

# PROCEEDINGS

**ABSTRACTS OF PAPERS, 79th Annual Meeting of the Virginia Academy of Science, May 22-25, 2001, James Madison University, Harrisonburg, Virginia**

## **Aeronautical and Aerospace Sciences**

NUMERICAL STUDY ON SUPERSONIC MIXING. T. M. Abdel-Salam, S. N. Tiwari & T.O. Mohieldin, Department of Mechanical Engineering, Old Dominion University, Norfolk, VA 23529. In recent years, considerable fundamental research has been conducted in response to the increased interest in the development of scramjet propulsion systems. Significant amount of experimental and numerical research have been directed towards injectors design that must produce rapid mixing and combustion of the fuel and air. Numerical results for a three-dimensional compressible flowfield around a swept ramp fuel injector are presented. The main goal of this research is to address the capability of an existing CFD code to simulate dual-mode mixing and combustion in scramjet engine. This investigation has focused on comparing the numerical results with the existing experimental results obtained by researchers at the University of Virginia. Experimental data was obtained on the tunnel center-plane and three-sectional planes downstream of the ramp. There is very good agreement in jet penetration, spreading, shape and peak concentration. Overall, the code applied to the specific problem shows an excellent agreement with the experimental data. Comparison of the non reaction and reaction results is also presented. The use of unstructured grid in the code highly reduced the CPU time required to model the current problem.

AERODYNAMIC CHARACTERISTICS OF AN AIRPLANE CONFIGURATION WITH VARIOUS WING AND TAIL ARRANGEMENTS. M.Leroy Spearman, Systems Analysis Branch, NASA-Langley Research Center, Hampton, VA 23681 & Jill C. Harper, Industrial and Systems Engineering Dept, Va. Polytechnic Inst. & State Univ., Blacksburg, VA 24061. A review has been made of some wind-tunnel data for the purpose of assessing the aerodynamic behavior of airplane designs having various wing and tail arrangements. The basic design consists of a body with a swept wing and a swept horizontal tail. The wing and the tail could each be mounted in a high, mid, or low position on the body. The horizontal tail could also be located at three longitudinal positions aft of the wing. Thus a matrix of 27 wing-tail positions was available and these were tested over a Mach number range from 0.50 to 4.63. The purpose of the investigation was to illustrate the effects of interference flow fields on the aerodynamic behavior as affected by the geometric design and the flight attitude. In general, the results indicate that coplanar wing-tail arrangements are reasonably well behaved whereas some nonplanar arrangements result in undesirable nonlinearities. In addition, there are some arrangements in which the flow fields may be favorably exploited.

HOPF- BIFURCATION OF A 2-D SUPERSONIC AEROELASTIC SYSTEM FEATURING CUBIC PHYSICAL AND AERODYNAMICAL NONLINEARITIES. Piergiovanni Marzocca<sup>1</sup>, Liviu Librescu<sup>1</sup>, & Gianfranco Chiochia<sup>2</sup>, <sup>1</sup> Engineering Science and Mechanics Dept., Va.Polytechnic Inst.& State Univ., Blacksburg, VA 24061 & <sup>2</sup> Dipartimento di Ingegneria Aeronautica e Spaziale, Politecnico di Torino, 10129 Italy. The next generation of aerospace vehicles may feature increasing structural flexibility, operate in severe environmental conditions and have greater maneuverability than current one's. To achieve such requirements, an exploitation of the load carrying capacity of the structure and the capability that is provided should be used. A better knowledge of the factors contributing to the occurrence of the flutter instability boundary, and an understanding of the factors determining the character of the flutter boundary, (benign or catastrophic), is required. Techniques enabling one to convert a catastrophic flutter into a benign flutter are needed. This investigation examines the catastrophic and benign character of the flutter instability boundary of 2-D lifting surfaces in a supersonic flow field. To address the problem, the

method based on the Liapunov First Quantity is used to study the bifurcational behavior of the aeroelastic system near the flutter boundary. The study should enhance the reliability of aeroelastic analysis and design criteria for aircraft.

SHOT PEENING - THE OBSCURE PROCESS. Abdelrahman M. Rabie. , ISAT Dept., James Madison Univ., Harrisonburg VA 22807. Shot peening is a cold-working process used to improve the fatigue life and corrosion resistance of metallic components. The performance of the peened components is governed by a number of inter-related parameters; one of the influential parameter is peening coverage. In manufacturing, the coverage should be monitored to ensure the consistency of the peening process as well as the quality of the peened components. Therefore, on-line methods, based on objective criteria, to evaluate and monitor coverage are progressively introduced to replace current off-line, time consuming, subjective methods. Several advancements in sensory, measurements, and computer technologies have contributed to the introduction of such new methodologies. The presentation covers description of the peening process and its applications, process parameters, and methodologies used in coverage control.

A BRIEF SURVEY OF SOME HISTORICAL AIRPLANE CONFIGURATION TYPES. M. Leroy Spearman, Systems Analysis Branch, NASA-Langley Research Center, Hampton, VA 23681. Over the years airplane designs have appeared in many shapes and forms. How should an airplane look and what must be considered in the conceptual design? Fundamentally an airplane is designed to support itself at specified flight conditions with a specified payload. The lift required for sustained flight could be provided with only a lifting wing and this has given rise to many flying-wing designs. However, some considerations other than sustained flight have lead to a variety of other design features. Requirements for stability, control and maneuverability have lead to the addition of tail surfaces behind the wing (aft tail) or in front of the wing (canard). Special requirements for the accommodation of passengers and cargo have lead to various body arrangements. Thus the large variety of airplane configurations that have appeared have been dictated by different and often conflicting requirements that include performance, mission, and safety.

### **Agriculture, Forestry and Aquaculture Science**

A COMPARISON OF HAND-HARVESTED AND MACHINE-HARVESTED BUTTER BEANS. Carl E. Niedziela Jr. & Christopher D. Mullins, Virginia Cooperative Extension, Virginia State University, Petersburg, VA 23806. Butter bean or baby lima bean (*Phaseolus lunatus* L.) production is limited in Virginia due to the availability and cost of labor for harvesting. This study was conducted to determine the effect of harvest method on the yield of commercial butter bean production. On 26 May 2000, a 0.44 ha field on a private farm near Skippers, Va. was planted with 'Thorogreen' butter beans. The field was laid-out in a randomized complete block with four replications and two treatments (hand-harvested and machine-harvested). Each 3.6 m x 136 m plot was two rows wide. Border rows were left on each side of the field. The hand-harvested plots were picked twice (9-10Aug. and 17Aug.). The machine-harvested plots were harvested once (16Aug) using a Pixall BH100 single-row bean harvester. Means were separated using least significant difference. There were no differences between the first hand-harvest and the machine harvest. However, the fresh pod yield was higher for the two hand-harvests (4959 kg/ha) than a single machine-harvest (2013 kg/ha). The shelled bean yield was higher for two hand-harvests (1313 kg/ha) than a single machine-harvest (606 kg/ha). The shelled weight per 15 kg of beans was equal for the two treatments.

ENVIRONMENT-FRIENDLY PRODUCTION OF CANTALOUPE AND SWEET CORN. Ronald A. Bowen and Harbans L. Bhardwaj, Agricultural Research Station, Virginia State University, Petersburg, VA 23806. In order to reduce/eliminate use of inorganic nitrogen fertilizers, we conducted two separate field experiments during each of 1999 and 2000 to evaluate the potential of winter cover crops, especially lupin, to meet nitrogen needs of cantaloupe and sweet corn. The treatments consisted of lupin, hairy vetch, Austrian winter pea (AWP), recommended rate of nitrogen fertilizer, and a control. The cantaloupe and sweet corn were grown following winter production of cover crops in a randomized complete block design with four replications. During 1999, the cantaloupe yields were 53.6, 45.0, 23.1, 13.0, and 5.6 MT/ha whereas the sweet corn yields were 8.5, 5.6, 3.1, 1.5, and 0.7 MT/ha, respectively following lupin, hairy vetch, AWP, 110 kg N/ha, and unfertilized control. During 2000, the cantaloupe yields were 27.8, 26.3, 8.6, 5.8, and 2.2 MT/ha whereas fresh sweet corn ear yields were 5.2, 3.9, 4.0, 4.8, and 1.2 MT/ha, respectively following lupin, hairy vetch, Austrian winter pea, control fertilized with 110 kg N/ha, and unfertilized control. These results demonstrate that lupin can be an excellent winter cover crop for meeting nitrogen needs and environment-friendly production of cantaloupe and sweet corn.

PROSPECTS OF WHITE LUPIN AS A WINTER GRAIN CROP IN VIRGINIA. Harbans L. Bhardwaj, Agricultural Research Station, Virginia State University, Petersburg, VA 23806. White lupin (*Lupinus albus* L.) has the potential to be an alternative winter grain crop. Lupin can provide nutritious food/feed grains and also reduce input costs and environmental pollution related to use of N fertilizers. Lupin seeds (32-38% protein) are suitable for on-farm utilization since high temperature cooking to neutralize anti-nutritional factors is not needed. The New Crops Program of Virginia State University has evaluated lupin production in Virginia for the past several years. These efforts have identified the need for winter hardy and high yielding cultivars, characterization of alkaloid content in lupin seed and its relationship with productivity, and strategies for management of anthracnose. Experiments with French cultivars have indicated that seed yield of up to 6547 kg/ha with a range from 3777 to 6547 is attainable. The cold weather during 2000-2001 season has helped us identify winter hardy germplasm received from USDA-ARS and Auburn University. Preliminary research with alkaloids has indicated that "Bitter" lupins (high alkaloid content) have an advantage over "Sweet" lupins (alkaloid-free or low alkaloid content). Considerable variation exists among lupin germplasm for development of high yielding sweet lupin cultivars. Prospects of developing lupin as a grain crop are good.

UNDERSTORY VEGETATION PATTERNS IN SHELTERWOOD STANDS. Heather K. Douglas & Mary E. Lehman, Dept. of Natural Sciences, Longwood College, Farmville, VA 23909. The forest management technique of shelterwood cutting results in increased sunlight penetration to the understory. This study assessed understory vegetation diversity and species composition patterns relative to time since shelterwood cutting disturbance. Percent coverage was estimated for all plant species found in randomly selected plots in a control site and in sites that had been shelterwood cut 2, 3, or 6 years ago. Species richness and diversity declined significantly with age since shelterwood cutting. Some species were commonly found throughout all sites, regardless of age since shelterwood disturbance (e.g., *Quercus* spp., *Acer rubrum*). Some species that dominated 2- and 3-year sites declined in importance or were not found in the 6-year site and the control site (e.g., *Liriodendron tulipifera*, *Andropogon virginicus*, *Rhus glabra*).

PERFORMANCE, HEALTH AND IMMUNE STATUS OF BEEF CALVES FED PROTEIN AND ENERGY SUPPLEMENTS DURING THE BACKGROUNDING PERIOD. R. J. Austin, J. P. Fontenot, W. S. Swecker, R. K. Shanklin, J. Fike & A. M. Shank, Department of Animal and Poultry Sciences, Virginia Polytechnic Institute and State University, Blacksburg, VA. 24060. Newly received or newly weaned calves are highly susceptible to the incidence of bovine respiratory disease. Four backgrounding trials were conducted to examine the effects of protein and energy supplements to stressed calves consuming grass hay and stockpiled forages. Supplements included different levels

of protein and energy. In all trials, supplemented cattle gained faster than unsupplemented cattle by d 42 ( $P < 0.05$ ). Daily gains were higher ( $P < 0.03$ ) for steers supplemented with corn compared to a 15% protein supplement. Steers supplemented at 0.5% body weight (BW) had higher gains than steers supplemented at 1.0% BW ( $P < 0.05$ ). During week 1, steers grazing fescue had higher daily gains than those grazing fescue-alfalfa ( $P < 0.05$ ). Blood glutathione peroxidase levels were not affected by supplements fed, but generally increased over time. In all trials, no consistent differences were detected in morbidity, number of animals treated or serum mineral concentrations due to treatment.

THE EFFECT OF AMOUNT AND FORM OF PHOSPHORUS AND PHYTASE SUPPLEMENTATION ON PHOSPHORUS UTILIZATION BY RUMINANTS. R. K. Shanklin, J.P. Fontenot, J.S. Radcliffe, R.J. Austin, & J.P. Rice, Department of Animal and Poultry Sciences, Virginia Polytechnic Institute and State University, Blacksburg, VA 24061-0306. Two metabolism trials were conducted to investigate the effects of the chemical form of phosphorus (P) and phytase supplementation. Eighteen wether lambs (average BW = 23 kg) were allotted to six diets for each of two metabolism trials. The diets were: 1) low P alone, or supplemented with 2) inorganic P, 3) phytic acid, 4) phytic acid and phytase, 5) cottonseed meal or 6) cottonseed meal and phytase. Apparent absorption of P was lowest ( $P < 0.005$ ) for the low P treatment compared to the other treatments. Ruminal fluid P was higher ( $P < 0.05$ ) for lambs fed supplemental P. Within supplementation treatments, ruminal fluid P was higher ( $P < 0.05$ ) for lambs fed organic P than for those fed inorganic P. Cottonseed meal resulted in higher ( $P < 0.001$ ) ruminal fluid P than phytic acid. Addition of phytase to the diets with organic P resulted in more P in the ruminal fluid ( $P < 0.04$ ) and tended to increase ( $P < 0.12$ ) serum P. There was a decrease ( $P < 0.003$ ) in serum P associated with the low P treatment.

TEACHING WATER QUALITY: VIRGINIA STATE UNIVERSITY'S YOUTH AQUACULTURE PROGRAM. Albert O. Reid & Brian L. Nerrie, Cooperative Extension, Virginia State University, Petersburg, VA 23806. Virginia State University's Youth Aquaculture Program (YAP) has met and exceeded its objectives. It was originally designed in 1991 to increase student awareness of farming in the aquatic environment. Educational programs have been provided to more than 500 schools in the commonwealth of Virginia. These programs included aquaculture farm visits, in-school presentations, field days, and educational displays. YAP has expanded to include student directed aquaculture production in a number of school systems. Water quality is one of the most important areas of study for students. Eight high schools with production systems were selected in which aquaculture is used as an educational tool to expose students to water quality issues. A four-step educational program was utilized. The steps include: pretest, observation, hands-on work, and post-test. Parameters explored were: temperature, dissolved oxygen, pH, chlorine/chloramines, ammonia, alkalinity, and hardness.

SMALL SCALE POND SPAWNING OF KOI CARP. Scott H. Newton, Cooperative Extension, Virginia State University, Petersburg, Va 23806. Koi carp, *Cyprinus carpio*, are colorful ornamental fish used mainly in small pools, which includes water gardens and aquatic pools in theme parks, zoos, and hotels where these fish may be easily viewed. They are highly prized by collectors worldwide. Four-year-old adult fish averaging 2.5 pounds each were stocked into three small ponds (1.8 ac) in May, 2000 to produce fingerling fish for small farm sales. Spawning mats were placed in the ponds in corner areas. The only management practice was water level maintenance until the spring, 2001. Ponds were drained and fish harvested during April, 2001 to recover the adults and one-year-old fingerlings. All adults were recovered for 100 percent survival. Approximately 1000 fingerlings were recovered from the three ponds for an average of 330 fish per pond that could be marketed. This experiment demonstrates another opportunity for aquaculture product production on a small farm scale to diversify market potentials.

RAINBOW TROUT CAGE CULTURE: SETTLEABLE SOLIDS COLLECTOR. Brian L. Nerrie & Albert O. Reid. Cooperative Extension, Virginia State University, Petersburg, VA 23806. Environmental impacts of agriculture, including aquaculture, are being watched by the media, the public and by government regulatory agencies. Minimizing negative effects on the environment is one objective of the aquaculture industry, which strives for sustainability. Cage culture is an alternative enterprise that brings underutilized water bodies into production. Rainbow trout are double-cropped during the winter season in cages from which warm-water catfish or hybrid striped bass have been harvested. Sinking feed, used to limit competition by birds, may be used, but results in feed loss through the cage bottom. Nutrient inputs derived from cage culture (unconsumed feed, feces, organic debris) can be reduced utilizing a settleable solids collector. The cost, design and construction of a portable settleable solids collector for cage culture are described. Implications of excess nutrient effluent from cage culture operations are discussed for Virginia and international operations.

FUNGAL AND BACTERIAL EPIZOOTIC IN BROWN BULLHEAD (*AMEIURUS NEBULOSUS*) FROM AN URBAN FISHERY. Stan Webb<sup>1</sup>, Greg Garman<sup>2</sup>, Steve McIninch<sup>2</sup>, David Crosby<sup>3</sup>, <sup>1</sup>Dept. Of Biology, <sup>2</sup>Center for Environmental Studies, VCU, and <sup>3</sup>Cooperative Extension, PO Box 9081, VSU, Petersburg, VA 23806. During April 1999, an urban fishery, Swan Lake in Bryd Park, Richmond, had a fish kill involving over 300 brown bullheads. VCU personnel investigated this epizootic. External clinical signs showed bullheads had light to heavy infestation of leeches and lesions involving a *Saprolegnia* sp. Internal pathology showed livers were discolored with focal hemorrhagic areas. *Aeromonas hydrophila* and *Plesiomonas shigelloides* were recovered from external lesions, liver, and gall bladder. The pathology of external lesions was a necrotizing dermatitis into the underlying muscles with focal areas of necrosis and invasive bacteria. Additionally, pathology revealed that bullheads were infected with metacercaria called yellow grub. The cause of the epizootic was not determined by the investigation. However, since leeches used in modern medicine act as vectors for *Aeromonas* infections in humans, leeches may have been the primary vector causing *Aeromonas* and *Plesiomonas* septicemia in these brown bullheads.

FISH HEALTH STATUS IN VIRGINIA AQUACULTURE INDUSTRY: AN UPDATE. David Crosby, Cooperative Extension, PO Box 9081, VSU, Petersburg, VA 23806. In order to assist the emerging aquaculture industry in Virginia with fish disease problems and health issues, a Fish Health Diagnostic Laboratory was established at Virginia State University in 1993. Since, the laboratory has processed over 280 cases from Virginia fish producers. Fish health problems in Virginia's emerging aquaculture industry have varied with producer expertise, culture systems, and species. During 1996 to 1999, the laboratory processed 39 inspections and routine checks, mainly with tilapia. Results of these inspections found *Ichthyobodo* on tilapia approximately 50% of the time. No particular disease group dominated as a health problem for fish producers in Virginia. Parasites constituted about 30% to 40% of diagnostic casework from 1993 to 1999. The ciliated protozoan, *Trichodina*, was the most commonly found parasite on fish being raised in cages. Several significant fish diseases (Enteric septicemia of catfish, proliferate gill disease, and *Streptococcus*) have been identified in Virginia. The principal fish health issue among Virginia trout producers is fish health certification for interstate shipment.

COMPARISON OF RAINBOW, BROOK, AND GOLDEN TROUT IN CAGE CULTURE. Scott H. Newton, Cooperative Extension, Virginia State University, Petersburg, Va 23806. Research has been conducted over the past 16 years at VSU on winter cage culture of trout in non-traditional areas in Virginia. The 2000 - 2001 winter season was the first to compare production of the three primary Virginia freshwater trout. Survival of rainbow (92%) and golden (91%) trout was significantly better than brook trout (67%). Growth rates of all fish were similar at approximately 250% for the period. Production aspects of rainbow and golden trout were essentially the same, as expected, because the golden trout is a color variation of the rainbow trout. Fish size at stocking, feeding frequency and weather conditions are the primary variables affecting fish size at harvest in the spring.

ENVIRONMENTAL EFFECTS ON OIL, POLYUNSATURATED FATTY ACID, AND SOME PHYTOCHEMICALS IN VEGETABLE SOYBEAN. Ali Mohamed, Agricultural Research Station, VSU, Petersburg, Va 23806; Mentreddy Rao, Fort Valley State University, Fort Valley, GA 31030 & Mebrahtu, Agricultural Research Station, VSU. To introduce a new high protein vegetable to the American diet and to diversify the soybean use, soybean research programs at VSU and FVSU were aimed at developing vegetable soybean cultivars that would adapt to different US environments. Vegetable soybeans (*Glycine max* [L.] Merr.) are those which are harvested at R6 - R7 growth stage while the pod is still green and the seeds have developed to fill about 80-90% of the pod width. Twenty vegetable soybean genotypes from Virginia and fourteen from Georgia were analyzed for protein, oil, phytate, tocopherols, sterols, trypsin inhibitor activities, and unsaturated fatty acid profile. Mean protein, oil, and phytate were 7.6, 7.3, and 0.0164 g/100g fresh seeds, respectively. The mean total tocopherol was 309.24mg/g Freeze-dried seeds. d-tocopherol (127.59 mg/g) was higher than a and g-tocopherol (97.53 and 84.13, respectively). Variations in total sterol and sterol patterns were also found. The overall means were 234.8, 44.6, and 45.6 mg/g freeze-dried seeds for b-sitosterol, stigmasterol and campesterol, respectively.

PHYSIOLOGICAL EFFECTS OF SOYBEAN PHYTOCHEMICALS AND ITS POSSIBLE ROLE INCONTROLLING GLUCOSE LEVEL IN DIABETIC RATS. Ali Mohamed, ARS, VSU, Petersburg, Va 23806 Sam Bhatena, BNHRC/ARS/USDA, Beltsville, MD; Manuel Velasquez, Medical Center/George Washington University, Washington DC. & Ali Abdel Aziz, ARS, VSU. Soybeans are nutrient-dense, a high-quality source of protein, fiber-rich and vitamins. Soybeans are unique among legumes because of their high isoflavones contents. Protective and therapeutic benefits of soybean and its phytochemicals intakes have been documented. Soy bean has been reported to have protective effects on chronic diseases such as atherosclerosis, diabetes, and osteoporosis which are known to be influenced by hormonal related factors. Feeding studies with soybean showed a significant effect on the level of insulin, ACTH, testosterone, triiodothyronine (T3) and thyroxine (T4). Soy diet lowered plasma ACTH compared to casein fed rats. Rats fed soy protein had lower testosterone but higher T3 and T4 levels compared to casein fed rats. The data showed that long term feeding of soybean affects hormones that are involved in lipid and carbohydrate metabolism and cellular growth which may partly contribute to the long term protective effects of soy meal on chronic diseases.

PRELIMINARY PROTEIN/LIPID REQUIREMENTS AND OVERVIEW OF STATUS OF SUMMER FLOUNDER (*Paralichthys dentatus*) RESEARCH IN VIRGINIA. M. H. Schwarz<sup>1</sup>, T.G. Gaylord<sup>1</sup>, R.W. Cool<sup>1</sup>, G. Davitt<sup>1</sup>, M.L Jahncke<sup>1</sup>, and S.R. Craig<sup>2</sup>, <sup>1</sup>VSAREC 102 S. King Street, Hampton VA, 23666, and <sup>2</sup>College of Veterinary Medicine, VPI&SU. Limited data on nutritional requirements of summer flounder grown in recirculating aquaculture systems (RAS) is a serious constraint to development of summer flounder as a viable aquaculture species. In one study, dietary lipid levels were tested ranging from 8 to 12%, and while not statistically validated due to a high degree of variability within replicates, the 8 percent lipid level demonstrated improved growth and survival. Dietary lipid level was significant at (P<0.003) with respect to lipid levels in finray muscle and inversely to liver lipid content. In a protein study 35, 40, 45, 50, 55, and 60% dietary protein was investigated. Fish in the study were compromised with a bacterial pathogen resulting in termination of the study by week eight, however at (P<0.05) mortalities in replicates fed 35, 40, and 45% protein were significantly higher than 55 and 60% protein diets. The 50% protein diets was not significantly different at (P<0.05) to either the lower or higher protein diets.

THERMAL OPTIMA FOR THE PRODUCTION OF SUMMER FLOUNDER (*Paralichthys dentatus*). R. W. Cool<sup>1</sup>, T. G. Gaylord<sup>1</sup>, M. H. Schwarz<sup>1</sup>, M. L. Jahncke<sup>1</sup>, and S. R. Craig<sup>2</sup>, Virginia Seafood Agricultural Research and Extension Center, 102 S. King Street, Hampton, VA 23669 and <sup>2</sup>VPI&SU, Blacksburg, VA. 24061. The objective of this study was to evaluate the environmental temperature most suitable to culture juvenile summer flounder. Nine 38-l aquaria, in replicates of

three (19, 24, 29<sup>o</sup> C), were stocked with ten juvenile flounder per tank (9.5 g/fish). Fish were fed to satiation once daily and amounts of feed were quantified. At the termination of the 10-week trial, fish were weighed individually and three fish per aquarium were dissected for intraperitoneal fat weight, muscle weight (divided into ordinal white muscle and finray muscle) and liver weight. The remaining fish were pooled for whole body composition analysis. Muscle and liver were processed for protein and lipid determination. Analyses was performed using SAS and differences were deemed significant at  $P < 0.1$ . Growth in the 29<sup>o</sup>C tanks was significantly greater than the 19<sup>o</sup>C, but not significantly greater than the 24<sup>o</sup>C tanks. Condition indices found only the finray muscle in the 29<sup>o</sup>C tanks to be significantly higher than the 19<sup>o</sup> and 24<sup>o</sup>C tanks. Lipid content in the 29<sup>o</sup>C tanks was significantly higher than the 19<sup>o</sup> and 24<sup>o</sup>C tanks.

WHAT DO GOOD BUGS EAT WHEN THEY RUN OUT OF BAD BUGS? M. Kraemer, R. Grayson, and J. McConnell. P.O. Box 9061, Virginia State University, Petersburg, VA 23806. Greenhouse vegetable production is largely dependent on biological control because of a lack of effective pesticides registered for greenhouse vegetable use and increasing pesticide resistance found in major pest species. Costs to establish and maintain natural enemies can be substantial. When host populations decline the natural enemy often declines rapidly as food resources become scarce. The result is a rapid resurgence of the pest populations and additional natural enemies must be ordered. We investigated the potential use of dill flowers as a supplemental food for parasitoids (*Encarsia formosa*, *Eretmocerus californicus*) of *Bemesia* type whiteflies, a major greenhouse pest. Umbels of dill flowers were excised and placed in plexiglass cages, with stems in either water with or without systemic pesticides (dimethoate, malathion). After 3 days 98 to 100 percent of the parasitoids in the systemic treatments were dead (18% to 32% were found on the flowers) whereas less than 20% of the control had died. This indicated that the parasitoids had feed on dill nectar. Parasitoid use of dill nectar was confirmed using Energy Dispersive X-ray Analysis (EDXA) of insects caged with excised dill flowers in rubidium laced water. EDXA was shown to be sensitive enough to use this technique for the smallest of insects.

COMPATIBILITY, YIELD AND QUALITY OF 'MATUA' PRAIRIEGRASS GROWN WITH LEGUMES. J. F. Guay<sup>1</sup>, A. O. Abaye<sup>1</sup>, P. R. Peterson<sup>2</sup>, and J. P. Fontenot<sup>1</sup>, <sup>1</sup>Va. Polytechnic Inst. & State Univ., Blacksburg, VA 24061, and <sup>2</sup>University of Minnesota, St. Paul, MN 55108. 'Grasslands Matua', *Bromus willdenowii* (Kunth), is a cool-season, perennial, high quality, high producing brome grass variety. In the spring of 1998, alfalfa (*Medicago sativa*), red clover (*Trifolium pratense*), ladino clover (*Trifolium repens*), and annual lespedeza (*Lespedeza stipulacea*) were drilled into an existing matua stand. Botanical composition, quality, and yield were estimated. No significance differences due to the legume treatments were found for 1998 harvests. During the 1999 growing season, ladino clover and red clover frequently comprised over 50 percent of the plots and significantly decreased the amount of matua in the stands ( $p < 0.05$ ), indicating a possible incompatibility. In 1999, ladino clover and red clover increased total yield ( $p < 0.05$ ). The greatest improvement in quality also occurred in the ladino clover and red clover treatments during the 1999 growing season, with a 10 to 20 percent decrease in neutral detergent fiber ( $p < 0.05$ ). Although legumes increased the total yield and the quality of the forage mixture, ladino clover and red clover out competed matua at the seeding rates used.

