data collected confirmed the RNA-Seq results. ChIP-Seq methods are being optimized to identify the direct targets of OpaR. Select targets were confirmed direct targets via *in vitro* electrophoretic mobility shift assays (EMSA) with purified hexahistidine tagged OpaR. A previously published position specific weighted matrix (PSWM) will be utilized to assist in identification of possible OpaR binding sites.

DIVERGENCE OF X CHROMOSOME HETEROCHROMATIN AMONGST SPECIES OF THE ANOPHELES GAMBIAE COMPLEX. Atashi Sharma, Maria Sharakhova & Igor V. Sharakhov, Department of Entomology, Virginia Polytechnic Institute and State University, Blacksburg, VA - 24061. Malaria is a scourge infecting 215 million people annually. The vector mosquito *Anopheles gambiae* along with its six sibling species forms the *gambiae* complex. Major vector *Anopheles gambiae* sensu stricto (s.s.) is currently undergoing incipient speciation into two molecular forms, designated M and S. Differences between these forms were determined on the basis of heterochromatin (repetitive DNA) present in X chromosomes using light microscopy and Fluorescence *in situ* hybridisation (FISH). In addition, 18S rDNA (responsible for protein synthesis) probe and species specific satellite DNA (important part of heterochromatin) was labelled and mapped to *An. gambiae*. We found significant differences in both the patterns and intensity of heterochromatin between the M and S forms. The 18S rDNA probe mapped adjacent to the heterochromatin in all the laboratory strains tested. Overall, our study indicates differences in heterochromatin between and within the species of *gambiae* complex and suggests a possible role of heterochromatin in speciation and protein synthesis.

Biomedical and General Engineering

ELECTROSPINNING AND CHARACTERIZATION OF LINEAR-DENDRITIC COPOLYMERS AS A NEW TISSUE ENGINEERING SCAFFOLD. Donald Jr C Aduba[1], Jefferson W. Overlin[1], Gary L. Bowlin[1] & Hu Yang[1,2], [1]Department of Biomedical Engineering, Virginia Commonwealth University, Richmond, VA 23284 & [2]Massey Cancer Center, Virginia Commonwealth University, Richmond, VA 23298. Polyamidoamine dendrimers (PAMAM) are an important class of macromolecules, which are known for their highly branched nanoscale structures and high density of surface groups. Numerous studies have been conducted to develop PAMAM dendrimer-based nanocarriers to deliver a broad spectrum of functional moieties such as drugs, imaging agents, and ligands. The purpose of this work is to explore a new way of using PAMAM dendrimers for wound healing and drug delivery applications. Particularly, we have developed novel electrospun nanofiber scaffolds made of linear-dendritic copolymer comprised of methoxy-polyethylene glycol (mPEG) as modifier to couple (PEGylate) dendrimer in modulating their biological and surface properties while facilitating electrospun nanofiber formation. In our study, we adjusted the degree of PEGylation of the dendrimer surface groups (100%, 50%, and 12.5%) by attaching PEG at 32:1, 16:1 and 4:1 ideal molar ratios respectively. Crosslinking reagents Eosin Y and 2,2-Dimethoxy-2-phenyl-acetophenone (DMPA) were used to help stabilize the electrospun scaffold. For each treatment, the scaffold's physical properties were evaluated. Ongoing studies include cell viability assays evaluating cell-scaffold

interactions and their response. This research was supported, in part, by NIH R21NS063200 and NSF CAREER Award CBET0954957. D.A. is a recipient of SREB-State Doctoral Fellowship.

