair of legs are modified for clasping the female and the remaining three pair are used for swimming.

CHEMICAL AND PHYSICAL CHARACTERISTICS OF SOILS OCCUPIED BY THE FUNGUS-GROWING ANT, *TRACHYMYRMEX SEPTENTRIONALIS*, IN SOUTHEASTERN VIRGINIA. Jonathan P. Howell & Deborah A. Waller, Department of Biology, Old Dominion University, Norfolk, VA 23529. Blackwater Ecologic Preserve is a 129 hectare tract of land, located in Isle of Wight, undergoing a regimen of controlled burning to increase the population of longleaf pines (*Pinus palustris*). Three populations of the fungus-growing ant, *Trachymyrmex septentrionalis*, have been under study for four years. During the summer of 2003, soil samples from the populated and adjacent, unpopulated sites were collected and tested for soil moisture, organic matter (OM), and pH. Total soil moisture was found to be significantly lower ($F = 11.23$; $p = 0.001$) in populated ($14.92 \pm 0.60\%$) versus unpopulated ($17.55 \pm 0.50\%$) areas. No significant differences were found for soil organic matter or pH between the two site types (OM: $0.83 \pm 0.08\%$ vs. $0.73 \pm 0.07\%$; pH: 6.31 ± 0.02 vs. 6.34 ± 0.02). Based on these findings, soil moisture may be considered as an important factor, either directly (chamber excavation) or indirectly (vegetative cover), in the dispersal and foundation of new *T. septentrionalis* colonies.

THE COLLECTION AND OCCURRENCE OF *PSOROPHORA HORRIDA* (DYAR AND KNAB) IN SOUTHEASTERN VIRGINIA. Norman A. Grefe & Deborah A. Waller, Dept. of Biol., Old Dominion Univ., Norfolk, VA 23529. Mosquitoes are ecologically important as prey for aquatic and

aerial predators. The life history, diversity and distribution records for many species are poorly known because control efforts focus on common disease vectors. A study of the diversity and response of mosquitoes to prescribed burns is underway at the Blackwater Ecological Preserve (BEP), a longleaf pine habitat owned by Old Dominion University in Isle of Wight County in southeastern Virginia. In a preliminary survey, 75 specimens of *Psorophora horrida* were collected over a few days in July 2003. Only one other record exists for *Ps. horrida* in Virginia, from 1904 in Shenandoah County. This summer, woodland pool species is typically found in piedmont habitats in other states. *Psorophora horrida* never appeared in extensive mosquito collections by Grefe from Suffolk and Isle of Wight County over the past few years, although it might have been collected in other localities and misidentified as *Psorophora ferox*, a similar species.

RESPONSE OF THE SYMBIOTIC GUT PROTOZOANS OF TERMITES TO ESSENTIAL OILS. Deborah A. Waller, Dept. of Biol., Old Dominion Univ., Norfolk, VA 23529. Previous studies demonstrated that a one-week exposure to some essential oils kills termites and/or inhibits feeding. One possibility is that a lethal essential oil kills the symbiotic gut protozoans and the termite subsequently starves. The present study examined the responses of the subterranean termites *Reticulitermes flavipes* (one colony) and *R. virginicus* (two colonies) and their gut protozoans to a 24 h exposure to five essential oils. For each colony, there were two experimental units per oil and two control units. Each unit contained a red napkin circle (6mm diam) for food that received either no treatment (control) or a drop of oil. Ten termite workers were placed in the container and incubated at 26°C. After 24 h, numbers of surviving termites, red (fed) termites and numbers of protozoans/three termites/unit were counted. Survivorship varied significantly among treatments. Termites fed only on control red circles and one red circle of one essential oil. Protozoan numbers varied significantly among treatments and colonies, with no indication that essential oils were lethal to protozoans.

