UNDERGRADUATE RESEARCH Highlights

Wise, CF, Wise, JTF, Wise, SS, Thompson, WD, Wise Jr., JP, Wise Sr., JP. Chemical Dispersants Used in the Gulf of Mexico Oil Crisis are Cytotoxic and Genotoxic to Sperm Whale Skin Cells. *Aquatic Toxicology*. 2014; 152: 335-340. (University of Southern Maine)

In 2010, the Deepwater Horizon Rig exploded, releasing millions of gallons of crude oil into the Gulf of Mexico. Unprecedented amounts of chemical dispersants were used in the clean-up attempt. This research examines the effects of the dispersants on the skin cells of sperm whales. John P. Wise is a professor of toxicology and molecular epidemiology in the Department of Applied Medical Sciences at the University of Southern Maine and the director of the Maine Center for Toxicology and Environmental Health. Catherine Wise is starting a doctoral program in toxicology at North Carolina State University this fall. This work was supported by the Prince William Sound Regional Citizens Advisory Council and the Maine Center for Toxicology and Environmental Health [955.12.02]. This paper was developed under a GRO Fellowship Assistance Agreement, number MA-91739301-0, awarded by the U.S. Environmental Protection Agency (EPA). It has not been formally reviewed by the EPA. The views expressed in this paper are solely those of the authors, and the EPA does not endorse any products or commercial services mentioned in this paper.

Aldeborgh H, George K, Howe M, Lowman H, Moustakas H, Strunsky N, Tanski JM. Analysis of Small Molecule X-ray Crystal Structures: Chemical Crystallography with Undergraduate Students in a Teaching Laboratory. *Journal of Chemical Crystallography.* 2014; 44: 70-81. (Vassar College)

This report describes the spectroscopic characterization and X-ray crystal structures of six small molecule organic compounds obtained by undergraduate students enrolled in an advanced integrated laboratory course at Vassar College in 2012. The structures reveal several different types of intermolecular interactions, such as hydrogen bonding, pi-stacking, halogen-halogen interactions, and C-H•••X (X = O, N, halogen) interactions. Intermolecular interactions are important for students to learn about as they come to understand the ways in which atoms and molecules may pack together in the solid state. A high-impact way to teach students about different types of intermolecular interactions, while integrating teaching and research, is requiring them to determine an X-ray crystal structure and engage in the writing process to publish the results. Tanski is a professor of chemistry at Vassar College. Aldeborgh is a laboratory manager at Memorial Sloan-Kettering Cancer Center. George is a 2014 graduate of Vassar College with a major in drama and a minor in chemistry. Howe is a 2014 graduate who will attend graduate school in chemistry at UCLA. Lowman is employed at a legal consulting firm and specializes in renewables and the environment. Moustakas is a 2014 graduate who will attend graduate school in chemistry at Dartmouth College. Strunsky is attending graduate school in counseling at Westminster Theological Seminary. The work was supported by Vassar College and the National Science Foundation under Grant No. 0521237 to Tanski.

Babinkostova L, Bombardier KW, Cole MC, Morrell TA and Scott CB. Algebraic Properties of Generalized Rijndael-like Ciphers. *Groups Complexity Cryptology.* 2014; 6: 1: 37-54 (Boise State University)

AES (Advanced Encryption Standard) is a block cipher chosen in 2001 as the United States' official symmetric key cryptosystem for top secret information. Although all current attacks on AES are too slow to be practical attacks, there are theoretical attacks that raise concern about the long-term security of AES. A motivation for investigating the group theoretic structure of AES and alternative platforms and specifications is to identify and exclude properties that can be exploited to undermine the security of such systems. In this paper we examine such conditions for AES-like systems over several mathematical platforms. Babinkstova is an associate professor of mathematics and the director of the Complexity Across Disciplines Program, supported by a National Science Foundation REU grant, at Boise State University. Morell is currently enrolled in a doctoral program in mathematics at the University of Wisconsin. Bombardier is currently enrolled in a doctoral program in mathematics at the University of Iowa. Cole is currently enrolled in a doctoral program in mathematics at Brown University. Scott is currently working at Colorado College. The research was supported by the National Science Foundation (DSM 1062857) and Boise State University; the grants were awarded to Babinkostova.

Macedo NJ, Neto CC, Liberty AM, Ferreira TL. Zebrafish as an in Vivo Screen for Early Black Cranberry Proanthocyanidin Biomolecular Activity. *American Journal of Molecular Biology.* 2014; 4: 2: 37-48. (University of Massachusetts Dartmouth)

The present study was designed to test in vivo the role of cranberry proanthocyanidins (PACs) in inhibiting cancer-cell survival. The zebrafish are a useful in vivo model,

and they were used to look at the effect of PACs on developing embryos. In vitro results were supported showing that the PACs inhibit cells undergoing rapid cell division preferentially over adult normal cells. This work supports in vitro work indicating that PACs can inhibit cancer cells more than normal cells. Tracie Ferreira is an associate professor in the Department of Bioengineering. Cathy Neto is a professor in the Department of Chemistry/Biochemistry. Nicholas Macedo began this work as a sophomore in the bioengineering program and performed this work as a summer project and throughout the following semester as an independent project. He was supported by an incentive grant for undergraduate research from the dean's office of the College of Engineering, as well as funds from the Office of Undergraduate Research at UMass Dartmouth.

