NKG2D RECEPTOR ACTIVATION OF NF-KB ENHANCES INFLAMMATORY CYTOKINE PRODUCTION IN MURINE EFFECTOR CD8+ T CELLS. Emily Whitman & Amorette Barber, Dept. of Biol. and Env. Sci., Longwood Univ., Farmville VA 23901. To induce strong immune responses, naïve $CD8^+$ T cells require stimulation through the TCR and costimulatory receptors. However, the effect of activating costimulatory receptors on activated T cells is unclear. The NKG2D costimulatory receptor is expressed on $CD8^+$ T cells with its ligands expressed on tumor cells and during some infections. In order to determine how activation of costimulatory receptors alters effector $CD8^+$ T cell functions, this study compared the activation of the NF-κB signaling pathway by two costimulatory receptors, CD28 and NKG2D. Activation of murine effector $CD8^+$ T cells through CD3 and NKG2D receptors enhanced activation of NF-κB as shown by increased phosphorylation of IKKα, IκBα, and NF-κB and IκBα degradation. Activation of the NF-κB pathway lead to increased secretion of pro-inflammatory cytokines, including IFN-alpha and IFN-gamma, and decreased secretion of anti-inflammatory cytokines, including IL-10 and CCL2. NF-κB activation also increased the effector molecules TNF-alpha, lymphotoxin alpha and beta, and Fas ligand. These data show that stimulation through NKG2D leads to the differential activation of signaling pathways and potentially enhances the anti-tumor and anti-viral functions of effector $CD8^+$ T cells. (Supported by: Longwood University's PRISM program, Faculty Research Grants, and BES department).

Biomedical and General Engineering

STORMWATER RUNOFF FILTRATION MEDIA FOR TRACE METAL CAPTURING. Gail M Moruza, Zach Goehring & Brittany Toney, James Madison Univ., Harrisonburg VA, 22801. Nationwide, stormwater runoff has been identified as the leading cause of water-quality impairment due to the trace metals found within that accumulate over time and create potentially toxic chemical imbalances in ecosystems. Effective stormwater runoff filtration is a key part in preventing dangerous contaminants from being released into the environment and causing harm to the health of aquatic and terrestrial organisms and eventually humans. In particular, the accumulation of trace metals in ecosystems and eventually human drinking water has been known to cause cancer, high blood pressure, liver disease, kidney disease, growth reduction, growth abnormalities, and chronic anemia in the organisms which ingest the metals. The hazardous amassing of trace metals can be alleviated through the study of the most effective filtration media such as zeolite, perlite, and peat. Essential factors affecting filtration efficacy, which are covered in this study, include mass of media and media type used, which in turn determines the mechanisms by which contaminants are captured from solution. From the initial data of this research, it was determined using a one-way ANOVA procedure that no significant difference in filtration capabilities existed between the media types examined. The ANOVA procedure did, however, determine that a greater media mass captured a significantly greater amount of trace metal from solution than did the smaller media mass.

EX VIVO DNA ASSEMBLY. Zachary B. Canfield, Adam B. Fisher & Stephen S. Fong, Department of Chemical and Life Science Engineering, Virginia Commonwealth

University, Richmond VA 23284-2006. Our ability to re-design existing natural biological systems for useful purposes is limited by our capability to design and build DNA sequences that encode specific functionality. However, it is still a challenge to engineer biology in a directed manner through logical genetic design. To circumvent this problem synthetic biologists build large libraries of genetic parts where – by rigorous characterization – sequence design principles and suitable biological solutions ascertained. Unfortunately, *de novo* DNA synthesis is still cost prohibitive, especially when testing combinatorial libraries, so it is more cost effective to purchase DNA as short "building blocks" and assemble them in-house. While powerful methods exist for DNA assembly, current approaches suffer from trade-offs of being either time-consuming or monetarily expensive. The *ex vivo* DNA assembly method is fast and efficient at assembling DNA while remaining relatively inexpensive in that they only require lysate harvested from a common laboratory strain of Escherichia coli. This makes the *ex vivo* cloning approach particularly attractive in experimental schemes where large libraries of constructs must be created and screened for desired functionalities.

