

UNDERGRADUATE RESEARCH Highlights

D'Souza MJ, Kashmar RJ, Hurst K, Fiedler F, Gross CE, Deol JK, Wilson A. Integrative Biological Chemistry Program Includes the Use Of Informatics Tools, GIS and SAS Software Applications. *Contemporary Issues in Education Research (CIER)*. 2015; 8:3: 193-214. (Wesley College)

Wesley College revised requirements for its baccalaureate biological chemistry program to include a one-semester course, Physical Chemistry for the Life Sciences, and project-based experiential learning courses using instrumentation, data-collection, data-storage, statistical-modeling analysis, visualization, and computational techniques. Open-sourced geo-referenced census, health, and health disparity data were coupled with GIS and SAS tools to develop use-cases for chronic adult obesity in which income, poverty status, health insurance coverage, education, and age were categorical variables. For the State of Delaware, age and educational attainment were found to be limiting obesity risk-factors in its adult population. Malcolm D'Souza is professor of chemistry and associate dean at Wesley College. Richard Kashmar is professor of chemistry. Kent Hurst is visiting professor of environmental science. Frank Fiedler is associate professor of mathematics and department chair. Catherine Gross is a student in the MAT STEM program at Wesley College. Jasbir Deol is a graduate student at the Temple University School of Pharmacy. Alora Wilson is at the University of Maryland Eastern Shore School of Pharmacy. The project was supported by an NIH-NIGMS IDeA Award (P20GM103446); an NSF EPSCoR Award (IIA-1301765); an NSF ARRA Award (NSF ARI R2 0960503); an NSF S-STEM grant (NSF DUE 1355554); and the State of Delaware.

Cox W, Fischer BJ. Optimal Prediction of Moving Sound Source Direction in the Owl. *PLoS Computational Biology*. 2015; 11: 7. (Seattle University)

Predictive movements are especially important in the capture of prey when a predator must predict the future location of moving prey. How sensory information is transformed to motor commands for predictive behaviors is an important open question. We used a theoretical approach to specify how a population of neurons should respond to a moving stimulus to allow for a Bayesian prediction to be decoded from the neural responses. This provides a novel theoretical framework that predicts properties of neural responses that are observed in auditory and visual systems of multiple species. Brian Fischer is an assistant professor of mathematics at Seattle University. Weston Cox, who is currently employed,

participated in the research as a junior and senior electrical-engineering major for independent study credit and during the summer between his junior and senior years. The research was supported by NIH grant DC012949 to Brian Fischer.

Smolyaninova VN, Zander K, Gresock T, Jensen C, Prestigiacomo J, Osofsky MS, Smolyaninov II. Using Metamaterial Nanoengineering to Triple the Superconducting Critical Temperature of Bulk Aluminum. *Scientific Reports*. 2015; 5: 15777. (Towson University, Naval Research Laboratory, University of Maryland College Park)

We have shown the viability of the metamaterial approach to dielectric-response engineering for enhancing the transition temperature, T_c , of a superconductor. In this report, we demonstrate the use of alumina-coated aluminium nanoparticles to form the recently proposed epsilon near zero (ENZ) core-shell metamaterial superconductor with a T_c that is three times that of pure aluminium. IR reflectivity measurements confirm the predicted metamaterial modification of the dielectric function, thus demonstrating the efficacy of the ENZ metamaterial approach to T_c engineering. Vera Smolyaninova is a professor of physics at Towson University. Kathryn Zander, physics major at Towson, participated in the research for independent study credit. Zander graduated from Towson University in May 2015 and plans to apply to graduate school. This research was supported in part by FCSM Undergraduate Research and Towson Undergraduate Research Grants, which were awarded to Zander, and by NSF grant DMR-1104676 to Towson.

Taylor MP, Ye Y, Adhikari SR. Conformation of a Flexible Polymer in Explicit Solvent: Accurate Solvation Potentials for Lennard-Jones Chains. *J. Chem. Phys.* 2015; 143: 204901: 1-12. (Hiram College)

In this work we study how the size and shape of a flexible polymer chain in solution changes in response to variations in solvent density and temperature. We use a rigorous theoretical approach to map the polymer-in-solvent system to a much simpler polymer-only system with a set of interaction potentials that exactly reproduce the effects of solvent. This approach greatly reduces the computational complexity of the polymer-in-solvent problem, allowing us to study conformational transitions of macromolecules (such as proteins) in a dense solvent environment. Mark P. Taylor is an associate professor of physics at Hiram College. Shishir Adhikari

and Yuting Ye, both physics majors, worked on this project as summer research assistants and for their senior capstone experiences. Adhikara is currently in a doctoral program in physics at Case Western Reserve University, and Ye is a medical student at Washington University. The work was funded by an RUI grant from the National Science Foundation, Division of Materials Research.