BIOCHEMICAL COMPOSITION OF FOUR SPECIES OF FRESHWATER MUSSELS HELD AT A STATE HATCHERY. Aaron Liberty and Richard J. Neves. Dept. of Fisheries and Wildlife Sciences, Virginia Polytechnic Institute and State University, Blacksburg, VA 24061-0321. The ability to hold freshwater mussels in captivity is often necessary for purposes of relocation and propagation of imperiled species. Four species of unionid mussels, including two long-term brooders, *Villosa iris* and *V. vanuxemensis*, and two short-term brooders, *Amblema plicata* and *Pleurobema oviforme*, served as surrogates for endangered species and were held at the Aquatic Wildlife Conservation Center (AWCC), Marion, Virginia, for a two-year trial period. Glycogen, protein, and lipid were measured seasonally from mantle tissue and compared between AWCC specimens and those from their wild source populations. Seasonal variability of glycogen was greatest, with significant differences found in the spring of 2003 and 2004 for *V. iris*, and in the spring of 2003 for *V. vanuxemensis*. Protein and lipid showed less seasonal variability among species found in the river and held at the hatchery. These results suggest that the AWCC is a suitable facility to hold freshwater mussels for extended periods of time.

A STATUS SURVEY OF FRESHWATER MUSSEL POPULATIONS IN THE UPPER NORTH FORK HOLSTON RIVER, VIRGINIA. Jess W. Jones and Richard J. Neves. Dept. of Fisheries and Wildlife Sciences, Virginia Polytechnic Institute and State University, Blacksburg, VA 24061-0321. Previous freshwater mussel surveys (1915-1997) at sites in the North Fork Holston River watershed upstream of Saltville, VA, documented 21 species. Approximately 363 survey hours were spent sampling 47 sites in a 48 mile reach of the river between Saltville and Ceres. Thirteen species of live freshwater mussels were collected. In order of relative abundance, these were: mountain creekshell, *Villosa vanuxemensis* (27.1%), rainbow mussel, *V. iris*, (23.3%), slabside pearlymussel, *Lexingtonia dolabelloides* (10.4%), Cumberland moccasinshell, *Medionidus conradicus*, (10.3%), fluted kidneyshell *Ptychobranthus subtentum* (6.4%), pheasantshell, *Actinonaias pectorosa* (5.5%), wavyrayed lampmussel, *Lampsilis fasciola*, (5.3%), Tennessee clubshell, *Pleurobema oviforme*, (4.4%), shiny pigtoe, *Fusconaia cor* (2.9%), kidneyshell, *Ptychobranthus fasciolaris* (2.9%),

Tennessee pigtoe, *F. barnesiana*, (1.1%), fluted shell, *Lasmigona costata*, (0.01%), and pocketbook, *Lampsilis ovata*, (0.01%). Species richness has remained relatively stable over the last 100 years in this reach of river. However, declines in abundance are now evident in a 4 mile reach immediately upstream of Saltville.

Psychology

ROMANTIC PARTNER'S PERCEPTIONS OF APPEARANCE AND THE EFFECT ON RELATIONSHIPS. Kristin M. Grasso, Virginia Consortium Program in Clinical Psychology & Thomas F. Cash, Ph.D. Dept. of Psychology, ODU. Literature has looked at how body image operates in women. However, few studies attempt to understand how intimate relationships mediate this construct. Measuring body image with a self-discrepancy approach is important to understanding one's view of themselves and may affect how one feels their romantic partner views their appearance. Consequently, it is expected that this will translate into how satisfying the sexual and overall relationship is. The following study attempted to address this in a sample of college-aged women. This was done by further analyzing validity on the PAIRS, a self-report assessment of persons' perceptions of and reactions to their partner's attitudes toward their appearance. It was hypothesized that this measure would correlate highly with the BIQ-E, the BESAQ, the DSFI, and the RAS. Results supported this and found that the PAIRS subscales significantly predicted sexual self-consciousness and both sexual and relationship satisfaction. One's perception of their Partner's attitudes, the effect of those attitudes, and one's own body image seems to have a significant impact on satisfaction in romantic relationships. The PAIRS measure has been supported as a reliable and valid measure to assess these constructs in women.