SYNTHESIS AND CHARACTERIZATION OF ANTIEPILEPTIC NANOMEDICINE FOR TRANSBUCCAL DELIVERY. Donald Jr C Aduba[1], Olga Y. Zolotarskaya[1], Gary L. Bowlin[1] & Hu Yang[1,2], [1]Department of Biomedical Engineering, Virginia Commonwealth University, Richmond, VA 23284, & [2]Massey Cancer Center, Virginia Commonwealth University, Richmond, VA 23298. Epilepsy therapeutic treatment is aided with a variety of formulations such as sustained release tablets, sprinkle tablets, delayed release capsules and syrup solutions, which primarily rely on oral administration. Using nanoparticles to deliver central nervous system (CNS) drugs can help enhance brain uptake. However, intravenous injection is often applied for nanoparticle-based therapeutics and likely cause poor patient compliance among patients suffering from such chronic disease as epilepsy. The purpose of this work is to develop antiepileptic nanomedicine and nanofiber formulation and to explore the buccal mucosa as a non-invasive adsorption site for delivery of nanomedicine. Antiepileptic drug valproic acid (VPA) was used as a model drug with highly branched nanoscale polyamidoamine (PAMAM) dendrimer as the underlying carrier to construct nanomedicine. The synthesized VPA nanomedicine, confirmed by ^{1}H NMR was then loaded to electrospun nanofiber scaffold to make a mucoadhesive formulation designed for transport across the buccal mucosa. This research was supported, in part, by NIH R21NS063200 and NSF CAREER Award CBET0954957. D.A. is a recipient of SREB-State Doctoral Fellowship.

A CELLULARIZED ELECTROSPUN FIBER/HYDROGEL COMPOSITE MESH FOR LIGAMENT TISSUE ENGINEERING. P. S. Thayer[1], A. Dimling[2], M. R. Hahn[3], S. A. Guelcher[4] & A. S. Goldstein[1,2], [1]School of Biomedical Engineering & Sciences, Virginia Tech, Blacksburg VA, [2]Dept. of Chemical Engineering, Virginia Tech, Blacksburg VA, [3]Dept. of Biomedical Engineering, RPI, Troy NY, & [4]Dept. of Chemical & Biomolecular Engineering, VU, Nashville TN. Electrospinning is applied extensively for fabrication of fibrous meshes for research in the development of engineered tissues. While promising due to their fibrous architectures, electrospun meshes suffer from limited overall thickness and cellular infiltration, which prevent applications beyond thin tissues. Herein, we describe a two-step process to overcome these limitations. First, a dual electrospinning/electrospraying apparatus is used to incorporate cells into thin (~ 150 μm) meshes which are rolled. Second, the pores of the rolled meshes are filled with a cross-linked polyethylene glycol (PEG) hydrogel to create large cylinder-shaped composite meshes. In this study, the mechanical properties of these composite meshes – fabricated from both electrospun poly(lactic-co-glycolic acid) (PLGA) and poly(ester-urethane urea) (PEUUR) – are compared. Mechanical testing indicated that incorporation of the hydrogel does not change the overall mechanical properties. The PEUUR-based composite meshes have favorable mechanical properties for ligament applications due to their elasticity. Electrosprayed cells were visualized through histological cross-sections after 5 days of static culture, revealing nuclei distribution through the cross-section. Composite meshes were

cultured for 7 days under perfusion, cell number was maintained compared to immediately post-fabrication values and greater compared to static.

LOCATION AND DIRECTION DEPENDENT TENSILE PROPERTIES OF SWINE UTEROSACRAL AND CARDINAL LIGAMENTS. Ting Tan, Frances M. Davis, Suzanne Nicewonder & Raffaella De Vita, Department of Engineering Science and Mechanics, Virginia Tech, Blacksburg VA 24061. Uterosacral and cardinal ligaments help suspending the vagina and uterus on pelvic floor. Laxity of these ligaments can lead to women suffering pelvic organ prolapse (POP). Epidemiological studies suggest that the structural and mechanical changes occurring in these ligaments are critical to understanding the progression of POP. Specimens harvested from the uterosacral-cardinal ligament complex have been examined through scanning electron microscopy (SEM) and histology and tested for location and direction-dependent tensile mechanical properties. Collagen fibers were found to be arranged mainly in the longitudinal direction (normal to the long axis of vaginal wall) than the transversal direction (parallel to the long axis of vaginal wall). Sections of the ligaments stained with hematoxylin and eosin were also examined under microscope revealing smooth muscle orientation. The tensile testing results for uterosacral ligament, right cardinal ligament and left cardinal ligament specimens demonstrated that the mechanical response strongly depends on location. The tangent modulus of the linear region of the stress-strain curve varies significantly through the uterosacral-cardinal ligament complex, gradually increasing when specimens from cardinal ligaments transition into uterosacral ligaments. Moreover, the tensile testing findings on cardinal ligaments oriented in longitudinal and transversal directions indicated that these ligaments are anisotropic. Funding was provided by NSF CAREER Grant No. 1150397.