Scott E, Goodyear N, Nicoloro JM, Marika DJ, Killion E, Duty SM. Laundering Habits of Student Nurses and Correlation with the Presence of *Staphylococcus aureus* on Nursing Scrub Tops Pre- and Postlaundering. *American Journal of Infection Control*. 2015; 43: 1006-1008. (Simmons College and University of Massachusetts Lowell)

Little is known about student-nurse laundering practices. In this study, student nurses swabbed their scrub tops after clinicals and after laundering, and completed a laundry survey, which indicated that 13.5 percent of students wore the same scrub more than once and that few followed recommended guidelines by using hot water (20 percent) or bleach (5.6 percent) when laundering scrubs. After clinical shifts, 17 percent of swabs tested positive for *Staphylococcus aureus*; however, laundering eradicated it from 64.3 percent of positive samples but this was not statistically significant. As a result of this study, we recommend that nurse educators should include safe laundering practices in foundations of nursing courses. Elizabeth Scott is an associate professor of biology and public health at Simmons College. Nancy Goodyear is an associate professor of clinical laboratory sciences at UMASS Lowell. Susan Duty is an associate professor of nursing at Simmons College. Desta Marika is employed as a nurse. Emma Killion is employed as a nurse. This research was supported by an industry grant from Procter & Gamble.

Almagambetov A, Velipasalar S, Baitassova A. Mobile Standards-Based Traffic Light Detection in Assistive Devices for Individuals with Color-Vision Deficiency. *Intelligent Transportation Systems, IEEE Transactions*. 2015; 16: 3: 1305-1320. (Syracuse University/Embry-Riddle Aeronautical University)

This paper presents a robust, traffic-standards-based, and computationally efficient method for detecting the status of the traffic lights without relying on GPS, lidar, radar information, or prior (map-based) knowledge. It is the first work to use official ITE and BSI standards for defining traffic light colors. Akhan Almagambetov is an assistant professor of electrical and computer engineering (Embry-Riddle Aeronautical University), and Senem Velipasalar is an associate professor in the Department of Electrical Engineering and Computer Science (Syracuse University). Assel Baitassova, a senior computer-science major (Syracuse University), was involved

in the research as an independent project. Baitassova is currently a project manager at the National Bank of the Republic of Kazakhstan. This research was supported by a grant from the National Science Foundation.

Prioli SC, Kahan TA. Identifying Words that Emerge into Consciousness: Effects of Word Valence and Unconscious Previewing. *Consciousness and Cognition*. 2015; 35: 88-97. (Bates College)

We examine word reading in continuous flash suppression (CFS) and binocular viewing. Reaction times were greater for words of negative relative to neutral valence when viewed in CFS. Reaction times were less to words of negative relative to neutral valence when shown binocularly. Results extend prior findings with Chinese words to English. Data support there being cognitive aftereffects after previewing stimuli in CFS. Todd Kahan is a professor of psychology at Bates College. Simone Prioli is in the process of applying to physician assistant programs. Portions of this project were completed with support to Todd Kahan by a James McKeen Cattell Fund Fellowship.

Liggett MR, Hoy MJ, Mastroianni M, Mondoux MA. High-glucose Diets have Sex-specific Effects on Aging in *C. elegans*: Toxic to Hermaphrodites but Beneficial to Males. *Aging*. 2015; 7: 6: 383-388. (College of the Holy Cross)

Using the model *C. elegans*, this study identified novel sex-specific effects of high-glucose diets, which are known to decrease lifespan of hermaphrodites and accelerate loss of mobility with age. This study demonstrated that high-glucose diets had benefits for male aging: a 10-percent increase in median lifespan and an 85-percent increase in old-age mobility. Thus, even within the same species, the response to glucose is not universal, and inclusion of both sexes is key for developing good models. Michelle A. Mondoux is an assistant professor of biology at the College of the Holy Cross. Marjorie Liggett, Mike Hoy, and Mike Mastroianni were all biology majors who contributed to this work as Summer Science Research Fellows and conducted undergraduate research for credit. Liggett graduated in 2013, is a special-education teacher with Teach For America, and is currently applying to medical school. Hoy graduated in 2014, is employed as a research technician in the Walhout lab at UMass Medical School, and is currently applying to PhD programs. Mastroianni is currently a senior at Holy Cross and is working on a related project for his senior thesis as part of the biopsychology concentration. Research was funded by the CHC Biology Department and BD Corporation Summer Fellowships (MRL 2012; MJH and MM 2013). Mondoux was supported by the Ardizzone Fund and Batchelor-Ford Faculty Fellowship.