### Archaeology

SETTLEMENT PATTERNS ON VIRGINIA'S APPALACHIAN PLATEAU: TOTO, I DON'T THINK WE'RE IN KANSAS OR EVEN RICHMOND ANYMORE. Michael B. Barber, USDA-Forest Service, 5162 Valleypointe Parkway, Roanoke, VA 24015. The typical settlement models developed for the Middle Atlantic region are reviewed and modified through the additions of bedrock geology, tool function, lithic type, site setting, and social organization. The over-generalizing of 1970s is confounded by collected data and used to create lower level expectations. The Appalachian Plateau of Virginia is used to pragmatically test the applicability of the new model. While the model has the flexibility to provide "fit" for the physiographic region, site types such as quarries and quarry reduction stations are absent.

COMMUNITY-BASED ARCHAEOLOGY AND HISTORY AT ITS BEST: THE ELK RUN ANGLICAN CHURCH RESEARCH PROGRAM. John T. Eddins, Cultural Resource Division, The Louis Berger Group, 1819 H. Street N.W., Suite 900, Washington, D.C. 20006. The Elk Run Anglican Church site (44FQ179) research program is a community run history and archaeological research program in southern Fauquier County, Virginia. Elk Run was the first Anglican Church established in the mid-18th century in the frontier region that would later become Fauquier County. The church was abandoned shortly after 1800. After more than a century and a half of absence from the public consciousness, the Elk Run Church has become a renewed focus of community activity and interest. A local preservation committee has initiated a broad program of historical and archaeological research, based on community volunteer effort. The archaeological research has thus far resulted in the exposure of a symmetrical cruciform church foundation and one burial in an associated cemetery. Individual interests, education, entertainment, and community history have all been served through the volunteer program.

ARCHAEOLOGY AND ARCHITECTURE AT THE "FIELDING LEWIS STORE," FREDERICKSBURG, VIRGINIA. Michael Klein and Emily Lindtveit, Center for Historic Preservation, Mary Washington College, Fredericksburg, Va. Architectural analysis and archaeological fieldwork were conducted at the two-and-one-half-story Georgian structure generally referred to as the "Fielding Lewis Store," located in Fredericksburg, Virginia. Independent analytical methods produced evidence for a circa 1750 construction date and a circa 1808 renovation of the building. These dates: 1) place the storehouse among the earliest brick structures in Fredericksburg; and 2) suggest that the renovation of the building followed the devastating 1807 fire that destroyed a significant portion of downtown Fredericksburg.

ANALYSIS OF FAUNAL REMAINS FROM THE KITCHEN FEATURE, MOUNT PLEASANT SITE, ORANGE COUNTY, VIRGINIA. Laurel D. Miller, Dept. of Soc. and Anth., James Madison Univ., Harrisonburg, Va. 22807. Preliminary analysis of the faunal remains from the kitchen feature at the Mount Pleasant Site, Montpelier, Orange County, suggests that the Madison family slaves occupied this site. The faunal remains were analyzed according to species and element using authoritative manuals and comparative skeletal materials at James Madison University. The findings from this site were then compared to the Kingsmill Plantation Slave Quarter site in Williamsburg and the Storehouse and Dry Well at Monticello. Of the identifiable pieces in the assemblage, the majority of the remains were identified as the domestic pig, *S. scrofa*, with a small amount of large mammal, small mammal, bird, fish and reptile included. The body parts represented are consistent with the findings at the Kingsmill Quarter site and the Storehouse site, both representative of the typical slave diet in the Virginia Piedmont and Coastal Plain regions.



THE COLLECTING AREA AS THE UNIT OF ANALYSIS: THOUGHTS ON THE LANDSCAPE APPROACH AND NON-SITE SPECIFIC ARCHAEOLOGY. Carole L. Nash, Dept. of Soc. And Anth., James Madison Univ., Harrisonburg, Va. 22807. An analysis of Virginia Department of Historic Resources Archaeological Site Inventory Forms for Madison County, Virginia demonstrates great variation in the understanding of what constitutes an archaeological site. Based on field checks, 70% of the forms for sites on private land actually document collecting areas: poorly defined areas of cultural activity that, if surveyed according to current standards, would be better characterized as overlapping or spatially discrete, multiple occupations. This paper presents the results of the Madison County study and considers an archaeological practice based on the collecting area as the unit of analysis. Examples of this "non-site archaeology," which incorporates a larger-scale landscape approach, are given.

THE ANALYSIS OF A GUILFORD-AGED CHIPPING CLUSTER FROM 44GY18. George A. Tolley. U.S.D.A. Forest Service, , 5162 Valleypointe Parkway, Roanoke, VA 24015. During the last two weeks of July, 2000 the George Washington and Jefferson National Forests sponsored a joint Archeological Society of Virginia Certification Field School and Passport in Time Program at the Fairwoods Livery Site (44GY18) in Grayson County, Virginia. This is the second field school the forests has sponsored to investigate the prehistoric use of Mount Rogers rhyolite at this site. This paper will address the results from the analysis of a Guilford- aged chipping cluster that was discovered during this latter field school. This chipping cluster, unique to the site at this time, contained two Guilford projectile points with more than 100 pieces of rhyolite debitage, flakes, and core fragments. The analysis of this material will be concentrated on identifying the variety of rhyolite pieces that formed this chipping cluster, any tools or utilized flakes within the cluster, and identify if possible particular knapping techniques utilized by the Guilford occupants.

ANALYSIS OF LITHIC MATERIAL FOUND IN UNIT N1287.5 W2.5 OF THE FAIRWOOD LIVERY SITE (44GY18). William H. Weddle, III, Dept. of Soc. and Anth., Radford University, Radford, VA 24142. 3,858 artifacts were excavated from the 2.5' square unit at this site in Grayson County, Virginia. 3,777 of these artifacts are debitage associated with lithic reduction. 97.9% of the debitage was produced from porphyritic rhyolite, 1.3% is chert and the remaining debitage consists of chalcedony/chert, chalcedony, quartz, crystal quartz, jasper and greenstone. 70 tools were excavated, of which 70% are cutting tools. Most of the tools were also produced from porphyritic rhyolite. Diagnostic artifacts excavated include three complete projectile points and one small grit tempered pottery sherd. The oldest projectile point excavated is a Kirk point of light blue rhyolite dating to 9450 to 8850 BP (Early Archaic). The Guilford point dates to approximately 4950 BP (Middle Archaic). The Brewerton point dates to 4850 to 3650 BP (Late Archaic). The pottery sherd indicates Woodland period use of the site. The site appears to have been used for lithic reduction. However, the presence of the cutting tools indicates that the site had other uses as well. The same types of artifacts were found in all levels, indicating that the site was used for the same or similar functions from the Early Archaic through the Woodland periods.

AN ANALYSIS OF A RECENTLY EXCAVATED GLASS ASSEMBLAGE FROM THE MOUNT PLEASANT SITE, ORANGE COUNTY, VIRGINIA. Megan B. Veness, Dept. of Soc. and Anth., James Madison Univ., Harrisonburg, Va 22807. Mount Pleasant, the mid-18th century boyhood home of President James Madison Jr., has been under excavation by Montpelier archaeology staff and James Madison University archaeological field schools for the past six years. Over 1300 pieces of glass were excavated from two features (a root cellar and a kitchen) during the 2000 field school. The amount, variety and total vessel count is important for determining the activities represented in the features, as well as the general date of deposition. The predominant glass type was wine bottle glass; a minimum of ten vessels were cross-mended and four different groups were identified. The bottles in each group exhibited different characteristics such in color, size and shape and were classified according to the typology developed by Noel-Hume.

**Astronomy, Mathematics and Physics**

A MODEL OF ONE-DIMENSIONAL COUPLED HARMONIC OSCILLATORS AND APPLICATIONS. Robert Knapik, Rick Massaro, & G.R. Taylor, Physics Dept., James Madison Univ., Harrisonburg, VA 22807. In certain crystal lattice structures, vibrations of atoms oscillate under a linear restoring force in approximately one dimension. These systems can be modeled by using weakly coupled, one-dimensional harmonic oscillators. A physical model, which consisted of gliders linked by springs moving on an air track, was analyzed in order to investigate these coupled spring-mass systems. This system was limited to the size of the track so a computer model was developed to extend the experiment. Methods and techniques from classical mechanics, linear algebra and Fourier analysis were used to develop the computer model and to further analyze the physical model. The equations of motion of a system of  $n$  oscillating masses can be solved through numerical techniques. The results from the experiments show that the computational analysis of the  $n$ -mass system is a reliable way of finding the normal mode frequencies. This analysis can be extended to investigate the properties of solids whose atomic behaviors can be simplified to this one-dimensional model.

TEMPERATURE DEPENDENT ELECTRICAL PROPERTIES IN TRANSPARENT CONDUCTING OXIDE THIN FILMS. Timothy J. Nagle<sup>1</sup>, Gerald R. Taylor, Jr<sup>1</sup> David Lawrence<sup>2</sup>, & Geoff Stenger<sup>2</sup>, Department of Physics<sup>1</sup>, ISAT<sup>2</sup>, James Madison Univ, Harrisonburg, Va. 22807. Transparent conductive thin films are in high demand due to their potential for use in liquid crystal displays, photovoltaic cells, space applications, and other electro-optical devices. Transparent ITO thin films were deposited on glass substrates by varying techniques. Such properties of the films as electrical resistivity, Hall coefficient, Hall mobility, and carrier concentration will be discussed, in addition to a summary of the experimental techniques employed. The temperature dependence of electrical properties was studied from 77K to room temperature. Also discussed are such surface properties as grain size and microstructure as measured using atomic force microscopy (AFM) and scanning tunneling microscopy (STM).

LIGHT SOURCES IN TIME AND ENERGY CALIBRATION. Jason Mace & Kevin Giovanetti, Physics Dept., James Madison Univ., Harrisonburg, VA 22807. Key issues in measuring the lifetime of a Muon to one ppm will be presented. A brief overview of the lan detector and the Muon lifetime experiment at Paul Scherrer Institute will be provided as background. Problems typically encountered in time calibration, including systematic effects will be covered. An initial design of the calibration system will be shown along with possible light sources.

PARALLEL-PROCESSING N-BODY ORBIT COMPUTATION. Justin Lacy & Joseph W. Rudmin, Physics Dept., James Madison Univ., Harrisonburg, VA 22807. An ephemeris of the solar system was generated using Maclaurin Series polynomials on three different computer systems, for the purpose of a speed comparison. In all three systems, the algorithm used to generate the polynomials was the Parker-Sochacki modification of the Picard iteration, which is well-suited for parallel processing. The first system was a nine-computer Beowulf-type parallel processing system, consisting of 500 MHz PC's connected together with serial Ethernet cards. The code was written in High-performance Fortran, and included the motions and all of the gravitational interactions of the sun and nine planets. In the second system, the code was written in Fortran 77 operating on a 600 MHz PC with a 32-bit Unix operating system. In the third system, the code was written using a compiled Basic (Power Basic) operating on a single 600 Mhz PC with the Dos 16-bit operating system. The two single-computer systems were roughly equal speed, whereas the parallel processing system was about 70 times slower, probably due to limitations of the coaxial serial communication lines.

SCIENTIFIC APPLICATIONS FOR DATABASES. William M. Quarles and Kevin L. Giovanetti, Dept. of Phys., James Madison Univ., Harrisonburg, VA 22807-0001. There are two main types of databases, flat and relational. Flat databases are simple lists or tables, do not require specialized software, but cannot store much information. Relational databases establish relationship between several flat databases, and are very powerful tools for storing a large amount of information with a complicated organization. Open source software and its advantages are introduced. Oracle, an expensive commercial relational database program, is being quickly displaced in use MySQL, a faster and free open source program. PHP is an open source server-side scripting language for creating dynamic webpages, and has intrinsic functions for interfacing with many other programs, including MySQL and Apache Web Server. Many web developers believe that Apache, PHP, and MySQL are the ultimate combination for creating a website. Finally, three applied databases using MySQL are shown: the membership database for the CLAS Collaboration at Jefferson Lab; the calibration database for Hall B of Jefferson Lab; and NAIS, PostDoc, and ScienceDesk at NASA. The Giovanetti Team's work in databases included installing MySQL, creating the membership database, and investigating interfacing using ODBC, Perl, PHP 4.0, and Java. (Supported by the National Science Foundation).

THE AEROACOUSTICS OF EXTERNAL-COANDA WASTE GAS FLARES. Caroline Smith, Dept. of Mathematics, James Madison Univ., Harrisonburg, VA 22807. (Invited paper) The problem of noise disturbance emanating from gas flares that are used by the oil industry will serve as an example of how mathematics can be used to solve real problems. Methods for modeling the noise emitted by plane and curved wall jets, and how these techniques were applied to external-coanda waste-gas flares of the type commonly used in the petrochemical industry will be given. These models in conjunction with measurements on real and simulated flares lead to the development of novel new flare nozzles which considerably reduced the turbulent mixing noise associated with such flares.

ANALOG COMPUTER SIMULATION OF NONLINEAR LASER DYNAMICS. Nicholas L. Silverman, Steven M. Klotz, & David W. Sukow, Department of Physics and Engineering, Washington and Lee University, Lexington, VA 24450-0303. We study the nonlinear dynamical behavior of a semiconductor laser subject to delayed opto-electronic feedback. We perform this study by designing a simple electronic circuit whose behavior is governed by the same delay-differential equations that govern the laser system. This circuit analog approach offers important experimental advantages compared with the full opto-electronic laser system, since it operates at much lower frequencies and has easily tunable parameters. Furthermore, the circuit can be investigated systematically using automated data acquisition and control of system parameters. The dynamics we observe are in good agreement with numerical and theoretical predictions. One interesting modification of the idealized circuit is the addition of a low-pass filter into the delayed feedback loop; this models the unavoidable frequency dependence inherent in the real laser system. Contrary to some current hypotheses, we find that such filtering does not affect the fundamental oscillation frequency of the system. The only apparent effect is to shift the global dynamics in a manner that reflects the reduced overall feedback strength as a result of filtering.

CALCULATING THE ATTENUATION OF SOUND IN A BUBBLY LIQUID USING THE KRAMER-KRONIG RELATIONS. Stanley A. Cheyne, Walter C. McDermott, & Patrick J. Martin, Department of Physics and Astronomy, Hampden-Sydney College, Hampden-Sydney, VA 23943. The attenuation of sound is calculated using the Kramer-Kronig Relations. The Kramer-Kronig Relations make it possible to calculate attenuation as a function of frequency if the phase speed is known. Experimental and theoretical phase speed data is used to calculate attenuation and compared to theory [K.W. Commander and A. Prosperetti, "Linear pressure waves in bubbly liquids: Comparison between theory and experiment," J. Acoust. Soc. Am. **85**, 732-746 (1989)]. Attenuation is strong near the individual bubble resonance making it difficult to make direct measurements. Converting experimentally determined phase speed data makes it possible to obtain attenuation data indirectly. PACS number: 43.35 Bf.

IMMEDIATE CREATING AN ACTIVE LEARNING CLASSROOM--USE OF STUDENT POLLING FOR FEEDBACK. William W. McNairy, Dept. of Physics, Duke University, Durham, NC 27708. In the Spring of 2001 at Duke a system of infrared remote control devices was installed for use in the Introductory Physics courses. Student evaluations of these courses in past have consistently ranked the lecture element low in value compared with other components of the course. Instructors in the lecture (70-150 students) also had difficulty in eliciting responses to polling questions, whether they were of a conceptual or computational nature. We have installed a response system which uses individual IR transmitters similar to TV/VCR remote controls. Students are polled on questions with up to 10 responses and can indicate three levels of confidence for their response. Projection of the computer interface screen shows students that their responses have been recorded. Results of the poll can then be immediately displayed on a bar graph. This flexible system then allows for re-polling after a discussion period which allows for 'peer instruction' or after a live demonstration of the principle being explored. Initial response of students has been very universal and enthusiastic.

TIDES IN THE IONOSPHERE MEASURED USING LOW FREQUENCY B FIELDS. Michael J. Wallace Hampden-Sydney Col., Hampden-Sydney, VA 23943-0726, & John P. Wallace, Casting Analysis, Weyers Cave, VA 24486. Measuring the magnetic fields in the N-S and E-W directions at the earth's surface in the frequency range from 1 Hertz to 1290 Hertz over periods of months allows the detections of phenomenon in and above the earth-ionospheric cavity. Using a narrow frequency band measuring technique we were able to reject anthropogenic noise and isolate long-term periodic data from the incoherent noise generated in above the surface the earth due to lightening, geomagnetic storms and other unidentified sources.

ATMOSPHERIC CARBON AND THE FUTURE OF THE RADIOCARBON DATING METHOD. Ross T. Thomas, Dept. of Physics, & Troy J. Siemers, Dept. of Mathematics, Virginia Military Inst., Lexington, VA 24450. Many branches of science rely upon the radiocarbon dating technique as a tool for determining the age of organic samples. Knowledge of historical concentrations of atmospheric carbon over time is critical in making accurate age determinations with the technique. Since the beginning of the industrial revolution humans have substantially increased the amount of carbon in the atmosphere. These increases cause ambiguities in the results of radiocarbon dating for young samples. Increased coal utilization and even greater amounts of atmospheric carbon over the next 20 years will make the situation much worse. Corrections may only be possible if atmospheric carbon levels in the future are assessed on a regional basis around the world.

A SIMPLE DEMONSTRATION OF FLUID FLOW AS RELATED TO ARTERIAL DISEASE. Richard. B. Minnix, Dept. of Physics, Virginia Military Inst., Lexington, VA 24450. The rate at which a fluid can be pumped through a cylindrical tube depends upon several factors: the pressure gradient, the viscosity of the liquid, and the radius of the tube. A simple apparatus designed to keep the first two factors constant consists of two soda straws (2.5 mm and 5.0 mm inside diameter) of the same length attached via rubber stoppers at the same depth on opposite sides of a gallon plastic milk jug used as a common reservoir. While results do not agree with Poiseuille's Law, the measured volume flow rate is shown to depend dramatically upon the radius of the tube.

**Biology**

ANABOLIC AND CATABOLIC PATHWAYS FOR MAINTAINING PHOSPHATIDYLCHOLINE HOMEOSTASIS. R. Trisdorfer, S. E. Barbour & A. Kapur, Dept. of Microbiology and Immunology, Virginia Commonwealth University. Phosphatidylcholine (PC) is the most abundant phospholipid in mammalian cell membranes. Maintenance of PC mass is critical to cell survival. Cells treated with exogenous enzymes that disrupt this balance rapidly activate enzymes that will reestablish homeostasis. In the Mc Ardle-RH7777 (MCA) rat hepatocytes, addition of an anabolic pathway through transfection of a vector for the synthetic enzyme phosphatidylethanolamine N-methyltransferase (PEMT) causes no change in PC mass. My data indicate that these transfected cells also show a decrease in one of their degradative enzymes, calcium-independent phospholipase A2 (iPLA2) as a possible reaction to the decrease in other synthetic enzymes in these cells. In Chinese Hamster Ovary (CHO) cells treatment with the catabolic enzyme secreted phospholipase A2 (sPLA2) causes an increase in PC synthesis thereby stabilizing PC mass. My data indicate that CTP:phosphocholine cytidyltransferase (CT), an important synthetic enzyme, is induced to translocate to the membrane and thus become active when this treatment occurs. These findings further reinforce the importance of PC homeostasis in mammalian cells and the interrelatedness of the metabolic pathways involved.

INVOLVEMENT OF BLOOD CLOTTING IN PREGNANCY LOSS INDUCED BY LIPOPOLYSACCHARIDE INJECTION IN CD-1 MICE. Jory C. Enzler<sup>1</sup>, Carolyn M. Conway<sup>2</sup>, & Arthur F. Conway<sup>1</sup>, <sup>1</sup>Dept. of Biology, Randolph-Macon College, and <sup>2</sup>Dept. of Biology, Virginia Commonwealth University. Pregnant CD-1 mice were injected in a tail vein with 5mg of *E. coli* lipopolysaccharide (LPS) in phosphate-buffered saline (PBS) on the ninth day of gestation and then sacrificed 6 or 12 hours after injection. Reproductive tracts were frozen at -50 Celsius and sectioned at 20 micrometers. Control mice were injected with PBS or left uninjected. LPS injection caused a significant decrease in maternal body weight, a significant increase in total endogenous peroxidase staining in the trophoblastic giant cell layer at the maternal-embryonic interface (indicating increased tissue destruction in that location), and an increased accumulation of granulocytes in the decidua below the mesometrium. These changes are consistent with the initial stages of LPS-induced pregnancy loss. Immunostaining for fibrinogen (probably reacting primarily with polymerized fibrin under our conditions) was not significantly altered by LPS treatment in any of the locations sampled in implantation sites, so these results are not consistent with the involvement of the terminal steps of blood coagulation in the early changes leading to LPS-induced pregnancy loss.

BRIEF ELECTRICAL STIMULATION OF THE FOOT OF THE NEONATAL RAT INDUCES A PERMANENT INCREASE IN ADULT PAIN SENSITIVITY. Maria LaPlante, Andrea Gocke & Corey Cleland, Department of Biology, James Madison University, Harrisonburg, VA 22980. Inflammatory injury in neonatal rats can lead to long-lasting increases in adult pain sensitivity. However, it is unknown whether the pain messages that impinge on the spinal cord or the peripheral inflammation are responsible. Consequently, we developed a model in which electrical stimulation of the paw is used to mimic painful sensory input, but without associated tissue damage. Anesthetized neonatal rat pups received electrical stimulation of the left paw at varying developmental stages, stimulation intensities and frequencies. After reaching adulthood (56 days), their thermal pain sensitivity was tested. The results revealed that the electrically stimulated left paw was more sensitive

to pain than the right paw, supporting the hypothesis that activation of the nerve fibers at an early age without tissue damage causes long-term effects on the pain sensitivity of rats. In addition, maximal increases in pain sensitivity were found at P-5 and at intensities greater than 2.5 mA, consistent with activation of C fibers. Variation in frequency of stimulation did not appear to alter the increased pain sensitivity. (Supported by NIH and the Jeffress Foundation).

ANALYSIS OF THE *TRANSPARENT TESTA* MUTANTS OF *ARABIDOPSIS THALIANA* FOR A SUBSTRATE REGULATED FEEDBACK MECHANISM OF ENZYME EXPRESSION. Michelle M. Barthelet & Brenda S. J. Winkel, Dept. of Biology, Virginia Tech, Blacksburg, VA 24061. The *transparent testa* (*tt*) loci identify genes of flavonoid metabolism in *Arabidopsis*. Although the flavonoid pathway itself has been extensively studied, many questions remain regarding the regulation of its enzymes. A previous investigation of the *tt* mutants uncovered a possible feedback mechanism in the flavonoid pathway. We hypothesize that this mechanism may be activated by the flavonoid intermediate, naringenin chalcone, or by flavonol glycosides. This feedback mechanism appears to elevate levels of the flavonoid enzymes, chalcone synthase and flavanone 3-hydroxylase, in at least two mutant lines, *tt3* and *tt5*. Chalcone isomerase appears to be overexpressed in the *tt6* mutant line. New evidence from analysis of mRNA and protein indicates that feedback control operates at different points of gene expression for each of these enzymes. Feeding experiments are being performed to test whether these effects can be replicated in wild type *Arabidopsis* plants and to determine the specific intermediates or end-products involved. (Supported by: Sigma Xi Grant-in-Aid of Research and the Graduate Research Development Project [GRDP], Va. Polytechnic Inst. & State Univ.).

MITOCHONDRIA-ENDOPLASMIC RETICULUM SIGNALLING IN APOPTOTIC NEURONAL DEATH IN AN AI-INDUCED NEURODEGENERATION MODEL. Othman Ghribi,<sup>1</sup> David A. DeWitt,<sup>2</sup> Michael S. Forbes<sup>1</sup>, Mary M. Herman,<sup>3</sup> John Savory<sup>1</sup>, <sup>1</sup>Dept. of Pathology, University of Virginia, Charlottesville, VA <sup>2</sup>Dept. of Biology and Chemistry, Liberty University, Lynchburg, VA. <sup>3</sup>IRP, NIMH, NIH. Neurodegenerative diseases, including Alzheimer's disease, are characterized by a progressive and selective loss of neurons which may involve apoptosis. Intracisternal administration of aluminum maltolate to New Zealand white rabbits results in many of the histologic and biochemical changes associated with Alzheimer's disease. Aluminum maltolate induced the release of cytochrome c from the mitochondria which is a key event triggering apoptosis. Co-administration of cyclosporin A prevented this release. Previous work has also implicated the ER in regulating apoptosis, either independently of or in concert with mitochondria. Members of the *Bcl-2* family of proteins have been shown to either inhibit apoptosis, as is the case with Bcl-2, or promote it, in the case of Bax. The treatment of young adult rabbits induced both cytochrome c translocation from brain mitochondria to cytosol, and caspase-3 activation. Furthermore, these effects are accompanied by a decrease in Bcl-2 and an increase in Bax in immunoblots of ER extracts. Supported by the Department of Defense.

HOMOLOGY MODELING OF THE *tt4* MUTANTS IN *ARABIDOPSIS THALIANA*. C. D. Dana<sup>1</sup>, D. R. Bevan<sup>2</sup> & B. Winkel-Shirley<sup>1</sup> <sup>1</sup>Depts. of Biol. and <sup>2</sup>Biochem., Virginia Tech, Blacksburg, VA 24061. Chalcone synthase (CHS) catalyzes the first committed step in flavonoid biosynthesis, a major pathway of plant secondary metabolism. An allelic series for the *Arabidopsis* CHS locus, *tt4*, has

been characterized at the gene, protein, and end product levels by Saslowsky and co-workers. The mutations identified in each of these alleles were also located on a homology model of the wild type Arabidopsis CHS protein, which is based on the crystal structure of CHS from *Medicago sativa* published by Ferrer and co-workers. We have extended this analysis, refining the original model and generating structures for the mutant proteins, in order to determine how mutations may affect protein structure and function. The *tt4*(UV113) allele contains a mutation that causes a disruption of enzymatic activity while maintaining a stable protein. In contrast, the *tt4*(38G1R) mutation results in a truncated protein that is both inactive and unstable. Interestingly, two temperature sensitive alleles, *tt4*(UV01) and *tt4*(UV25), exhibit significant conformational differences when modeled at different temperatures. These computational approaches are providing new insights into how residues outside the CHS active site may impact enzyme activity, function, and stability.

