Undergraduate Research Highlights

Armas JA, Reynolds KJ, Marsh ZM, Stefik M, Scott GE, Zhang S. Ring-Banded Spherulitic Crystals of Poly(3-butylthiophene) via Controlled Solvent Evaporation. *Macromolecular Chemistry and Physics*. 2018; 219, 1800204. doi: 10.1002/macp.201800204 (California Polytechnic State University)

The preparation of ring-banded spherulites in poly(3-butylthiophene) via controlled solvent evaporation of solution-cast films is reported. The spherulites display unusual concentric ring-banded structures under both polarized and unpolarized lights. The periodic bands of the spherulite consist of alternating ridge and valley surface patterns and the crystalline lamellae in the bands are more or less parallel to the radial growth direction of the spherulite. A possible diffusion-induced rhythmic growth mechanism is proposed to interpret the formation of periodic banding of the spherulite. Shanju Zhang is an associate professor of chemistry and Gregory Scott is an assistant professor of chemistry at Cal Poly. Morgan Stefik is assistant professor/polymer at the University of South Carolina. Jeremy Armas and Karina Reynolds were fourth-year students during their work on the project. Reynolds is currently pursuing PhD study at the University of Southern Mississippi. Zachary Marsh is a PhD student at the University of South Carolina.

Taft JD, Colonnetta MM, Schafter RE, Plick N, Powell WH. Dioxin Exposure Alters Molecular and Morphological Responses to Thyroid Hormone in *Xenopus laevis* Cultured Cells and Prometamorphic Tadpoles. *Toxicological Sciences*. 2018; 161:196–206. doi: 10.1093/toxsci/kfx213 (Kenyon College)

Amphibian metamorphosis is driven by thyroid hormone (TH). We used prometamorphic tadpoles and a cell line of the African clawed frog (*Xenopus laevis*) to examine immediate effects of dioxin exposure on TH. Gene expression patterns suggest cross-talk between the thyroid hormone receptor (TR) and aryl hydrocarbon receptor (AHR) signaling pathways. In XLK-WG cells, expression of *Cytochrome P450 1A6* (*cyp1A6*), an AHR target, was induced 1000-fold by 100 nM TCDD (2, 3, 7, 8 tetrachlorodibenzo-*p*-dioxin). *Krüppel-Like Factor 9* (*klf9*), the first gene induced in a cascade of TH responses tied to metamorphosis, was upregulated over 5-fold by 50 nM triiodothyronine (T3) and 2-fold by dioxin. Co-exposure to T3 and TCDD boosted both responses, further inducing *cyp1A6* by 75 percent and *klf9* about 60 percent. Additional canonical targets of each receptor, including trβa and trβb (TR) and *udpgt1a* (AHR), responded similarly. Induction of TH targets by TCDD in XLK-WG cells predicts that exposure could speed metamorphosis. We tested this hypothesis in two remodeling events: tail resorption and hind limb growth. Resorption of *ex vivo* cultured tails was accelerated by 10 nM T3, while a modest increase in resorption by 100 nM TCDD lacked statistical significance. Hind limbs doubled in length over four days following 1 nM T3 treatment, but limb length was unaffected by 100 nM TCDD. TCDD co-exposure reduced the T3 effect by nearly 40 percent, despite TCDD induction of *klf9* in whole tadpoles, alone or with T3. These results suggest that tissue-specific TCDD effects limit or reverse the increased metamorphosis rate predicted by *klf9* induction. Wade Powell is professor of biology at Kenyon College. The research reflects the honors thesis work of Justin Taft 2013, Maggie Colonnetta 2015 (co-first authors) and Rachel Schafer 2018, with contributions from Natalie Plick 2016. Taft is a PhD student at Mount Sinai, Colonnetta is a PhD student at Princeton University, Plick is a postbaccalaureate IRTA at National Institute of Aging, and Schafer is a technician at the James Comprehensive Cancer Center at The Ohio State University. The research was supported by NIH AREA Grant: R15 ES011130-05 and the Kenyon College Summer Science Program.

Koerner LJ, Johnson SM, Manke LS. Multiple Sampling Photodiode Readout That Overcomes ADC Resolution Limit. *2018 IEEE Photonics Conference* (IPC). 2018, doi: 10.1109/IPCon.2018.8527180 (University of St. Thomas)

We present a light detection system (for point-of-care diagnostics) consisting of a multiple-sampling readout that forgoes the resolution limit set by a low-cost microcontroller ADC. Experimental measurements demonstrate a >5 * 10^6 input range and a noise floor of <210 fA. Lucas Koerner is assistant professor of electrical and computer engineering at University of St. Thomas (UST). Savannah M. Johnson is a third-year UST mechanical engineering major, electrical engineering minor, and completed work on this project in the spring 2018 semester. As a third-year UST mechanical engineering major, business minor, Lucas S. Manke completed work on this project during the spring 2018 semester. He will graduate in 2019. This research was supported by a UROP summer grant.

