A COMPARATIVE ANALYSIS OF METHODS FOR BASELINE REMOVAL IN PRETERM INFANT RESPIRATION SIGNALS. Pallavi Ramnarain & Paul A. Wetzel, Ph.D. Department of Biomedical Engineering, Virginia Commonwealth University, Richmond, VA 23284. Baseline drift removal is an critical step in preprocessing data for event detection applications. The goal of this work was to compare five different methods for basline drift removal in preterm infant respiration signals. These included a linear spline approximation, a cubic spline approximation, a recurrent neural network approach, a first derivative based approach and a second derivative based approach. Respiration was measured using a thermistor embedded in infant nasal cannula. All five methods were compared using the same event detection algorithm to evaluate their effectiveness at drift removal. The most effective method for this application was the second derivative method.

Botany

THE *FLORA OF VIRGINIA* PROJECT: A 2009-2010 UPDATE. Marion B. Lobstein, Dept. of Biol., NVCC, Manassas, VA 22205. Virginia, for its landmass, has the most diversity of vascular plant species of any state in the United States. It had the first flora, the *Flora Virginica* in 1739, yet does not have a modern *flora*. The Virginia Academy of Science for over eighty years has supported efforts to produce a modern *Flora of Virginia*. In 2001 the Foundation of the *Flora of Virginia*, Inc, was formed in 2001 and in May 2002 received 501(c) 3 status. Progress continues to be made on the efforts to develop a *Flora of Virginia* including fund-raising and public outreach efforts. Work on the content of the Flora of Virginia including the nearly 300 of the core illustrations have been commissioned, completed, and funded by VAS funds. Grants from Robins Foundation and Old Dominion have been obtained for the Project during this past year. The Academy, including the Fellows, continues to provide essential support including financial for this Project. Other progress includes completion of treatments of the dichotomous keys of 190 of the 199 vascular plant families in Virginia and the first step in developing species and genus descriptions has been completed. The second step of herbarium work on descriptions is complete and the third and final step of species genus descriptions is 94% completed. The projected publication date is late 2012 or early 2013.

ANTIOXIDANT ANALYSIS OF SELECTED TEMPERATE SPICES. Erinda Stefi & Michael H. Renfroe, Dept. Biology, James Madison University, Harrisonburg VA 22807. There is a growing interest in natural antioxidants due to their major role in human health. Spices are main targets when searching for antioxidants. The addition of antioxidants in people's diets is very important in preventing degenerative diseases such as cancer, cardiovascular, neurological diseases and cataracts. The purpose of this research project was to determine the hydrophilic and lipophilic antioxidant content of seven Mediterranean spices: basil, oregano, sage, thyme, rosemary, marjoram and mint. The antioxidant content of each spice was directly related to the drop in ABTS absorbance upon the addition of the spice extract to the HAA and LAA reagents. A standard curve was established by measurements of known concentrations of trolox, a

well-characterized antioxidant that is soluble in both hydrophilic and lipophilic assays. For each spice, a statistical analysis of the variance and the comparison of sample means were performed using the analysis of variance, followed by the Dunnett's T3 post-hoc test (≤0.05). For all the spices analyzed, higher HAA and total antioxidant activity (TAA=HAA+LAA) values were obtained from their ground form compared to their leaf form. The spice with the highest TAA of 36.25 µmol TE/g fw was thyme, while the spice with the lowest TAA of 8.43 µmol TE/g fw was sage leaves.