ALUMINUM INDUCED APOPTOSIS *IN VITRO* AS A MODEL OF ALZHEIMER'S DISEASE. Douglas W. Strand<sup>1</sup>, Othman Ghribi,<sup>2</sup> Nena Fox<sup>3</sup>, Kathleen J.S. Griffioen<sup>1</sup>, Michael S. Forbes<sup>2</sup>, John Savory<sup>2</sup>, & David A. DeWitt<sup>1</sup>, <sup>1</sup>Dept. of Biology and Chemistry, Liberty University, Lynchburg, VA <sup>2</sup>Dept. of Pathology, and <sup>3</sup>Dept. of Microbiology, University of Virginia, Charlottesville, VA. The fundamental mechanism for cell loss in Alzheimer's disease is currently unknown although recent evidence suggests a possible role for apoptosis. In previous studies, intracisternal aluminum (Al) administration to aged rabbits has yielded many biochemical and pathological similarities to Alzheimer's disease and implicates apoptosis. To better understand Al induced neurodegeneration, we have developed an *in vitro* model using human neuroblastoma (NT2) cells. Al was shown to lead to substantial cell death within 24 hours of incubation. Nuclear fragmentation and condensation suggestive of apoptosis was observed as early as 3 hours and increased substantially through 24 hours. Detection of cytochrome c provided evidence that Al induced cell death occurred through apoptosis since Al treated cells had reduced mitochondrial immunoreactivity. We propose that this *in vitro* model, with Al as a trigger, may be used to test theories of neurodegeneration as well as screen potential therapeutic agents. Supported by the Jeffress Memorial Trust.

NEURAL MECHANISMS UNDERLYING HYPERALGESIA IN THE RAT. Jason Freund & Corey Cleland, Department of Biology, James Madison University, Harrisonburg, VA 22980. Inflammation causes increased pain sensitivity, known as hyperalgesia. There is substantial indirect evidence that the underlying changes occur in the peripheral nervous system, spinal cord and the brain, however direct estimates of the individual functional contributions are lacking. We have developed a model to directly examine the magnitude of spinal cord contributions to hyperalgesia in Freund's Adjuvant-treated rats. Rats were inflamed by injection of Freund's adjuvant (100%, 30 ml) into the left hindpaw. The following day, rats were anesthetized and spinalized and EMG electrodes were placed bilaterally around flexor muscle in both hindlimbs. The following day, electrical stimulation was delivered to the surface of the foot to evoke withdrawal reflexes whose magnitude was quantified by EMG. Our results show that unilateral inflammation unexpectedly depressed the spinal component of the flexion withdrawal reflex bilaterally. This is in contrast to a net increase in reflex strength in response to natural stimulation, suggesting that there is a large peripheral sensitization that exceeds the central de-sensitization. (Supported by NIH and the Jeffress Foundation).

CONTINUED ASSESSMENT OF COTTON STAINER RECOVERY FROM HURRICANE IMPACT. Harold J. Grau, Dept. of Biol., Chem., & Env. Sci., Christopher Newport Univ., Newport News, VA. 23606. Cotton stainers (*Dysdercus* sp.) are pan-tropical hemipterous insects that feed primarily on Malvaceous plants. Several distinct populations of *D. andreae* are found on St. Thomas, USVI. In September of 1995, and again in July of 1996, the island suffered direct hits by tropical hurricanes. As might be expected, the populations of *D. andreae* exhibited severe reductions in densities and distribution, being totally eliminated from several locations. Data collected in July 2000 show that the Hull Bay population had made significant recovery in terms of densities and habitat utilization, although they were still below pre-hurricane levels; average body size measures were considerably smaller than in the two years immediately after the storms. Two other populations had returned to pre-storm average body sizes, but their population densities and habitat utilization had decreased from that of 1998, dramatically so in the case of the Tutu Beach population. Dry conditions that preceded data collection may have contributed to the low numbers of insects during that time. Recovery from the storms appears to be complete for those populations that survived the initial impact. (additional information is available at <http://users.cnu.edu/~hgrau/>)

BOTTLENOSE DOLPHIN UTILIZATION OF THE ELIZABETH RIVER, VIRGINIA. Kevin M. Foss & James R. Reed, Dept. of Biology, Chemistry and Environmental Science, Christopher Newport University, Newport News, VA 23606. As the Elizabeth River is both toxin laden and extensively used by commercial, military and pleasure craft, it presents a unique and previously unstudied habitat for Bottlenose dolphins (*Tursiops truncatus*). Using standard protocols for dolphin research, 43 cruises were made over the course of three years and data was recorded on behavior, location and number and animals were recorded on film. The most common behavior observed was feeding. An annual pattern of usage of the river began in May, with a peak in August and no activity from November to April. A diurnal pattern of movement appeared to be used, with no effects seen due to tidal state or weather. Spatially, the dolphins used the main branch of the river most frequently, but with common use of the Lafayette River, a tributary. Using the photo ID data, 125 individuals have been identified using the Elizabeth River during the summer of 2000. A Caughley recapture estimate was used to derive a total population estimate of 216. Habituation to small boat traffic has been noted, as has reactions such as bunching and extended diving near larger vessels. A solitary dolphin overwintering for the past two winters and seen begging has been found dead from propeller strike.

REPRODUCTIVE ECOLOGY OF THE EASTERN BOX TURTLE (*TERRAPENE CAROLINA CAROLINA*) IN A MIXED OAK-PINE WOODLAND IN THE CENTRAL VIRGINIA PIEDMONT. Gordon L. Wilson, Dept. of Biol., George Mason Univ., Fairfax, VA. 22030-4444. A three year ecological study focusing on the reproduction of the eastern box turtle began in the fall of 1999 and will continue through the summer of 2002. Twelve females were radio-tracked through the summer of 2000, weighed at each capture, and X-rayed two to three times during June and July to determine if they were gravid. If gravid, clutch size, egg size, and egg weight were obtained. Mean clutch size was 3.2 (n = 5). Mean egg length and width were 36.4 mm and 21.1 mm, respectively (n = 4). Mean egg weight was 10.3 g (n = 4). Mitchell believed that throughout Virginia, box turtles laid a single clutch of eggs per year. However, one female (#60) laid two clutches in the summer of 2000. Her first clutch of three eggs was laid in mid-June and her second clutch of two eggs was laid in mid-July. Population data on this population was also gathered during this study. Home ranges of



the twelve females were calculated using the bivariate normal method. The mean home range size was 7.9 ha (S.D.= 9.6). The population estimate of the 11 ha study site was 279 turtles using the Peterson Index. Population density was 25 per ha. The F:M sex ratio was 1:1.5 for the 96 turtles whose sex was determined.

METABOLISM OF EXOGENOUS BIOGENIC AMINES IN TOAD-EATING AND NON-TOAD-EATING SNAKES. Lauren E. Laitala & John Temple, Dept. of Biol., Mary Washington College, Fredericksburg, VA 22401. The Florida banded water snake (*Nerodia fasciata*) is one of a few species of snakes that includes toads (Genus *Bufo*) in their diet and can tolerate toad toxin. When fed to non-toad eating snakes, toad toxin induces extensive cardiac arrhythmia, ventricular fibrillation and eventual lethal cardiac and muscular tetany. Serotonin is one component of toad toxin that is known to affect heart rate, vasoconstriction and blood pressure in vertebrates. The goal of this research was to address the hypothesis that toad-eating water snakes (*N. fasciata*) would have a greater ability to break down orally-administered serotonin than non-toad-eating rat snakes (*Elaphe obsoleta*). Following an oral dosage of serotonin (0.00052mg/g body weight), blood was collected hourly for six hours and the serotonin and metabolite levels were analyzed by HPLC. Results indicate that there is no significant difference in serotonin clearance from the blood between the two snake species at the dose and times tested. (Supported by Sigma Xi Grant-in Aid of Research and the Mary Washington College DuPont Summer Science Program).

IN VITRO STUDY OF MOUSE MAMMARY TUMOR VIRUS. Dheeraj K. Goswami & Lynn O. Lewis, Dept. Biological Sciences, Mary Washington College, Fredericksburg, VA 22401. Mouse mammary tumor viruses have been linked to cancer in mice since the 1930's. However, only recently have there been data that have linked the viruses to breast cancer in humans. One of the difficulties in the study of this connection is that researchers have been unable to produce cancer cells in the tissue culture of mouse mammary cells. The purpose of this study is to try to produce cancer cells in tissue culture using a variety of hormones and chemicals. Mouse mammary cells with and without viruses were used to compare and contrast the effects of the hormones and chemicals on their growth and structure. Numerous trials were conducted with a combination of progesterone, estrogen and the carcinogen 2,4-dimethylbenzanthracine. A control of 300 cells per 75 cm<sup>2</sup> flask was used with their growth being recorded after five 12-hour intervals (60 hours total). The effects of the hormones with the carcinogen were recorded at various points over a month-long span. The data showed that while the hormones and carcinogens did have an impact on the structure and growth of the cells, they were apparently not able to produce any cancer cells in the tissue culture.

THE EFFECTS OF VINCRISTINE AND PACLITAXEL ON BCL-2 LEVELS IN ME-180 AND CAO-3 CARCINOMA CELLS. Karyn Havas & Rosemary Barra, Dept. of Biol. Sciences, Mary Washington College, Fredericksburg, VA 22401. Bcl-2 is a protein that defines a new class of oncogenes. Its primary role in a healthy cell is to regulate the occurrence of apoptosis, or programmed cell death. Many haemopoietic cancers are characterized by a mutation affecting Bcl-2 expression. The over expression of this gene increases the ability of a cell to survive, even under adverse conditions and in the presence of DNA damage. The goal of this investigation was to determine the effects of two antineoplastic, antimicrotubular drugs, paclitaxel and vincristine, on the levels of Bcl-2 in ovarian and cervical carcinoma cells. Initial studies were performed using the MTT

cytotoxicity assay to determine the LD<sub>50</sub> of each of the drugs. An immunoblot procedure was carried out following treatment of cultured cells with the drugs at concentrations below the LD<sub>50</sub> value and a Bcl-2 ELISA assay was performed to quantify the Bcl-2 levels. The results indicate that expression of Bcl-2 increases following treatment with vincristine and paclitaxel. It was noted that Bax, a proapoptotic protein, and various dimers were formed. It was concluded that the two drugs stress the cells causing an increase in Bcl-2 levels. These results suggest that Bcl-2 may play a role in decreasing the effectiveness of the drugs.

THE EFFECTS OF METHYL-b-CYCLODEXTRIN AND LOVASTATIN ON EMBRYONIC AXIAL TORSION AND ORGAN PLACEMENT IN CHICKENS. Tamera Y. Sandrof, Douglas H. Shedd, Department of Biology, & Ann M. Fabirkiewicz, Department of Chemistry, Randolph-Macon Woman's College. The *sonic hedgehog* (*shh*) gene produces a signaling molecule, Sonic hedgehog protein (Shh), exclusively on the left side of the primitive streak in the avian embryo. Shh undergoes autoproteolysis and binds cholesterol onto its newly formed carboxyl terminus. The new molecule indirectly activates the signaling for the dextral rotation of both the primary axis and the heart. Chick embryos were treated with methyl-b-cyclodextrin and lovastatin to reduce the level of cholesterol and inhibit the Shh signaling process. The treatment did not produce a statistically significant effect on torsion or heart looping. With greater numbers, however, the effects on heart looping may have been statistically significant.

MOLECULAR REGULATION OF VITAMIN D ACTIVATION: INVOLVEMENT OF THE RENAL VITAMIN D RECEPTOR (VDR) DOWN REGULATION. A Bajwa & MJ Beckman, Virginia Commonwealth University, Richmond, VA, USA. The synthesis of 1,25-(OH)<sub>2</sub>D<sub>3</sub> is regulated by dietary calcium, by PTH to increase 1 $\alpha$ -OHase and decrease 24-hydroxylase and by 1,25-(OH)<sub>2</sub>D<sub>3</sub> which regulates its own synthesis through a VDR dependent negative feedback effect on both 1 $\alpha$ -OHase and preproparathyroid hormone production. This study examines the molecular mechanism of renal vitamin D activation induced by hypocalcemia, and tests the hypothesis that the activation process is the result of negative feedback regulation blockade at the transcriptional level. Differential display RT-PCR was carried out using RNA isolated from the 2 groups that demonstrated extremes in regulation of 1 $\alpha$ -OHase gene expressions, the -Ca+D group and the +Ca+D/1,25(OH)<sub>2</sub>D<sub>3</sub> group. A panel of 8 different combinations of anchor and arbitrary primers produced 7 gene products that correlate with hypocalcemia and 6 gene products that correlated with hypercalcemia. Authentic differentially regulated gene products in the two samples will be confirmed by the real time RT-PCR method. It is expected that this study will result in identification of two sets of gene products that participate in either increased 1 $\alpha$ -OHase gene expression or that participate in 1 $\alpha$ -OHase gene suppression.

### **Biomedical and General Engineering**

THERMODYNAMIC ANALYSIS OF A SOLAR ASSISTED HEAT PUMP. Ahmed AL-Mogbel, Francis B. Gorozabel, Sushil K. Chaturvedi, College Of Engineering and Technology, Old Dominion University, Norfolk, VA 23529. A direct expansion solar-assisted heat pumped is analyzed for domestic hot water applications. The heat pump employs a solar collector panel that also acts as the evaporator for the heat pump cycle. The system employs refrigerant R-134a that is expanded directly

into the solar panel where it is evaporated by solar energy. The thermal performance of the system is evaluated for three refrigerants namely R-12, R-22, R-134a, by employing the first and second law of thermodynamics. The system parameters, including the collector area and the compressor RPM, are chosen so that the evaporator to ambient temperature difference is in a narrow range of  $-1$  °C to  $14$  °C depending the solar radiation intensity in the collector plane. Results show that for R-134a, the coefficient of performance varies from 3.3 to 4.88 for winter like conditions. A comparison of results obtained for R-12 with R-134a shows that the system performance is degraded by about 5% when R-134a is used as the refrigerant. For parameters considered in this study the second law efficiency ranges from 0.32 to 0.45 depending on the refrigerant and the level of incident solar radiation.

GEOMETRIC PARAMETERS EFFECTING FINITE ELEMENT ANALYSIS OF INDENTATION OF ARTICULAR CARTILAGE. Corrie E. Spoon & Jennifer S. Wayne, Orthopaedic Research Laboratory, Depts. of Biomedical Engineering and Orthopaedic Surgery, Virginia Commonwealth University, Richmond, VA 23298. Indentation tests are commonly used to determine the mechanical properties of articular cartilage. This investigation sought to evaluate the effect of changing geometric parameters on the properties determined from creep indentation. Finite element analysis (FEA) was used to simulate the indentation of normal and repair cartilage with varying ratios of indenter radius to cartilage height ( $a/h=0.5, 1.5$ ) and cartilage radius to indenter radius ( $r/a=2, 5$ ). The vertical displacement of the cartilage under the indenter from FEA was curve fit to the biphasic theory to determine the aggregate modulus, permeability, and Poisson's ratio. The curve fit properties were compared to determine the effect of altering the geometric parameters. The effects of geometric changes were independent of cartilage properties (repair vs. normal). Aggregate modulus was not greatly affected by the geometric changes studied. Permeability was affected by changes in indenter and cartilage lengths for  $a/h=0.5$ . Indentation experiments of cartilage with  $a/h=1.5$  are not affected by  $r/a$  for values of 2 and 5. Experimental setups with  $a/h=0.5$  should have  $r/a$  values greater than 2.

DEVELOPMENT OF TDI NANOSCALE STRUCTURES. D. Pestov, N. Levit & G. Tepper, Department of Chemical Engineering Virginia Commonwealth University, Richmond, VA 23284. In this work we combine a spray on technique known as Rapid Expansion of Supercritical Solution (RESS) and gas phase crosslinking techniques to develop a new nanoscale composite material. By RESS we obtained about 1 micron diameter particles of poly(dimethylsiloxane), bis(12-hydroxystearate) terminated. These particles were then exposed to 2,4-toluyne diisocyanate (TDI) saturated vapor at room temperature. After this reaction a composite material was obtained. It consists of cross-linked initial siloxane and a new nanoscale needle like TDI polymer. It is found that the TDI polymer needles initiate from surface imperfections. Scanning Electron and Atomic Force microscopy was used for imaging. Based on FT-IR data and microscope-imaging, a scheme for the TDI polymerization reaction is proposed. The composite material has a high surface/volume ratio and potential for use in sensor applications. This work was funded by the EPA, National Center for Environmental Research and Quality Assurance.

HEALTH CARE THROUGH INTERNET. Shan Lu & Ding Y. Fei, Department of Biomedical Engineering, Virginia Commonwealth Univ., Richmond, VA 23298. A real time health care system was developed for out-of-hospital patients. It takes advantage of Internet and wireless communication

technology. Two portable devices (PE504 and Vitalpoll) and certain software were developed to implement this system. PE504 is a microcontroller-based device which can collect bio-signals and transfer them to Vitalpoll. It has 4 independent channels suitable for ECG, heart rate, blood pressure and body temperature. The sampling rate is up to 40kHz and the resolution is 12 bit. Vitalpoll will collect and store medical data coming from the patient and finally transfer them to an internet access point (home PC or mobile handheld system) by using Bluetooth wireless technology. It has RS232, USB and PCMCIA interface so that it can be connected to various medical devices. DSP was also used to process the signal. System analysis and management software is developed to pace, monitor and control the Vitalpoll and PE504. The software is running from a Windows 2000 server located in the hospital monitor center. The physicians in the center can monitor the real time medical signal of any patients in the network by their IP addresses. All the patients' records are stored in the database that can be accessed by certain physicians. This project is funded by Department of Biomedical Engineering, VCU.

MECHANICAL CHARACTERISTICS OF A TENDON/SUTURE INTERFACE. John R. Owen<sup>1</sup>, Timothy J. Marqueen<sup>1</sup>, Charles L. McDowell<sup>1</sup>, Jennifer S. Wayne<sup>1,2</sup>, & Thomas P. Loughran<sup>1</sup>, Orthopaedic Research Laboratory, <sup>1</sup>Depts. of Orthopaedic Surgery and <sup>2</sup>Biomedical Engineering, Virginia Commonwealth University, Richmond, VA 23298. Extensive tendon healing research has been performed over the years. Characteristic changes in repair site tensile strength during healing have been defined, as well as, the tendon's intrinsic ability to heal, and the efficacy of various suture patterns. Yet, gapping of tendon ends during healing continues to be a significant problem. All research to date has focused on the tendon/tendon interface. None have investigated the separate role of the tendon/suture interface in the healing process. This study investigates the role of this one factor. Without cutting the tendon, sutures were placed in the deep flexor tendons of forty chickens. The animals were euthanized at nine time points ranging from immediately after surgery to four weeks later. Suture pullout tests were performed and revealed a significant decrease in strength during the first six days following surgery and a recovery of strength during the third and fourth weeks. These results support the hypothesis that the suture/tendon interface plays a significant role in the tendon healing process. This study was funded by a grant from Virginia Commonwealth University's A.D. Williams Foundation.

CHANGES IN LOWER EXTREMITY PERFORMANCE DURING A DYNAMIC, HIGH-INTENSITY EXERCISE. Michael L. Madigan, Dept. of Biomedical Engineering & Peter E. Pidcoe, Dept. of Physical Therapy, Virginia Commonwealth University, Richmond, VA 23298. The purpose of this study was to investigate the effects of neuromuscular fatigue on lower extremity landing biomechanics. Ground reaction force and kinematic data were collected from 12 healthy male subjects during the performance of a fatiguing, single-leg landing protocol. Joint torque and power estimates were calculated using a 3-D link-segment model and an inverse dynamic analysis technique. As subjects fatigued, frontal plane torque at the hip decreased resulting in less frontal plane work being performed at the hip. This suggests more frontal plane movement was transmitted through the pelvis, exposing the lumbar spine to higher stresses. Sagittal plane torque decreased at the knee and ankle, and increased at the hip. This redistribution of torques resulted in less work, or energy absorption, being performed at the knee and ankle. As a result, this decrease in energy absorption may expose the passive musculoskeletal structures within the knee and ankle to higher stresses.

THE EFFECT OF SURFACE PREPARATION ON CARRIER LIFETIMES IN DETECTOR GRADE CdZnTe. R.F. Kessick & G. Tepper, Department of Chemical Engineering, Virginia Commonwealth University, VA 23284. The spectroscopic performance of cadmium zinc telluride (CZT) room temperature radiation detectors is currently limited by both bulk and surface imperfections introduced during the growth, harvesting and fabrication of these devices. Bulk imperfections have been relatively well studied and are known to trap charge and reduce detector performance. Surface imperfections including mechanical damage or adsorbed chemical species are known to trap charge or increase leakage current, but it has proven difficult to characterize the electronic properties of CZT surfaces. It is desirable to characterize the electronic properties of CZT surfaces to understand the effects of processing treatments such as mechanical polishing, chemical etching or passivation. Here it is shown that contactless thermally stimulated lifetime measurements using a pulsed laser microwave cavity perturbation method can provide important information on electronic decay on the semiconductor surface. Carrier lifetimes were measured as a function of surface roughness and chemical etching, the surface effects were resolved by analyzing distinct features in the electronic decay profiles generated by the contactless method.

A MODIFIED TIME-COST TRADE-OFF MODEL FOR MANUFACTURING APPLICATIONS. Hisham M. AbdelSalam & Han P. Bao, Dept. of Mech. Engr., Old Dominion Univ., KDH 238, Norfolk, VA 23529. In addition to scheduling projects, project managers are frequently confronted with the problem of having to reduce the scheduled project total completion time (indicated by the "Critical Path Method" network analysis) to meet a pre-specified deadline. This problem, project crashing or Time-Cost Trade-Off, has been formulated and solved using several methods, starting with enumerative methods and ending with artificial intelligence. Despite the fact that the widespread use of CPM technique was mainly achieved by, and for, construction industry applications, one can state that CPM is equally suitable for planning any one-time projects involved in the manufacturing industry. In this paper, a modified time-cost trade-off model is being presented and implemented. While the demonstration is based on a relatively small network, the potential for application to huge projects will be the key finding of this paper.

MECHANICAL FUNCTION PREDICTED BY MRI PARAMETERS IN CARTILAGE. K. J. Shields, K. A. Kraft<sup>1</sup>, J. S. Wayne, D.G.Disler<sup>2</sup>, J. R. Owen, & C. Yin, Orthopaedic Research Laboratory, Departments of Biomedical Engineering and Orthopaedic Surgery, and <sup>1</sup>Department of Radiology, Virginia Commonwealth University, Richmond, VA 23298 and <sup>2</sup>Commonwealth Radiology, Richmond, VA 23298. Healthy articular cartilage functions to facilitate lubrication and stress distribution in diarthroidal joints. Degeneration of cartilage, such as in osteoarthritis, results in deterioration of these functions as damage occurs in the collagen/proteoglycan network of cartilage. Correlating changes in composition with mechanical function through non-invasive techniques such as MRI is valuable. The current study examined the effects of proteoglycan depletion and collagen depletion on the biomechanical properties of modulus and permeability and correlated the results with MRI parameters. Samples of cartilage from porcine patellae were evaluated biomechanically and through MRI. The samples were then enzymatically treated to deplete a portion of the proteoglycan component or the collagen component. The biomechanical and MRI characteristics were then re-evaluated. Results indicate alterations to the biochemical composition yielded differences in the biomechanical properties and the MRI parameters. This study was funded by Virginia's Commonwealth Health Research Board (CHRB).

USING SMART RADIOS TO BOOKMARK BROADCAST CONTENT. Alen Docef, Virginia Commonwealth University, Richmond, VA 23284 & Bruce R. MacAlister, Punchee, Inc., 1805 Grove Avenue, Richmond, VA 23220. The Punchee Wireless Interactive Radio is a service that provides radio advertisers and audiences with a one-button solution to the problem of advertisement bookmarking. Subscribers to the service can react to selected commercials by pushing a button on an Information Appliance. The system uses broadcast bookmarks to record and store subscriber selections. Punchee.com then allows subscribers to explore the branded products via the Internet. The interactive radio system must be able to recognize the audio material being bookmarked, via audio watermarking. Two watermarking algorithms have been implemented for the Punchee system: an in-house algorithm, and the commercial Bluespike algorithm. The algorithms have been evaluated comparatively for reliability, latency, and robustness. The in-house watermarking algorithm has a smaller latency, while the Bluespike algorithm is more robust. Both algorithms are robust enough to withstand digital/analog/digital conversion and transmission via analog FM modulation. A demonstration system was developed for the complete Punchee system: user device, monitoring station, and central database server. The project also developed embedded logic in a "smart" car radio that, on user's spoken command, bookmarks the broadcast and transmits it to the server.

### Botany

CHESTNUT BLIGHT: AMERICAS WORST SILVAN TRAGEDY. Eric P. Hogan & Gary J. Griffin, Dept. of Plant Path. Phys. and Weed Science., Va Polytechnic Inst. & State Univ., Blacksburg, Va 24061. The American chestnut (*Castanea dentata*) was for many years regarded as one of the most economically important hardwoods in the US. The tree provided rot resistant lumber, chestnuts for food, and tannins for leather. In the early 1900's the chestnut blight fungus (*Cryphonectria parasitica*) was introduced into the United States and Europe. The blight destroyed nearly all the canopy American chestnuts and reduced the tree to an under-story shrub. The fungus invades the tree through a wound in the bark and produces a canker, killing tissue as it expands. Once the fungus has girdled the tree and invaded the vascular cambium the tree will die. On the surface of the cankers, fruiting bodies produce sexual and asexual spores, which cause spread. In Europe, infected trees have recovered naturally from the blight. This is primarily the result of the spread of naturally occurring hypovirulent (= low virulence) isolates of the fungus. Hypovirulent strains exist in the U.S. as well, but the limited spread of hypovirulent strains and high susceptibility of American chestnut has prevented natural recovery. Hope for the future involves further study of hypovirulence, breeding programs with American and Asian blight resistance and forest management strategies.

SPATIAL PATTERN OF WHITE HYPOVIRULENT ISOLATES OF *CRYPHONECTRIA PARASITICA* ON GRAFTED AMERICAN CHESTNUT TREES. Eric P. Hogan & Gary J. Griffin, Dept. of Plant Path. Phys. and Weed Science., Va Polytechnic Inst. & State Univ., Blacksburg, Va 24061. In 1980 a clearcut plot of grafted American chestnut trees (*Castanea dentata*) was established in Lesesne State Forest, Virginia. In 1982-83 naturally formed blight cankers, within a zone ranging from the ground to 183cm on the grafted trees, were inoculated with a mixture of four European (white), and six pigmented, hypovirulent strains of the chestnut blight fungus (*Cryphonectria parasitica*). After 14 years it was determined that the white strains had spread throughout three of the inoculated grafts, which have low levels of blight damage. Natural blight cankers were sampled from these three trees to determine the spatial pattern of the white isolates and

white vc groups among cankers on the grafted American chestnut trees. Forty-eight vc groups were identified among the 110 white isolates collected. Using a double matrix statistical test described by Milgroom et al., the pattern of white vc groups among the three grafts was found to be aggregated ( $P=0.019$ ), whereas the pattern of white isolates was found to be random ( $P=0.325$ ). These findings suggest that aggregation of white vc groups and random distribution of white isolates are favorable to biological control of chestnut blight.