Berger KE, McCormick GM, Jaye JA, Rozeske CM, Fort EH. Synthesis of Acridines through Alkyne Addition to Diarylamines. *Molecules*. 2018; 23, 2867. doi: 10.3390/molecules23112867 (University of St. Thomas)

A new synthesis of substituted acridines is achieved by palladium-catalyzed addition of terminal acetylenes

between the aryl rings of bis(2-bromophenyl)amine. By including a diamine base and elevating the temperature, the reaction pathway favors the formation of acridine over a double Sonogashira reaction to form bis(tolan)amine. This method is demonstrated with several aryl-alkynes and alkyl-alkynes. Eric Fort is associate professor of chemistry and director of the Aquinas Scholars Honors Program at University of St. Thomas. Kristen Berger worked on the project as an undergraduate from 2015 to 2018 and is a graduate student in chemistry at Purdue University. Grant McCormick worked on the project as an undergraduate from 2014 to 2016 and is a medical student at the University of Nebraska. Joseph Jaye worked on the project as an undergraduate from 2014 to 2016 and is a doctoral student in chemistry at UCLA. Christina Rozeske worked on the project as an undergraduate from 2012 to 2014 and is now employed. The research was funded by the Department of Chemistry, Undergraduate Research Program, and Faculty Development at the University of St. Thomas and the American Chemical Society's Petroleum Research Fund.

Murrell LB, Hume DW. A Comparison of Farmers' Perceived Impacts on the Environment in Belize and Kentucky. *Contemporary Journal of Anthropology and Sociology*. 2018; 8: 1: 19–33. (Northern Kentucky University)

This paper explores how farmers in Belize and Kentucky perceive their impacts on the environment. Ethnographic data were collected from rural farming villages in Orange Walk District (OWD), Belize, and from rural farming communities in northern Kentucky, United States. The findings of the interviews reveal how these two cultures perceive environmental problems, how environmental problems impact them, and how farmers influence the natural world. In addition to examining how rural Belizeans and Kentuckians understand their impacts on the environment (i.e., climate change, water pollution, biodiversity loss, deforestation, energy use and pollution, agricultural pesticide and herbicide use, genetic engineering, soil erosion, invasive species, and population growth), this paper also discusses how perceived environmental concerns and impacts are both similar and different between Belizean and Kentuckian farmers. Douglas Hume is chair and associate professor in the Department of Sociology, Anthropology, and Philosophy at Northern Kentucky University (NKU). Laura Bronte Murrell worked on the project as part of a summer study abroad project in Belize and fourth-year honors capstone at NKU; she graduated in 2017.

Dubrovsky A, Kitts CL. Effect of the Specific Carbohydrate Diet on the Microbiome of a Primary Sclerosing Cholangitis and Ulcerative Colitis Patient. *Cureus*. 10(2): e2177. doi: 10.7759/cureus.2177 (California Polytechnic State University)

A 20-year-old female was diagnosed with ulcerative colitis (UC) at age 14 and primary sclerosing cholangitis (PSC) at age 16. The PSC was successfully treated with high doses of oral vancomycin; however, the UC was more difficult to manage. After many drug treatments failed to treat the UC, the patient began following the specific carbohydrate diet (SCD). This report documents fecal microbiome changes resulting from following the SCD for two weeks. The DNA extracted from fecal samples was subjected to 16S rRNA gene sequencing to quantify bacterial species abundance. Not only were substantial changes in the fecal bacterial composition detectable within two weeks, but all UC symptoms were also controlled as early as one week following the start of the diet. The patient's fecal microbiota was dramatically different from those of three healthy control subjects and showed remarkable loss of bacterial diversity in terms of species richness, evenness, and overall diversity measures. Other specific changes in bacterial composition included an increase in Enterobacteriaceae, including Escherichia and Enterobacter species. A two- to threefold decrease was observed in the prevalence of the most dominant fecal bacterial species, Fusobacterium ulcerans, after two weeks on the SCD. Overall species diversity and evenness increased to levels near the controls, although species richness remained low. These findings provide information on the fecal bacteria from a patient with PSC and UC, following prolonged oral vancomycin treatment, and identifies a potentially specific microbial effect for the SCD. Christopher L. Kitts is professor in the Biological Sciences Department at Cal Poly and director of the Cal Poly Center for Applications in Biotechnology. Alanna Dubrovsky worked on the project during her third and fourth years at Cal Poly with the support of departmental student SLO research funds. She wrote the manuscript and finished the submission as a medical student at the University of California, Davis.