BODY SATISFACTION AND RACIAL IDENTITY DEVELOPMENT DIFFERENCES BETWEEN BLACK AND WHITE FEMALES. Courtney Hanley & Barbara Winstead, Old Dominion University. Researchers have investigated possible reasons for Black women consistently reporting higher levels of body satisfaction than White women. One area gaining attention is the possibility that, as a woman forms her identity the saliency of her race group may fluctuate, thereby affecting body satisfaction. The current study investigated the relationship between the importance of race to identity development and body satisfaction attitudes between Black and White college women. It was hypothesized that body satisfaction will be affected by the importance of race group (as defined by the Cross Racial Identity Model and the White Racial Identity Attitude Scale) to each woman. A negative relationship between Stage One (Pre-Encounter) attitudes and body satisfaction was found for Black women. Implications and limitations of the current study for future research are addressed in the Discussion. Results of the study may provide a platform for research investigating a multi-cultural approach to body satisfaction improvement programs.

BODY IMAGE AND THE ASSESSMENT OF APPEARANCE BEHAVIORS: DEVELOPMENT AND VALIDATION OF THE APPEARANCE BEHAVIORS INVENTORY. Erin Mehalic, Dept. of Psych., Old Dominion University. The purpose of the study is to develop and validate the Appearance Behaviors Inventory, a three-scale measure, derived from prior versions, of body-image self-regulatory behaviors, guided by Cash's cognitive behavioral model of body-image functioning. Participants were 193 college women from Old Dominion University. An anonymous survey was completed that measured the participants' negatively (avoidant and compulsive) and positively motivated appearance-related behaviors, their body-image evaluation and investment, body-image quality of life, and the personality factor of self-presentational perfectionism. Item validity and internal consistency of this three-subscale, 59-item assessment was established, as well as its freedom from socially desirable responding. In testing hypotheses, convergent relationships were

found between the Appearance Behavior Inventory scales and measures of body-image evaluation and investment, body-image quality of life, and the personality trait of perfectionistic self-presentation. Implications and limitations of this research are discussed.

THE RELATIONSHIP OF FEMINIST IDENTITY AND GENDER ROLE ATTITUDES TO BODY IMAGE. Kate Nuckols & Thomas F. Cash, Dept. of Psych., Old Dominion University. Negative body image is a prevalent problem among the women in this country. Previous studies have shown a link between women's traditional views about male-female relations and negative body image. Expanding on this research, we were also interested in how feminist identity is related to body image, disturbed eating attitudes, and attitudes towards attractive women. The purpose of this study was to see how the variables of feminist identity, male-female relations, and views of attractive women are related to body image investment and evaluation and disturbed eating attitudes. Results from correlational and multiple regression analyses show that traditional gender role attitudes and competitive attitudes towards other women were the best predictors of dysfunctional body image and disturbed eating. Women who are more traditionally feminine and who have negative attitudes towards attractive women were shown to have more problematic body image and eating habits. These findings were consistent with prior studies. Feminist identity provided little significant findings and does not appear to provide a significant buffer against dysfunctional body image. Research on feminism and body image has been conflicting, and more is needed to come to a more decisive conclusion.

ADJUSTMENT TO COLLEGE IN LEARNING COMMUNITY VS. TRADITIONAL STUDENTS. K.E. Steer, Virginia Consortium Program in Clinical Psychology, Virginia Beach, VA 23462 & J. A. Morrow, Old Dominion Univ., Norfolk, VA 23529-0267. This study examined the effects of learning community assignment on adjustment to college as measured in academic and social self-concept and academic attitudes. The participants in this study, from a large public university, were 156 first year students of diverse ethnic backgrounds. They were selected using non-probability sampling. Participants were administered three measures one year following their first year experience. The Academic Attitude Scale – AAS (Wong & Fry, 1998), the Academic Self-Concept Scale – ASCS (Reynolds, 1988), and the Social Self-Concept Scale – SSCS (Reynolds & Lyon, 1996) indicated that there were no significant differences between learning community and non-learning community students on adjustment to college.