THE SEASONAL DISTRIBUTION OF AUTOTROPHIC PICOPANKTON IN THE CHESAPEAKE BAY. Bonnie Brown<sup>1</sup> and Harold G. Marshall<sup>2</sup>. <sup>1</sup>Dept. Oceanography, Earth, and Atmospheric Science., <sup>2</sup>Dept. Biological Sciences, Old Dominion University, Norfolk, Va., 23529-0266. Water samples from 7 lower Chesapeake Bay stations were monitored monthly with water samples taken above and below the pycnocline, and then processed for epifluorescence microscopic examination. Data from a ten year period is presented. The abundance and distribution of autotrophic picoplankton in the Chesapeake Bay indicated a single summer pulse characterized this community at all the stations. The maxima occurred usually during July or August, with minimum abundance occurring in winter. The onset and duration of the summer maximum often varied under the influence of water flow in the system, but was generally initiated by June, peaking in either July or August, then declining into winter. Abundance generally increased with rising water temperature, and decreased with declining water temperatures. Summer pulses were at  $10^6$  to  $10^8$  cells/ml, with lowest winter concentrations at approximately  $10^4$  cells/ml. Cell abundance was generally higher above the pycnocline, except during colder periods of winter. Supported by Va. Dept. Environmental Quality.

MONITORING VIRGINIA ESTUARIES FOR THE TOXIC DINOFLAGELLATE *PFIESTERIA PISCICIDA* AND *PFIESTERIA*-LIKE DINOFLAGELLATES. Todd Stem and Harold G. Marshall, Dept. Biological Sciences, Old Dominion University, Norfolk, Va., 23529-0266. For the past 3 years we have been monitoring Virginia estuaries for *Pfiesteria* spp. and *Pfiesteria*-like organisms (PLO) as one component of the Virginia Task Force on *Pfiesteria* to determine their presence, and degree of representation in these waters. Our results indicate PLO are ubiquitous in Virginia estuaries and the Chesapeake Bay. Monthly or twice monthly samples were examined each year from over 100 stations between June and November. *Gyrodinium* spp., *Cryptoperidiniopsis* spp., and *Gymnodinium* spp. were the more abundant PLO. Greatest concentrations were in shallow waters of 10-20 ppt salinity, oxygen at  $>6$  mg/l, and temperatures  $>20$  degrees C. Highest concentrations reached 49,000 cells/ml, and located along the Virginia inlets of the Potomac River, and lowest at ocean shoreline estuaries. No toxic *Pfiesteria* strains were detected. In 2000, 72.6% of the water samples contained PLO, with 8.0% of these having concentrations over 200 cells/ml. Associated studies in our laboratory involve SEM validations of species, cell cultures of clones of these species. Our results are confirmed with other established external labs for verification of results. Supported by the Virginia Dept. of Health, Va. Dept. of Environmental Quality, and Center for Disease Control and Prevention.

PHYTOPLANKTON COMPOSITION IN VIRGINIA ESTUARIES. Jennifer McNally, Todd Stem, Bonnie Brown, and Harold G. Marshall, Dept. Biological Sciences, Old Dominion University, Norfolk, Va., 23529-0266. The Chesapeake Bay phytoplankton populations are dominated by a diatom flora that produces a peak spring bloom followed by lesser seasonal peaks in summer and fall.

Long term monitoring indicates significant variability in the onset and duration of these growth patterns. Cyanobacteria and dinoflagellates share summer bloom dominance, with the major components decreasing into winter months. Less favorable water quality conditions (high nutrients, reduced light availability) are favored by cyanobacteria, dinoflagellates, and picoplankton; with more favorable conditions (lower nutrient levels, increased light availability) dominated by a diatom flora. Sporadic dinoflagellate blooms begin in early spring and continue into early fall. The presence of cyanobacteria within the system is common, with at least 14 potential toxin producers (dinoflagellates and diatoms) identified within the estuary. Increased nutrient loadings would promote shifts in the floral balance from a diatom based system to one less favorable as a food and oxygen source, and increase the abundance and distribution of cyanobacteria, dinoflagellates, and possibly any introduced exotic species in this estuary. Supported by the Virginia Department of Environmental Quality.

OSMOTIC TOLERANCE IN *SAINTPAULIA IONANTHA*. Michael H. Renfroe, Dept. of Biology, James Madison University, Harrisonburg, VA 22807. Cryopreservation of African violet (*Saintpaulia ionantha* Wendl.) offers the potential for long-term germplasm preservation. Successful cryopreservation relies on removal of intracellular water. Such water removal subjects the plant tissue to water stress. Therefore, investigation of osmotic tolerance is an essential step to successful cryopreservation. A recent approach to cryopreservation involves encapsulation and dehydration of excised shoot tips, followed by freezing in liquid nitrogen. African violet shoot tips subjected to this procedure did not survive the treatment. Experimental investigations showed that dehydration in a culture medium supplemented with 0.75 M sucrose was the critical step producing the tissue injury. Additional experiments were conducted to investigate the conditioning of shoot tips to osmotic stress. Shoot tips were serially transferred to media of increased osmolarity, then to a growth medium on which they were observed for recovery and growth. Shoots on medium supplemented with 0.75 M sucrose recovered as well as did shoots on a medium with 0.525 M sucrose, but neither of these groups grew as well as did shoots on medium with 0.3 M sucrose. However, shoots that were serially conditioned to osmotic stress grew better than shoots without the conditioning.

SCANNING ELECTRON MICROSCOPY EXAMINATION OF 150 YEAR OLD HERBARIUM SPECIMENS OF CYANOPROCARYOTE TAXA ORIGINALLY PREPARED BY L. RABENHORST. Lubomira Burchardt<sup>1</sup> and Harold G. Marshall<sup>2</sup>, <sup>1</sup>Department of Hydrobiology, Adam Mickiewicz University, Poznan, Poland, <sup>2</sup>Dept. Biological Sciences, Old Dominion University, Norfolk, Va., 23529-0266. During the mid-1800's, L. Rabenhorst made extensive collections of algae throughout Europe, and one of his herbarium collections is located at Adam Mickiewicz University. From this collection samples from 47 dried cyanoprocaryota herbarium specimens were prepared for examined with scanning electron microscopy and 40 of these provided various levels of external morphological traits. Cell walls, filament details and dimensions, and remnants of gelatinous sheaths were observed, with sufficient phenotypic characteristics presented for many of these taxa to be used for comparative identification with currently used taxonomic keys. Species within *Scytonema*, *Cryptococcus*, *Nostoc*, *Gloeocapsa*, *Tolypothrix*, *Microcystis*, *Oscillatoria*, *Phormidium* are among those that provided vivid details. This study indicates SEM can be used in the examination of the external morphology in some of these dried algal specimens. Although this usage may be limited, it represents another approach that may be applied in the examination of many of these herbarium algal taxa, and have value when used for comparisons to similar species in current collections.



POPULATION GENETICS OF TWO VIRGINIA MALLOWS (*ILIAMNA COREI* AND *I. REMOTA*) USING ISSRS. Tracey A. B. Slotta and Duncan M. Porter, Biology Department, Virginia Tech, Blacksburg, VA. Two species in *Iliamna* Greene, *I. corei* and *I. remota*, have been questioned as to their designation as separate species. *Iliamna remota*, the Kankakee Mallow, is found in several disjunct populations in eastern Illinois, Indiana, and western Virginia. It is speculated that *I. remota* was introduced into Virginia during the early 1900s via human activity and railways. *Iliamna corei*, the Peters Mountain Mallow, is known from one population located in southwest Virginia on Peters Mountain. Currently, their populations do not overlap and their habitats differ greatly. Both *I. corei* and *I. remota* are classified as endangered at the state level and *I. corei* is federally listed as well. Conservation efforts are underway to preserve populations in both species. Inter-simple sequence repeats (ISSRs) were used to investigate genetic similarities of the two species. ISSRs have been shown to be informative in species and population studies and for estimating genetic diversity of rare and endangered plant species. Ten primers were used for 37 individuals representing *I. corei* and *I. remota*. For *I. remota*, four Virginia, one Indiana, and four Illinois populations were sampled. *Iliamna corei* representatives were obtained from the natural population on Peters Mountain and the research garden at Virginia Tech. The data were analyzed using cluster analysis and by UPGMA and neighbor-joining analysis. The results correlate with the geological distribution of the species and suggest multiple introduction events of *I. remota* to Virginia.

POLLINATION BIOLOGY OF THE GALÁPAGOS ENDEMIC *TOURNEFORTIA RUFO-SERICEA* HOOK. F. (BORAGINACEAE). Conley K. McMullen, Dept. of Biol., James Madison Univ., Harrisonburg, Va. 22807. *Tournefortia rufo-sericea* Hook. f. (Boraginaceae) is an endemic shrub that inhabits the moist uplands of several islands in the Galápagos archipelago. Research on its reproductive ecology, which included visitor observations, bagging experiments, and nectar studies, was conducted with an emphasis on elucidating the importance of diurnal versus nocturnal pollination. Ants were found to be the most common visitor to the small, white flowers of this species, and they were the only diurnal visitors. Ants, beetles, moths, and crickets made visits at night. Diurnal insect activity proved to be greater than nocturnal insect activity. However, the flowers of this species produce little pollen and virtually no nectar, and the insects do not appear to be important pollen vectors. Bagging experiments indicate that *T. rufo-sericea* is highly autogamous, and there is no significant difference in fruit set between flowers exposed to pollinators during the day and those exposed at night. These results support the hypothesis that the plant species able to establish themselves early in the history of the islands were those that possessed upon arrival, or subsequently evolved, the ability to self-pollinate. The initial absence of insect pollinators in the archipelago selected for this mode of reproduction.

A PRELIMINARY PHYLOGENETIC STUDY OF *ALTERNANTHERA FORSSK.* (AMARANTHACEAE) IN THE GALAPAGOS ISLANDS. Jennifer A. Clevinger, Conley K. McMullen, Curtis C. Clevinger & Steven M. Bernacki, Dept. of Biology, James Madison University, Harrisonburg, VA 22801. Fourteen species of *Alternanthera* Forssk. (Amaranthaceae) are known to inhabit the Galápagos Islands. Six species are endemic, five are natives and three are introduced weeds. The majority of these species are thought to have originated in the western (Andean) region of South America, and arrived in Galápagos via long-distance dispersal by birds. This study is using chloroplast and nuclear DNA markers to construct a phylogeny of the Galápagos members of *Alternanthera*. The phylogeny will be used to: 1) determine the number of colonization events

needed to account for all members of the genus within the archipelago; 2) identify mainland sister group(s); 3) demonstrate the role of adaptive radiation in this process; and 4) prepare a taxonomic revision of Galápagos members of *Alternanthera*. Preliminary data from the internal transcribed spacer (ITS) region of the nuclear ribosomal repeat and the chloroplast non-coding regions between the *trnT* and *trnF* genes suggest that at least two colonization events must be hypothesized to account for the endemic species found on the Galápagos Islands.

WHAT DO GENES TELL US ABOUT EVOLUTION OF FLOWERING PLANTS. Khidir W. Hilu<sup>1</sup> and Thomas Borsch<sup>2</sup>. Department of Biology. <sup>1</sup>Virginia Polytechnic Institute and State University, Blacksburg, VA. <sup>2</sup>Botanisches Institute und Botanischer Garten, University of Bonn, Germany. Evolution and early divergence of flowering plants have been a disputable matter. Different hypotheses have been proposed on the identities of most basal lineages and the subsequent diversification. Recent molecular studies have resulted in radical changes of earlier concepts on angiosperm evolution. However, some inconsistencies exist among recent phylogenies, particularly for the basal lineages. Combining data sets HAS improved the picture particularly when large numbers of genes are included, but dominance of individual genes in a combined data set is a consideration. Our work in this area using the spacers and the *trnL* intron of the plastid region *trnT-trnL* HAS resolved a phylogeny congruent with that obtained from the 5-gene, 3-genome phylogeny. At the base of the phylogeny, Amborella represents the earliest diverging angiosperm, followed by Nymphaeales and an Austrobaileya-Illicium-Schisandra clade. Both eudicots and monocots are monophyletic. The dicot *Ceratophyllum* appears in close affinity with monocots. The congruence between phylogenies based on the combined data sets and the *trnT-trnF*-region implies that a fast evolving noncoding region can provide valuable historical information useful in deep level phylogenies.

A MODEL STUDY OF DISPARITIES IN GENE DIFFERENTIATION OF THE PLASTID AND NUCLEAR GENOMES OF THE PEANUT PLANT. Melillo, D. Monroe, and K.W. Hilu. Department of Biology. Virginia Tech, VA 24060. The cultivated peanut, *Arachis hypogaea*, belongs to *Arachis* section *Arachis* (Fabaceae, legumes). Within section *Arachis* there are about 29 species including the crop. Section *Arachis* consists of three different genomes (A, B and D), and two tetraploid species (*A. hypogaea* and *A. monticola*). The peanut crop is thought to be an allopolyploid derived from *A. monticola*, which most likely evolved from two of the wild species within section *Arachis*. The objective of this project is to examine the genetic relationships between the crop and species of section *Arachis* using sequences from the nuclear ITS and the plastid *trnT-F* regions. ITS show no variability among species. The *trnA-trnB* region of *trnT-F* show indels and nucleotide substitutions that resolved two clades demonstrating genetic relationships among genomes and wild and cultivated species. However, additional information from the *trnC-trnF* region is needed for better resolution.

THE NATION'S CHAMPION AMERICAN ELM IS SICK. R. Jay Stipes. Virginia Tech, Blacksburg, VA 24061-0331, Karen B. Stipes, Blacksburg High School, Blacksburg, VA 24060 and Chad Husby, Ohio State University, Columbus, OH 43210. The nation's largest American elm (*Ulmus americana* L.), located near Traverse City, MI, has contracted Dutch elm disease (DED) caused by the fungal pathogen, *Ophiostoma novo-ulmi*. (= *Ceratocystis ulmi*). The mammoth, multi-stemmed specimen estimated to be 300-400 yrs. Old exhibits a height of ca. 112ft (= ca 10 stories), a circumference of ca. 23.5 ft. and a branch spread of ca. 115 ft. We observed extensive and

generalized symptoms in July, 2000, and the pathogen was successfully isolated from biopsied stem and foliar tissues on standard laboratory agar media. The tree is located in a very high disease hazard site, surrounded by hundreds of diseased and dying elms. Successful therapeutic intervention of DED with systemic fungitoxicants in advanced stages (more than ca. 20% crown symptom expression) of systemic infection is rarely successful. We deem the prognosis to be disappointing even if some disease remission results from massive fungicide administration. Such enormous botanical tragedies as this underscore the vital needs for public education and awareness, of scouting for diseased trees, of epidemiological data and overall and most of all for the *prevention* of disease.

CHARACTERIZATION OF MICROSATELLITE LOCI FROM FLOWERING DOGWOOD (*Cornus florida*). Liles, J. S. and P. R. Cabe, Washington and Lee University. We cloned, sequenced, and designed primers for nine unique dinucleotide microsatellite loci from the flowering dogwood (*Cornus florida*). Each primer set was individually optimized for annealing temperature and Mg<sup>++</sup> concentration. Primers were tagged fluorescently, and PCR products from each primer pair were generated from eighteen individuals; fragments were run on ABI 377 automated sequencers for allele identification. Of the nine loci, one was monomorphic, and the remaining eight showed high levels of variation, with 7-13 alleles per locus and observed heterozygosities between 0.67 and 1.0. These markers will be ideal for studies of population structure and dispersal of pollen and seeds.

GROWTH, MORTALITY AND RECRUITMENT IN AN OAK FOREST IN SOUTHWESTERN VIRGINIA. Richard W. Rhoades, 611 Rose Ave., Blacksburg, VA 24060. Permanent plots in an Appalachian oak forest dominated by *Quercus prinus*, *Q. alba*, and *Acer rubrum* were sampled in 1994 and every 2 years until 2000 to determine growth of trees and saplings as well as changes in density of all classes of vegetation. Growth was determined by repeated dbh measurement. Mortality was determined by differences in density over the six-year period corrected for percent recruitment. A 56% increase in sapling density was significant, but a 6% increase in high seedlings and a 25% decrease in low seedlings were not significant. Radial growth varied from 3.7 mm/yr for *Q. alba* to 1.8 mm/yr for *Nyssa sylvatica*. Sapling growth was much lower, 0.6 – 1.6 mm/yr. Measures of growth fell within the range reported in other studies. There were significant differences among species of saplings, but not of trees. It is the conclusion of this study that the stand, a maturing, second-growth forest, is in a state of flux. Increases in saplings of white pine and red maple will probably result in dominance by these species with fewer oaks in about twenty years.

INTERACTIONS OF ALLELOPATHIC AND NUTRIENT STRESSES. Timothy D. Marshall & Mary E. Lehman, Dept. of Biol., Longwood College, Farmville, Va. 23909. In nature, plants seldom have ideal growing conditions; they often experience stress from a variety of sources. While most research focuses on these stresses individually, it is more realistic to look at the interaction of stresses. The interaction of two common stresses, allelopathy and nutrient stress, was examined in a nutrient culture system, using cucumber (*Cucumis sativus*) as a bioassay species and ferulic acid as a representative allelochemical. Exposure to a severe nutrient deficiency stress (1/64 X Hoagland's solution) reduced the ability of cucumber seedlings to recover from subsequent ferulic acid stress. When the treatment order was reversed, chronic exposure to low concentrations of ferulic acid (0.1, 0.2, 0.4 mM) had little influence on the effects of subsequent nutrient stress. The nutrient treatment was the major determinant of growth irrespective of previous allelochemical exposure. This study suggests that allelopathic and nutrient stresses may interact, with nutrient stress predominating.

*PFIESTERIA* TOXIN STABILITY AND RESTORATION OF TOXICITY FROM ALGAL-GROWN CULTURES. Brian Dyer, Andrew Gordon, Harold Marshall, and Robert Knight. Dept. of Biological Sciences, Old Dominion University, Norfolk, VA 23529-0266. The ichthyotoxicity of the dinoflagellate *Pfiesteria piscicida* has been successfully demonstrated and maintained in our laboratory using the standard tilapia bioassay. Numerous preliminary experiments have been performed and some of the results are given below. Our goal in this research is to isolate, purify and identify the *Pfiesteria* toxin(s). Using modified bioassay procedures we have maintained *P. piscicida* toxicity for more than 1 year. Toxicity was restored when an algal-grown culture (6 weeks) was re-exposed to fish. Fresh filtrates of toxic *Pfiesteria* aquarium waters were compared to control filtrates. While filtrates were toxic, they showed a significant reduction in toxicity to fish over a 48 hour period when compared to *Pfiesteria*-containing toxic waters. Frozen filtrates, up to one month, showed no appreciable reduction in toxicity when compared to fresh filtrates. Filtrate toxicity was retained after storage for 48 hours at room temperature. These results indicate that the component of toxicity observed in tilapia bioassay is associated with vegetative *Pfiesteria* cells rather than dissolved toxin only. Supported by Va. Dept. Health, Va. Dept. Environmental Quality and the Center for Disease and Prevention.

COMPARISON OF PHYTOPLANKTON SUCCESSION IN A FARM POND AND A STORM WATER RETENTION POND LOCATED IN A COMMERCIAL SHOPPING AREA. Bethany J. Gobeille, Geoffrey J. Wiedenmayer, & Stephen W. Fuller Department of Biology, Mary Washington College, Fredericksburg, Va. 22401. Growth and succession of phytoplankton are affected by a number of factors, including temperature and nutrient levels, as is described by the Plankton Ecology Group (PEG) model (Sommer, 1989). Two ponds in Fredericksburg, Virginia were the focus of this study, which took place from September 2000 to April 2001. Pond A is located at Hazelwild Farm in a rural area of Fredericksburg, while pond B is located in Central Park, a highly commercialized area. The environmental settings of pond B seemed to indicate a higher level of pollution exposure than pond A; however, no noticeable difference in the number or diversity of phytoplankton classes was noted. Chemical nutrient concentrations in pond A consistently had much higher levels of nitrogen and silica than did pond B, while phosphorus levels in both ponds were similar. Additionally, the phytoplankton succession in both ponds loosely correlated with the succession pattern predicted by the PEG model.

ANALYSIS OF NATURAL HYBRIDIZATION BETWEEN *RHODODENDRON PERICLYMENOIDES* AND *R. ATLANTICUM*: I. FLORAL CHARACTERS. Monica Harris and Bruce L. King, Dept. of Biol., Randolph-Macon College, Ashland, VA 23005. Ten floral characters and discriminant analysis were used to compare populations of *R. periclymenoides* and *R. atlanticum* and to examine putative hybrid populations. Most of the floral characters provided some discrimination of populations within species but the greatest discrimination was between species. Discriminant analysis provided no evidence of hybridization in one putative hybrid population. In another putative hybrid population the variation pattern shown by discriminant analysis was interpreted as evidence of bidirectional introgression supporting the conclusions drawn by King (2000) from micromolecular evidence and feeding patterns of a monophagous leaf beetle. One discriminant function discriminated among *R. periclymenoides*, *R. atlanticum*, and the hybrid population. The intermediacy of putative hybrids was demonstrated in the second discriminant function.

THE FLORA OF VIRGINIA PROJECT. J. Christopher Ludwig, Department of Conservation and Recreation Division of Natural Heritage, 217 Governor Street, 3<sup>rd</sup> floor, Richmond, Virginia 23219. The Flora of Virginia Project has been initiated to produce a manual to the 3700+ vascular plant taxa in Virginia. At the minimum, the manual will include keys, descriptions, habitat, range maps, and illustrations of the Virginia taxa. Additional information such as wetland status, chromosome numbers, heritage rarity ranks, photographs, and economic uses may be included as appendices, either within the manual or through electronic media (web, attached compact disc, etc.). The manual will provide a tool for plant identification and study for use by broadest of professional and avocational users from academia, government, industry and the public. It will assimilate and build on the rich tradition of botanical exploration of Virginia culminating in works such as the 1739 *Flora Virginica* by John Clayton. The latest genetic-based information on evolutionary relationships will be incorporated into the work along with the best traditional taxonomic approaches. The manual will increase interest in the appreciation and conservation of Virginia's diverse and unique botanical heritage. The completion is scheduled for December 2007.

### Chemistry

REACTIONS BETWEEN CHLOROCARBONS, HYDROCARBONS, AND CuO, C.R. Vestal, H.M. Sturgill, & T.C. DeVore, Department of Chemistry, James Madison University, 22807. Flow kinetics were as used to investigate the reaction between 2,4-pentanedione, methanol, or tetrachloromethane and copper (II) oxide. The reaction with 2,4-pentanedione produced CO<sub>2</sub>, Cu<sub>2</sub>O, Cu, 2-propanone, ketene and traces of acetic acid at temperatures above 550 K. Water may also have been produced, but this product has not been identified with certainty. Once initiated, the reaction rate increased rapidly before decreasing as the CuO surface was depleted. This is consistent with a branching chain mechanism similar to the mechanisms often found in combustion processes. Methanol also reacted rapidly above 550 K to largely produce CO<sub>2</sub> and Cu. Tetrachloromethane did not react nearly as readily. Phosgene and CuCl<sub>x</sub> (x=1,2) were the main products produced during this reaction. The reaction kinetics have been determined for each of these reactions and a possible reaction mechanism has been developed for the CuO/ 2,4- pentanedione reaction.

MICELLAR CATALYSIS OF NITRIC OXIDE DISSOCIATION FROM ZWITTERIONIC DIAZENIUMDIOLATES. Stacy E. Price, Patricia Lorenzo & Keith M. Davies, Dept. of Chemistry, George Mason University, Fairfax, VA 22030. Diazeniumdiolates of the structure R<sub>1</sub>R<sub>2</sub>N[N(O)NO]<sup>-</sup>, are of pharmacological interest since they spontaneously dissociate into nitric oxide (NO) in aqueous solution. We studied the dissociation rates of four zwitterionic diazeniumdiolates (R<sub>1</sub>=R<sub>2</sub>=CH<sub>2</sub>CH<sub>2</sub>NH<sub>3</sub><sup>+</sup>), (R<sub>1</sub>=R<sub>2</sub>=CH<sub>2</sub>CH<sub>2</sub>CH<sub>2</sub>NH<sub>3</sub><sup>+</sup>), (a spermine derivative), and (R<sub>1</sub>=CH<sub>2</sub>CH<sub>2</sub>CH<sub>2</sub>NH<sub>3</sub><sup>+</sup>, R<sub>2</sub>=CH<sub>2</sub>CH<sub>2</sub>CH<sub>3</sub>) in phosphate buffer solutions in the presence of SDS micelles. All reactions were SDS catalyzed and conform to a pseudo-phase kinetic model with the substrate partitioned between the aqueous and micellar phases. The magnitude of the binding constants shows good correlation with the number of quaternary nitrogen sites in the substrate, consistent with a coulombic interaction between the protonated amino groups of the diazeniumdiolate and the negatively-charge micellar surface. The rate constant for the micellar-bound substrate showed a five-fold increase in reaction rate over that in the aqueous phase. The rate enhancement is believed to be due to an elevated hydrogen-ion concentration in the Stern layer surrounding the micelle. Adding hydrophobic salts, Et<sub>4</sub>N<sup>+</sup>Cl<sup>-</sup>, inhibits the catalysis by displacing H<sup>+</sup> from the Stern layer.

SYNTHESES OF HIGHLY FUNCTIONAL NORBORNENE DERIVATIVES AND SUBSEQUENT RING OPENING METATHESIS POLYMERIZATION USING RUTHENIUM CATALYSTS. James H. Wynne<sup>1,2</sup>, Christopher T. Lloyd<sup>1</sup>, Steven E. Bullock<sup>2</sup> & Robert F. Cozzens,<sup>1,2</sup> <sup>1</sup>Dept. of Chemistry, GMU and <sup>2</sup>Chemistry Division, Naval Research Laboratory, Code 6120, Washington, DC 20375. There is a recent demand for novel monomers to produce block polymers possessing electrostrictive or conductive properties. Due to the ring opening metathesis polymerization mechanism of which they undergo, norbornene and its subsequent derivatives are the substrates of choice. We report the synthesis of a series of highly functional norbornene monomers. Formation of the Diels-Alder adduct of cyclopentadiene and a variety of dienophiles afford novel intermediates possessing the norbornene substrate. Subsequent alterations to the previously synthesized adducts afford even more derivatives containing functionalities such as alkyl groups, bulky protecting groups as well as chelated metal atoms such as gold. The synthesis, characterization, function and design will be discussed.

ART AND CHEMISTRY: COMMON INTERSECTIONS. William H. K. Wightman,<sup>1</sup> & James P. Wightman,<sup>2</sup> <sup>1</sup>School of Art and Art History, James Madison University, Harrisonburg, Virginia 22807 and <sup>2</sup>Department of Chemistry, Virginia Polytechnic Institute & State University, Blacksburg, Virginia 24061. A number of demonstrations are used to illustrate principles discussed in general chemistry including the ignition of hydrogen balloons, precipitation reactions, universal indicators, and flame emission. These demonstrations add a sense of relevance and immediacy to the lecture. Presentation and discussion of the demonstrations is traditionally done not unexpectedly in terms of chemical concepts and vocabulary. However, from a visual arts perspective, chemical demonstrations can be rich in the vocabulary and processes of that field as well. This study examines the connectivity between chemical demonstrations and select elements/processes unique to the visual arts, proposes that an aesthetic sensibility surrounded and subsequently shaped the chemical demonstrations conducted by Michael Faraday, and establishes the pedagogical relationship between science and art instruction as guided by aesthetic considerations.