DuBois PM, Shea TK, Claunch NM, Taylor EN. Effects of Oxygen on Responses to Heating in Two Lizard Species Sampled along an Elevational Gradient. *Journal of Thermal Biology*. 2017; 68: Part B: 170–176. doi: 10.1016/j.jtherbio.2017.02.008 (California Polytechnic State University)

Thermal tolerance is an important variable in predictive models about the effects of global climate change on species distributions, yet the physiological mechanisms responsible for reduced performance at high temperatures in air-breathing vertebrates are not clear. We conducted an experiment to examine how oxygen affects three variables exhibited by ectotherms as they heat—gaping threshold, panting threshold, and loss of righting response (the latter indicating the critical thermal maximum)—in two lizard species along an elevational (and therefore environmental oxygen partial pressure)

gradient. Oxygen partial pressure did not impact these variables in either species. We also exposed lizards at each elevation to severely hypoxic gas to evaluate their responses to hypoxia. Severely low oxygen partial pressure treatments significantly reduced the gaping threshold, panting threshold, and critical thermal maximum. Further, under these extreme hypoxic conditions, these variables were strongly and positively related to partial pressure of oxygen. In an elevation where both species overlapped, the thermal tolerance of the high elevation species was less affected by hypoxia than that of the low elevation species, suggesting the high elevation species may be adapted to lower oxygen partial pressures. In the high elevation species, female lizards had higher thermal tolerance than males. Our data suggest that oxygen impacts the thermal tolerance of lizards, but only under severely hypoxic conditions, possibly as a result of hypoxia-induced anapyrexia. Emily Taylor is a professor or biological sciences at Cal Poly. The study was performed in 2016. Undergraduates P. Mason Dubois and Tanner K. Shea worked on the project during the William L. Frost Summer Research Program with the help of graduate student Natalie Claunch. Dubois is employed as a biologist, Shea is pursuing his master's degree in quantitative biology at the University of New Mexico, and Claunch is a PhD candidate in biology at the University of Florida. Support for Dubois was provided by the William L. Frost Summer Research Program, and the Cal Poly Research, Creative, and Scholarly Activity (RSCA) Program funded supplies and travel.

Ye H, Ng J. Shielding Effects of Myelin Sheath on Axolemma Depolarization under Transverse Electric Field Stimulation. *PeerJ*. 2018; 6:e6020 doi: 10.7717/peerj.6020. (Loyola University Chicago)

Axonal stimulation with electric currents is an effective method for controlling neural activity. An electric field parallel to the axon is widely accepted as the predominant component in the activation of an axon. However, recent studies indicate that the transverse component to the axolemma is also effective in depolarizing the axon. To quantitatively investigate the amount of axolemma polarization induced by a transverse electric field, we computed the transmembrane potential (Vm) for a conductive body that represents an unmyelinated axon (or the bare axon between the myelin sheath in a myelinated axon). We also computed the transmembrane potential of the sheath-covered axonal segment in a myelinated axon. We then systematically analyzed the biophysical factors that affect axonal polarization under transverse electric stimulation for both the bare and sheath-covered axons. Geometrical patterns of polarization of both axon types were dependent on field properties (magnitude and field orientation to the axon). Polarization of both axons was also dependent on their axolemma radii and electrical conductivities. The myelin provided a significant "shielding effect" against the transverse electric fields, preventing excessive axolemma depolarization. Demyelination could allow for prominent axolemma depolarization in the transverse electric field, via a significant increase in myelin conductivity. This shifts the voltage drop of the myelin sheath to the axolemma. Pathological changes at a cellular level should be considered when electric fields are used for the treatment of demyelination diseases. The calculated term for membrane polarization (Vm) could be used to modify the current cable equation that describes axon excitation by an external electric field to account for the activating effects of both parallel and transverse fields surrounding the target axon. Hui Ye is associate professor in the Department of Biology at Loyola University Chicago. Jeffrey Ng performed research with Ye in his third and fourth years as an undergraduate and is currently studying for an MS degree in informatics in the Biology Department at Loyola. Support for Ng was provided by an undergraduate research fellowship and the Research Support Fund at Loyola University Chicago.

Kasprzak CR, Scherzinger ET, Sarkar A, Miao M, Porcincula DH, Madriz AM, Pennewell ZM, Chau SS, Fernando R, Stefik M, Zhang, S. Ordered Nanostructure of Carbon Nanotube-Polymer Composites from Lyotropic Liquid Crystal Templating. *Macromolecular Chemistry and Physics*. 2018; 219: 1800197. doi: 10.1002/macp.201800197 (California Polytechnic State University)

A series of polymer nanocomposites containing single-walled carbon nanotubes (SWNTs) are prepared from polymerizable quaternary ammonium surfactants using photo-polymerization. The surfactant monomers with various alkyl chains of nonpolar tails form lyotropic liquid crystalline (LLC) mesophases in aqueous medium with hexagonal packing of cylindrical micelles. Addition of SWNTs does not change the hexagonal mesophases but enhances the order-disorder transition temperatures and alters the rheological behaviors. After photo-polymerization, the microstructures of hexagonal packing are changed while addition of SWNTs does not disrupt the resulting microstructures. Under the shear flow, the defect-free monodomain structures are obtained in the LLC phase and subsequently locked in the solid film after polymerization. Shanju Zhang is an associate professor of chemistry, and Raymond Fernando is professor and Endowed Chair for Polymers & Coatings Specialty, at Cal Poly. Morgan Stefik is assistant professor/polymer at the University of South Carolina. Christopher Kasprzak and Evan Scherzinger worked on the project as undergraduate students. Sophia Chau, Miranda Miao, Dominique Porcincula, and Zachary Pennwell are fourth-year students; and Alejandro Madriz is a third-year student. Karprzak is pursuing PhD study at Virginia Tech. Amrita Sarkar is a PhD student at

the University of South Carolina. The research was funded by the National Science Foundation.