PARENTAL AND PEER ATTACHMENT AS PREDICTORS OF DIFFERENTIATION OF SELF IN FIRST YEAR COLLEGE STUDENTS. D. S. Vick, Virginia Consortium Program in Clinical Psychology & J. A. Morrow, Old Dominion Univ. This study explored the relationship between Bowlby's (1963) construct of attachment and Bowen's (1978) construct of differentiation of self in first-year college students. Using non-probability sampling, the study included an ethnically diverse population of 274 students from a large, public southeastern university. The Differentiation of Self Inventory – DSI (Skowron, 1998, 2001) and the Inventory of Parent and Peer Attachment – IPPA (Armsden & Greenburg, 1987) revealed that parental and peer Attachment factors were significant predictors of differentiation of self in first-year college students. Significant differences were also found for gender and for living arrangement. Specifically, female students report significantly higher levels of parent and peer communication than male students. Females also showed more emotional reactivity and lower levels of I-Position than male students. For living arrangement, students who lived apart from their parents reported significantly higher parent trust than those who lived with their parents. Students who lived with their parents, reported a higher level of parent alienation than those who lived on their own. No significant age differences were found.

STEREOTYPES ABOUT MEMORY AND AGING: FACTORS INFLUENCING RATINGS OF MEMORY ABILITY. Ryan M. Clements, Anastasia, S. Fisher, & Heather M. Niesman, Dept. of Psychol., Washington and Lee Univ., Lexington VA 24450. Earlier experiments from our

laboratory showed that in assessing memory failures of both young and elderly targets, elderly participants are less biased in their beliefs about memory and aging than are college-aged participants. However, unlike findings in previous research, the elderly are not more lenient in their ratings of the memory failures of targets in their peer age group. In the present work, young and elderly subjects received questionnaires assessing personal beliefs about their own and others' memory abilities. Results indicated that beliefs about personal memory ability significantly affected memory performance among the elderly, but not the college-aged participants. The elderly but not the young were influenced by false feedback about their memory performance. Results also indicate that both the elderly and the college-aged subjects assess the memory abilities of others according to the same directional stereotype, but that the elderly are more fair in their assessment of others' failures while still being strict on their ratings of elderly targets' memory failures.

AN INVESTIGATION OF CONTROL CONDITIONS IN ASCH-TYPE EXPERIMENTS. V. Denise A. Lugenbeal, Lauren H. Compton, Adam J. Stinson, Justin A. McWethy & James P. O'Brien, Tidewater Cmnty. Coll., Virginia Beach VA, 23453. Reports additions to data from replications of Asch (1956) control conditions in a 2x2x2x2 protocol: 4-yr. vs. 2-yr. and male vs. female students with authoritative vs. peer and male vs. female Experimenters. Asch demonstrated stimulus clarity, a requisite feature of the "Asch dilemma," among his 4-yr. male undergraduate control participants: 94.6% of Ss were error-free, mean error = .08, and % error trials = .7%. With 12 of 18 cells completed; the respective measures for 260 men are 80.8%, .32, and 2.69%. The respective measures for 371 women are 73.1%, .53, and 4.43%. We conclude that Asch's stimuli do not constitute "an utterly clear perceptual fact" for most male conditions and for all female conditions. In fact, the only cell (n = 29) that may approximate Asch's standards for stimulus clarity is the direct replication of Asch. Therefore, scores of replications of Asch's experimental conditions over the past half century; and, in fact, those data in Asch's (1956) Experiment 1 which were acquired by authoritative female Experimenters, must be reevaluated. The use of comparable, contemporary, high-fidelity control conditions are a fundamental aspect of research design, even for topics and methods that have been extensively investigated.

ATTENTIVE DRIVING: VERBAL WARNINGS APPLIED TO COLLISION AVOIDANCE SYSTEMS. Katrina R. Lewis & Carryl L. Baldwin, Dept. of Psyc., Old Dominion University, Norfolk, VA 23529. Technological advances in conjunction with continued efforts to improve transportation safety have led to the implementation of in-vehicle collision avoidance systems (CAS). Whereas previous research has been void of context, the current investigation examines the alerting effectiveness, perceived urgency, and annoyance level, as well as collision avoidance, of verbal CAS warnings as a function of signal word and presentation level to potential hazards in a simulated driving environment. Fifteen participants drove a simulated vehicle while attempting to avoid collisions. CAS warnings consisting of each combination of signal word and presentation level and a control (no warning) condition were presented in a randomized order just prior to potential collision situations. A significant main effect for signal word ($F[1,14]=13.58, p<.002$, partial $\eta^2=.49$) and presentation level ($F[1,14]=6.81, p<.02$, partial $\eta^2=.33$) was observed for ratings of perceived urgency. These results support previous findings indicating that both acoustic and semantic aspects of verbal CAS warnings can be used to convey hazard level. These results have implications for improving the design and user acceptability of in-vehicle collision avoidance systems and for improving transportation safety.