FIBRONECTIN MECHANICS AND SIGNALING IN EPITHELIAL TO MESENCHYMAL TRANSITION. Lauren A. Griggs, Min Zhao, Roshni Malik, Dr. Lynne Elmore, & Dr. Christopher Lemmon, Dept. of Biomed. Engr., Virginia Commonwealth Univ., Richmond VA 23284-3067. This work is part of an ongoing study that investigates the role of the microenvironment in the induction of Epithelial to Mesenchymal Transition (EMT). Previous studies have shown that Transforming Growth Factor-beta-1 (TGFβ-1) drives epithelial cells to undergo EMT; however, the precise mechanism of TGFβ-1-induced EMT is not well understood. Our research examines the relationship between assembly of the extracellular matrix protein fibronectin (FN) into insoluble fibrils and the occurrence of EMT. Coupled with evidence that increased tissue stiffness is a modulator of disease severity, we have crafted the following over-arching hypothesis: *increased tissue stiffness drives FN assembly, which exposes cryptic binding sites for various growth factors, such as TGFβ-1, and creates a high concentration of these growth factors at the cell surface, which in turn drives EMT*. The current work examined the role of FN assembly in non-transformed, healthy MCF10A mammary epithelial cells. Results showed that non-treated epithelial cells assembled very little FN and maintained high levels of epithelial markers, while TGFβ-1-treated cells had a marked increase in FN assembly, as well as increased mesenchymal markers and decreased epithelial markers. Inhibition of FN fibril assembly was shown to inhibit EMT progression. By establishing an innovative mechanism by which growth factor signaling induces EMT through interaction with the ECM, this research will serve to combat the development and initiation of metastasis, and potentially identify novel targets within the tumor microenvironment for cancer therapy.

BUILDING 3D TISSUE UTILIZING MECHANICALLY STIMULATED SPATIAL ORGANIZATION AND DIFFERENTIATION OF HUMAN MESENCHYMAL STEM CELLS. Jiten D. Narang & Christopher A. Lemmon, Dept. of Biomedical Engineering, Virginia Commonwealth University, Richmond VA 23284. Our research utilizes an array of deformable microfabricated pillars to provide mechanical stimuli

to control alignment and spatial organization of cells while also influencing differentiation. Manipulating cross sectional area and geometry as well as the height of the pillars provides precise control of the spatially-localized substrate stiffness. Varying stiffness in different regions allows us to direct differentiation into multiple lineages within one cell monolayer. A novel stacking method is used to stack these sheets, developing a 3D tissue with controlled architecture. Human mesenchymal stem cells are plated on top of the pillars with the cleavable fibronectin facilitating the attachments between cell and substrate. Providing cells with mechanical cues from the oval pillars influences cellular and ECM spatial organization. Once confluent and organized, cell layers are treated with a blend of osteogenic and adipogenic induction medias that complement the respective mechanical cues to induce differentiation. This organized and differentiated cell layer can then be inverted, brought into contact with the assembling 3D microtissue, and disassociated from the pillars. Cells adhere to the growing microtissue and are left behind once the inverted pillar substrate is removed. Multiple repetitions of this method yield a structurally organized, cell type specific 3D tissue. Results show that providing a stiffness gradient allows for accurate spatial alignment and organization of cells on microfabricated pillar arrays.