Nunley K, Lu W. Detecting Network Intrusions Using a Confidence-Based Reward System. *IEEE Proceedings of the 32nd International Conference on Advanced Information Networking and Applications*. 2018; 1: 175–180. doi: 10.1109/WAINA.2018.00083 (Keene State College)

Combining multiple intrusion detection technologies into a hybrid system has been recently proposed to improve the comprehensive intrusion detection capability. However, such a hybrid system is not always stronger than its component detectors. Getting different detection technologies to interoperate effectively and efficiently has become a major challenge when building operational intrusion detection systems (IDSes). In this paper, we propose a novel reward system model in order to increase the accuracy and reliability of hybrid IDSes. In particular, the proposed confidence-based reward system built within a reinforcement learning algorithm includes three components. Namely, a relative discount factor, a confidence extraction technique, and a unique reward computing algorithm. The preliminary case studies show that the proposed reward system has a potential to improve the anomaly detection accuracy, decrease false alarm rate, and improve adaptability to new network traffic. Wei Lu is associate professor in the Department of Computer Science at Keene State College. Kole Nunley worked on the research as a computer science undergraduate at Keene State College. He is now an associate technical consultant working with Cantina Consulting in Boston. The research was supported by the Building Excellence in Science and Technology (BEST) Grant and CCI Funding at Keene State College.

Callahan J, Mota M. Solving Scramble Squares Puzzles with Repetitions. *Involve*. 2019; 12: 343–349, doi: 10.2140/involve.2019.12.343 (St. Edward's University)

A Scramble Squares puzzle consists of nine square pieces with half of an image on each side. To solve the puzzle, the pieces are arranged in a 3-by-3 grid so that sides of adjacent pieces form complete images. A repetition is a half-image that appears more than once on a piece. Previous research uses a graph-theoretical approach to establish necessary and sufficient conditions for solutions without repetitions to 2-by-2 Scramble Squares puzzles. We use a similar approach to establish necessary and sufficient conditions for solutions with repetitions to 2-by-2 Scramble Squares puzzles. Jason Callahan is a professor of mathematics at St. Edward's University. Maria Mota worked on the research as a fourth-year mathematics major and graduated in May 2018. Partial support for the research was provided by NSF grant no. 1525490.

Kirschner S, Miller A. Does Peacekeeping Really Bring Peace? Peacekeepers and Combatant-Perpetrated Sexual Violence in Civil Wars. *Journal of Conflict Resolution*. doi: 10.1177/0022002719831069 (Allegheny College)

Peacekeeping mitigates killing, but nonlethal violence also influences both positive peace and stability. We evaluate peacekeepers' effect on one such type of abuse, sexual violence. We posit that peacekeepers raise the cost of abuses and foster institutional and cultural changes that curb violence. We find that missions both reduce the chance of any violence and limit its prevalence; larger deployments and multidimensional missions are more effective. Governments curtail violence more quickly than rebels do in response to military contingents; rebels are especially responsive when missions include large civilian components. These findings contribute to our understanding of peacekeeping in three primary ways: we expand the evaluation of peacekeeping to consider nonlethal violence; we draw attention to mission size, capacity to use force, and civilian-led programming as determinants of effectiveness; and we demonstrate how addressing nonlethal violence requires similar tools as lethal violence but is further enhanced by specific civilian-led initiatives. Shanna Kirschner is associate professor of political science at Allegheny College. Political science undergraduate Adam Miller worked on the research in 2016–2018 as an independent study and summer project, and graduated in 2018. He is enrolled in the MA program at Maxwell School of Citizenship and Public Affairs, Syracuse University. The research was supported by Allegheny College-Howard Hughes Medical Institute Global Health Grant and the NSF Advanced Empirical Research on Politics for Undergraduates Program.