SYNTHESIS OF SIDEROPHORES: 4-HYDROXY-2-ALKYLQUINOLINES. Sean R. Donohue & Wayne M. Stalick, Department of Chemistry, George Mason University, Fairfax, VA, 22030. A study of iron transport in *Pseudomonas aeruginosa* led to the isolation of a class of iron chelators associated with the cytoplasmic membrane of iron rich cells. These siderophores were isolated in extremely small amounts, but spectroscopic identification suggested that the two most prevalent constituents were 4-hydroxy-2-nonylquinoline and 4-hydroxy-2-heptylquinoline. Synthesis of the postulated quinolines and comparison of the synthesized product to the biological extracts will provide confirmation of structure. The initial approach at synthesis involved blocking the hydroxy group followed by side chain elongation of commercially available 4-hydroxy-2-methylquinoline(**1**). Blocking the hydroxy group was a problem because the quinoline exists primarily as its keto tautomer and is unreactive. The second approach involved reacting (**1**) with two equivalents of base to form a dianion, which upon reaction with one equivalent of alkyl halide should permit elongation of the methyl substituent. A variety of changes in the base, solvents, and electrophiles used have, thus far, been unsuccessful in producing the product in high yields.

SYNTHESIS OF SIDEROPHORES: 8-HYDROXY-2-ALKYLQUINOLINES. Habib Ziayee & Wayne M. Stalick, Department of Chemistry, George Mason University, Fairfax, VA, 22030. In iron-rich environments an association between an iron chelator and the cytoplasmic membrane of *Pseudomonas aeruginosa* allows for the transportation and metabolism of iron. These siderophores were isolated in extremely small amounts and were thought to be 8-hydroxy-2-alkylquinolines. Siderophores are compounds that facilitate iron uptake by organisms and can be either membrane-bound or secreted. The 8-hydroxy-2-alkylquinolines are well known iron chelators that bind iron via the oxygen and nitrogen as a bidentate ligand. The initial approach at synthesis involved blocking the hydroxy group followed by side chain elongation of the commercially available 8-hydroxy-2-methylquinoline. Experimentally, blocking the 8-hydroxy group occurred through the reaction of the starting material with  $K_2CO_3$  and  $CH_3I$  in acetone. This method provided relatively good yields. The second step involved reacting the 8-methoxy-2-alkylquinoline product with base to form an anion, which upon reaction with 1-iodohexane gave the corresponding carbon chain elongation. The final product has yet to be isolated, however, GC results show its presence, in the case of the 8-methoxy-2-heptylquinoline.

THE SYNTHESIS OF ANALOGS OF 2-AMINOETHOXYDIPHENYL BORATE (APB) AS POTENTIAL MODULATORS OF STORE-OPERATED CALCIUM CHANNELS (SOCC) IN HUMAN PLATELETS. Sally Elliott & Roy L. Williams, Dept. of Chem./Biochem., Old Dominion Univ., Norfolk, Va. 23529-0126. APB has been described in the literature as a membrane permeable agent capable of modulating calcium entry into human platelets and thus inhibiting platelet aggregation. Such compounds may be considered of value with regard to potential cardiovascular dysfunction. This laboratory has undertaken the synthesis of several novel analogs of APB, which will help define or characterize the possible APB receptor on the SOCC. These new compounds were also designed to test the potential of APB to exist in a five membered ring. Diphenyl boronic anhydride has been condensed with N,N-dimethyl ethanolamine and 2-amino-1-phenylethanol to give two new APB analogs, which have been characterized by infrared, and nuclear magnetic resonance spectroscopy (nmr). Specific nmr data of APB and the dimethyl analog would suggest that APB does indeed exist in a five membered ring form. Methylation of this dimethyl analog leads to a rapid degradation of this compound and the release of choline methiodide.

POTENTIAL ENTACTOGENIC ANALOGS OF INDOLE AMINES. Richard Seitz & Roy L. Williams, Dept. of Chem./Biochem., Old Dominion Univ., Norfolk, Va. 23529-0126. The methylene dioxyphenethylamine known as Ecstasy has been characterized as an entactogen, or a drug that can apparently enhance one's empathy level but it has recently become an highly acceptable street drug. The mechanism of action of this unique drug appears to be associated with modulation of the serotonin neurochemistry in the CNS. Earlier studies from this laboratory described the synthesis of two new potential entactogens (AS1 and AS2) using methylene dioxyphenyl propanone and ammonia. These two compounds were found to exhibit a level of activity in mice which was interesting but difficult to describe or compare to known sedative/hypnotics or analgesics. We have now elected to synthesize serotonin or tryptamine analogs in an effort to hopefully study the structure-activity-relationship (SAR) of this class of drugs. Methylene dioxyphenyl propanone was condensed with tryptamine in methanol at room temperature at a pH of 6 and the intermediate imine was then reduced with sodium cyanoborohydride in situ. The free base of this tryptamine analog of Ecstasy was isolated in 45 % yield and characterized with IR, nmr and elemental analysis. We have not carried out any biological evaluations of this compound to-date.

PHYTOESTROGENS IN CRANBERRY JUICE: POTENTIAL HEALTH BENEFITS. Laura Fautleroy & Roy L. Williams, Dept. of Chem./Biochem., Old Dominion Univ., Norfolk, Va. 23529-0126. The consumption of cranberry juice as a means of treating or preventing urinary tract infections (UTIs) in women is a well established paradigm and is a widely accepted folk remedy for this particular dysfunction. The mechanism of action associated with cranberry juice consumption and UTIs has not been elucidated to date. Several possible mechanisms have been proposed but discarded over the years. We have recently detected the presence of several important phytestrogens in cranberry juice including the isoflavonoids genistein and daidzein. We have also detected relatively low levels of a unique stilbene compound known as trans-resveratrol (TR). Other researchers have shown that genistein can induce apoptosis, or scheduled cell death, in certain cancer cell lines. We have recently shown that TR is also capable of inducing apoptosis in human prostate cancer cells *in vitro*. This ability to induce apoptosis raises an interesting question with regard to a possible new mode of action of cranberry juice and the treatment and prevention of UTIs in women. We will describe our method of extraction and analysis of cranberry juice using high-pressure liquid chromatography (HPLC) and discuss the possible involvement of these phytoestrogens in combating UTIs.

PHOTOCHEMISTRY OF BIOLOGICALLY ACTIVE CIS-TRANS STILBENES. Paul Kazas & Roy L. Williams. Dept. of Chem./Biochem., Old Dominion Univ., Norfolk, Va. 23529-0126. Over the past several years many researchers have investigated the biological properties of the stilbene based phytochemical known as trans-resveratrol (TR). This compound exhibits a remarkable profile of positive health effects as a potent antioxidant, an anti-cancer agent and an agent capable of inhibiting human platelet aggregation as well as inducing apoptosis in human cancer cells *in vitro*. TR is observed to undergo rapid but not complete photolytic isomerization to the less stable cis form. This cis isomer has also been shown to be quite active biologically and is found in a variety of plant extracts. We have studied this photolysis in an effort to obtain samples of the cis isomer for further biological testing. This paper will describe the photolysis of TR and several analogs of TR including the triacetyl and trimethoxy derivatives, which have been synthesized in this laboratory. Trimethoxy TR appears to undergo a rapid trans to cis conversion while the triacetyl derivative is inactive. We will also describe the photolysis of a tetra hydroxy analog of TR known as piceatannol. Other studies in this laboratory have shown that wine contains low levels of these stilbene moieties which is of interest to the current wine and health issue.

SYNTHESIS AND CHARACTERIZATION OF CONTROLLED SIZE ACCEPTOR POLYMER BLOCKS FOR POTENTIAL PHOTO-ELECTRONIC APPLICATIONS. Yiqing Wang,<sup>1</sup> Zhen Fan,<sup>1</sup> Charls Taft,<sup>1</sup> & Sam Sun,<sup>1,2</sup> <sup>1</sup>Center for Materials Research and <sup>2</sup>Department of Chemistry, Norfolk State University, Norfolk, VA 23504. The design, synthesis and characterization of an electron deficient acceptor conjugated polymer block are described. The conjugated acceptor copolymer block is a part of a novel nano phase separated D-B-A block copolymer system composed of conjugated donor block -nonconjugated bridge - conjugated acceptor block. This novel block copolymer system is expected to enhance the opto-electronic energy conversion efficiencies. Two key functional monomers: [4-(Diethoxy-phosphorylmethyl)-5-(2-ethyl-hexane-1-sulfonyl)-2-(2-ethyl-hexyloxy)-benzyl]-phosphonic acid diethyl ester and [4-(Diethoxy-phosphorylmethyl)-5-(2-ethyl-hexane-1-sulfonyl)-2-(2-ethyl-hexyloxy)-benzyl]-phosphonic acid diethyl ester have been synthesized and characterized. They are used in the ongoing work of building different sized acceptor copolymer block. The experimental procedure and characterization are described.



SYNTHESIS AND CHARACTERIZATION OF COMPLEXES OF Co(II), Ni(II), Cu(II) AND Zn(II) WITH AMIC ACID LIGANDS AS MOLECULAR MODELS FOR METAL-DOPED POLYIMIDES. Dennis Thekkudan, D.L. Polo, L.M. Vallarino & J.W. Williams (CHEM 406L), Department of Chemistry, Virginia Commonwealth University, Richmond, VA 23284-2006. This work is part of an ongoing class project that investigates the coordinating ability of the amic acid sites of polyimides through a study of the metal complexes of representative monomeric amic acid models. The ligands, N-(4-chlorophenyl)phthalamic acid (H-CINPPA) and N-(3-methyl-phenyl)phthalamic acid (H-mMeNPPA), were synthesized by condensation of phthalic anhydride with the appropriate substituted aniline. They were then reacted with the metal acetates to yield complexes of the general formula  $ML_2 \times (\text{solvent})_n$ , where  $n = 0.5 - 1.5$  and the solvent is acetic acid, water and/or methanol. The complexes of Co(II), Ni(II) and Zn(II) had identical IR spectra and solubility patterns. On the basis of the d-d electronic spectra of the Co(II) and Ni(II) species, and of the  $^1\text{H}$  NMR spectrum of the Zn(II) species, these complexes were assigned an octahedral coordination geometry with the amic acid anions acting as bidentate chelating ligands *via* the carboxylate groups. The less soluble Cu(II) complex, which had a somewhat different IR spectrum, was instead assigned a dimeric or polymeric structure with bridging carboxylates.

CHARACTERIZATION OF MOUSE GUANINE-7-METHYLTRANSFERASE MRNA. Keith E. Newbrough & Thomas O. Sitz, Dept. of Biochemistry, Virginia Tech, Blacksburg, VA 24061. The guanine-7-methylation of the cap structure in eucaryotic mRNA is essential for ribosome binding and translation. Recently the cDNA sequence for the human guanine-7-methyltransferase has been determined. The mRNA for this important enzyme is 6,203 nucleotides long. It has an unusually long 3'-untranslated region, 4,576 nucleotides in length. This mRNA codes for a protein 476 amino acids long. We wish to determine the length of the mRNA for this methyltransferase in mice by northern blot analysis. Initial experiments with a 40 nucleotide long DNA probe were unsuccessful. In addition, when random primer labeling of the complete human cDNA sequence was used as a probe of both human and mouse mRNA, no bands were observed. The truncated coding region of the human cDNA sequence that is highly conserved, was subcloned into a transcription vector, pSP73. This will be used to make an RNA probe to determine the size of the mouse methyltransferase mRNA. Genomic analysis of mouse ESTs have allowed us to determine the sequence and coding region of the mouse guanine-7-methyltransferase mRNA. It appears to be 2,035 nucleotides long with a 3'-untranslated region only 550 nucleotides long, substantially smaller than the human mRNA.

ACTIVE SITE LABELING OF GUANINE-7-METHYLTRANSFERASE. Amber R. Bonham & Thomas O. Sitz, Dept. of Biochemistry, Virginia Tech, Blacksburg, VA 24061. The guanine-7-methyltransferase (GMT) enzyme modifies the 5'-cap structure found in eucaryotic mRNAs. Without the methylation the mRNA does not function, i.e. the mRNA is not translated into protein. We have been able to label the active site of this enzyme by cross-linking  $^{32}\text{P}$ -labeled RNA to the GMT with short wavelength UV light. We wanted to determine if non-capped RNA and a short single strand of DNA would also bind to the enzyme. We used a DNA oligo 18 deoxynucleotides long (18mer) and an RNA oligo 11 nucleotides in length (11mer). Both of these nucleic acids bound and were cross-linked to the GMT enzyme. We normally label the 3'-end of nucleic acids with the enzyme RNA ligase and  $^{32}\text{P}$ -cytidine bis phosphate (\*pCp). This enzyme would not transfer the \*pCp to DNA but did label the RNA well. The 5'-ends of the 11mer RNA and the 18mer DNA were labeled

with the enzyme polynucleotide kinase and  $\gamma$ - $^{32}\text{P}$ -ATP. To determine if the radioactive cross-linking was specific, the cap analog GpppG was added to reactions. The cap analog inhibited the binding of the capped 6mer RNA and 11mer RNA by about 50% and the binding of the 18mer DNA by about 30%. Therefore, this GMT enzyme does not bind non-capped RNA and single stranded DNA.

LUMINESCENT pH SENSORS: FACTORS AFFECTING RESPONSE. Bernadette A. Higgins & Benjamin A. DeGraff, Dept. of Chem. MSC 7701, James Madison University, Harrisonburg, VA 22807. A new area within chemical sensor design is pH sensing because of the desire to measure pH remotely. A pH change can be detected by changes in the luminescence, which will depend on the molecule's protonation state. In this research, a pH sensitive 1,10-phenanthroline derivative was synthesized and complexed with ruthenium (II) or rhenium (I) and other ligands to make various complexes. The pH sensitivity of the complexes was characterized using absorbance and emission spectra and lifetime measurements at various pH levels. The pH dependence of the complexes was modeled using a simple two species model for the equilibrium between the protonated and deprotonated state of the complex. The pH sensitivity was evaluated using this model to determine the protonation state at various pH levels. These complexes exhibit pH dependent photophysical properties including changes in pH can alter the emission brightness, color, and lifetime.

THE REACTIONS BETWEEN  $\text{CCl}_4$  AND  $\text{V}_2\text{O}_x$  ( $X = 3, 4, \text{ AND } 5$ ). J. Sumner, D. Linnestaedt, & T.C. DeVore, Department of Chemistry MSC 7701, James Madison University, 22807. The kinetics of the reactions between tetrachloromethane ( $\text{CCl}_4$ ) and the vanadium (III, IV, V) oxides at temperatures between 400 K and 900 K were investigated using a flow reactor coupled to a Fourier Transform Infrared Spectrometer. The principal gas phase products produced initially were phosgene and  $\text{VOCl}_3$ . X-ray diffraction of the solid residue from the reaction showed that reduced vanadium oxides and non-volatile vanadium oxychlorides were also produced during this reaction. All of the reactions had similar activation energies ( $\sim 85 \text{ kJ/mol}$ ) and steric factors ( $\sim 5 \times 10^7 \text{ min}^{-1}$ ), suggesting that they followed a similar mechanism. A mechanism similar to that presented by Klabunde (Environ. Sci. Technol. 1994, 28, 1243) was developed. The enthalpies of reaction calculated for the steps in this mechanism indicate that the transfer of chlorine atoms is the rate-limiting step in this process.

APPLICATIONS OF FOURIER TRANSFORM-INFRARED (FT-IR) MICROSCOPY TO FORENSICS. Jenny M. Oran, Donna S. Amenta, & Thomas N. Gallaher, Department of Chemistry MSC 7701, James Madison University, Harrisonburg, VA 22807. Fourier Transform - Infrared (FT-IR) Microscopy is a useful tool in the forensic analysis of trace evidence (i.e. hairs, fibers, powders, etc.). It requires little sample preparation and causes minimal sample destruction. These aspects are important in forensic science especially when there is a limited amount of evidence collected from a crime scene. The purpose of this research is to demonstrate the power of FT-IR Microscopy and Attenuated Total Reflectance, in identifying powders and fibers that can be found at a crime scene.

A MOLYBDENUM COMPLEX CONTAINING A CROWN ETHER PROTOTYPE. Katherine E. Norton, Cristina Angelo, D. S. Amenta, J. W. Gilje, & A.D. Morton Department of Chemistry, James Madison University, MSC 7701 Harrisonburg, VA 22807. The purpose of this research is to synthesize, characterize, and study the reactivity of a transition metal complex whose ligand contains a crown ether. First, model compounds  $\text{Mo}(\text{CO})_3\text{Cp}(\text{CH}_2)_3\text{C}_6\text{H}_3$  (**1**) and  $\text{Mo}(\text{CO})_3\text{Cp}(\text{CH}_2)_3\text{C}_6\text{H}_3(\text{OCH}_3)_2$  (**2**) were synthesized and an x-ray crystal structure was obtained for **1**. Molecular modeling calculations were performed on **1** and found to be in good agreement with the x-ray data. Further calculations on **2** and a crown ether analogue **3** demonstrated conformations very similar to that of **1**. However, insertion of a sodium cation into the crown ether cavity resulted in a conformational change, which brought the sodium cation into proximity with a carbonyl group in **3**. Compound **2** was converted into an acyl complex by carbonyl insertion mediated by the addition of a phosphine ligand. Reaction rate studies of **2** with triphenylphosphine were monitored by  $^{31}\text{P}$  and  $^1\text{H}$  NMR. Work is progressing toward the preparation of **3**, where the influence of cation inclusion within the crown ether moiety on the rate of migratory insertion will be assessed.

### Computer Science

(No Abstracts Submitted)

### Education

(No Abstracts Submitted)

### Environmental Science

SOLID PHASE MICROEXTRACTION OF PESTICIDES IN THE SOUTH FORK HOLSTON RIVER. L.J. Hainsworth, B.K. Patton & S. Turner, Emory & Henry College, Emory, VA. The South Fork Holston River is a relatively clean body of water. The watershed encompasses approximately 135,000 acres, most of which is woodland. Christmas tree farming has, over the past several years, become a major agricultural industry in the headwaters of the South Fork Holston. Since Christmas tree farming often involves significant pesticide use, farms have the potential to negatively impact aquatic ecosystems in the watershed into which they drain. This project was designed to evaluate the levels of several target pesticides in the river. Samples were collected at 2 stations along Whitetop Laurel Creek using solid-phase microextraction field samplers. The samplers were placed directly in the stream for 30 minutes, then analyzed by GC/MS (Shimadzu QP5000). The resulting mass spectra were identified using NIST AMDIS peak deconvolution and spectral identification software. No target compounds were discovered in any of the samples analyzed. The project will continue through May 2002.

PROPAGATION OF JUVENILE MUSSELS AT A NATIONAL FISH HATCHERY. A. K. Mummert, Newcomb T.J., & Neves R.J., Dept. of Fisheries and Wildlife Science & Cherry D. S., Dept. of Biology, Va. Polytechnic Inst. & S.U., Blacksburg, Va 24061. Captive propagation is often recommended as a recovery strategy for declining freshwater mussel populations. In partnership with U.S. Fish & Wildlife Service, attempts to establish suitable culture conditions at White Sulphur Springs N.F.H. are ongoing. Bioassays with juvenile mussels were undertaken to assess whether ammonia levels at the facility are suitable for juvenile survival. Additionally, bioassay results can aid in evaluating the extent to which environmental ammonia levels may contribute to mussel declines. In this study, juveniles of 2 species of freshwater mussels, *Lampsilis fasciola* and *Villosa iris*, were exposed to 5 concentrations of ammonium chloride over a 96 h test period, in static-renewal conditions. Trials were run at 12° C and 20° C, and mortality and water chemistry parameters were monitored at 24 h intervals. The 96 h LC<sub>50</sub> values were calculated using the Trimmed Spearman Karber method. Substantial differences in sensitivity between the 2 temperatures were not observed for either species. However, differences in tolerance were exhibited by the 2 species, with *L. fasciola* being more tolerant of unionized ammonia than *V. iris* (mean 96 h LC<sub>50</sub>'s of 0.24 and 0.11 mg/L NH<sub>3</sub>-N, respectively). The LC<sub>50</sub>'s of these 2 species are comparable to values reported for organisms typically used to set water quality standards. Based on documented levels of ammonia in the aquatic environment from anthropogenic sources, ammonia may limit freshwater mussel populations at affected sites.

OVULATION RATES IN COLORADO MULE DEER. S.D. Aksamit & P.F. Scanlon, Dept. Fisheries and Wildlife Sci., Virginia Tech., Blacksburg, VA 24061. Reproductive tracts were recovered from female mule deer (*Odocoileus hemionus*) following hunts at the U.S. Air Force Academy, Colorado Springs, CO which were held during the months of October, November and December. Ovulation was judged by the presence of corpora lutea in the ovaries. Numbers and sites of ovulations were recorded and ages of individual does were determined from tooth characteristics. No does ovulated prior to November and only 3 does killed in November had ovulated. Numbers of ovulations ranged from 1 to 4; the modal value was 2. In aggregate, 52.2% of ovulations were recorded in right ovaries. No fawns had ovulated. Ovulation rates tended to increase with age. Mean numbers of ovulations by age group were as follows: 1.4 for 1.5 y.o. does (n=5); 1.9 for 2.5 y.o. does (n=18); 1.7 for 4.5 y.o. does (n=3); 2.0 for 5.5 y.o. does (n= 12); and 2.0 for 6.5 y.o. does (n=14).

REPRODUCTIVE ORGAN WEIGHTS AND SPERMATOZOAN NUMBERS IN COLORADO MULE DEER. R. M. Brooks, Jr. & P. F. Scanlon. Dept. Fisheries and Wildlife Sci., Virginia Tech., Blacksburg, VA 24061. Reproductive organs of male mule deer, *Odocoileus hemionus*, recovered following hunts at the U.S. Air Force Academy, Colorado Springs, CO, were dissected. Weights of testes and epididymides were taken and spermatozoan numbers in testes and epididymides were determined. Data were related to month of death: deer were obtained in October, November, and December. Testes and epididymides weights increased with age through all age-groups, fawn to 3.5+y.o. Testes weights peaked in October and were declining in December. Epididymal weights were at a peak in December. Testicular spermatozoan numbers were at a peak in October and declined thereafter. Epididymal spermatozoan numbers were at a peak in November and declined dramatically in December. Changes in organ weights and in spermatozoan numbers are consistent with a build-up of spermatogenesis in preparation for a well-synchronized breeding season in late November and use of spermatozoa at that time. [Project supported by Minority Academic Opportunities Program, Virginia Tech]

STRENGTH MEASUREMENTS IN MULE DEER ANTLER TINES IN RELATION TO FLUORIDE CONTENT. T.E. Doggett, P.F. Scanlon, & J.H. Wilson. Depts. Fisheries and Wildlife Sciences and Biological Systems Engineering, Virginia Tech, Blacksburg VA 24061. Antlers of mule deer at the US Air Force Academy, Colorado Springs, CO were observed to have a high rate of breakages and they were found to have high concentrations of fluorides in teeth, antlers, and bones. Antlers were recovered from Colorado mule deer following hunting activities. Antler tines were designated Tine 1 through Tine 5 beginning with the brow tine (Tine1) and proceeding outward on the antler. Segments 18.8mm in width were sawn, using a saw with 2 blades in parallel, from all tines except brow tines. Antler segments were subjected to compression tests to failure using a SINTECH Universal MTS machine and the following measurements were generated: peak stress, energy to peak load, and modulus of elasticity. Fluoride concentrations in antler tines were determined using an ORION ion selective electrode. Clear relationships between strength measurements and fluoride concentrations were difficult to establish. However, Tine-5 was more resistant to compression than other tines probably due to a higher modulus of elasticity, which may be due to later growth of this tine. [Project supported by Minority Academic Opportunities Program, Virginia Tech]

PATTERNS IN DEER-VEHICLE COLLISIONS IN TWO VIRGINIA URBAN AREAS. C.R. Faustino & P.F. Scanlon, Dept. Fisheries and Wildlife Sci., Virginia Tech., Blacksburg, VA 24061. Records of deer-vehicle collisions in Lynchburg, VA and Blacksburg, VA were examined to determine patterns useful in management of deer in relation to urban and suburban traffic. Data were available for the intervals 1987 to 1998 for Lynchburg and for 1990 to 1998 for Blacksburg. Total numbers of deer-vehicle collisions increased annually in Lynchburg until a management program was instituted in 1993 and the declined steadily thereafter. Deer-vehicle collisions continued to increase in Blacksburg until 1997. While the trends in deer-vehicle collisions were increasing such accidents represented an increased percentage of all accidents. In both locations frequency of deer-vehicle collisions was worst in November and during the late evenings and before midnight. Deer-vehicle collisions occurred most frequently when people were commuting home from work under conditions of darkness. Reductions in accidents resulted when the Lynchburg deer management program was implemented. A major portion of that program consisted of deer removal. Educational programs informing commuters of when the risks of deer-vehicle collisions are greatest together with information on deer-collision avoidance strategies could prove beneficial as a component of a comprehensive urban deer management program. [Project supported by Minority Academic Opportunities Program, Virginia Tech]

DIFFERENCES IN GASTRO-INTESTINAL ANATOMY AMONG SMALL ANIMAL SPECIES. C.R. Faustino & P.F. Scanlon, Dept. Fisheries and Wildlife Sci., Virginia Tech., Blacksburg, VA 24061. Gastro-intestinal (GI) tracts were examined in 12 species to compare dimensions of GI tract components and to relate tract dimensions to food habits. The most conspicuous difference among species was in the presence or absence of the cecum and in the relative (i.e. % of GI tract length) size of the cecum. In general, GI tracts were shorter in carnivorous species (*Canis latrans*, *Vulpes fulva*, and *Blarina brevicauda*) and the cecum was small or absent. The GI tract of an omnivore, *Didelphis virginiana*, was relatively short and the cecum was 4.1% of the GI tract length. The relative length of the cecum (i.e. % of GI tract length) in 3 squirrel species (*Tamias striatus*, *Sciurus carolinensis*, and *Glaucomys volans*) ranged from 3.2 to 5.1%. In the seed eating species, *Peromyscus leucopus*, relative cecum length was 6.4%. In 3 herbivorous species (*Microtus pennsylvanicus*, *M. pinetorum*, and *Zapus hudsonius*) relative cecum length ranged from 12 to 16%. Herbivorous species had the longest GI tracts. [Supported by Pratt Animal Nutrition Foundation].

STRENGTH MEASUREMENTS OF MULE DEER BONES IN RELATION TO FLUORIDE CONCENTRATIONS. C. R. Hutchison, P. F. Scanlon, J. H. Wilson & L. M. Borrero-Yu. Depts. Fisheries and Wildlife Sci., and Biological Systems Engineering, Virginia Tech, Blacksburg VA 24061. A problem of frequently broken antlers in the mule deer population at the U.S. Air Force Academy, Colorado Springs, CO was associated with elevated fluoride concentrations in hard tissues (teeth, bones and antlers). This report concerns an attempt to relate measures of bone strengths to fluoride concentrations. Intact cannon (i.e. fused metacarpals) bones of mule deer were dissected free of tissue and subjected to three-point bending tests on an MTS Syntech instrument which yielded 3 data outputs (stress, energy and modulus of elasticity). These outputs were related to age and sex of deer and to fluoride contents of bones. There were no clear relationship between bone strength measurements and fluoride concentrations. Bones of males absorbed significantly more energy prior to breaking than did those of females. They were also bigger. There were no clear relationship between bone strength measurements and age. Female values for modulus of elasticity were significantly higher than those for males indicating that females had stiffer, more brittle bones.[Supported by Pratt Animal Nutrition Foundation].