AUDITORY ROUTE GUIDANCE SYSTEMS AND FACILITATING THE DEVELOPMENT OF COGNITIVE MAPS. Ian J. Reagan & Carryl L. Baldwin, Old Dominion University. The impact of providing supplementary auditory route guidance (ARG) information on navigation performance and cognitive map development was examined in a driving simulator. Information pertaining to either salient landmarks or cardinal directions was added to a standard ARG format to form three ARG formats (standard, landmark, and cardinal). We predicted that the landmark and cardinal formats would result in superior navigational performance and cognitive map development as measured by the number of trials required to learn each route and the number of errors made during

the learning of each route. Repeated measures ANOVAs revealed that participants required significantly fewer trials to learn routes with the landmark ARG format relative to the traditional ARG format and made significantly fewer navigational errors while using the landmark ARG format relative to both the cardinal ARG format and the standard ARG format. No degradations in driving performance were observed for any of the ARG formats. These results have implications for improving the design of in-vehicle route guidance systems without compromising transportation safety.

TESTING THE STRUCTURE OF PERSONALITY AMONG TELEWORKERS. Heather J. Downey & Donald D. Davis. Old Dominion University. For decades, personality theorists have been applying theory to the world of work by attempting to predict work behaviors using personality factors. As technology has advanced in the workplace alternatives to the traditional workplace, such as telework, have emerged. This research tests the hypotheses that the structure of personality is the same for the population of teleworkers and the general population and that this structure consists of six unique personality factors. Results indicated that extraversion, neuroticism, openness to experience, and agreeableness items load onto the expected factors. Conscientiousness and self-efficacy appeared not be distinct from one another. This may, however, be due to limitations of the study. Future research should be done to lend support to the conclusion that personality structure is the same in teleworkers as in the general population. In addition, personality should now be looked at as a predictive tool in understanding effectiveness of teleworkers.

THE EFFECT OF THE *PFIESTERIA* TOXIN ON RAT BEHAVIOR IN THE ELEVATED PLUS MAZE. E. A. Tracy, S. A. Schultz & P. M. Duncan, Department of Psychology, Old Dominion University, Norfolk, VA 23529. This study is part of an ongoing project investigating the effects *Pfiesteria* has on rats with regard to anxiety. *Pfiesteria* is a toxic dinoflagellate found in nearby waters responsible for several mass fish kills. Twenty-three male, Long Evans rats were observed on the elevated plus maze (EPM) to give a measure of anxiety. The rats were separated into two groups, *Pfiesteria*-exposed and a control group. The rats were tested in the EPM for ten minutes on each of four consecutive days. Anxiety is present when the rats make fewer total entries throughout the maze and spend less time in the open arm areas of the maze. Significant differences were seen for the first test day only. Rats exposed to *Pfiesteria* made fewer total entries than the control group, $t(21)=2.98, p<.05$, spent less time in the open arm area of the EPM, $t(21)=2.10, p<.05$, and thus demonstrated more anxiety than the control group. Exposure in humans has also caused anxiety as indicated by self-report. Anxiety in the current study was not as strong as seen in previous experiments, perhaps due to a less toxic *Pfiesteria* culture.

MALE AND FEMALE FACE RECOGNITION: WHO REMEMBERS WHO? Joel Ojdana & Laura L. Westerman, Washington and Lee University. Can males and females recognize faces of their own sex better than the opposite sex? If so, does the angle the face is viewed from have an effect on recognition? We presented a slide show of 12 male and 12 female faces to 36 male and female college students. A recognition test was administered after the initial presentation. The test included 12 faces from the original slide show and 12 new faces. These faces were presented from the front, as a profile, or inverted. No significant differences were found between males and females in facial recognition accuracy under all conditions. Faces viewed as profiles were hardest to recognize, followed by inverted faces, leaving frontal faces easiest to recognize. Female faces were recognized more often than males overall, except in the profile condition in which male faces were recognized more accurately. Thus, further research is needed to reveal the nature of the interaction between orientation and the sex of the face.