Martin E, Kim S, Unfried A, Delcambre S, Sanders N, Bischoff B, Saavedra R. 6th Vital Sign App: Testing Validity and Reliability for Measuring Gait Speed. *Gait and Posture*. 2019; 68: 264–268 doi: 10.1016/j.gaitpost.2018.12.005 (California State University, Monterey Bay)

Background: Gait speed tests are useful predictors of different health outcomes in people. These tests can be administered by the convenience of one's smartphone. Research Question: Is the 6th Vital Sign app valid and reliable for measuring gait speed? Methods: The study used a prospective test-retest design. Fifteen college subjects were asked to walk at their normal pace for 2 min. Each subject performed two trials. Speed was recorded by the 6th Vital Sign app, Brower timing gates, and by hand-measurement of distance walked divided by the 2 min. Criterion validity was assessed by paired *t*-tests, Cohen's D effect sizes, and Pearson correlation tests. Inter-trial reliability within each device was assessed with Pearson correlation tests. Results: Speed measured by the app was

significantly lower than speed measured by gates (p = 0.004) and by hand-measurement (p = 0.009). The difference between gates and hand-measurement was not significant (p = 0.684). The speed measured by gates and hand-measurement were very highly correlated (r = 0.974), but speed measured by app was only moderately correlated with gates (r = 0.370) and hand-measurement (r = 0.365). The inter-trial reliability was fairly high with correlations of r = 0.916, 0.944, and 0.941 when speed was measured by the app, gates, and hand-measurement, respectively. Significance: The app tended to underestimate speed when compared to gate and hand-measurements. Therefore, we conclude that the 6th Vital Sign app is not valid for use for clinical diagnosis or prognosis. Eric Martin is assistant professor of kinesiology, Steven Kim is assistant professor of mathematics and statistics, and Alana Unfried is assistant professor of mathematics and statistics at CSU Monterey Bay. At the time of the research, Shelby Delcambre was a kinesiology undergraduate and Undergraduate Research Opportunities center (UROC) researcher, working on the project 2016–2018, and is now employed. Nathan Sanders was a statistics undergraduate and UROC researcher, working on the project 2017–2018; he is now enrolled in graduate school. Brian Bischoff was a UROC researcher and worked on the project 2016–2019. Rosie Saavedra was a UROC researcher and ANDALE scholar, working on the project 2017–2019. The student research was supported by the UROC.

D'Souza MJ, Wentzien D, Bautista R, Santana J, Skivers M, Stotts S, Fiedler F. Data-Intensive Undergraduate Research Project Informs to Advance Healthcare Analytics. *2018 IEEE Signal Processing in Medicine and Biology Symposium (SPMB)*. doi: 10.1109/SPMB.2018.8615591 (Wesley College)

This study highlights the disparities in the reported obesity-related death-rates and the obesity-rate percentages recorded for all 50 US states. Visual and statistical analysis shows considerable disparities in the obesity-related death-rate record-keeping amongst the 50 US states. For example, in 2015, Vermont with the sixth lowest obesity-rate had the highest reported obesity-related death-rate. In contrast, Alabama had the fifth highest adult obesity-rate in the nation, yet it had a very low age-adjusted mortality rate. Such disparities make comparative analysis difficult. Malcolm J. D'Souza is professor of chemistry and dean, Derald Wentzien is professor of mathematics and data science, and Stephanie Stotts is associate professor of environmental science at Wesley College. Frank Fiedler is professor of mathematics and chair of the Wesley College STEM programs. Riza Bautista (mathematics), Jose Santana (environmental science), and Michael Skivers completed this 2016–2018 Wesley College research project as part of a sponsored directed research program. Currently Bautista is a bioinformatics PhD candidate at the University of Delaware; Santana is employed at Fr. Meyer's Sohn, North America, LLC; and Skivers is employed at Chesapeake Utilities in Dover, DE. The research was supported by an IDeA award (NIH-NIGMS P20GM103446, DE-INBRE), an NSF EPSCoR Grants IIA-1301765 and 1757353 (DE-EPSCoR), an NSF S-STEM Grant 1355554, the NASA Delaware Space Grant Consortium grant program (NNX15AI19H), and the State of Delaware.

Johnson LR, McCray D, Ragusa JM. #NeverTrump: Why Republican Members of Congress Refused to Support Their Party's Nominee in the 2016 Presidential Election. *Research & Politics*. 2018; 5:1: 1–10. doi: 10.1177/2053168017749383 (College of Charleston)

In an election characterized by countless headlines, the refusal of Republicans to support their party's nominee was a constant topic of discussion in 2016. Our paper looks to explain why Republican members of Congress joined the so-called #NeverTrump movement. In the first part, we document the varied—and often contradictory—explanations of the #NeverTrump movement offered by journalists, pundits, and politicians during the campaign. We then categorize these popular explanations into to four theoretical categories: policy preferences, identity, electoral motivations, and establishment dynamics. In the second part, we test the varied claims. We believe two findings stand out and have broader implications for American politics. First, despite the popular belief that members of Congress are single-minded in their pursuit of reelection, we find that a lawmaker's religion and sex—both in the identity category—had the largest effects on the decision to join the #NeverTrump movement. Second, the results show that establishment Republicans were more likely to support Donald Trump's candidacy. Notably, the direction of this effect is inconsistent with popular explanations of the #NeverTrump movement but consistent with a range of academic studies. Jordan Ragusa is associate professor of political science at the College of Charleston. Lauren Johnson and Deon McCray were undergraduates when this research began in fall 2016 and performed their work as part of independent studies. Both have since graduated. Johnson now lives in Des Moines and works with community organizations on local and state housing policy. McCray lives in Philadelphia and is planning to attend law school.