ANTIOXIDANT ANALYSIS OF SELECTED TROPICAL SPICES. Melanie M. Pommer & Michael H. Renfroe, Dept. of Biol., James Madison Univ., Harrisonburg VA 22807. Antioxidants are molecules which react to neutralize free radicals before they can damage biological molecules. The human body produces these naturally; however, the body's supply of antioxidants often is not sufficient to neutralize all free radicals. In this case, one may consider consuming foods or beverages that are rich in various antioxidants. Some common antioxidant-rich foods and beverages are fruits, vegetables, tea, coffee, red wine, soy products, herbs, and spices. The purpose of this research was to determine the antioxidant activity of seven ground tropical spices: mace, allspice, nutmeg, turmeric, cinnamon, cloves, and ginger. The ABTS/H_2O_2/HRP method was used to determine hydrophilic and lipophilic antioxidant content of each spice. The decrease in ABTS radical concentration due to antioxidant activity was monitored at 730 nm using a spectrophotometer. A standard curve was established using trolox. Reduction power of antioxidants extracted from each spice was reported as Trolox Equivalents (TE) in mol/g fresh weight. An analysis of variance and Dunnett's T3 test were conducted to determine significance of the difference of means (=0.05). Cloves, allspice, cinnamon, and mace were found to have the highest total antioxidant activity (TAA) ranging from 4.08 TE to 68.8 TE/g fw. Ginger, turmeric, and nutmeg had the lowest TAA ranging from 1.96 TE to 2.66 TE/g fw.

A TAXONOMIC REVISION OF THE ENDEMIC MEMBERS OF CORDIA L. (BORAGINACEAE) IN THE GALÁPAGOS ISLANDS. Julia K. Stutzman & Conley K. McMullen, Dept. of Biol., JMU, Harrisonburg VA 22807. The Galápagos Islands have long been an arena for biological diversity, scientific discovery, and more recently, conservation. Identification and documentation of the flora of the Galápagos can aid with conservation efforts. The purpose of the study reported here is to conduct a taxonomic revision of, and create an accurate taxonomic key for the four endemic members of the genus *Cordia* in this archipelago (*C. revoluta* Hook. f., *C. leucophlyctis* Hook. f., *C. anderssonii* (Kuntze) Gurke, *C. scouleri* Hook. f.). Taxonomic uncertainty among the species has resulted in the inability of these species to be evaluated for conservation status by the International Union for Conservation of Nature. A taxonomic study of these *Cordia* species will determine how they are to be identified in the field. A related GIS analysis of the population locations of each species will assess species distribution on the islands. Proper identification and distribution assessment of the endemic *Cordia* populations will allow for a determination of the conservation status of each species.

STRUCTURE OF FOLIAR GLANDS OF *STIZOPHYLLUM RIPARIUM* (BIGNONIACEAE). M. J. Drake & W. John Hayden, Dept. of Biol., UR, Richmond, VA 23173. *Stizophyllum riparium*, is a liana widely distributed in the neotropics characterized by foliar glands associated with pellucid-punctae in the leaves. We investigated structure of these glands via light and scanning electron microscopy using specimens obtained from the Kaxil Kiuic reserve located in Yucatan, Mexico. The glands arise from protoderm, are located in small depressions on both leaf surfaces, and consist of three or four basal cells that support a disk-like gland body with upturned edges. Cells of the gland body radiate from the central basal cells to the upturned gland margin; these cells are elongated parallel to the underlying epidermis. Cuticle separates from the outer periclinal walls of the gland body consistent with a merocrine-eccrine mode of secretion. Mesophyll immediately adjacent to foliar glands remains undifferentiated (no distinct palisade and spongy layers) and lack chloroplasts, rendering gland-associated leaf regions translucent. Similar, but non-pellucid, glands are known in the Asian genus *Incarvillea*; however, most foliar glands in the family are characterized by a palisade-like secretory layer supported by either a single, grossly enlarged, basal cell, or numerous small basal cells. Foliar glands in Bignoniaceae can be interpreted as homologous with glandular trichomes.