EQUILIBRIA AND NO-REGRET STRATEGIES IN CANCER TREATMENT. Natasha D. Sheybani[1], Ishaan A. Nerurkar[2], & Hu Yang[1], [1]Department of Biomedical Engineering, Virginia Commonwealth University, Richmond VA 23298 and [2]School of Engineering and Applied Sciences, University of Pennsylvania, Philadelphia PA 19104. In Orlando *et al.* 2012, *Cancer Treatment as A Game: Integrating Evolutionary Game Theory Into the Optimal Control of Chemotherapy*, the authors propose a model in which the tumor's strategy is determined by natural selection and the oncologist's strategy is determined by the solution to a control problem. In this paper, we adopt the evolutionary growth model from Orlando *et al.*, and define payoff functions for the oncologist and the tumor cell to model the interaction as a zero sum game. John von Neuman's minmax theorem proves that for every finite two player zero sum game, the security strategies of the players are equilibrium strategies. We apply this to define the equilibrium strategies of the game, which by evolutionary logistic growth equations and the payoff functions of the game formulated in this paper, predict the population size of the tumor. We then extend this model to a dynamic setting, in which the oncologist administers a drug over a defined treatment period. We propose a weighted majority algorithm which recommends drug delivery rates at every administration for the oncologist. The algorithm has a no regret property, which ensures that by the end of the treatment period, the average loss from the rates chosen by the oncologist is asymptotically no worse than if the oncologist had known the best fixed delivery rates in hindsight. This study holds vast applications to the optimized engineering and administration of drug cocktails for chemotherapeutic applications.

EYE TRACKING: A NOVEL TOOL FOR OBJECTIVE ASSESSMENT OF mTBI. Jefferson W. Overlin, Cassie P. Turnage, Ankita Dosaj, Kristina M. Kelly, & Paul A. Wetzel, Ph.D., Department of Biomedical Engineering, Virginia Commonwealth University, Richmond, VA 23284. Mild traumatic brain injury (mTBI) is common among active duty military personnel, civilians in the workplace, and athletes competing in contact sports. The effects of mTBI on mental capability and stamina

have been widely documented. However, objective assessment of mTBI can be challenging. The measurement of eye movements using current eye tracking technologies represents a novel, efficient, and objective means of detection of mTBI. Visual stimuli to evaluate functional eye movement capability were developed for active duty military personnel diagnosed with mTBI and a control group. Eye movement data were collected with two-dimensional eye tracking systems at 500 Hz (Eye Link II, SR Research) and 1000 Hz (Eye Link 1000, SR Research) in two separate ongoing studies. Data were analyzed for response latency, number of saccades, eye movement amplitude, duration, velocity, acceleration, accuracy, and stability. To date, we have found significant differences for several eye movement tasks and parameters during reading, saccadic tracking, and smooth pursuit tracking, suggesting that the areas of the brain associated with these eye movements are sensitive to mTBI.

CONTROLLED RELEASE OF RAT-ADIPOSE DERIVED STEM CELLS FROM ALGINATE MICROBEADS. S. K. Leslie [1] D. J. Cohen[2], B. D. Boyan[2], Z. Schwartz [2] [1.]Dept. of Chemical and Life Science Engineering and [2.]Dept. of Biomedical Engineering, VA Commonwealth University. One notable disadvantage of cell based therapies is that the injected cells tend to disperse away from the intended site. The aim of this project is to develop a system of injectable hydrogels to deliver stem cells for the purpose of tissue regeneration, thereby allowing the cells to remain at the area of injury, to proliferate and secrete soluble factors that will facilitate tissue regeneration. The hydrogel employed is alginate; however; it does not readily degrade *in vivo* for six months. We demonstrated the controlled release of viable cells from degradable alginate microbeads via alginate-lyase mediated degradation *in vitro*. Degradable alginate microbeads were made by combining equal volumes of LVM alginate and alginate-lyase solution to form alginate microbeads of various ratios of alginate-lyase to alginate (1.75 U/g to 0.06 U/g). The results showed that cells released from the degradable microbeads maintained their osteogenic phenotype. In addition we showed that microbeads were able to degrade *in vivo* and their by-products did not illicit an inflammatory response. Lastly, we demonstrated the ability of the degradable alginate microbeads to localize cells at the delivery site *in vivo*. These results indicate that the system of degradable hydrogels can localize and release viable cells at the site of interest.

EVALUATION OF A NOVEL BLOOD ANALOG FOR MOCK CIRCULATION TESTING. Stephen J. Warren, Gerald E. Miller., Biomedical Engineering Department, Virginia Commonwealth University, Richmond VA 23284. For this experiment the object is to look into the effects of shear dependent viscosity on the flow fields with a physiological model. 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 which non uniform shear rates which should have a pronounced effect on the velocity profile of a Newtonian versus non Newtonian fluid. 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.