Vance MM, Shepherd M, Ortlip AT, Staudmyer T, Tate-Moore A, Rosette VD, Boutagy NE, LaManca JJ, Pellinger TK, Werner TJ. The Effects of Acute Creatine Supplementation on Arterial Stiffness: A Pilot Study. *Abstracts, American College of Sports Medicine Mid-Atlantic Regional Conference*. 2018. (Salisbury University)

Arterial stiffness (AS) has long been regarded as an indicator of disease and is an independent predictor of cardiovascular events. Thus, identification and characterization of behaviors promoting the development of arterial stiffness are necessary. There is a void in our knowledge on the impact of exercise, in particular creatine monohydrate supplementation, on the stiffening process in the major elastic arteries. As of this writing, there is one experiment that examined the relationship between acute (< 7 day) creatine supplementation and arterial stiffness. However, the previous study used arterial stiffness indices that were dependent on several factors including blood pressure, thus subjected to interpretation. Purpose: To determine the effects of acute creatine monohydrate supplementation on AS. Methods: 12 male, physically active participants were randomized in a double-blind fashion to placebo (PL) (n = 6, 23±2 yrs) or creatine (CM) (n = 6, 21±2 yrs) groups. Subjects received 0.3 g/kg/day creatine monohydrate or placebo in gelatin capsules for 7 days. Subjects were instructed to avoid nutritional supplements for at least 14 days prior to start of the study period. A series of anthropometric measurements, ultrasonography of the carotid artery, applanation tonometry, and blood pressure acquisition were conducted at baseline and on day 7 of the study period. Results: There were no significant differences between PL and CM in carotid-femoral pulse wave velocity (CF PWV) (4.60±10.42 vs. -2.71±21.20 % change), β-stiffness index (5.81±26.3 vs. 1.65±41.35 % change), central pulse pressure (CPP) (-17.38±16.31 vs. 6.05±24.61 % change), and arterial compliance (AC) (19.79±37.50 vs. 12.48±53.89 % change) (all P > 0.05). There were also no significant differences in body weight (0.53±0.79 vs. 0.20±0.87 % change), fat mass (-3.40±3.49 vs. –0.23±8.17 % change), and fat-free mass (1.12±0.98 vs. 0.23±0.80 % change) between PL and CM, respectively (all P>0.05). Conclusions: Using a randomly controlled, double-blind trial with validated measurements of AS, acute creatine supplementation does not appear to impact vascular compliance in young, otherwise healthy males. Timothy J. Werner is assistant professor and John LaManca is professor in the Exercise Science Department at Salisbury University. Thomas K. Pellinger is associate professor and program chair of applied health physiology at Salisbury University. Morgan M. Vance and Meghan Shepherd are undergraduate students in the Exercise Science Department at Salisbury University.

Bou-Abdallah F, Flint N, Wilkinson T, Salim S, Srivastava AK, Poli M, Arosio P, Melman P. Ferritin Exhibits Michaelis–Menten Behavior with Oxygen but Not with Iron during Iron Oxidation and Core Mineralization. *Metallomics*. 2019; 11: 774–783. doi: 10.1039/C9MT00001A (State University of New York Potsdam)

This study was undertaken to measure two Michaelis–Menten parameters (Km,Fe and Km,O2) during iron oxidation and deposition inside ferritin, the major iron storage protein in mammals, under physiologically relevant O2 concentrations, but also in the presence of excess Fe(II) and O2 concentrations. Earlier literature values were excessively high and physiologically irrelevant. Under oxygen concentration close to physiological, we determined a Km,O2 values of ~1–2 μM, indicating that iron oxidation and mineralization in ferritin should not be affected by the oxygenation level of cells, and should proceed even under hypoxic events. Based on our results, we proposed a kinetic model of iron oxidation in which the inhibition of the protein's activity is caused by bound iron(III) cations at the catalytic center of ferritin, with the rate limiting step corresponding to an exchange or a displacement reaction between incoming Fe(II) cations and bound Fe(III) cations. Fadi Bou-Abdallah is professor of chemistry at SUNY Potsdam. Artem Melman is associate professor of chemistry at Clarkson University. Paolo Arosio is professor of molecular biology and Maura Poli is research professor at the University of Brescia in Brescia, Italy. Nicholas Flint is a fourth-year student in biochemistry at SUNY Potsdam and plans to attend graduate school. He worked on this project in his third and fourth years for research credits. Tyler Wilkinson is a PhD candidate in chemistry and biomolecular science at Clarkson University. Samantha Salim is a third-year chemistry and biomolecular science student at Clarkson University who plans to attend graduate school. Ayush Kumar Srivastava is a graduate student at the University of Brescia and a past visiting scholar at SUNY Potsdam. The research was supported by the National Institute of Health, Award Numbers R15GM104879 (F. B. A.); and NSF award CHE 1150768 (for Melman. Flint and Salim were partly supported by a Kilmer Undergraduate Research Apprenticeship (SUNY Potsdam) and the Ronald E. McNair Post-Baccalaureate Achievement Program (Clarkson University), respectively.