SELECTIVE FORAGING OF DIATOMS BY THE MARSH PERIWINKLE (LITTORINA IRRORATA) IN THE CHESAPEAKE BAY ECOSYSTEM. Charlotte L. Clark & Harold G. Marshall, Dept. Biol. Sci., ODU, Norfolk, VA 23529-0266. The marsh periwinkle is a common snail in tidal mud flats of Virginia's estuarine marshes of the Chesapeake Bay. It is described as a grazer of detritus and algae as it moves across the surface sediment of these inter-tidal regions. Common components of this sediment are diatoms, both of sediment and plankton origin. The objective of this study was to determine to what extent these snails utilize diatoms as a food source. Replicate samples of snails (large and small) and sediment (ca. 30 g) were taken monthly (January to April 2010) in the exposed intertidal mud flat of the Lafayette River, Norfolk. The snails were brought back to the laboratory where their fecal pellets were then collected. Diatom frustules were counted in both the fecal pellets and the sediment. There were 35 diatom taxa identified in this process. Diatoms were considered living that contained a recognizable protoplast; those lacking a protoplast as non-living. The results indicated no significant difference in the presence of empty frustules between the sediment and fecal pellets, or between the size of the snail and the sediment. The results indicated *Littorina irrorata* did not efficiently utilize living diatoms as a food source. The snail's major food source is more likely to be soft bodied algae and detrital material than these diatoms.

INTEGRATING ECOLOGY AND GENETICS TO UNDERSTAND ADAPTATION TO NOVEL ENVIRONMENTS. Carrie A. Wu, Dept. of Biol., UR, Richmond, VA 23233. Specialization to local environmental conditions can generate the adaptive population differentiation that is required for ecological speciation. A particularly dramatic example of ecological specialization involves alpine endemics, which have evolved characteristic suites of adaptations, such as strikingly prostrate, cushion-like

growth forms, in response to similar selective environments. We are investigating the ecological and genomic basis of this common ecological transition to alpine environments using the mountain monkeyflower, *Mimulus tilingii*. In contrast to the widely distributed *M. guttatus, M. tilingii* populations are confined to subalpine and alpine habitats throughout western North America, in high altitude "habitat islands" that provide a unique set of replicate evolutionary experiments in trait divergence to common ecological influences. Despite the close geographic proximity of the progenitor species *M. guttatus,* we detected high levels of genetic and phenotypic divergence between the two species. Using nuclear microsatellites and chloroplast sequence data, we demonstrate that *M. tilingii* is indeed genetically distinct from *M. guttatus*, and actually comprises its own geographically structured species complex. Common garden studies indicate that the two species are primarily divergent in vegetative, rather than floral traits, consistent with patterns of reduced stature often observed in alpine plants. In addition, greater morphological than neutral genetic differentiation between the species suggests a major role for natural selection in maintaining the distinct, compact morphology of *M. tilingii*.

INTRODUCTION TO THE CAPE FLORISTIC REGION. W. John Hayden, & M. J. Drake, Dept. of Biol., UR, Richmond, VA, 23173. Floristic regions (kingdoms) can be defined on the basis of endemic taxa at relatively high rank (families, subfamilies, tribes). Most floristic regions coincide with major continental land masses and their biotic uniqueness can be readily explained as a consequence of isolation during past episodes of plate tectonic movement. In contrast, the miniscule Cape floristic region is manifestly distinct floristically despite having a tectonic history common with the African continent. Recent floristic studies recognize 8920 species of flowering plants, 69% of which are endemic to the region; the Cape region occupies a mere 0.5% of the land area of Africa but holds 20% of the continent's plant diversity. Endemic families include: Geissolomataceae, Grubbiaceae, Penaeaceae, Roridulaceae, and Stilbaceae (s.s.). Families with more than 10 genera endemic to the Cape region include: Asteraceae, Aizoaceae, Ericaceae, Fabaceae, Rutaceae, Proteaceae, Orchidaceae, Iridaceae, and Restionaceae. Several vegetation communities exist, but fynbos, a sclerophyllous shrub land adapted to fire and acidic, nutrient-poor soils dominates the region. Many plants from the Cape region have entered the horticulture trade and are now widespread in cultivation. On the other hand, the Cape region is considered a global biodiversity hotspot, with many pressing conservation needs. Overall, the Cape flora shows significant affinities to the flora of Africa and floras of the Southern Hemisphere (Gondwana).