PREDICTING CARPAL KINEMATICS IN THE WRIST DURING SCAPHOLUNATE LIGAMENT DISSOCIATION. Edward J. Tremols & Dr. Jennifer S. Wayne, Orthopedic Research Lab, Depts. of Biomedical Engineering & Orthopedic Surgery, Virginia Commonwealth Univ., Richmond VA, 23284. The wrist is a complex structure consisting of articulations between multiple bones. The carpal bones are found between the radioulnar articulation and the metacarpals and provide stability to the wrist. Injuries are common with varying success of surgical reparative procedures. This study proposes a computational model to predict scapholunate carpal kinematics throughout wrist motion where biomechanical function is determined by accurate 3D articular anatomy, ligament tensions, muscle forces, and external loading. A rigid body model was created using a high resolution CT scan of a male left arm. The set of CT images was brought into MIMICS, and accurate 3D bony anatomy created. These solid bodies were assembled in SolidWorks/Motion and force elements were applied to replicate the physiologic loadings experienced through tendons and ligaments. Validation was accomplished via comparison to a previous cadaver study which sought to understand scapholunate kinematics with the scapholunate intact and excised. Agreement between model and experiment was very good to excellent. The model also has the capability of predicting other important biomechanical parameters that are not typically feasible experimentally such as joint contact forces and ligament tensions. These will be explored for surgical procedures to restore scapholunate function.

LASER SINTERED TITANIUM SURFACES MIMIC TRABECULAR BONE STRUCTURE AND INDUCE OSTEOBLAST DIFFERENTIATION IN A POROSITY-DEPENDENT MANNER. A. Cheng[1], D. J. Cohen[2], S. L. Hyzy[2], A. Humayun[2], B. D. Boyan[3] & Z. Schwartz[3]. [1]Dept. of Biomedical Engineering, GA Institute of Technology, Emory University & Peking University, [2]Dept. of Biomedical Engineering, VA Commonwealth University, and [3]School of Engineering, VA Commonwealth University. An increasing number of orthopaedic and dental implants are being implanted and must successfully serve a longer lifespan. Selective laser sintering (SLS) is a form of additive manufacturing that can produce customized, porous titanium alloy implants with high resolution. We created 3D titanium surfaces with low, medium and high porosity based on a human trabecular bone template, which were further blasted and pickled to induce combined micro-/nano-roughness. We characterized the porosity (41-76%), surface chemistry (Ti, O and C being the three most prominent elements), wettability (62 ± 18 degrees), roughness and topography (showing combined micro-/nano-roughness). We then analyzed MG63 osteoblast response to surfaces. Cell viability on surfaces with varying porosity was not significantly different. DNA (proliferation) and alkaline phosphatase specific activity (early osteoblast differentiation) decreased with increasing porosity, and osteocalcin (late osteoblast differentiation), osteoprotegerin (bone remodeling), VEGF (blood vessel formation), and BMP2, 4 (factors for creating an osteogenic environment) increased with increasing porosity. The most favorable cell response was shown on high porosity surfaces. The results of the present study indicate that surface modification and three dimensional structure can enhance bone apposition and osseointegration.

A LOW COST HAPTIC DISPLAY FOR VIRTUAL SIMULATIONS IN A 3D ENVIRONMENT INTENDED FOR USERS WHO ARE BLIND OR VISUALLY IMPAIRED. R. Petrella[1], D. Pawluk[1] & N. Guidice[2], [1] Department of Biomedical Engineering, Virginia Commonwealth University, Richmond VA 23284 and [2]Department of Spatial Information Science and Engineering, University of Maine, Orono Maine 04469. Individuals who are blind or visually impaired lack access to rich and immersive graphical and pictorial diagrams. Presented is a tactile display that allows the user to explore and interact with 3D, virtual diagrams. The device combines four elements: a computer/laptop, LeapMotion (motion tracking), LabView Program, and piezoelectric elements (viobrotactile feedback). By outputting vibratory frequency to the user, information about the size, direction, distance, and location of the virtual object can be communicated. Additionally, changing the parameters of texture, feedback pattern, location of feedback (finger, hand, or tool), or number of points of contact can enrich the user experience. Preliminary testing shows the ability of the device to act as a basic user interface in a 3D space in real time. The authors are interested in continuing this research with a human trial. This study was generously funded by NSF Award #1218310.