Chartas G, Canas MH. The Variable Relativistic Outflow of IRAS 13224-3809. *The Astrophysical Journal*. 2018; 867:2: ar. 103. doi: 10.3847/1538-4357/aae438 (College of Charleston)

The discovery of an ultrafast outflow has been reported in the z = 0.0658 narrow-line Seyfert galaxy IRAS 13224-3809. The ultrafast outflow was first inferred through the detection of highly blueshifted absorption lines and then confirmed with a principal component analysis. Two of the reported properties of this outflow differed from those typically detected in other AGNs with ultrafast outflows. First, the outflow velocity was found not to vary with v = 0.236c ± 0.006c. Second, the equivalent width of the highly blueshifted absorption line was reported to be anticorrelated with the 3-10 keV flux of this source. We present a reanalysis of the XMM-Newton observations of IRAS 13224-3809 considering the influence of background. We

also undertook a different analysis approach in combining the spectra and investigated the change of the properties of the outflow as a function of 3-10 keV flux and time. We confirm the presence of an ultrafast outflow in IRAS 13224-3809; however, we find that the background spectra used in the Parker et al. analyses dominate the source spectra for energies near the blueshifted iron lines. By reducing the source extraction regions to improve the signal-to-noise ratio, we discover larger than previously reported outflow velocities and find that the outflow velocity varies from ~0.2c to ~0.3c and increases with 3-10 keV flux. The previously reported anticorrelation between equivalent width of the iron line and 3-10 keV flux disappears when the background spectra are reduced by optimizing the source extraction regions. George Chartas is associate professor in the Department of Physics and Astronomy at College of Charleston. Undergraduate Manuel H. Canas worked on the research as an independent study and senior thesis project in 2017–2018. The research was supported by NASA via the grants SAO GO6-17099X12 and NNX16AH33G.

Fragile PC, Ballantyne DR, Maccarone TJ, Witry JWL. Simulating the Collapse of a Thick Accretion Disk due to a Type I X-ray Burst from a Neutron Star. *Astrophysical Journal Letters*. 2018; 867:2: ar. L28. doi: 10.3847/2041-8213/aaeb99 (College of Charleston)

We use two-dimensional, general relativistic, viscous, radiation hydrodynamic simulations to study the impact of a Type I X-ray burst on a hot and geometrically thick accretion disk surrounding an unmagnetized, non-rotating neutron star. The disk is initially consistent with a system in its low/hard spectral state and is subject to a burst that rises to a peak luminosity of 10^{38} erg s-1 in 2.05 s. At the peak of the burst, the temperature of the disk has dropped by more than three orders of magnitude and its scale height has gone down by more than one order of magnitude. The simulations show that these effects predominantly happen due to Compton cooling of the hot plasma, and clearly illustrate the potential cooling effects of bursts on accretion disk coronae. In addition, we demonstrate the presence of Poynting–Robertson drag, though it only enhances the mass accretion rate onto the neutron star by a factor of ~3–4 compared to a simulation with no burst. Simulations such as these are important for building a general understanding of the response of an accretion disk to an intense X-ray impulse, which, in turn, will be crucial for deciphering burst spectra. Detailed analysis of such spectra offers the potential to measure neutron star radii, and hence constrain the neutron star equation of state, but only if the contributions coming from the impacted disk and its associated corona can be understood. P. Chris Fragile is professor in the Department of Physics & Astronomy at College of Charleston. Fourth-year student Jason W. L. Witry worked on the research as part of a summer project/independent study; he is now enrolled in graduate School. The research was supported by SC NASA EPSCoR RGP 2017 and National Science Foundation grant AST-1616185.

Teklu A, Barry C, Palumbo M, Weiwadel C, Kuthirummal N, Flagg J. Mechanical Characterization of Reduced Graphene Oxide Using AFM. *Hindawi: Advances in Condensed Matter Physics*. 2019; ar ID 8713965. doi: 10.1155/2019/8713965 (College of Charleston)