MAMMAL COLLISIONS WITH U.S. AIR FORCE AIRCRAFT, 1987-1996. C. M. Lensch, C. A. Tedrow, & P. F. Scanlon. Dept. Fisheries and Wildlife Sci., Virginia Tech., Blacksburg, VA 24061. Problems with aircraft and birds are well known but mammals also adversely impact aircraft operations. The record system for bird-aircraft strikes also records incidents involving mammals. The records for the period 1987 to 1996 were examined for mammal-related incidents. Data were examined by species involved and by time and place of incidents. Bats were involved in the majority of incidents. Fifteen species of bats were identified in mammal-aircraft strikes. A majority of bats were not identified. Bats were involved in strikes in nine countries in addition to the United States. Other species involved in mammal-aircraft collisions included: two species of deer (white-tailed and black-tailed), coyotes, dogs, a cat, chipmunks, jackrabbits, and unspecified rabbits. Practically all collisions occurred at night or at dawn or dusk. Bat species present difficult management problems as they are nocturnal and insectivorous. Large mammal species, such as deer can be excluded from airfield areas.

STRENGTH MEASUREMENTS IN WING BONES OF NORTHERN BOBWHITES IN RELATION TO FLUORIDE CONTENT. C.D. Ponds, P.F. Scanlon, & J.H. Wilson. Depts. Fisheries and Wildlife Sciences, and Biological Systems Engineering, Virginia Tech, Blacksburg VA 24061. Relationships of fluoride concentration in bones of Northern Bobwhites, *Colinus virginianus*, to measures of bone strength were determined in housed and wild Bobwhites. Wings of Bobwhites were obtained from hunters and radii and ulnae were dissected free. From a sample of housed Bobwhites radii, ulnae, and tibiae were dissected. Bones were tested using a Sintech Universal MTS in 3 point bending tests to failure to determine peak stress and peak energy to stress. Fluoride concentrations were determined in radii using an ion selective electrode (ORION). Fluoride concentrations in radii were twice as high in housed bobwhites as in comparably aged wild bobwhites. Energy absorbed prior to breakage by radii was higher in housed bobwhites though the stress (which depends in part on bone cross-sectional area) was comparable in both groups. Access to fluoridated water in captivity seemed to increase fluoride content of bones while influencing select bone strength characteristics. [Project supported by Minority Academic Opportunities Program, Virginia Tech]

CARUNCLE NUMBERS IN UTERI OF RED DEER (*Cervus elaphus*). P. A. Strickland, P. F. Scanlon, & R. Kelly. Dept. Fisheries and Wildlife Sci., Virginia Tech., Blacksburg, VA 24061. The placenta in deer species is classified as "cotyledonary". This type of placenta is common to ruminants. Cotyledonary placentas are characterized as having specific attachment sites "caruncles" within the uterus. Numbers of caruncles vary considerably among ruminants and in several species not all caruncles are attached during pregnancy. Reproductive organs of red deer from New Zealand farms and from Norwegian hunting grounds were dissected and numbers of caruncles were determined. Numbers of caruncles ranged from 4 to 12 with a modal value of 8. The overall mean was 8.2. Caruncles were equally distributed among the uterine horns. Red deer have more caruncles than white-tailed or mule deer, less than moose, and considerably less than cattle, sheep, or goats. [Project supported by Minority Academic Opportunities Program, Virginia Tech]

FOOD PASSAGE RATES IN THREE BIRD SPECIES. R.E. Stultz, R.B. Hiller & P.F. Scanlon. Dept. Fisheries & Wildlife Sci. Virginia Tech., Blacksburg, VA 24061. Passage rates of food in wild birds relate to the potential for spread of viable biological entities through feces. Feeding chromic oxide and its recovery in feces allows estimation of passage rates. Rates of passage of food through the gastro-intestinal tracts of 3 bird species were studied. Five individuals of each of the following species were used: Canada geese, *Branta canadensis*; Japanese quail, *Coturnix coturnix japonica*; and Northern bobwhite, *Colinus virginianus*. All were housed individually and were fed *ad libitum* after a capsule with a known amount of chromic oxide was force-fed to each. Feces were recovered hourly over 24 hours. Chromic oxide was measured in individual feces samples and food passage rates determined. In Canada Geese initial chromic oxide recovery was at 2 hours post consumption, peaked at 4-5 hours, and declined through 10 hours to negligible amounts. In Japanese quail initial chromic oxide recovery was at 1 hour, peaked at 2-3 hours, and declined to negligible amounts beyond 8 hours. In Northern bobwhites initial recovery was at 1 hour, peak recovery was at 3-4 hours, and recovery declined to negligible amounts after 9 hours. Food moves rapidly (12-24 hours) through all 3 species. Considerable potential exists for Canada geese to transport botanical entities by geese given their mobility.

STRENGTH MEASUREMENTS OF RIBS OF MULE DEER. J. H. Wilson, P.F. Scanlon, T.W. Pettit, L. M. Borrero-Yu, & E. J. Wilson. Depts. Fisheries and Wildlife Sci., and Biological Systems Engineering, Virginia Tech., Blacksburg, VA 24061. Mule deer at the USAF Academy base, Colorado Springs, CO, had a high frequency of antler breakages and high concentrations of fluoride were noted in hard tissues (bones, teeth, and antlers) of deer at the base. Antlers are difficult to procure and bones were considered as substitutes for study. Bones (fifth ribs) from hunter-harvested deer were removed intact and had strength measurements done using an MTS Syntech 5/G in a 3-point test configuration. Fluoride concentrations were measured. The strength test was a three-point bending test to failure on a mid-point of intact fifth ribs. Data on strength measurements of ribs of 229 deer were obtained and related to bone fluoride concentrations. Data on strength measurements are presented in relation to fluoride concentration, and sex and age of deer. Fluoride concentrations were higher in females of comparable age groups and also increased with age in both sexes. Shear force was higher in males but was influenced by larger rib size. Shear force increased to age 3.5 years but declined thereafter. Sex and age had interactive effects on the 'strength' measurements as these related to fluoride concentrations.

INFLUENCE OF HYDROPEAKING ON THE ABUNDANCE AND DISTRIBUTION OF INVERTEBRATES IN THE SMITH RIVER, VIRGINIA. Katherine M. Hanna, Tammy J. Newcomb & Marcy R. Anderson. Dept. of Fish. & Wildlife Sciences, Virginia Polytechnic Inst. & State Univ., Blacksburg, VA 24061-0321. Benthic macroinvertebrates were sampled at 12 fish sampling stations in the tailwater of Philpott Dam in July 2000 and April 2001. A riffle within each site was stratified into top, middle, and bottom sections and surber samples were collected at two randomly selected locations within each section. Samples were preserved in 70% ethanol and returned to the lab for identification to family and measures of wet weight. Species richness, ANOVA, and linear regression were used to evaluate longitudinal trends with increasing distance from the dam and to determine significant differences between sites and years. Richness was low near the dam but increased at site 4.2 km and remained high downstream. Both wet weight and abundance were significantly greater in April than July and Ephemerellidae dominated the samples in April. Abundance of aquatic invertebrates in this tailwater was similar to abundances found in Appalachian streams where trout growth was limited. All sites, with the exception of sites 4, 8, and 12 in April, had lower densities than what is commonly found in trout streams in Virginia.

### Geography

(No Abstracts Submitted)

### Geology

STUDY OF THE LITHOLOGY AND SOURCE OF THE STONE WALL ALONG SUNKEN ROAD AT FREDERICKSBURG, VIRGINIA. Stephen P. Flora, W.C. Sherwood, Department of Geology & Environmental Science. The stone wall along Sunken Road was an important feature at the Battle of Fredericksburg, during the Civil War and is now a landmark of that site. The dominant rock type making up the stone wall is a coarse sandstone from the Aquia Formation. The Aquia sandstone consists of coarse quartz sand of various colors with a feldspar matrix. A few large quartz pebbles up to 2 inches in diameter are included. Other rocks found in the wall are composed of various igneous and metamorphic lithologies. The percentages of each rock type in the wall were determined by conducting linear traverses at set intervals along the wall. In addition to lithologic identifications, evidence of mechanical quarrying was noted on a small number of the rocks indicating that some of the rocks were mined from quarries in the area. Several abandoned quarries in the Aquia were identified within two miles of the stone wall. Wadell Roundness Values were used to rate the degree of roundness of the rocks in the wall and it was determined that the majority of the rocks in the wall are subrounded to subangular blocky in shape. In addition to shape, sizes of the rocks were also measured. The lithology, roundness, and size of the rocks in the stone wall are being statistically analyzed and the results used to determine if other rocks may have been brought in to rebuild sections of the wall at a later time.

DETERMINING THE ORIGIN OF SULFATE IN SELECTED WATERS OF SHENANDOAH VALLEY, VIRGINIA. Robert H. Greenlaw, S.J. Baedke, Department of Geology & Environmental Science. Sulfate is an ubiquitous constituent in most reservoirs of water on Earth. However, in the Shenandoah Valley waters with significant concentrations of sulfate are seemingly rare. Statistical analyses of previously published data indicate that a few springs and wells in the Valley have significantly higher concentrations of sulfate. In order to determine the origin of sulfate in these waters, samples were collected



and analyzed for predominant chemical character and isotopes of sulfur. Sulfur isotopes can be used to discriminate between natural (e.g. pyrite, limestone, gypsum, organic matter) and anthropogenic sources of sulfur. The results of this study will provide previously unknown data about the origin of sulfate in waters of the Valley and how it relates to Valley geology and/or identify pollutants if present.

SOIL PEDOGENESIS OF DEBRIS FANS, GRAVES MILL, VA. Brian H. Neely, L. Scott Eaton, Department of Geology & Environmental Science. Debris-flow fan deposits in the upper Rapidan River Basin record a long and complex history of activity. During a storm on June 27, 1995, 30.5 inches of rain in 16 hours initiated approximately 1000 slope failures, and incised stream channels and debris fans. The Generals debris fan complex, located 1 km west of Graves Mill in the Blue Ridge physiographic province, was partially impacted by the deluge, and the scouring from the floodwaters exposed prehistoric fluvial and mass movement deposits. This event has allowed the study of soil pedogenesis and geomorphic activity of prehistoric debris flow fans. Cosmogenic  $^{10}\text{Be}$  dating and soil chronosequence studies reveal a minimum of five distinct ages of debris fans, spanning from approximately 500,000 YBP to present. The oldest debris fan exhibits two distinct debris flows. The upper unit has a 1.0 m argillic horizon, a 2.5 YR Munsell color, and a clay content of 72%. The lower unit has an argillic horizon that exceeds 0.8 m, a 10R Munsell color, and a clay content of 40%. In contrast, the youngest fan surface lacks significant soil pedogenesis, shows Munsell colors of 10YR, and a clay content of only 3%. XRD analyses of the soil profiles reveal a range of clay mineralogy that includes Kaolinite, Illite, Chlorite, and Vermiculite. Additional research of the debris fan should help further elucidate the landscape evolution of this region.

THE KARST DEVELOPMENT OF THE UNION AND HURRICANE RIDGE CAVE SYSTEMS, DICKSON SPRING DRAINAGE BASIN, MONROE COUNTY, WEST VIRGINIA. Christopher M. Printz, L. Scott Eaton, Department of Geology & Environmental Science. The Dickson Spring drainage basin of northern Monroe County, West Virginia, is a well-developed karst basin that encompasses an area of approximately 25 mi<sup>2</sup>. Until recently, little has been known about subsurface flow routes of waters within the Dickson drainage basin, other than their eventual emergence at the Dickson Spring. However, two recent cave discoveries have revealed significant portions of this complex karst drainage system. These are the Hurricane Ridge and Union Cave systems, which currently comprise more than five miles of known cave passage, and new passages are progressively being surveyed and explored. Union Cave has been positively dye-traced to the Dickson Spring, 6.5 miles to the north. Mapping of cave passages within Union cave reveals that many of the active tributaries, as well as abandoned paleo-passages, flow (or once flowed) southward, whereas the active main river passage flows almost due north to the Dickson Spring. These two cave systems lie near the southern boundary of the Dickson drainage basin, south of which waters drain southward to Indian Creek. The research assesses the possible roles of headward erosion and stream piracy of the Dickson drainage basin in capturing waters that once drained to the south. The study also examines the evolution of the Hurricane Ridge and Union Cave systems, with emphasis on their hydrology, and structural and lithological controls on passage development and passage orientation. This aspect of the study is accomplished through the ongoing surveying and mapping of cave passages and subsurface geology. The results of this study should help elucidate the subsurface hydrology of this region.

A GIS CONSTRUCTION OF A GEOLOGIC MAP OF THE GEORGE WASHINGTON NATIONAL FOREST. Mark Villa, W.C. Sherwood, Department of Geology & Environmental Science. The purpose of this project was to compile a geologic map of the George Washington National Forest in a GIS environment. Quadrangle maps of 1:100,000 scale and state geologic maps of 1:250,000 scale were digitized in Abicas, a GIS program for personal computers by Innovative Technologies of America, Inc.. Lithological formations were attributed to areas created using the digitized maps. Area files were converted to shape files for use in ArcExplorer and ArcInfo. There was extensive edge matching required at this stage to form a complete map of the National Forest from individual shape files of quadrangles. At the same time that the bedrock geology was being compiled in the GIS format, a database containing acid resistivity linked to lithology was created in spreadsheet form. This data can be imported into ArcInfo and added as an attribute to formations. The GIS environment offers the ability to attach numerous other attributes to formations and overlay multiple layers containing any mappable features.

USE OF ELECTRICAL RESISTIVITY TO DISTINGUISH EARTH MATERIALS IN THE APPALACHIANS WITH SPECIAL APPLICATION TO DEBRIS FLOW DEPOSITS, GRAVES MILL, VIRGINIA. Erin F. Sutton & C.F. Watts, Dept. of Geol., Radford Univ., Radford, VA 24142. Mapping and characterizing debris flows are important to obtain information useful in identifying locations and conditions prone to future debris flow events and identifying and characterizing actual debris flow deposit material. Two-dimensional electrical resistivity profiling was completed at 16 sites in Virginia and Northeast Tennessee to determine if this geophysical technique was useful in identifying debris flow deposits from six different geological substrata. The resistivity of debris flow material was found to be dependent upon the clay content and the void ratio; “young” debris flows with low clay contents and high void ratios have average resistivities exceeding 1,250 Wm. Residual soils developed in the period of time between flow events. Therefore in areas of accumulation, debris flows are commonly seen as layers of high resistivity above soils of low resistivity. The wenner array produced a more accurate model of the subsurface than the dipole-dipole array. This was due to the extremely high lateral and vertical variability of subsurface conditions associated with layering and boulders.

PETROLOGY, MACRO- AND MICRO-STRUCTURES, AND SCANNING ELECTRON MICROSCOPY OF THE DEVONIAN MILLBORO AND NEEDMORE SHALES, HIGHLAND COUNTY, VIRGINIA. L. L. Combs & P. S. Sethi, Department of Geology, Radford University, Radford, VA 24142-6939. The Devonian Millboro and Needmore Shales outcrop in Highland County, Virginia, along US Route 250 on Bullpasture Mountain. This project seeks to characterize the petrology, macro- and micro-structures, and SEM (Scanning Electron Microscopy) fabric of the two shale units. Methods of analysis include the determination of relative indices of bioturbation in hand sample, thin section analysis and microphotography, and SEM. Both field and lab results indicate that the Millboro Shale is significantly more laminated and pyritiferous than the bioturbated Needmore Shale. Interestingly SEM studies of the relatively more bioturbated Needmore Shale do, however, reveal presence of clearly visible, micron-scale framboids of pyrite disseminated through the rock. Additional data being collected will serve to explore cause-and-effect relationships between the mineralogy and petrology of such shales and their environmental properties/behavior, specifically – potential for acid drainage and problems related with slope instability.

A MULTIMEDIA, INTERACTIVE CD-ROM FOR TEACHING/LEARNING GEOLOGY OF THE VALLEY AND RIDGE AND THE APPALACHIAN PLATEAUS PROVINCES OF VIRGINIA. P. S. Sethi<sup>1</sup>, R. C. Whisonant<sup>1</sup>, K. K. Cecil<sup>2</sup>, P. L. Newbill<sup>1</sup> & L. L. Combs<sup>1</sup>, <sup>1</sup>Department of Geology, Radford University, Radford, VA 24142-6939 and <sup>2</sup>New River Community College and Radford High School, Radford, VA 24141. This paper presents an interactive, multimedia CD-ROM focusing on the geology of the Valley and Ridge and the Appalachian Plateaus physiographic provinces of Virginia. Latest models pertaining to learning psychology and educational theory were merged with modern multimedia instructional technology tools for creation of this unique teaching/learning resource. The two CD-ROM set includes coverage of the topics of physiography, geology, economic resources, environmental issues and connections between geology and human history of the two provinces. The CD-ROM contains state-of-the-art slide shows, video clips, animations, narratives and user-friendly text screens with a intuitive navigational scheme and is designed for the ninth grade Earth Science students and interested laypeople. A detailed Teacher's Guide (including worksheets for students) accompanies the CD-ROM and discusses coverage of the Earth Science SOLs. For ordering please contact the Virginia Division of Mineral Resources at (804) 951-6340.

DENUDATION FROM CATASTROPHIC FLOODING IN NORTHERN VENEZUELA, DECEMBER, 1999, L. Scott Eaton, Dept. of Geology and Environmental Science, James Madison University. Landslides and catastrophic flooding occurred in the Coast Range of northern Venezuela in December 1999. The state of Vargas received 300 mm of rainfall during the first two weeks of December, followed by an additional 900 mm during December 14 to 16. This deluge triggered thousands of landslides, including debris flows, and caused flash flooding in communities along a 40 km coastal zone north of Caracas. Estimates of fatalities range from 10,000 to as high as 50,000. In the disaster zone, the mountain range rises to 2,600 m within 6 km of the coast, producing steep slopes commonly in excess of 45°. Most of the initial landslides occurred in thin soils overlying weathered schist and gneiss bedrock and developed into debris flows as they moved downslope into secondary drainages. A survey of 10 impacted watersheds shows that the spatial distribution of flood and debris-flow deposits is highly variable. Although most watersheds exhibited evidence of both processes, some experienced either debris flows or water floods. Historically, the region experienced major flooding and landsliding events, though of lesser magnitudes in 1936 and 1951. Legends originating from indigenous inhabitants tell of the mountain range periodically "spitting out" rocks onto the fans. Stratigraphic studies of deposits that predate the 1999 event suggest that flooding events of equal or greater magnitude than the 1999 flood have occurred in the last 500 to 1000 years. Soils of some prehistoric debris-flow deposits are probably no older than Holocene as they show a near absence of pedogenesis, including minimal rubification, clay coatings of peds, and clast weathering. The debris fans on the north coast of Venezuela will almost certainly continue to be sites of catastrophic flooding and landsliding.

## Materials Science

NANO-PHASE OXIDES FORMED ON HPS STEELS. R. Balasubramanian<sup>1</sup>, D C Cook<sup>2</sup>,  
<sup>1</sup>Department of Physics, James Madison University, Harrisonburg, VA 22807, USA, <sup>2</sup>Department of Physics, Old Dominion University, Norfolk, VA 23529, USA. Nanophased oxides found in the corrosion coatings of atmospherically weathered steels have properties that are scientifically significant and industrially important. Samples of high strength steels of varying composition were exposed in Campeche, along the Gulf of Mexico for up to one year and the development of corrosion products as a function of steel type and exposure time were studied using Mössbauer Spectroscopy and X-ray diffraction. Both X-ray diffraction and transmission Mössbauer spectroscopic (TMS) results indicated that lepidocrocite, maghemite and goethite were the dominant oxides. TMS analysis at 77K indicated that for up to three months of exposure, lepidocrocite and maghemite accounted for nearly 80% of the relative amount, with goethite contributing only 20% to the mixture. However, as the exposure time increased to 6 months, the relative contribution of goethite increased at the expense of decreasing amounts of maghemite. Monitoring the environment during the exposure time indicated that the average time of wetness decreased. The decrease in the relative contribution of maghemite to the total oxide concentration is related to the decreasing time of wetness, with increasing exposure time. Nearly 20% of the goethite was nanophase exhibiting the superparamagnetic behavior.

A GAS FLOW PROPORTIONAL COUNTER FOR SCATTERING GEOMETRY MOSSBAUER STUDIES OF TIN. L. E. Brown, C. D. Robinson, W. C. McDermott, Department of Physics and Astronomy, Hampden-Sydney College, Hampden-Sydney, Virginia, 23943, USA. A gas flow proportional was constructed and tested for use in nondestructive testing of a banjo tone ring that is made of a tin alloy. The goal was to produce a counter out of readily available material that could be used in back scattering geometry Mossbauer experiments. The detector was constructed using a square body design which should produce a uniform gain over the detector except at the corners where the electric field is non-uniform. The construction criteria, design, and gain uniformity measures are presented and the data show that this detector operates according to the design specifications.

OPTICAL SPECTROSCOPY OF EUROPIUM DOPED GALLIUM NITRIDE PREPARED BY SOLID SOURCE MOLECULAR BEAM EPITAXY. Ei Ei Nyein<sup>1</sup>, U. Hommerich<sup>1</sup>, J. T. Seo<sup>1</sup>, J. Heikenfeld<sup>2</sup>, & A. J. Steckl<sup>2</sup>, <sup>1</sup>Research Center for Optical Physics, Hampton University, VA 23668 and <sup>2</sup>Nanoelectronics Laboratory, University of Cincinnati, Ohio 45221-0030. Thin Film Electroluminescent (TFEL) Displays are all solid-state devices and offer several advantages over well known LCD's including increased brightness and viewing angle. We are currently investigating Eu doped GaN as a potential red phosphor for TFEL display applications. Eu doped GaN films were grown by solid source molecular beam epitaxy on Si (111) substrates. The material was optically characterized through temperature dependent emission spectroscopy using an Argon laser at 336-363 nm for above band gap excitation. A strong red emission was obtained at ~622 nm, which corresponds to a Eu<sup>3+</sup> inner 4f-shell transition from the <sup>5</sup>D<sub>0</sub> to <sup>7</sup>F<sub>2</sub> state. A temperature dependent study of the red Eu<sup>3+</sup> line showed that the integrated emission intensity decreased by a factor of 13 between 13 K and 300 K. On the contrary, the emission lifetime changed only slightly (~10-20%) for the same temperature range suggesting that non-radiative decay processes are small. Therefore, the observed thermal quenching of red Eu emission is assigned to a strongly temperature dependent pumping process.

RECENT RESULTS ON THE OPTICAL PROPERTIES OF CR DOPED II-VI MATERIALS. A. G. Bluiett<sup>1</sup>, U. Hommerich<sup>1</sup>, J. T. Seo<sup>1</sup>, R. Shah<sup>1</sup>, S.B. Trivedi<sup>2</sup>, S.W. Kutcher<sup>2</sup>, R.J. Chen<sup>2</sup>, C.C. Wang<sup>2</sup>, & H. Zong<sup>2</sup>, <sup>1</sup>Research Center for Optical Physics, Department of Physics, Hampton University, Hampton, VA 23661. <sup>2</sup>Brimrose Corporation of America 5020 Campbell Blvd., Baltimore, MA 21236. Cr<sup>2+</sup> in tetrahedrally coordinated CdTe and Cd<sub>0.55</sub>Mn<sub>0.45</sub>Te crystals are under investigation as potential host materials for tunable, mid-infrared (MIR) laser development. The small crystal field splitting of the degenerate free ion energy levels of Cr<sup>2+</sup> induces absorption (approximately 1900nm) and stokes shifted emission (approximately 2500nm) bands in the MIR. Also, the relatively large ionic mass and tetrahedral environment of Cr<sup>2+</sup> in these host materials contributes to high luminescence efficiency. Preliminary data from the Cr<sup>2+</sup>:CdTe free running laser will be reported.

AFM ANALYSIS OF THE BIODEGRADATION OF PHA THIN FILMS. Justinn F. Arceo, Dr. Brian Augustine, Department of Chemistry, James Madison University, MSC 7701, Harrisonburg, VA 22807. A co-polymer mixture of polyhydroxybutyrate (PHB) and polyhydroxyvalerate (PHV) were spun-cast onto glass slides to create thin films. These films are naturally biodegradable by a variety of bacterially-produced enzymes. In our study, the P(HB-HV) thin films were degraded by concentrated *Streptomyces* enzyme. Atomic force microscopy (AFM) was used to image and analyze the data. Both *ex-situ* and *in-situ* experiments were performed on the P(HB-HV) to determine the kinetics of the biodegradation. The *in-situ* experiment was performed using a liquid cell, which allowed for real-time analysis. Degradation was observed uniformly across the surface of the P(HB-HV). We have also developed a height standard using soft-lithography techniques to microfabricate P(HB-HV) structures with dimensions as small as 3  $\mu\text{m}$ .

### Medical Science

*SERRATIA MARCESCENS*: PRODIGIOSIN PRODUCTION. Shana N. Levine & M.C. Simurda. Department of Biology, Washington and Lee University, Lexington, VA 24450. *Serratia marcescens* bacterial colonies can vary in color from deep red to light red to white depending on the growth conditions and medium composition. The color is due to the presence of prodigiosin, a tripyrrylmethene molecule that is also known to be a pH indicator. In basic conditions prodigiosin is white, therefore, the purpose of our research was to determine if the white and red bacterial colonies are both producing prodigiosin. Hexane extractions of bacterial broth cultures separated the prodigiosin from the bacterial cell envelope. Thin layer chromatography of the extracts, using 1:1::acetone:*n*-hexane as the solvent, resolved that white bacteria do not but red bacteria do produce prodigiosin. TLC of extracts from two mutant strains 933 and WCF that are block in each of the two arms of the bifurcated metabolic pathway leading to prodigiosin production, show that neither mutant is capable of prodigiosin production. However, growth of these mutants in proximity to each other on an agar plate show that the intermediate metabolite produced by the WCF strain can be used by the 933 strain to produce the complete prodigiosin molecule. In this situation strain 933 bacteria are red and the TLC analysis shows identity with the red prodigiosin molecule produced by the wild type bacteria.

ISOLATION AND SEPARATION OF CELL POPULATIONS FROM THE MOUSE ANTERIOR PROSTATE. Rachel E. Hess-Yoder, Sarah M. Herr, & Roman J. Miller, Dept. of Biol., Eastern Mennonite Univ., Harrisonburg, Va. 22802. A method to isolate and separate a heterogeneous cell population from mouse anterior prostate tissue into viable, homogeneous populations is being developed to better characterize the unique function of individual cell types. Cell suspensions with an average yield of 2,266 cells/mg tissue were obtained through a two hour incubation of minced prostate tissue in an enzyme mix of collagenase, deoxyribonuclease, and protease made in Earl's Balanced Solution with Bovine Serum Albumin (BSA). A unit density gradient of 0.3-2.4% BSA in Hanks Balanced Salt Solution separated the mixed cell suspension via cell mass and density. Four aliquots that denoted semi-purified homogeneous cell types were selected: (1) Red blood and connective tissue cells predominated the first 50-ml aliquot (9,625 cells, 86.1 percent viable). (2) Stem cells, fibroblasts, and smooth muscle cells were the majority in the third 50-ml aliquot (17,175 cells, 86.2 percent viable). (3) Vacuolated secretory epithelial cells predominated the fourth 50-ml aliquot (10,100 cells, 79.2 percent viable). (4) Large epithelial cells dominated the eighth 50-ml aliquot (6,100 cells, 83.7 percent viable). Obtaining a mixed cell suspension with high percent viability and separation in four semi-purified aliquots illustrates progress toward the goal of this research. (Supported by: Daniel B. Suter Endowment, EMU).