TITANIUM SURFACE PROPERTIES ALTER MACROPHAGE ACTIVATION. Kelly Hotchkiss, Sharon Hyzy, Zvi Schwartz, Barbara Boyan & Rene Olivares-Navarrete, [1]School of Engineering, Virginia Commonwealth University. Biomaterial surface properties including chemistry, topography, and energy regulate cell response. Rough titanium (Ti) surfaces with high surface energy modulate inflammatory cytokine release from stem cells and osteoblasts, but the effect of these modifications on immune cells, including macrophages, is less understood. Macrophages are among the first cells to interact with the biomaterial. Macrophages can activate as pro-inflammatory (M1) or anti-inflammatory (M2), which controls the inflammatory microenvironment and host response to a material. Our aim was to examine the effect of surface microstructure and energy on macrophage activation and cytokine production *in vitro* using primary C57Bl/6 mouse macrophages. Cells were cultured on smooth Ti, rough hydrophobic and hydrophilic Ti surfaces with tissue culture polystyrene (TCPS) control. Pro-inflammatory IL-1β, IL-6, and TNFα were lower on rough hydrophilic Ti surfaces in comparison to TCPS and hydrophobic Ti surfaces. Rough hydrophilic surfaces induced an M2 phenotype characterized by IL-4, IL-10, and IL-13 secretion. Release of pro-inflammatory and anti-inflammatory cytokines was similar between smooth and rough hydrophobic surfaces. Here we demonstrate that macrophage polarization can be controlled through surface modifications, specifically roughness and energy, to promote anti-inflammatory M2 polarization.

DEPENDENCE OF SURFACE NANOSTRUCTURES ON HYDROPHILICITY FOR ENHANCED OSTEOBLASTIC DIFFERENTIATION AND MATURATION ON TITANIUM IMPLANTS. Ethan M. Lotza[1], Rene Olivares-Navarretea[1], Sharon Hyzya[1], Zvi Schwartza,[2] & Barbara D. Boyana,[3] [1]Department of Biomedical Engineering, Virginia Commonwealth University, Richmond VA, [2]Department of Periodontics, University of Texas Health Science Center at San Antonio, San Antonio, TX, [3]Department of Biomedical Engineering, Georgia Institute of Technology, Atlanta, GA. Control of the microenvironment surrounding an implant to facilitate repair and

function of bone tissue can be achieved by modifying the implant surface. Studies have highlighted the importance of nanostructured and hydrophilic implant surfaces to enhance bone repair. Although it has been shown that surface roughness has an effect on hydrophilicity, no attempt has been made to distinguish between their effects on the process of healing and osseointegration. To test this, mesenchymal stem cells (MSCs) and normal human osteoblasts (OBs) were cultured separately on either tissue culture polystyrene (TCPS), non-nanostructured/hydrophobic SLA (grit-blasted/acid-etched treatment), nanostructured/hydrophilic modSLA (SLA with 0.9% saline storage), or nanostructured/hydrophobic SLAnano (aged modSLA, removed from saline, and stored dry). Compared to TCPS, osteoblastic differentiation and maturation were enhanced in both MSCs and OBs while inflammatory markers decreased. Among surfaces, modSLA had the highest levels of osteoblastic markers while few differences were detected between SLA and SLAnano. These findings suggest that the enhancement of osseointegration by nanostructures is dependent on the surface hydrophilicity of the titanium implant.