Nanoindentation coupled with Atomic ForceMicroscopywas used to study stiffness, hardness, and the reduced Young's modulus of reduced graphene oxide. Oxygen reduction on the graphene oxide sample was performed via LightScribe DVD burner reduction, a cost-effective approach with potential for large scale graphene production. The reduction of oxygen in the graphene oxide sample was estimated to about 10 percent using FTIR spectroscopic analysis. Images of the various samples were captured after each reduction cycle using Atomic Force Microscopy. Elastic and spectroscopic analyses were performed on the samples after each oxygen reduction cycle in the LightScribe, thus allowing for a comparison of stiffness, hardness, and the reduced Young's modulus based on the number of reduction cycles. The highest values obtained were after the fifth and final reduction cycle, yielding a stiffness of 22.4 N/m, a hardness of 0.55 GPa, and a reduced Young's modulus of 1.62 GPa as compared to a stiffness of 22.8 N/m, a hardness of 0.58 GPa, and a reduced Young's modulus of 1.84 GPa for a commercially purchased graphene film made by CVD. This data was then compared to the expected values of pristine single layer graphene. Furthermore, two RC circuits were built, one using a parallel plate capacitors made of light scribed graphene on a Kapton substrate (LSGC) and a second one using a CVD deposited graphene on aluminum (CVDGC). Their RC time constants and surface charge densities were compared. Alem Teklu, is associate professor and Narayanan Kuthirummal is professor in the Department of Physics & Astronomy at the College of Charleston. The following undergraduates worked on the research as part of their fourth-year thesis projects: Matthew Palumbo (2015), Canyon Barry (2016), Collin Weiwadal (2016), and Jason Flagg (2018).

Beckham GK, Suchomel TJ, Sole CJ, Bailey CA, Grazer JL, Kim SB, Talbot KB, Stone MH. Influence of Sex and Maximum Strength on Reactive Strength Index-Modified. *Journal of Sports Science and Medicine*. 2019; 18: 65–72. (California State University, Monterey Bay and East Tennessee State University)

Reactive strength index-modified (RSImod) is a measure of lower body explosiveness calculated by dividing jump

height by time to takeoff. RSImod is different between stronger and weaker athletes and between males and females. The purpose of this study was to evaluate differences in RSImod between males and females while controlling for maximal strength and lower body explosiveness. Forty-three female and 58 male Division-I athletes performed countermovement jumps on a force plate during unloaded (0kg) and loaded (20kg) conditions. We used an ANCOVA to test whether RSImod is different between sexes conditioning on relative maximum strength (PFa) and average RFD 0-200ms (RFD200) measured during the isometric mid-thigh pull (IMTP). Differences of 0.087 (95% CI: 0.040-0.134; p = 0.0005) and 0.075 (95% CI: 0.040-0.109, $p < 0.0001$) were observed for RSImod between sexes in unloaded and loaded conditions, respectively. A male with PFa of 186 (grand mean of the sample) and RFD200 of 6602 N/s (grand mean of the sample) is predicted to have 28% greater RSImod than a female of similar PFa and RFD200. Maximum strength development should be a primary aim of training in female athletes, in addition to other trainable factors, such as stiffness and RFD. George Beckham is assistant professor of kinesiology and Steven Kim is assistant professor of mathematics and statistics at California State University, Monterey Bay (CSUMB). Timothy Suchomel is assistant professor of human movement sciences at Carroll University. Christopher Sole is assistant professor of health and human performance at The Citadel. Christopher Bailey is a clinical assistant professor of kinesiology, health promotion, and reaction at the University of North Texas. Jacob Grazer is assistant professor of health and human performance at Georgia College & State University. Michael Stone is professor of exercise and sport science at East Tennessee State University. Kasie Talbot worked on this research project through the Undergraduate Research Opportunity Center Researcher Program in spring 2018. She graduated from CSUMB with a BS in mathematics with a statistics concentration. She is currently pursuing an associate of the Society of Actuaries credential and a position as an associate actuary. The Undergraduate Opportunities Center (UROC) at CSUMB and the US Department of Education (#P031C160221) provided support for this study.

Sarvate DG, Cowden W. A Simple Construction of 3-GDDs with Block Size 4 Using SQS(v). *Bulletin of the Institute of Combinatorics and Its Applications (BICA)*. 2018; 84: 40–44. (College of Charleston)

Recently a 3-GDD(n,2,k,λ1,λ2) was defined by extending the definitions of a group divisible design and a t-design. It was shown that the necessary conditions are sufficient for the existence of a 3-GDD(n, 2, 4, λ1, λ2) except possibly when n ≡ 1, 3 (mod 6), n /= 3,7,13 and λ1 > λ2. In this short note we prove that the necessary conditions are sufficient for the existence of a 3-GDD(n, 2, 4, λ1, λ2) for n ≡ 1, 7, 9 (mod 12). The proof depends on a basic construction of a 3-GDD(n,2,4,λ1 = 3,λ2 = 1). We also prove that for n ≡ 3 (mod 12), necessary conditions are sufficient except when λ1 ≡ 9 (mod 12) and hence an open problem is to find a construction of a 3-GDD(n, 2, 4, 9, 1) for n ≡ 3 (mod 12), n /= 3. Dinesh G. Sarvate is professor of mathematics at the College of Charleston. William Cowden is an undergraduate majoring in mathematics at the College of Charleston who worked on the research as a summer project. The research was supported by the School of Sciences and Mathematics at the College of Charleston.