THE ROLE OF FIBRONECTIN SIGNALING IN EPITHELIAL TO MESENCHYMAL TRANSITION. Lauren A. Griggs, Dalton M. Berrie, Kirubel Feleke & Christopher A. Lemmon, Department of Biomedical Engineering, Virginia Commonwealth University, Richmond VA 23284-3067. This work is part of an ongoing study that investigates the relationship between assembly of the extracellular matrix protein fibronectin and the occurrence of epithelial to mesenchymal transition (EMT). Previous studies have shown that a combination of growth factors, specifically Transforming Growth Factor-beta (TGF-β), and substrate stiffness drive epithelial cells to undergo EMT. Fibronectin's ability to serve as a growth factor delivery system along with its tendency to be assembled by cell-generated forces, which become larger on stiffer surfaces, led us to examine the hypothesis that substrate stiffness drives fibronectin assembly, which creates a high concentration of binding sites at the cell surface for various growth factors such as TGF-β that in turn regulate EMT. Here we show that when MCF10A mammary epithelial cells were grown in the presence of TGF-β, there was a reorganization of the mesenchymal marker actin into stress fibers, a decrease in the epithelial marker E-cadherin at the cell-cell junctions, and an increase in fibronectin assembly. To further define the roll of fibronectin assembly in EMT, we demonstrated that in the presence of TGF-β, EMT marker expression was significantly decreased when fibronectin assembly was inhibited by addition of the functional upstream domain (FUD) fibronectin-binding motif of the bacterial cell wall protein adhesin F1. (Supported by: an American Cancer Society Institutional Research Grant

via VCU/Massey Cancer Center and funds from the VCU Presidential Research Incentive Program).

EYE RESPONSE TO OVERPRESSURE FROM FIREWORKS. Vanessa D. Alphonse, Andrew R. Kemper, Brock T. Strom III, Stephanie M. Beeman & Stefan M. Duma, Virginia Tech-Wake Forest Univ. Center for Injury Biomechanics, Virginia Polytechnic Institute and State University, Blacksburg, VA, 24061. Injuries from fireworks are prevalent among youth. The eye is the most frequently injured body part and accounts for more than 2000 fireworks-related injuries annually. Although it is suggested overpressure can cause serious eye injuries, there is no empirical evidence to support this. The purpose of this research is to assess whether overpressure from fireworks can cause eye injury. This study evaluates the response of six human cadaver eyes to charges at distances of 22 cm, 12 cm, and 7 cm from the cornea. A pressure sensor inserted into the eye measured intraocular pressure. An array of pressure sensors around the eye was used to calculate rise time, positive duration, positive impulse, and wave velocity. High speed video was recorded for each event. No major eye injuries were observed; however, minor corneal abrasions were caused by projected material (confirmed with high speed video). Intraocular pressure was used to calculate injury risk, which was less than or equal to 0.01% for hyphema, lens damage, retinal damage, and globe rupture. The low calculated injury risk supports the lack of observed injuries. The combined presence of injuries caused by projected material and lack of injuries directly caused by overpressure indicated that overpressure from fireworks does not cause major eye injury at these energy levels.