Posters

EFFECTS OF GLUCOSE CONCENTRATION ON FIBRILLOGENESIS IN BREAST EPITHELIAL CELLS. B. A. Martinez[1], L. Griggs[1], M. Zhao[2], L. Elmore[2], & C. A. Lemmon[1], [1]Department of Biomedical Engineering, School of Engineering and [2]Department of Pathology, Virginia Commonwealth University. Fibronectin (FN) is a soluble glycoprotein that makes up a major component of the extracellular matrix in tissues. Studies have shown its importance in wound healing and embryonic development. FN expression is low in most adult healthy tissues; however, in many cancers FN expression is dramatically increased. Studies from rat mesangial kidney cells have shown a linkage between high glucose concentration and increased FN expression. A common hallmark of many cancers is increased glucose transport into the cell as well as increased glucose metabolism within the cell. We thus hypothesize that increased glucose metabolism may be a driving factor in increased FN assembly in tumors. To investigate this, healthy mammary epithelial cells, premalignant epithelial cells, and malignant epithelial cells were cultured using various glucose concentrations. Previous studies have shown that assembly of FN drives a process known as Epithelial to Mesenchymal Transition (EMT), which has been implicated in cancer. Results show that glucose appears to have a biphasic effect on healthy epithelial cells: at low concentrations, epithelial cell-cell junctions start to break down, but cells don't appear mesenchymal. At higher concentrations, cells start to appear more mesenchymal. In contrast, pre-malignant cells show an opposite relationship: low glucose induced a more mesenchymal phenotype. These results suggest a complex relationship between cell malignancy, extracellular glucose, FN assembly, and EMT. This research was funded by the IMSD program at VCU CoHD.

CHANGING DIFFERENTIATION PATHWAYS OF HUMAN MESENCHYMAL STEM CELLS BY ALTERING FIBRONECTIN ASSEMBLY. T. J. Petet, J. Narang & C. A. Lemmon, Dept of BME, VCU. Stem cells differentiate when exposed to relevant growth factors and chemical signals, and also differentiate in response to the stiffness of their substrate. However, the link between mechanical and chemical signals

is not well understood. The aim of this study is to investigate whether assembly of the extracellular matrix protein fibronectin (FN) serves as an integration point for mechanical and chemical signals, and that differentiation depends on the assembly of FN. It is hypothesized that by blocking FN assembly, substrate stiffness can be high yet the stem cells will undergo differentiation as though they were on a soft surface. In order to test this, we cultured human mesenchymal stem cells on stiff (glass) FN-coated substrates in the presence of a 1:1 mix of adipogenic and osteogenic differentiation factors. FN was inhibited with a fragment of the bacterial protein F1 adhesin (FUD), which has previously been shown to inhibit assembly of FN into fibrils that are a key component of the extracellular matrix. Cells were cultured for 10 days to allow the cells to differentiate and then were fixed and stained for differentiation markers. Preliminary data supports the hypothesis: FUD blocked assembly of FN and drove differentiation towards an adipocyte lineage, while untreated samples showed an osteogenic lineage. Future experiments will use surfaces with varying stiffness to determine whether the hypothesis holds across the range of substrate mechanical properties.

COMMON CORE AHP APP. David S. Parker, Biomedical Engineering, Virginia Commonwealth University. In the School of Allied Health at VCU assessing the students as they progress through practical training is a very important tool. It identifies areas for the student where he or she needs to improve as well as areas in which that student is doing well. Currently both the students as well as the teacher are doing the evaluations on paper. The problem caused by this is that evaluations filled out can easily be lost, or not stored properly. As a result, the progress of a student over time cannot be tracked very well. To fix this issue an application is being created to conduct as well as store the evaluations by the student as well as the teacher. This app uses the set of questions that was created by Dr. Dianne Simmons to assess the student's progress. The results of these questions will then be stored in a web database using Wi-Fi, so that the student can easily compare current results with previous results. Also, the student will be provided an area to tell the teacher of areas they thought they did well in, and areas they need to improve in. Another thing that this application will allow is for the student and the teacher to share their evaluations with each other. This will be achieved by using Bluetooth to share the information. Because of this the student will be allowed to compare their own assessment to the teachers' assessment. This can open up a discussion between the student and the teacher on the things that they need to improve as well as things they need to keep doing well.