FLOWER AND INFLORESCENCE STRUCTURE IN *DORSTENIA* (MORACEAE): AN UNDERGRADUATE DISCOVERY SCIENCE PROJECT. W. John Hayden, Dept. of Biol., UR, Richmond, VA, 23173. Flowers of *Dorstenia* are small, unisexual, structurally reduced, and densely aggregated into capitula; as such, they test well students' basic concepts of floral morphology. Student teams were provided with inflorescences from three species of *Dorstenia* from which they prepared paraffin-embedded sections for study with light microscopy (LM); students also studied

inflorescence surfaces via scanning electron microscopy (SEM). LM and SEM images were pooled with macrophotographs and line drawings from the literature to create an image bank. In class, each student then created, from scratch, a short PowerPoint presentation designed to analyze/interpret flower and inflorescence structure, drawing as needed from the image pool. At first students balked at the relatively open-ended and unstructured nature of the assignment, but soon began to engage with the challenge of making sense of the flowers and the different ways that the same structure can appear when rendered by different imaging techniques. Students discovered for themselves the peculiar flowers of *Dorstenia,* thus broadening their understanding of the fundamentals of flower structure and floral diversity.

Chemistry

IS TiF2 REALLY LINEAR? T.C. DeVore, Department of Chemistry and Biochemistry, James Madison University, Harrisonburg VA 22807. The molecular geometry of the first row transition metal difluorides has been of interest to experimentalists and theorists for over 40 years. Recently, Wilson et al. concluded that the was no evidence that any of these compounds were non-linear. Density functional theory (DFT-B3LYP with a 3-611G++ (3df,3pd) basis set) has been used to determine the molecular geometry and the vibrational frequencies for TiF_2 and Ti_2F_6. These calculations indicated that the $^3B_2$ ground state of TiF_2 was non-linear with a bond angle of ~ 139.2°. The bond length was 180.6 pm. The $^3B_{2u}$ ground state of Ti_2F_6 has D_{2h} symmetry with terminal and bridging bond lengths of 178.3 and 180.3 pm respectively. The terminal F-Ti-F bond angle is 125.1°. The IR active Ti-F stretching frequencies are 728.19 and 625.13 cm^{-1} for TiF_2 and 755.9, 681.0 and 513.0 cm^{-1} for Ti_2F_6. The calculations indicate that in contrast to the recent conclusions reached by Wilson et al., the ground state of TiF_2 is non-linear.

THE SYNTHESIS OF NITROGEN-AND SULFUR-CONTAINING HETEROCYCLES FROM CYCLO-PROPANOL FRAGMENTATION. Georgia T. Stoyanov, Kelly L. George & Kevin P.C. Minbiole, Deptment of Chemistry and Biochemistry, James Madison University, Harrisonburg VA 22807. The prevalence of heterocycles as the backbone of common pharmaceutical entities has created a demand for simple reactions to prepare them. Our research aimed to create six-and seven-membered heterocycles containing both a carbonyl group and either sulfur or nitrogen in the ring. This is modeled after a cyclopropanol fragmentation approach to the formation of oxepanes developed previously in our group. Our current endeavor is to synthesize nitrogenous heterocycles, specifically piperidines and azepines, as well as sulfur-containing thiepanes. The nitrogenous approach begins with suitably protected α-or β-amino acid ethyl esters which were transformed by cyclopropanols via the Kulinkovich reaction. The resulting α-or β-amino cyclopropanols were then reacted with various aldehydes to form an aminal. Subsequently, various Lewis acids were investigated to promote the rearrangement of the aminal into the piperidine or azepine. Analogously, a seven-membered sulfur-containing heterocycle was formed, albeit in low yields.