EXTINCTION VERSUS REINFORCEMENT TESTING IN RATS USING A CLOZAPINE DISCRIMINATION TASK. Chad L. Stephens, Adam J. Prus, Alan L. Pehrson, Scott D. Philibin, & Joseph H. Porter, Dept. of Psychology, Virginia Commonwealth University, Richmond, VA.

Clozapine (CLZ), the prototype for atypical antipsychotic drugs (APDs), establishes a robust discriminative cue in two-lever drug discrimination studies that is pharmacologically specific to most atypical APDs. CLZ drug discrimination studies have been conducted using both reinforcement and extinction testing conditions that have produced different results. The present study evaluated both extinction and reinforcement testing conditions in rats trained to discrimination 1.25 mg/kg CLZ from vehicle (VEH) in a two-choice drug discrimination task. A fixed ratio 30 food reinforcement schedule was used for both CLZ and VEH training sessions and for the reinforcement test sessions. CLZ generalization did not differ between extinction and reinforcement test conditions for any of the compounds tested. CLZ fully substituted ($> 80\%$ drug-lever responding [DLR]) for itself at the 0.625 mg/kg dose. The typical APD haloperidol, failed to substitute for the CLZ discriminative cue. Based on these results, studies using either extinction or reinforcement testing conditions in the two-choice drug discrimination procedure should find similar results.

Statistics

A WRITING COURSE FOR STATISTICS & OPERATIONS RESEARCH. W. Scott Street, IV & Jill R. Hardin, Department of Statistical Sciences and Operations Research, Virginia Commonwealth University, Richmond, VA 23284-3083. Through a Center for Teaching Excellence at Virginia Commonwealth University grant, we have developed a writing intensive course for the undergraduate students of our Department. Surveys of students, faculty, and industry professionals have helped us to identify deficient areas in student communication as it pertains to writing in statistics and operations research. We will discuss the results of these surveys and present our general course plan. Our approach aims not only to correct student deficiencies, but also to train students in the fundamentals of professional writing. Examples of course content will be presented. Techniques employed in the course include peer-reviewing, editing, written correspondence, oral presentation, and working in groups. We anticipate that this course will provide students with crucial skills for academic and professional success.

THE SEARCH FOR E-OPTIMAL BLOCK DESIGNS. J. P. Morgan, Department of Statistics, Virginia Tech, Blacksburg, VA 24061. A regular graph design (RGD) is a block design for v treatments in b blocks of size k that is (i) binary, (ii) equireplicate, and for which (iii) the pairwise treatment concurrence counts take only two values, which differ by one. John and Mitchell (1977) conjectured: "If an incomplete block design is D-optimal (or A-optimal or E-optimal), it is an RGD (if an RGD exists)." They then went on to enumerate, aside from a few cases beyond their computational reach, the A-, D-, and E-best RGD's for v up to 12 and up to 10 replicates. Currently no design is known that contradicts their conjecture for the A or D criteria. While many of their designs have been proven E-optimal, there are still more than a few open cases. Employing a blend of theory and computation, the E-optimality problem is here solved for v up to 15. Included are counterexamples to conjectured E-optimal designs in John and Mitchell's (1977) table, and designs which they were unable to solve. The concept of 2-regular graphs plays a key role.

SOME IMPLICATIONS OF V -UNIFORM ERGODICITY FOR INFERENCE WITH NONLINEAR TIME SERIES. Thomas R. Boucher, Dept. of Statistics, Virginia Polytechnic Institute and State University, Blacksburg VA 24061-0439. One method of demonstrating ergodicity of a Markov chain is to construct a test function V of the chain that satisfies a stochastic drift criterion. Limit laws exist for partial sums of functions of the data that are uniformly bounded by the test function V . We apply existing results that enable norm-like test functions to be 'boosted' to an exponential, implying the existence of all moments of the stationary distribution of the Markov chain and a novel approach to asymptotic results for statistics. We demonstrate that V -uniformly ergodic cyclic threshold autoregressive time series models and certain nonlinear autoregressive time series models fall under this rubric.