Pham A, Gil CJ, Smith SC, Li S. Orbital Engineering of Two-Dimensional Materials with Hydrogenation: A Realization of Giant Gap and Strongly Correlated Topological Insulators. *Physical Review B: Condensed Matter and Materials Physics*. 2015; 92: 3: 035427-035434. (University of New South Wales, Sydney, Australia)

The paper demonstrates that by modifying the surfaces of single metals like Pb, Mo, and W with hydrogen, these metals can be transformed from normal metals to a novel state of material known as topological insulators with spin polarized edge states. We also propose that BN substrate can be used to fabricate these 2D structures. Anh Pham is a postdoctoral fellow in the School of Materials Sciences and Engineering at UNSW. Sean C. Smith is the director of integrated materials design at UNSW. Sean Li is a professor in the School of Materials Science and Engineering at UNSW. Carmen Gil is currently an undergraduate student and McNair Scholar in the School of Chemical Engineering at the University of Florida. Gil conducted the research as part of an engineering exchange program with the University of New South Wales in Sean Li's research group. The computational resources were supported by Intersect Australia Ltd and the National Computing Infrastructure.

Tilley A, Carter E, Wassermann S, López-Angarita J. Enhancing Management Effectiveness of Invasive Lionfish using Distance Sampling and Detection Probability. *Aquatic Conservation: Marine and Freshwater Ecosystems*. 2015; 00. (School for Field Studies Center for Marine Resource Studies)

The spatial ecology of the invasive lionfish *Pterois volitans* and *Pterois miles*, one of the greatest threats to coral reef fisheries in the Caribbean, is little understood. This study determined that distance sampling is an effective method for accurate estimation of lionfish population density and detection probability. These metrics can help to identify priorities for management areas and track population changes, along with successful removal of lionfish. Alex Tilley was previously a lecturer with The School for Field Studies at the Center for Marine Resource Studies in the Turks and Caicos Islands. He is now the founding director of Talking Oceans in Bogotá, Colombia. Juliana López-Angarita is also a founding director of Talking Oceans. Elliott Carter, a student at Davidson College, participated in this research as part of his study-abroad experience with The School for Field Studies. Sophia Wassermann was an intern at the school's Center for Marine Resource Studies. This research was supported by the center.

Juhl SJ, Dunn NJH, Carroll MK, Anderson AM, Bruno BA, Madero JE, Bono Jr MS. Epoxide-Assisted Alumina Aerogels

by Rapid Supercritical Extraction. *Journal of Non-Crystalline Solids*. 2015; 426: 141-149. (Union College, NY)

In this work, alumina aerogels were prepared via epoxide-assisted gelation followed by rapid supercritical extraction, and characterized by a variety of spectroscopic and surface analysis methods. Surface areas as high as 790 m²/g and densities as low as 0.05 g/mL were achieved for the alumina aerogels. Preliminary catalytic testing indicates that these materials have moderate ability to catalyze reactions of interest in mitigating automotive pollution. Mary K. Carroll is a professor of chemistry, Ann M. Anderson is the Agnes S. MacDonald Professor of Mechanical Engineering, and Bradford A. Bruno is a professor of mechanical engineering at Union College. Stephen J. Juhl (BS, chemistry, 2012) worked on this project during the summer of 2011 and for his senior thesis. Juhl now is enrolled in a graduate chemistry program at Pennsylvania State University. Nicholas J. H. Dunn (BS, chemistry, 2011) contributed to this research during the summer of 2010 and for his senior thesis. Dunn is a doctoral student in chemistry at Penn State. José E. Madero (BSME, 2012) contributed to this research as a summer 2012 undergraduate researcher and as a postgraduate researcher in 2013. Madero is enrolled in the mechanical-engineering graduate program at Washington University St. Louis. Michael S. Bono, Jr. (BSME, 2009), worked on this research for his senior thesis project. He subsequently earned a PhD in mechanical engineering from Cornell University and is currently a postdoctoral student at the Massachusetts Institute of Technology. This research was supported by the National Science Foundation (CHE-9847901 and DMR-1206631) and through Union College's Summer Research Fellowship, Faculty Research Fund, Student Research Grant, and Presidential Green Grant Programs.

Hamel JA, Nease S, Miller CW. Male Mate Choice and Female Receptivity Contribute to Reproductive Interference between Insect Species. *Behavioral Ecology and Sociobiology*. 2015; 69: 6: 951-956. (University of Florida)

Mating between species is common, but seldom adaptive. Mate preferences and receptivity to mating attempts may both contribute to such matings, also called reproductive interference. Our findings suggest that both male mate choice and female receptivity contribute to mating between two secondarily sympatric insect species. Jennifer Hamel is an assistant professor of biology at Elon University. Christine Miller is an assistant professor of entomology at the University of Florida. Savannah Nease is currently working on honeybee research and extension at the University of Florida. Nease contributed to this study in 2012-2013 through the University of Florida University Scholars Program. The research also was supported by National Science Foundation Grant IOS-0926855 to Christine Miller.