NICOTINE STIMULUS GENERALIZATION TO BUPROPION. T. Bondareva, Richard Young & Richard A. Glennon, Department of Medicinal Chemistry, Virginia Commonwealth University, Richmond, VA 23298. Bupropion is a clinically available agent used both as an antidepressant *Wellbutrin* and as a smoking cessation agent *Zyban*. Its mechanism of action is still unknown in both instances. Its chemical structure is unique and unrelated to those of nicotinic agents. Although bupropion does not bind at brain  $\alpha 4\beta 2$ -type nicotinic acetylcholinergic (nACh) receptors, it can block nicotine-induced hypothermic and antinociceptive effects in the mouse. Bupropion is suggested to be a nicotinic antagonist. We used drug discrimination, with rats trained to discriminate 0.6 mg/kg of nicotine from vehicle, to determine whether or not bupropion is a nicotinic antagonist. If bupropion is a nicotinic antagonist, it should block the stimulus effect of nicotine. However, bupropion failed to antagonize this effect; it produced nicotine-like effects in stimulus generalization studies ( $ED_{50} = 5.50$  mg/kg). Perhaps bupropion is effective in smoking cessation therapy because it can antagonize certain of nicotine's effects while mimicking certain other of its effects. [Supported by DA-05274.]

EFFICACY OF  $\gamma$ - VERSUS  $\alpha$ -TOCOPHEROL IN ATHEROSCLEROSIS PREVENTION. W. Ross Brown & Kathryn E. Loesser, Dept. of Biol., Mary Washington College, Fredericksburg, VA 22401. The  $\gamma$ - form of tocopherol has recently been proposed to have a greater effect on the progression of atherosclerosis than that of  $\alpha$ -tocopherol. The purpose of this experiment was to explore whether  $\gamma$ -tocopherol would have a greater effect than  $\alpha$ -tocopherol on prevention of atherosclerotic plaque development and on lowering cholesterol levels. Three groups of hyperlipidemic mice were fed high cholesterol feed: 1 group's food was supplemented with  $\gamma$ -tocopherol, another group's food was supplemented with  $\alpha$ -tocopherol and no supplements were added to the control group feed. Animals were sacrificed at the end of 14 weeks and blood along with heart and aorta samples were evaluated. Blood cholesterol and triglyceride levels were significantly higher ( $p < 0.05$ ) in the control group than in the tocopherol-supplemented groups. The semi-quantitative evaluation of plaque development in heart and artery cross sections showed that the  $\gamma$ -tocopherol-supplemented mice had the lowest atherosclerotic plaque development, the  $\alpha$ -

tocopherol fed group showed a slightly higher presence of plaques, and the control group showed the highest plaque occurrence. Gamma tocopherol supplementation seems to slow plaque development but more studies need to be done to confirm these findings.

THE ROLE OF CADMIUM IN THE INDUCTION AND EXACERBATION OF AUTOIMMUNITY IN TWO RODENT MODELS. Elizabeth K. Leffel & Kimber L. White, Jr. Dept. of Pharm. & Tox., Va. Commonwealth Univ., Richmond, VA, 23298. The Brown Norway rat (BN) is an induction model for SLE. A self-limiting increase in IgE levels occurs after exposure to autoimmune-inducing compounds. We utilized this characteristic to develop a "mercury challenge" model. Female BN were exposed via drinking water to 3, 30, 300 ppm cadmium chloride (Cd) for 9 weeks then challenged with 1 mg/kg mercuric chloride (Hg). There were increases in urinary Cd levels in the 30 and 300 ppm dose groups. Hg resulted in significant increases in IgE levels, compared to pre-challenge levels. No differences were observed between control and treated rats. This data does not reflect the inverse dose response expected. Therefore, cadmium in this model does not appear to induce autoimmunity, at the doses tested. The NZB/W mouse is an exacerbation model for SLE. Female NZB/W mice were exposed to 0, 0.03, 0.3, 3, and 10 ppm via drinking water for 4 or 31 weeks. Kidney cadmium levels were significantly increased in the 3 and 10 ppm groups. Proteinuria developed at 15 weeks of exposure in treated groups and 27 weeks in vehicle mice. This early onset of disease indicates that Cd may exacerbate autoimmune disease in those genetically predisposed.

TRYPTAMINES AS 5-HT<sub>6</sub> SEROTONIN RECEPTOR LIGANDS. Manik R. Pullagurla<sup>1</sup>, Bryan L. Roth<sup>2</sup> & Richard A. Glennon<sup>1</sup>, <sup>1</sup>Department of Medicinal Chemistry, Virginia Commonwealth University, Richmond, VA 23298 and <sup>2</sup>Department of Biochemistry, Case Western Reserve University. To date, 14 distinct types of mammalian 5-HT receptors have been identified. 5-HT<sub>6</sub> receptors belong to the family of seven transmembrane helix GPCRs and are positively coupled to an adenylate cyclase second messenger system. There is growing interest in this receptor because of the high affinity of several antidepressants and antipsychotics, suggesting a role in psychiatric disorders. 5-HT<sub>6</sub> receptor antagonists might be useful in the treatment of neuropsychiatric disorders, memory and cognitive dysfunction, and as anticonvulsants. We have earlier reported N<sub>1</sub>-(benzenesulfonyl)tryptamines as 5-HT<sub>6</sub> receptor antagonists. In the present investigation we have further studied the structural requirements for the binding of the N<sub>1</sub>-(benzenesulfonyl)tryptamines at the 5-HT<sub>6</sub> receptors and have identified structural modifications that influence affinity.

STATUS EPILEPTICUS RESULTS IN AN INCREASE IN BASAL AND MAXIMAL CALCINEURIN ACTIVITY IN RAT FOREBRAIN HOMOGENATE. JE Kurz. Dept. of Biology, VA Commonwealth Univ., Richmond, VA 23284. We studied the effects of status epilepticus (SE) on calcineurin, a neuronally enriched, calcium-dependent phosphatase. Calcineurin is an important modulator of many neuronal processes, including learning and memory, induction of apoptosis, receptor function and neuronal excitability. Therefore, a SE-induced alteration of calcineurin activity could have significant physiological implications. SE was induced by pilocarpine injection and allowed to continue for 60 minutes. Brain region homogenates were assayed for calcineurin activity by dephosphorylation of p-nitrophenol phosphate. A significant SE-dependent increase in both basal and Mn<sup>2+</sup>-dependent calcineurin activity was observed in homogenates isolated from the cortex and

hippocampus, but not the cerebellum. This increase was specific to calcineurin. Both maximal dephosphorylation rate and substrate affinity were increased following status epilepticus. However, increased calcineurin activity was not due to an increase in calcineurin enzyme levels. Finally, increase in calcineurin activity was found to be NMDA-receptor activation dependent. The data demonstrate that SE resulted in a significant increase in both basal and maximal calcineurin activity.

REGIONAL IMMUNIZATION WITH PEPTIDE-PULSED DENDRITIC CELLS LEADS TO COMPARTMENTALIZED IMMUNE RESPONSES AND ENHANCED ANTITUMOR EFFICACY. D.W. Mullins, S.L. Sheasley, T.N.J. Bullock, T.A. Colella, and Victor H. Engelhard, Carter Immunology Center, Univ. of VA, Charlottesville VA. To evaluate the efficacy of immunization maneuvers in a context relevant to human cancer therapy, we established a preclinical model using HLA-A\*0201/H-2D<sup>d</sup> recombinant (AAD) mice. IV immunization of AAD<sup>+</sup> mice with dendritic cells (DC) pulsed with YMDGTMSQV (human A2-restricted tyrosinase antigen) induced protection against challenge with an AAD-transfected murine B16-F1 melanoma. Tumor outgrowth was significantly decreased and survival extended by tyrosinase epitope-pulsed DC immunization as compared with unpulsed DC or untreated controls. Interestingly, SQ immunization was more efficacious at controlling tumor than IV immunization. Antigen-specific assays revealed an expanded population of tyrosinase-specific CTL in both the proximal draining nodes and spleen following SQ immunization with peptide-pulsed DC; IV immunization induced a larger total population of Ag-specific CTL, but these cells were detected only in the spleen. Thus, enhanced tumor control may be achieved with a small cohort of reactive CTL, provided these cells reside in the appropriate compartment.

TRYPTAMINES AND ISOTRYPTAMINES: BINDING AT 5-HT<sub>2</sub> RECEPTORS. J. Chang-Fong<sup>1</sup>, Milt Teitler<sup>2</sup> & Richard A. Glennon<sup>1</sup>, <sup>1</sup>Department of Medicinal Chemistry, Virginia Commonwealth University, Richmond, VA 23298 and <sup>2</sup>Department of Pharmacology, Albany Medical College, Albany, NY 12208. The 5-HT<sub>2</sub> serotonin receptors are now well characterized and their distribution is established. Some 5-HT<sub>2</sub> receptor ligands are currently undergoing clinical assessment as potential treatment for a range of CNS-related diseases including schizophrenia, anxiety, sleep, feeding disorders, and migraine. We have previously shown that *isotryptamines* represent a novel class of 5-HT<sub>2</sub> agonists. Hoffman La Roche Pharmaceuticals has now developed *isotryptamines* with selectivity for 5-HT<sub>2C</sub> versus 5-HT<sub>2A</sub> receptors. Because most of these agents display <100-fold selectivity, we conducted structure-affinity studies to determine what structural features might be responsible for selectivity. Tetrahydropyrazinoindoles, bridged derivatives of phenylpiperazine combining the structural features of mCPP (a potent 5-HT<sub>2C</sub> agonist) and the *isotryptamines*, were also prepared and examined.

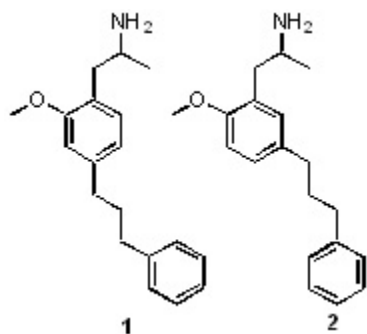
EXPLORATION OF POTENTIAL 5-HT<sub>5</sub> SEROTONIN RECEPTOR LIGANDS. Nantaka Khorana<sup>1</sup>, Malgorzata Dukat<sup>1</sup>, Carol Smith<sup>2</sup>, Milt Teitler<sup>2</sup> & Richard A. Glennon<sup>1</sup>, <sup>1</sup>Department of Medicinal Chemistry, Virginia Commonwealth university, Richmond, VA 23298 and <sup>2</sup>Department of Pharmacology, Albany Medical College, Albany, NY 12208. Diversity of the neurotransmitter serotonin receptor may be one of the reasons which causes serotonin to be involved in a variety of pathological changes. One of the newest receptor subtypes, 5-HT<sub>5A</sub> receptors, has been speculated to be involved in brain development and non-neuronal function. The lack of selective ligands for 5-



HT<sub>5A</sub> receptors has hampered understanding the functional role of these receptors. A pyridoindole was identified as a possible lead for the development of such agents. Structural manipulation has resulted in analogs with low nanomolar affinity for 5-HT<sub>5A</sub> receptors.

MITOGENIC EFFECT OF LIPOTEICHOIC ACID ON HUMAN EPITHELIAL CELLS. Robert B. Becker & Linda Ameen, Dept. of Biol., Mary Washington College, Fredericksburg, VA 22401. *Enterococcus faecalis* is a gram-positive bacterium existing as normal flora within the human colon and is implicated in many significant infections. We determined whether a component of gram positive bacterial cell walls called Lipoteichoic Acid (LTA) acted as a mitogen on human epithelial cells. Blocking studies utilizing Genistein, a tyrosine kinase inhibitor, were conducted to elucidate the pathway LTA may use to stimulate mitosis. LTA extracted from *E. faecalis* was incubated at a concentration of 10 mg per ml with ME-180 cervical, P-69 prostate, and Caco-2 colorectal carcinoma cells lines for 24, 48, and 72 hours. Additional trials treated with 250 mM genistein were also conducted. Proliferation was assessed at each time point by measuring BrdU incorporation. The results indicate that LTA may have a mitogenic effect on all of the cell lines. However, statistical differences were only found with the Caco-2 colorectal cells ( $p < .05$ ). Results from the blocking studies show that proliferation was inhibited by genistein, suggesting that a protein tyrosine kinase signal transduction pathway may be used by the mitogen.

NOVEL AND UNEXPECTED PHENYLISOPROPYLAMINE 5-HT<sub>2</sub> RECEPTOR LIGANDS. Jagadeesh B. Rangisetty<sup>1</sup>, Malgorzata Dukat<sup>1</sup>, Milt Teitler<sup>2</sup>, & Richard A. Glennon<sup>1</sup>, <sup>1</sup>Department of Medicinal Chemistry, Virginia Commonwealth University, Richmond, VA 23298 and <sup>2</sup>Dept. of Pharmacology, Albany Medical College, Albany, NY. 5-HT<sub>2</sub> serotonin ligands are being evaluated for the treatment of schizophrenia and depression. Phenylisopropylamines such as 1-(4-bromo-2,5-dimethoxyphenyl)-2-aminopropane (DOB) are high affinity 5-HT<sub>2</sub> agonists. We have investigated the structure-affinity relationships (SAFIR) for binding and the structural requirements for agonist activity. A 2,5-dimethoxy pattern seems optimal for agonism, and affinity is broadly modulated by the nature of the 4-position substituent. The present study examined several related analogs of **1**, which lack a 5-methoxy group. It was additionally found that shifting the phenylalkyl substituent from the nuclear 4- to the 5-position results in retention of affinity. For example **2** unexpectedly binds at 5-HT<sub>2A</sub> receptors with high affinity (K<sub>i</sub> = 13 nM) but now possesses 5-HT<sub>2A</sub> antagonist character.



GROWTH FACTOR-LIKE ACTIVITY OF LTA ON CERVICAL AND PROSTATE. Alexandra C. Racanelli & Linda C. Ameen, Dept. of Biol., Mary Washington College, Fredericksburg, VA 22401. The relationship between prokaryotic and eukaryotic cells and the effects prokaryotes have on their hosts is not fully understood. Bacteria are classified as either gram-positive or gram-negative. These microorganisms possess several properties, known as virulence factors, which facilitate their pathogenicity, or ability to cause a disease. Lipoteichoic acid (LTA) is a virulence

factor within the cell wall of gram-positive bacteria. It is composed of a glycolipid with an attached fatty acid n(glycosyl) polyglycerophosphate. This research used ME-180 and P69 cells to study LTA's possible mitogenic effects. Cell proliferation was quantified using an enzyme assay. T-test analysis indicated that LTA acted as a mitogen. Further studies are needed to confirm LTA's long-term effects on the host cell and to elucidate the pathway LTA may utilize to induce cellular proliferation.

ACCURATE INVITRO END-JOINING OF A FREE RADICAL MEDIATED DOUBLE STRAND BREAK BEARING A 3'OVERHANG WITH COHESIVE ENDS AND 3'-PHOSPHOGLYCOLATES: EFFECT OF KU ON REPAIR FIDELITY. K.V. Inamdar, S.Chen, P.Pfeiffer, S. Lees-Miller, M.F.Hannah, Jae Wan Lee, Tong Zhou and L.F.Povirk. Dept. of Pharmacology and Toxicology, Medical College of Virginia, VCU. The subunits of DNA-dependent protein kinase(DNA-PK; Ku86, Ku70, and DNAPKcs) are critical for the mammalian nonhomologous end-joining pathway of double-strand break repair. A plasmid substrate containing a model of a staggered free radical-mediated double-strand break, with cohesive phosphoglycolate-terminated 3'overhangs and a one base gap in each strand, was constructed. Our results indicate that Ku, but not DNA-PKcs, is required for accurate end-joining of staggered free radical-mediated DNA double-strand breaks in vitro. Ku plays specific roles in protecting DNA termini from degradation, and maintaining the alignment of short partial complementarities during gap-filling and ligation. The role of DNA-PK may be primarily regulatory, initially inhibiting both end alignment and end processing by displacing Ku from the extreme end of DNA. This inhibition appears to be subsequently relieved as a result of specific, DNA- PK- catalysed phosphorylation events, the details of which remain to be defined.

AZANICOTINE ANALOGS AS nACh RECEPTOR LIGANDS. Giovanni Ferretti<sup>1</sup>, Malgorzata Dukat<sup>1</sup>, Billy R. Martin<sup>2</sup>, M. Imad Damaj<sup>2</sup> & Richard A. Glennon<sup>1,2</sup>, <sup>1</sup>Department of Medicinal Chemistry, School of Pharmacy, and <sup>2</sup>Department of Pharmacology & Toxicology, Virginia Commonwealth University, Richmond, VA 23298. Nicotine is an alkaloid with a wide spectrum of biological activities – some beneficial, some detrimental – perhaps due to its inability to discriminate between the different subtypes of nicotinic acetylcholinergic (nACh) receptors. Although the antinociceptive effects of nicotine have been known for over 60 years, the recent discovery of epibatidine, a potent nACh agonist, has prompted a search for analogs that might be potential analgesic agents without unacceptable toxicity. On the basis of structure-activity relationships formulated in our laboratories we synthesized a series of chain lengthened and imidazoline analogs of nicotine. Preliminary data show that azanicotine ( $K_i=206$  nM) and homoazanicotine ( $K_i=7.8$  nM) possess analgesic activity ( $ED_{50}=21$  and 19 mg/mouse, respectively) and potency comparable to that of nicotine ( $K_i=2.1$  nM;  $ED_{50}=12$  mg/mouse). However, their antinociceptive actions, unlike those of nicotine, do not seem to involve  $\alpha 4\beta 2$  nACh receptors. These compounds may represent a novel mechanistic class of analgesics worthy of further investigation. [Supported by DA-05274.]

THE EFFECTS OF IL-1 AND IL-6 ON RAT SMOOTH MUSCLE CELL PROLIFERATION AND CYTOKINE PRODUCTION. Dahlia Peterson & Kathryn E. Loesser, Dept. of Biol., Mary Washington College, Fredericksburg, VA 22401. Interleukins 1 and 6 may be involved in the exacerbation of atherosclerosis. In this experiment, the effects on rat vascular smooth muscle cell

(VSMC) proliferation *in vitro* following incubation with either IL-6 or IL-1b were evaluated using ELISA BrdU Proliferation assays, cell counts, and tritium incorporation. RNA extraction, followed by RT-PCR was also performed to determine if rat VSMC produced IL-6 and/or IL-1 in a positive feedback response to treatment with these cytokines. Increase in cell number was measured using the trypan-blue exclusion method. The results indicate that IL-1b-treated cells had the lowest increase in cell number (29.5%) followed by control (49.7%), then 0.2 ng/ml IL-6 (91.1%) and highest in 0.4 ng/ml IL-6 (112.4%). Similar trends were obtained with tritium-labeled thymidine incorporation. However, very different results were obtained with ELISA BrdU; IL-1b and 0.4 ng/ml IL-6 showed a decrease in cell proliferation compared to the control and 0.2 ng/ml IL-6 increased cell proliferation. RT-PCR did not yield any consistent results. These experiments do not convincingly support a role of the cytokines IL-6 and IL-1b in atherosclerosis, although further research needs to be done to clarify these roles.

*IS PORPHYROMONAS ASACCHAROLYTICA* SUPEROXIDE DISMUTASE CAMBIALISTIC?  
Erin A. Clark & E.M. Gregory, Department of Biochemistry, Virginia Tech, Blacksburg, VA. Superoxide dismutase (SOD) from *Porphyromonas asaccharolytica* was a 42,000 mw dimeric protein. Inhibition of enzymatic activity by 2 mM  $\text{NaN}_3$  and time-dependent inactivation by 100 mM  $\text{H}_2\text{O}_2$  were consistent with iron at the active site. Denaturation of SOD from cell extracts in 5 M guanidinium chloride, 20 mM 8-hydroxyquinoline, and renaturation in 20 mM Tris (pH 7.0) but without added metal salt abolished SOD activity. Renaturation in the Tris buffer supplemented with either  $\text{MnCl}_2$  or  $\text{Fe}(\text{NH}_4)_2(\text{SO}_4)_2$  restored 50% and 42%, respectively, of the SOD activity initially denatured. Electropherograms of the native, Fe-reconstituted and Mn-reconstituted SODs revealed that each had a single band of SOD activity with the same relative mobility. SOD activity in native and Fe-reconstituted samples was inhibited >70% by 2 mM  $\text{NaN}_3$  whereas Mn-reconstituted SOD was inhibited <20%. These data are consistent with the insertion of either Fe or Mn into the active site with restoration of catalytic activity. This ability to express activity with either metal defines a cambialistic enzyme.

### Natural History & Biodiversity

POPULATION DECLINES OF MADTOM CATFISHES IN NORTH AMERICA AND POTENTIAL RESTORATION APPROACHES. John M. Kilpatrick, Department of Fisheries and Wildlife Sciences, Va. Polytechnic Inst. & State Univ., Blacksburg, Va 24061. Madtoms (*Noturus* spp.) are an extremely imperiled group of North American catfish, with 19 of the 25 described species protected in one or more of 19 states. 5 of these species are federally listed as threatened or endangered. My objectives were to determine reasons for madtom declines, identify common threats, and suggest possible restoration methods. Habitat loss, population fragmentation, predator introduction, poor water quality, and siltation have been the most common causes cited for declines in this genus. Biological traits such as low fecundity, narrow habitat requirements, and short life spans have contributed to madtom imperilment. Habitat preferences of madtoms usually include clean riffle-type areas of streams with availability of cavities for nesting. Recovery efforts such as habitat restoration and reintroductions have been directed at individual species, but efforts directed at preservation and restoration of entire systems would likely prove more effective. Artificial propagation and subsequent reintroduction into historic ranges will be important, but factors limiting madtom populations (e.g. adult survival, reproductive success, etc) must be identified for restoration efforts to be effective.

DISTRIBUTIONS OF FISHES IN RIVER DRAINAGES OF GREECE, WITH COMMENTS ON ASSESSING FISH BIODIVERSITY IN THE SOUTHERN BALKAN PENINSULA. W. C. Gretes<sup>1</sup> & E. G. Maurakis<sup>1,2</sup>, <sup>1</sup>Biology Department, Univ. of Richmond, VA 23173 & <sup>2</sup>Science Museum of VA, 2500 W. Broad St., Richmond, VA 23220. Distributions and species diversity of freshwater fishes were determined relative to physical factors (stream order, width, depth, elevation, river km, and water temperature) in four river drainages (Aliakmon, Aoos, Axios, and Strymon-Aggitis) in Greece. Stream order was negatively correlated with elevation and gradient, and positively correlated with stream width and depth. Number of species was positively correlated with stream order, width and depth, and negatively correlated with elevation and gradient. Changes in species composition among stream orders were related more to replacement rather than addition of species. Funded in part by the Thomas F. and Kate Miller Jeffress Memorial Trust, Science Museum of Virginia, and University of Richmond.

COMPARISON OF MYOMERE COUNTS IN LARVAL *HEMITREMIA FLAMMEA* AND POPULATIONS OF FOUR SPECIES OF *SEMOTILUS*. E. G. Maurakis<sup>1,3</sup>, R. Katula<sup>2</sup>, & W. C. Gretes<sup>3</sup>, <sup>1</sup>Science Museum of VA, 2500 W. Broad St., Richmond, VA 23220, <sup>2</sup>North American Native Fishes Assoc., 308 16<sup>th</sup> Ave. N., Onalaska WI 54650, & <sup>3</sup>Biology Department, Univ. of Richmond, VA 23173. Larval preanal, postanal, and total myomere counts of *Hemitremia flammea* were compared to those of *Semotilus corporalis*, *Semotilus lumbee*, *Semotilus thoreauianus* and GA (Altamaha drainage) and VA populations of *Semotilus atromaculatus*. Total myomere counts can be used effectively to separate species and populations of *S. atromaculatus*, *S. corporalis*, *S. lumbee*, *S. thoreauianus*, and *H. flammea*. Preanal myomere counts distinguish *S. corporalis* and VA *S. atromaculatus* but do not discriminate *H. flammea* from *S. thoreauianus*, nor *S. lumbee* from GA *S. atromaculatus*. Altamaha *S. atromaculatus* differs from VA *S. atromaculatus* in preanal, postanal, and total myomere counts, some adult meristic and morphometric characters, and has two unique undescribed *Dactylogyrus* species of gill parasites, characters that may warrant specific status for the GA Altamaha drainage population of *S. atromaculatus*. This study was funded in part by Science Museum of VA and Univ. of Richmond.

TIDE SPRING VIRGINIA-A REGIONAL TREASURE. James D. Lehman, Department of Physics, James Madison University, Harrisonburg VA. 22807. The presence of an ebb-and-flow spring in the Shenandoah Valley has intrigued observers for the past 240 years. Thomas Jefferson wrote about this phenomenon in his "Notes On The State Of Virginia". For many years the spring was an attractive objective for school field trips and social outing. In 1927, O.E. Meinzer identified and described the various flow patterns. Our five-year survey, beginning in 1982 monitored the site, logged seasonal changes, and attempted to model an underground profile. The spring is located in the outcrop belt of the Beekmantown formation. A triangular watershed to the south nourishes the spring activity. At present the area is a mixture of grazing land and mixed hardwoods – totally undeveloped. There are no immediate threats to the spring and watershed. Some local interest has been expressed in the recognition and preservation of this unusual natural phenomenon.

BENTHIC MACROINVERTEBRATE RESPONSES TO PHYSICALLY-COMPLEX HABITAT IN THE JAMES RIVER, VIRGINIA: LINEAR OR CURVILINEAR RELATIONSHIPS? Timothy W. Stewart, Tammy Shumaker, & Tom Radzio, Department of Natural Sciences, Longwood College, Farmville, VA 23909. We quantified response of a macroinvertebrate community to changes in habitat-structure abundance. Concrete slabs with stones attached were placed in the James River and retrieved after 28 days. Taxonomic richness and densities of macroinvertebrates were positively affected by stones. Total invertebrate density and densities of several taxa were linearly related to stone density. However, nonlinear relationships occurred between stone density and both macroinvertebrate taxonomic richness and chironomid (*Eukiefferiella* sp.) densities. Nonlinear relationships were characterized by increased macroinvertebrate densities and taxonomic richness across a gradient of increasing stone density when stones were rare (0-45 stones/0.08 m<sup>2</sup>; 0-40% of slab faces covered by stones), but weak responses to additional stones at higher stone densities (83-160 stones/0.08 m<sup>2</sup>; 89-96% coverage). We conclude that low levels of habitat structure greatly increase densities and taxonomic richness of benthic macroinvertebrates on hard substrata in the James River, and interstices provided by densely-packed substratum particles are not critical habitat for most taxa.