MATERIAL DESIGN IN INSECT RESPIRATORY TISSUE. Matthew R. Webster & Raffaella De Vita, Dept. of Engineering Science and Mechanics, Va. Polytechnic Inst. & State Univ., Blacksburg VA 24061. The respiratory system of insects is a natural microfluidic system. It is composed of a network of air filled tracheal tubes, many of which undergo periodic collapse and re-inflation during convective transport. The material design at multiple scales dictates the local behavior of the structures and their role in the transport of fluid. From a combination of mechanical testing and scanning electron microscopy (SEM) some aspects of the material design have been revealed. The results show that the trachea is orthotropic with very stiff thickenings known as taenidia lining the inner walls in the circumferential direction and providing compressive strength. Axially, a chitin fiber layer connects the taenidia and limits the axial extensibility. SEM micrographs revealed structural irregularities such as bifurcation in the taenidia in some locations. These irregularities were found to be more prevalent in the bending locations of the primary thoracic trachea indicating a possible role in the localized collapse of the tissue associated with convective respiration. Further tests will examine if differences in the taenidia organization correlate with differences in function of the trachea throughout the body. This study was supported the NSF-EFRI program grant No. 938047.

PIV INVESTIGATION OF ASCENDING AORTIC ARCH WITH A TILTING DISC VALVE. S. J. Warren, C. E. Taylor and G. E. Miller, Dept. of Biomedical Engineering, Virginia Commonwealth University, Richmond, VA 23285. For this project the object is to look into the effects of shear dependent viscosity on the flow

fields with the physiological. To isolate the parameters of the experiments the flow that is set to be investigated is the flow of blood out of the aortic valve into the aortic root. This is an area of flow with non-uniform shear rates which should have a pronounced effect on the velocity profile of a Newtonian versus non Newtonian fluid. This experiment has been completed before in literature to allow for comparison to data of previous works. The focus here is the comparison of shear dependent fluids and the fact that the fluid is tunable and controlled based on its computational model and the flow apparatus, the aorta, is made from open source patient-specific data that can be used to recreate that specific aorta. The valve for these experiments will be a tilting disc valve, which allows for known flow characteristics. The goal will be to conduct a statistical comparison that will give a non-dimensional score of the flow field to allow for a quantitative analysis of the device in the flow field.

Botany

QUANTITATIVE ANALYIS OF ANTIOXIDANTS IN SPECIALTY WINES. Alexandra C. Heil, Hannah E. Wines, & Michael H. Renfroe, Dept. of Biol., James Madison University, Harrisonburg VA 22801. Wines are sources of antioxidants such as procyanidins and resveratrol along with polyphenolics that provide important health benefits and help protect against hypertension, arteriosclerosis, cancer, and other diseases. Most commercial wines are made from the domesticated European grape (*Vitis vinifera*). However, there are specialty wines that are made from native American grapes (*Vitis labrusca*), and wines that are fruit based or blended with fruit extracts. Our research compared the antioxidant levels found in muscadine and scuppernong wines to those found in fruit-based or fruit-flavored wines. Antioxidants were measured using the trolox equivalent antioxidant capacity assay (TEAC) and results were reported in µmol trolox equivalents (TE) per mL. Muscadine and scuppernong wines from a single vineyard were compared and antioxidant concentrations ranged from 2.2-5.5 µmol TE/mL wine. Four fruit wines were compared from a single vineyard and the raspberry and peach were low in antioxidants (2.0 and 1.7 µmol TE/mL, respectively), whereas the blackberry and chocolate-flavored wines were very high in antioxidants (10.7and 12.6 µmol TE/mL, respectively). Other fruit wines were tested and fell either within this range or slightly below it. These results indicate that wines can vary significantly in their antioxidant content, and that scuppernong and muscadine wines were comparable to some reported values of European grape-based wines.

QUANTITATIVE ANALYSIS OF ANTIOXIDANT ACTIVITIES IN TOMATOES AND PROCESSED TOMATO PRODUCTS. Anna T. Dinh & Michael H. Renfroe, Dept. of Biol., James Madison University, Harrisonburg VA 22801. The amount of antioxidants present in food varies depending on environmental conditions in which produce was grown and how products were processed prior to consumption. This study focused on quantitative analysis of antioxidant activities in commercially produced whole tomatoes and processed tomato products (paste, sauce, juice, diced, and soup) and fresh tomatoes grown experimentally in different light intensities. Variations and significant differences were observed between different types of whole tomatoes,