MODELING WATER FLOW THROUGH GRAVEL NESTS USING ELECTRICAL CIRCUIT ANALYSIS. N. W. Brigle[1] & E. G. Maurakis[2,3], [1]Dept. Biomedical Engineering, Virginia Commonwealth University, [2]Biology Dept., University of Richmond & [3]Science Museum of Virginia. Using electrical circuit analysis (ECA), resistance and water current velocity of anterior, middle, and posterior sections of nests of *Nocomis micropogon* and *Nocomis leptochephalus* were determined. Each section's resistance was plotted against its corresponding cross-sectional area. Analysis of these plots yielded two equations (Universal Water Equation (UWE) and Universal Nest Equation (UNE)) for water current velocity. For *N. micropogon* and N. *leptocephalus*, the UNE yielded the best results for determining water current velocity around anterior (0% and 0.02% error respectively) and middle (0% and 0% error respectively) sections

of nests, while UWE yielded best results for determining water velocity for posterior (0.02% and 0.54% respectively) section of nests. Compared to water current velocity calculated by ECA, UNE yielded best results for determining water current velocity through anterior (0.01% and 0.18% error, respectively) and middle (0.12% and 0.02% error, respectively) sections of nests, while UWE yielded best results for determining water velocity for posterior (0.04% and 0.02% respectively) sections of nests. UWE and UNE can be applied to nests of other species of *Nocomis* and those of *Semotilus* and *Exoglossum* after nest micro-water currents field evaluation.

ROBOTIC PLATFORM TO GUIDE AND ASSIST INFANTS, POSSESSING VISUAL IMPAIRMENTS, WITH CRAWLING AND EXPLORATION. Muhammed M. Naqvi, Sean W. Megahan, David S. Parker, Dr. Dianne T.V. Pawluk, Ross A. Petrella & Dr. Peter Pidcoe, Department of Biomedical Engineering, Virginia Commonwealth University, Richmond VA 23284-2006. Without visual stimulus, infants who are blind or visually impaired (BVI) lack an opportunity to develop their motor, cognitive, and social skills. To solve this problem a robotic platform was created teach and foster independent exploration in BVI infants using haptic feedback and variable motor assistance. The robot platform was controlled and tracked by a smart phone application. A microcontroller on the robot platform interpreted the application data and supplied the infant vibrotactile feedback which described the distance and orientation of the target. Training paradigms were created to teach the infant to use the vibrotactile feedback and then gradually transition the infant off motor assistance. Preliminary testing showed successful functionality of the initial prototype. The robot platform and Android application designed were capable of determining distance and orientation relative to one another as well as providing haptic feedback and motor assistance to the infant. With mild improvements to the chassis, user interface and motors, the prototype would be ready for clinical trials.

Botany

TREE SURVIVAL IN CREATED PIEDMONT WETLANDS AND THE EFFECT OF SOIL CONDITIONS. M. Seidel & R. B. Atkinson, Dept. of Organismal and Environmental Biol., Christopher Newport Univ., Newport News VA 23606. Forested wetlands are the most frequently lost wetland type in the Eastern United States, and tree establishment efforts in created wetlands may be inadequate where survival rates are low. The purpose of this study was to evaluate survival rates using environmental variables as predictors of survival for seven woody plant species and three stocktypes. Trees were planted in March of 2009 in three created wetlands in Loudoun County, VA and survival was assessed annually during early August from 2009 to 2013. Overall survival after five years was 44.4% and survival was lowest between the first and second growing seasons. Survival of *Quercus palustris* in 1-gallon pots stocktype was highest (76.3%) and *Q. phellos* in tubeling stocktype was numerically lowest overall (7.95%). Survival rate was negatively related to organic matter content in the soil; however, depth and/or duration of hydroperiod may have influenced organic matter content. Support from the Peterson Foundation is gratefully acknowledged.