RELATIONSHIPS BETWEEN SUBSTRATUM PARTICLE SIZE AND MOLLUSK ABUNDANCE IN THE APPOMATTOX RIVER, VIRGINIA. Robert M. Northington, Timothy W. Stewart, & Joseph E. Garcia, Department of Natural Sciences, Longwood College, Farmville, VA 23909. Substratum particle size is an important determinant of the distribution and abundance of mollusks and other benthic invertebrates in aquatic ecosystems. For example, certain gastropods (i.e., snails) have adapted their foraging behavior to graze the surfaces of rocks for patches of freshwater algae. Rocks need to have sufficient surface area and algal coverage for these gastropods to graze effectively. In contrast, most bivalves (i.e., clams) require substrata consisting of small particles that allow for burrowing. We quantified relationships between substratum particle size and densities of two mollusks in the Appomattox River: the gastropod *Leptoxis carinata*, and the asian clam, *Corbicula fluminea*. We used a Surber sampler to collect mollusks from three broad habitat types characterized by dominant substratum particle size and flow regime. Habitat types included 1) sand/pool, 2) cobble/run, and 3) cobble/riffle (n = 3 replicates each). Results from statistical analysis showed that *Leptoxis* densities increased along a gradient of increasing particle size. Trends also suggested that *Corbicula* densities increased as a function of decreasing particle size.

PROPAGATION AND CULTURE OF ENDANGERED JUVENILE MUSSELS (UNIONIDAE) AT THE VIRGINIA TECH AQUACULTURE CENTER. Jess W. Jones, Richard J. Neves and Jeff J. Allen. Virginia Cooperative Fish and Wildlife Research Unit, Department of Fisheries and Wildlife Sciences, Virginia Tech, Blacksburg, VA 24061. Although North America contains the greatest diversity of freshwater mussels in the world, roughly 300 species, this family of mollusks is the most imperiled taxon in the United States. Biologists at the Virginia Tech Aquaculture Center have developed methods to propagate and culture endangered juvenile mussels for release into rivers of the upper Tennessee River drainage. Without immediate efforts to recover the 25 federally protected species in this drainage, the extinction of additional species is likely. The Tennessee Wildlife Resources Agency, U.S. Fish and Wildlife Service, and Virginia Tech have entered into a 5 year cooperative program to fund the production, culture, and release of numerous juvenile mussel species into rivers in eastern Tennessee. The goal of this project is to augment natural reproduction at sites

with these species and to release juvenile mussels at historic sites within those rivers to expand the population ranges. In 1998-2000, a total of 243,000 juvenile mussels of 9 species were released into the Clinch, Powell and Hiwassee rivers in Tennessee. Annual releases will continue, and an evaluation of the success of the releases will begin in the year 2001.

THE ECOLOGICAL SIGNIFICANCE OF TAIL SPOTS AND PLUMAGE IN FEMALE PROTHONOTARY WARBLERS. Jonathan R. Moore, Charles R. Blem & David W. Podlesak, Department of Biology, Virginia Commonwealth Univ., Richmond, VA 23284. One-year-old (SY) female Prothonotary Warblers (*Protonotaria citrea*) have distinctive subadult plumages, including a variable amount of white on the webbing of their rectrices. The extent of white varies from elongated spots only on the webbing of r5 and r6 to large, bright-white areas on r2-r6 (similar to the male pattern). Older females tended to have more white than first-year birds and changes between years always resulted in more extensive or equal areas of white on rectrices. Retrix patterns are not rigorous indicators of the age of female Prothonotary Warblers, but may function in signaling changes in maturity and potential fitness of older females. SY females with smaller amounts of white in their rectrices produced significantly smaller clutches, but nested earlier and had nestlings with faster growth rates, and greater fledging masses than first-year females with more male-like plumages. SY females tended to be absent from the study area in their first breeding seasons and may have skipped nesting or been forced to breed in marginal habitat away from study area.

STUDIES OF MAMMALS ON THE VIRGINIA BARRIER ISLANDS: BIOGEOGRAPHY, GENETICS, AND ECOLOGY. Nancy D. Moncrief<sup>1</sup> & Raymond D. Dueser<sup>2</sup>, <sup>1</sup>Virginia Museum of Natural History, Martinsville, VA 24112 & <sup>2</sup>College of Natural Resources, Utah State University, Logan, UT 84322. The Virginia barrier islands, which extend 150 km along the southern seaward margin of the Delmarva Peninsula, comprise the only undeveloped barrier system on the eastern seaboard. These islands are separated by deep inlets, tidal lagoons, and extensive salt marshes. They are subject to frequent storms; islands often are overwashed and sometimes inundated, creating a dynamic ecological and evolutionary environment. We are studying the mammals that inhabit these islands and the adjacent Delmarva Peninsula mainland. Our research is focused on four major areas: 1) historical and current biogeography; 2) ecological and genetic comparisons of island and mainland populations of rodents; 3) recent erosion events on the northern end of Myrtle Island; and 4) population dynamics and distributions of mammalian predators.

### Psychology

DOES THE TEMPORAL DEVELOPMENT OF READING PROCESSING SKILLS INFLUENCE LETTER DETECTION FAILURES? Breton Harris Permesly, Washington and Lee University. This experiment traces the temporal development of reading-processing skills in attempts at gaining insight into the effects reading proficiency has on the "Unitization" and "Phonetic-Recoding" hypotheses approach to letter detection errors. The experimenter presented 30 Washington and Lee undergraduates with two sets of passages in which they were to encircle instances of target letter. One set of passages was used to assess the effects of proficiency on the "Unitization" hypothesis, and the other set examined the effects of proficiency on the "Phonetic-Recoding" hypothesis. The

observed pattern of detection errors in the "Unitization" study was found to significantly depend not only on the presentation of the search passage, but also on the attained level of the subject's reading-processing skills. In the second study, although trends were observed that supported the hypothesized effects of temporal development of read-processing skills on phonetic factors in detection errors, no significant effects were observed.

THE EFFECTS OF GENDER AND STATUS ON THE ACCURACY OF DETERMINING LIES AND TRUTHS. Lisa A. Chew, Washington and Lee University, Lexington, Va. 24450. Do gender and status affect the accuracy of determining lies and truths? Participants were shown four 2-minute videos (each viewed twice) of targets with different status levels – a male professor (high), a female professor (high), a male student (low), and a female student (low). Each video included each of the following descriptions: someone the person liked, someone the person disliked, someone the person liked as if he/she disliked him/her, and someone the person disliked as if he/she liked him/her. The participants (males and females) were told that the targets lied between zero and four times and were then asked to determine whether each description was a lie or the truth and indicate their confidence in those determinations. Male participants were found to be significantly more accurate in their determinations of lies/truths for low status targets than for high status targets. Overall, the male participants were more confident in their determinations than were the female participants. A significant interaction indicated that the female participants had significantly higher confidence in the determinations for the high status target when it was a male and significantly higher confidence in the determinations for the low status target when it was a female.

ORIGINS AND MECHANISMS OF SEMANTIC MEMORY RETRIEVAL INHIBITION. Nathan R. Hoot & David G. Elmes, Department of Psychology, Washington and Lee University, Lexington, VA, 24450. Retrieval blocks can be induced in semantic memory by a variety of methods, including part-list cuing or priming with information semantically related to a target. Mechanisms underlying retrieval blocks may involve automatic spreading inhibition, but other interfering cognitive processes seem to play a role in this phenomenon as well. The first study attempted to evoke memory retrieval blocks using an indirect means of priming. Subjects studied a part list of United States with their capitols and were asked to recall the capitol of a given state after being primed with a studied or non-studied state. Results showed that studied primes inhibited retrieval more than non-studied primes, indicating that significant retrieval blocks may indeed be induced by indirect means. A new model was devised using a connectionist approach to illustrate one possible means of such retrieval inhibition. In the second study, studied and non-studied capitols were included as the possible primes. The results showed that state primes tended to inhibit retrieval more than capitol primes. To explain this finding, the concept of immediate memory was proposed to explain a possible mechanism underlying the cognitive process of memory retrieval.

HOW DOES RESPONSE MODALITY AFFECT FREE RECALL? Michael T. Morrow, Dept. of Psych., Washington and Lee Univ., Lexington, Va. 24450. Although significant studies have examined the interaction between presentation modality and encoding modality in memory performance, this research has continuously overlooked response modality as a significant variable. Therefore, this study investigates the interaction between presentation modality, encoding modality, and response modality in order to reexamine previous findings and proposals such as the translation

hypothesis. Participants were given an incidental instruction before viewing a wordlist. Words were presented visually and aurally, encoded by writing and speaking, and recalled through writing or speaking. A significant interaction appeared between encoding and response modality illustrating that regardless of presentation modality, when verbal encoding and response are paired, comparatively lower recall is observed. Also, responding in a different modality than the encoding modality, generated higher recall than responding in the same modality. Contrary to previous findings and the translation hypothesis, intermodal processing only produced higher recall in the auditory presentation condition. The results observed in this study demonstrate that response modality is a variable to consider.

THE ROLE OF RATE OF PRESENTATION AND TYPE OF ESTIMATION ON ACCURACY OF TIME PERCEPTION. Shelby R. Fierke, Department of Psychology, Washington and Lee University, Lexington, VA 24450. What affect does both rate of presentation and type of estimation have on the accuracy of time perception? In the present experiment 60 participants, 28 males and 32 females, were assigned to one of four groups in this 2x2 between subjects design. The four groups were divided between the two independent variables, rate of presentation (fast or slow) and type of estimation (prospective or retrospective). After a short slide show, absolute error values and estimations of time were taken from the participants by the reproduction method. A significant main effect for type of estimation was found, in that prospective estimates of time were longer than retrospective estimates of time. A significant interaction was also found. Prospective estimates were longest in the fast presentation group and shortest in the slow presentation group, while retrospective estimates were longest in the slow presentation group and shortest in the fast presentation group. Explanations for these results are presented and discussed using various models of subjective time perception.

THE EFFECT OF COMBINATION OF INSULIN-PRODUCED HYPOGLYCEMIA AND ETHANOL ON RAT PERFORMANCE IN THE RADIAL-ARM MAZE. J. Constantine, J. Kenney, & P. Duncan, Department of Psychology, Old Dominion University, Norfolk, VA 23529-0267. Male Long-Evans rats were trained to criterion performance on a win-shift procedure in a radial-arm maze (RAM) for food reward. The effects of two units/kg of insulin, 1500 mg/kg ethanol, and the combination of these drugs were then tested with a 2 X 2 factorial experimental design with both injections given IP 15 min before testing. Insulin was a between-subjects variable (two groups, n=10) and ethanol was a within-subjects manipulation given to half of each group on the first test day and to remaining rats on the second test day. Insulin produced a state of hypoglycemia in that blood glucose levels were reduced to approximately 65% of baseline value. Both ethanol and insulin significantly increased time required to complete the RAM trials, and ethanol caused an impairment of correct arm-choice. Insulin did not cause RAM errors. The combination of ethanol and insulin caused a non-significant tendency for potentiation of the increase in time of RAM completion. These results demonstrate that ethanol can impair working memory and ethanol or hypoglycemia produce general behavioral depression.



THE EFFECTS OF REPEATED ADMINISTRATION OF ETHANOL, AND OF INSULIN ON RAT PERFORMANCE IN THE RADIAL-ARM MAZE. B. Parris & P. Duncan, Department of Psychology, Old Dominion University, Norfolk, VA 23529-0267. In order to determine whether tolerance develops to the behavioral effects of ethanol, and of insulin-produced hypoglycemia, these drugs were administered on three days of radial-arm maze (RAM) tests. Ten rats were administered 1600 mg/kg ethanol, and ten were administered two units/kg insulin. Each drug was injected IP 15 min prior to the RAM tests and all rats had been given extensive training in the RAM. A no-drug control day preceded each drug test and drugged performance was compared to these control tests. Ethanol initially increased time to complete the RAM, but this effect was not seen on test days 2 and 3. Significantly increased RAM errors also occurred after ethanol treatment and persisted for all test days. Insulin treatment did not cause RAM errors, but did greatly increase RAM-completion time and this effect did not decrease on days 2 or 3. These results demonstrate that some effects of ethanol are subject to tolerance and do not persist after chronic treatment, but a similar effect of hypoglycemia does persist for at least three hypoglycemic episodes. The degree of hypoglycemia did not vary significantly over the three days of RAM tests.

THE EFFECTS OF TEAM PROCESS TRAINING AND PERCEIVED TASK AND LIFE WORK LOAD ON TEAM PERFORMANCE. Hope S. Hanner, Old Dominion University. The effects of task load and life load on team performance were examined in a time series design. Research participants were 55 students of an I/O Psychology course who were randomly assigned to teams. The 11 teams completed team assignments for which each individual received team grades three times per week for the entire semester. In addition to the team assignments, all individuals completed self-report questionnaires on the level of difficulty of the task (task load) and the level of current stress in their lives (life load). Midway through the course, students in a 3-hour behaviorally based team process training whose goal was to make the teams aware of the team processes, observed team processes in the context of the team assignments, and practiced with the teamwork processes. The hypotheses were that team training would bring about an increase in performance by teams, and alleviate the effect of work load and life load on team training. Results from autoregressive integrated moving average (ARIMA) analyses indicated that team training improved team performance and moderated the relationship between the task and life load variables with team performance. It appeared as though teamwork controlled the effects of both task (internal) and life (external) stressors on team performance. Implications of this study for future research were discussed.

AN INVESTIGATION OF CONTROL CONDITIONS IN ASCH-TYPE EXPERIMENTS: II. Lynn M. McGeein, Karen P. Craig & James P. O'Brien, Tidewater Community College, Virginia Beach VA 23456. The results are reported for the second year of a standardization protocol for stimuli used in Asch's (1951, 1956) independence-conformity paradigm (first year: *Va. J. Sci.*, 51 (2), p. 132). Asch's control condition is replicated for participants' sex and college (4-yr. college vs. community college) and experimenters' sex and status (authority vs. peer) constituting a 2x2x2x2 design. So far, only white male college undergraduates (the same type of subjects Asch used) err as seldom as Asch's controls (regardless of whether a male experimenter is authoritative or a peer). For many other conditions, percent error-free and mean error measures are more extreme than those found by Asch. In fact, the mean error for the sample least like Asch's, 55 community college women with a same-sex peer experimenter, is 0.91; or 11.4 times greater than Asch's 0.08. Most replications in the 50 years since Asch, using college undergraduates (men & women), replicate only the group

pressure experimental conditions and not controls. Therefore, the typical conclusion that women are more conforming than men in the Asch paradigm may be erroneous. As Asch demonstrated, the more ambiguous the stimuli the more conformity occurs.

THE EFFECTS OF EDUCATIONAL COURSES ON INMATE DEPRESSION. Karen E. Herrera, Tidewater Community College, Virginia Beach, Virginia 23456. In order to test the effects of educational courses on inmate depression, a modified version of the Geriatric Depression Scale (GDS) was administered to volunteer prisoners at Bexar County (Texas) Adult Detention Center who were either enrolled in educational courses (n=100) or who were not enrolled (n=100). APA ethical guidelines were implemented, and special safety precautions for working in a correctional facility were taken. Male inmates taking intense (college level or multiple) courses showed a 40% lower average depression score than male inmates taking no classes, but males taking parenting courses scored 24% higher (more depressed) than males taking no courses at all. Female inmates taking parenting courses scored 27% lower depression scores than females taking no courses.

THE EFFECTS OF SOCIAL CONTACT ON BEHAVIORAL RESPONSES FOLLOWING STRESSFUL AND ENRICHING ENVIRONMENTS. Jennifer K. West and Kelly G. Lambert, Dept. of Psychology, Randolph-Macon College, Ashland, VA 23005. Social contact and enrichment have been shown to act as buffers against some of the detrimental effects of chronic stress. This study sought to examine the role each plays on reducing emotional reactivity and increasing learning abilities in rats. Following exposure to a 10 day chronic unpredictable stress paradigm, results suggested that animals housed with a social partner were less anxious in an open field test. On the first day of testing in a dry land maze, exposure to an enriched environment enhanced learning. On the second day of testing in a dry land maze, a significant interaction between social contact and enriched environment was observed. Specifically, the rats housed in a standard environment demonstrated impaired learning ability when raised in isolation whereas the standard environment animals housed with a social partner demonstrated no learning deficits. Thus, social contact seems to be able to compensate for impoverished environmental conditions.

EFFECTS OF GENDER SCHEMAS ON OCCUPATIONAL JUDGEMENTS. Shawna J. Maio & Kelly B. Cartwright, Psychology Department, Christopher Newport University, Newport News, VA. Literature currently indicates that there are persistent wage and promotional inequities between males and females in the United States. These inequalities seem to favor men over women in occupational settings, and several studies have examined possible causes for these observed disparities. Theoretical explanations have included Human Capital Theory and Devaluation Theory. This research proposes that Gender Schema Theory may provide additional explanation for sex-based inequities. Participants were classified as schematic (masculine or feminine) or aschematic (androgynous or undifferentiated) based on the Bem Sex Role Inventory. The current study examined aschematic and schematic individuals' occupational judgements regarding fictitious resumes, predicting that gender schemas would affect judgements even when human capital and devaluation variables were controlled. No evidence of sex-based inequities or devaluation emerged. However, consistent with predictions, gender schemas appeared to affect individuals' suitability judgements of female applicants for schema-inconsistent positions, while no such effect was found for males.

EFFECTS OF REWARDS AND STANDARDS OF CRITERIA ON CREATIVITY IN THE ELEMENTARY SCHOOL CLASSROOM. Daniel M. Birdwhistell<sup>1</sup>, David G. Elmes<sup>1</sup> & Paul Notaro<sup>2</sup>. <sup>1</sup>Dept. of Psychology, Washington and Lee Univ., Lexington, VA 24450 and <sup>2</sup>Department of Psychology, Univ. of Missouri at St. Louis, St. Louis, MO 63121. Investigates how the promise of non-synergistic extrinsic rewards (candy) and quantitative standards of production (minimum levels of production for specific tasks) affect the creative performance of 41 3rd and 42 5th grade students relative to normal creative ability. The Average Standard Score on the Torrance Test of Creative Thinking, Figural Form B was used to measure overall creative performance. Individual creative behaviors were measured by fluency, originality, elaboration, abstractness of title, and resistance to closure on the same test. The promise of reward increased creative production in both 3rd and 5th grade students irrespective of ability, with higher increases in the 5th grade students. The reward significantly improved fluency, abstractness of title, and resistance to closure. The standard of production negatively affected creative production for students with normally low creative abilities. This result was especially negative with the 5th grade students.

A SECONDARY ANALYSIS OF LEADERSHIP BEHAVIORS AND VIRTUAL TEAM EFFECTIVENESS. J. Bryant & D. Davis, Department of Psychology, Old Dominion University, Norfolk, VA 23529-0267. No research to date has attempted to explore effectiveness of virtual teams with respect to specific leadership traits or practices. This study is an initial step toward understanding the interrelationship between the domains of team effectiveness and leadership. Transcripts of interviews with 41 managers of three international companies with offices in Asia were analyzed qualitatively with "team" (regional or global) as the unit of analysis. Ratings of team effectiveness from managers and this investigator were correlated. Further, specific leader behaviors assessed by the LMX-7 and MLQ were correlated with both ratings of team effectiveness. Results were generally inconsistent with regard to specific, identifiable leadership behaviors conducive to effectiveness in virtual teams. However, one LMX item, "quality of working relationship with leader", was found to be significantly correlated with ratings of team effectiveness from both managers and this investigator. Implications of this finding, as well as limitations of the research design and analytic methods, are discussed.

ESTIMATING STRESS, PERSONAL RELATIONSHIPS, AND VIOLENT TENDENCIES IN JAPANESE AND AMERICAN STUDENTS. S. Hinnefeld, M. Gibbons, J. Gibbons, K. Cartwright, & T. Marshall. Psychology Department, Christopher Newport University, Newport News, VA 23606. In the current study a self-report survey was administered to 419 junior high school and college students in Japan and America. Students reported their stress, violent thoughts, violent actions, and their relationships with parents, teachers, and peers. As expected, American students reported less stress, fewer violent thoughts, and better relationships with parents and peers than Japanese students. Interestingly, American junior high school students reported fewer violent behaviors than Japanese junior high school students.

THE EFFECTS OF COLOR AND EXPOSURE ON ACCURACY AND SPEED OF IDENTIFICATION. S. Wood & T. Betts, Department of Psychology, Christopher Newport University, Newport News, VA 23606. The goal of the current experiment was to determine if presentation color affects accuracy and reaction time when identifying old and new words. Specifically, participants were shown a set of 40 words to recognize later. The words were either colored or black. At test, participants made recognition ratings for 80 words (40 old and 40 new) and their accuracy and reaction times were recorded. Surprisingly, color affected recognition and reaction time for new words, but not old words. Apparently, colored words focused participants on identifying old words, which distracted them from identifying new words. Future research will replicate the current study across longer retention intervals.

AN EXAMINATION OF NEED FOR COGNITION AND DEFINING MOMENTS. R. Page, B. Sander, & J. Gibbons, Department of Psychology, Christopher Newport University, Newport News, VA 23606. The current study examined existential moments, or defining moments in the lives of the participants. Specifically, 16 participants reported ten of their most defining moments, and for each event estimated frequency of recall. They also rated memories of the events and pleasantness and importance of the events. Participants also filled out a need for cognition scale. The defining events and contrived existential moments were then incorporated into a computer-simulated program. One week later, participants were asked to correctly identify their events from the contrived events. Reaction times were recorded. Unexpectedly, participants showed faster reaction times to the contrived events. Interestingly, defining events became more pleasant over time for high need-for-cognition participants.

MALE CHARACTERS ARE MALICIOUS FOR GENDER SCHEMATIC INDIVIDUALS. B. Sander, E. Pope, & N. Traxel, Department of Psychology, Christopher Newport University, Newport News, VA 23606. The current study examined how participants' gender schemas determined the gender of the main and supporting characters in positive and negative stories. Schematic participants identified character gender best when the story was negative. Moreover, schematic participants remembered character gender best in negative stories with male lead characters. Future experiments will balance gender and analyze the data for gender effects.

### Statistics

MODEL ROBUST REGRESSION BASED ON GENERALIZED ESTIMATING EQUATIONS. Seth K. Clark, Jeffrey B. Birch, & Oliver Schabenberger, Dept. of Stat., Va. Polytechnic Inst. & State Univ., Blacksburg, VA 24061. One form of model robust regression (MRR) predicts mean response as a convex combination of a parametric and a nonparametric prediction. MRR is a semiparametric method by which an incompletely or an incorrectly specified parametric model can be improved through adding an appropriate amount of a nonparametric fit. The combined predictor can have less bias than the parametric model based estimate alone and, as shown in previous work for uncorrelated data with linear mean function, can converge faster than the nonparametric predictor alone. We propose extending the MRR technique to the problem of predicting the mean response for clustered non-normal data. We review parametric and nonparametric GEE methods then combine them through

a mixing parameter. As a special case where data are uncorrelated, this amounts to mixing a local likelihood estimate with predictions from a global generalized linear model. Bandwidth selection, mixing parameter estimation, and asymptotic convergence rates are discussed.

**BAYESIAN MODIFICATION TO THE TWO-STAGE EXPERIMENTAL DESIGN PROCEDURE WITH NEAR-SATURATED DESIGNS AND HETEROGENEOUS VARIANCE.** D'Arcy P. Mays, Department of Mathematical Sciences, Virginia Commonwealth University, Richmond, VA 23284-2014. Experimental designs are critical in the quality improvement of the manufacturing process and to the development of new processes. Experimental methods are often used to identify the most important controllable variables in the product. The relationship of the product response and the controllable variables can be determined by experimental data. Therefore, the empirical mean model should be established using multiple regression. Experimental designs often are evaluated with regard to estimating coefficients in the regression model. However, with dispersion effects many standard designs are not optimal for estimation of the mean model. A two-stage experimental design procedure developed by Mays and Myers, in which the first stage estimates the heterogeneous variance structure and the second stage augments for estimating the mean model, is beneficial in many situations. However, the first stage variance estimation is not reliable when small first stage experiment sizes are used. A modified two-stage procedure using a Bayes estimator indicates that the procedure is beneficial for the small first stage experiment sizes. This study focuses on the application of this modified procedure for several small designs. Near saturated and saturated designs such as Hybrid designs, Koshal designs, and small composite designs are chosen for the investigation. The examination of the variance estimation in the first stage for these designs will be performed in order to find the optimal number of replicates to make at each design location. The Bayesian procedure will be compared to the non-Bayesian procedure for the various variance structures as well as the different variance ratios, and is shown to be beneficial.

**CAPTURING NONCONFORMITY POINTS IN REGRESSION.** James E. Mays, Department of Mathematical Sciences, Virginia Commonwealth University, Richmond, VA 23284-2014. A study of the regression problem of developing confidence intervals around the estimate of mean response when there is both a small sample size and a possible misspecification of the form of the underlying model. Of particular interest is capturing the true mean response for the specific points that do not conform to the user's chosen model. For these points, classical parametric methods such as ordinary least squares (OLS) yield inaccurate fits and undesirable confidence interval coverage probabilities. Nonparametric alternatives such as local linear regression (LLR) yield large variances and undesirably wide confidence intervals due to the small sample size. The solution to this dilemma is to use semiparametric model-robust techniques that combine the parametric information available with a nonparametric adjustment to capture the structure missed by the parametric fit. Confidence intervals for two of these methods (based on linear estimates) are compared to those from OLS and LLR. An example and a simulation study establish the benefits of the model-robust confidence intervals by comparing coverage probabilities and widths. These benefits are apparent for fits based on recently developed data-driven criteria. Results are presented for the specific nonconforming points and across all points in the data sets.

AN ALTERNATIVE ESTIMATE OF LOCATION FOR CIRCULAR DATA. Bennett Sango Otieno & Christine M. Anderson-Cook, Dept. of Statistics, Va. Polytechnic Inst. & State Univ., Blacksburg, Va, 24061. Circular- or angular -data are dealt with in many fields of applied statistics. A well-known biological example is the migration of birds, or, as medical examples, the time (month) of onset of lymphatic leukemia and circadian rhythms like time of maximal blood pressure could be mentioned. A common problem of interest in circular data is estimating a "preferred direction" or "center" and its corresponding error estimate. This problem is complicated by the fact that there is no minimum or maximum on the circle-the so-called wrap-around effect. The usual statistics employed for linear data are inappropriate for directional data, as they do not account for the circular nature of directional data: the fact that  $1^{\circ}$  and  $359^{\circ}$  are only  $2^{\circ}$  apart. Common choices for summarizing the preferred direction are the sample circular mean (quite robust, especially if data is from Von Mises distribution), and sample circular median (very insensitive to the tails of the distribution). A circular analogue of the celebrated Hodges-Lehmann estimator for linear data is proposed, as an alternative estimate of "preferred direction" (center). The new measure of center is robust under general distributions, down weights outliers sparingly and gives some influence to the tail of the distribution.

LINEAR MIXED MODEL ROBUST REGRESSION. Megan J. Waterman, Jeffrey B. Birch & Oliver Schabenberger, Department of Statistics, Virginia Polytechnic Institute and State University, Blacksburg, VA 24061. Mixed models are powerful tools for the analysis of clustered data and many extensions of the classical linear mixed model with normally distributed response have been established. As with all parametric models, correctness of the assumed model is critical for the validity of the ensuing inference. Model robust regression techniques predict mean response as a convex combination of a parametric and a nonparametric model fit to the data. It is a semiparametric method by which incompletely or incorrectly specified parametric models can be improved through adding an appropriate amount of a nonparametric fit. In this talk we apply this idea of model robustness in the framework of the linear mixed model. The mixed model robust regression (MMRR) predictions we propose are convex combinations of predictions obtained from a standard normal-theory linear mixed model, which serves as the parametric model component, and a locally weighted maximum likelihood fit which serves as the nonparametric component. An application of this technique with real data is provided.