Chen L, Drake MR, Resch MG, Greene ER, Himmel ME, Chaffey PK, Beckham GT, Tan Z. Specificity of O-glycosylation in Enhancing the Stability and Cellulose Binding Affinity of Family 1 Carbohydrate-binding Modules. *Proceedings of the National Academy of Sciences of the United States of America*. 2014; 111. (University of Colorado at Boulder)

The study examined the functional role of O-glycosylation in the industrially relevant Family 1 carbohydrate-binding module (CBM). A library of 20 different glycosylation variants of the CBM were synthesized and characterized for their binding affinity to native cellulose, thermal stability, and proteolytic stability. It was found that proteolytic stability was dependent on glycan density, and that thermal stability and binding affinity enhancement were glycan site- and pattern-specific. Tan is an assistant professor at the University of Colorado at Boulder in the Chemistry and Biochemistry Department and BioFrontiers Institute. Greene performed the research during his junior and senior year as part of an independent study project. He will be pursuing a PhD in molecular and cell biology at the University of California, Berkeley beginning in fall 2014. The research was supported by a Department of Chemistry and Biochemistry Start-up Grant and a mini-grant from the Undergraduate Research Opportunities Program awarded to Greene.

Lee, H-c, Le Grice, V, Blakeslee, JP, Jensen, JB, Lee, Y. Stellar Populations of 16 Galaxies from the Hubble Space Telescope WFC3/IR Surface Brightness Fluctuation Observations. *Bulletin of American Astronomical Society.* 2014; 223. http://adsabs.harvard.edu/abs/2014AAS...22315201L. (The University of Texas-Pan American)

We have estimated the luminosity-weighted ages of 16 early-type galaxies in Virgo and Fornax clusters based upon the near-IR (F110W and F160W) SBF observations using the Hubble Space Telescope (HST). Hyun-chul Lee is an astronomy lecturer. Victoria Le Grice, an English major, successfully finished her minor in astronomy and will start graduate study at Texas State University. The research was supported by NASA through a grant from the Space Telescope Science Institute, which is operated by the Association of Universities for Research in Astronomy, Incorporated, under NASA contract NAS5-26555. Partial support also came from the Undergraduate Research Initiative at the UTPA.

June CM, Vallier BC, Bonomo RA, Leonard DA, Powers RA. Structural Origins of Oxacillinase Specificity in Class D beta-lactamases. *Antimicrobial Agents and Chemotherapy*. 2014; 58: 1: 333-341. (Grand Valley State University)

The structural basis for differences in substrate selectivity between two class D beta-lactamases was examined by determining the X-ray crystal structures of the enzymes in complex with the beta-lactam substrate oxacillin. Comparison of the complexes provides novel insight on how substrate selectivity is achieved among subtypes of class D beta-lactamases. By elucidating important active site interactions, these findings can also inform the design of novel antibiotics and inhibitors. Powers is an associate professor of chemistry. Vallier is currently employed at Perrigo, Inc., as a quality-control technician. She conducted the research presented in this paper over the summer and academic year 2011-2012. This research was supported by an NIH R15 AREA grant to Powers.

Murph JH, Faulkes Z. Abundance and Size of Sand Crabs, Lepidopa benedicti (Decapoda: Albuneidae), in South Texas. *The Southwestern Naturalist*. 2013; 58: 4: 431-434. (The University of Texas-Pan American)

Sand crabs are a widely spread but little known family of crabs. This was the first research project to study the ecology of any species in this family. Faulkes is an associate professor in the Department of Biology. Murph performed this research as part of an REU program at UTPA in 2009-2010 and was supported by a National Science Foundation Research Experience for Undergraduates Site grant (award DBI- 0649273). She is currently a graduate student at Capella University.

Flinchum BA, Louie JN, Smith KD, Savran WH, Pullammanappallil SK, Pancha A. Validating Nevada ShakeZoning Predictions of Las Vegas Basin Response Against 1992 Little Skull Mtn. Earthquake Records. *Bulletin of the Seismological Society of America*. 2014; 104:1: 439-450. (University of Nevada, Reno)

This study developed a method of computing ground motions from earthquakes in Nevada and validated computations for

Las Vegas against recordings of southern Nevada's largest natural earthquake. Louie is a professor of geophysics in the Nevada Seismological Laboratory who teaches in the Department of Geological Sciences and Engineering of the Mackay School of Earth Sciences and Engineering, College of Science. Louie employed Flinchum and Savran as undergraduate interns from 2011 to 2012. Flinchum is currently enrolled in a master's program in geophysics at the University of Wyoming. Savran is currently in a joint San Diego State University-Scripps Institution of Oceanography PhD program. The research was supported by federal grants, UNR Foundation funds, and lab funds. Savran won a related undergraduate-research award from the university and a summer fellowship from the Southern California Earthquake Center. Flinchum undertook a summer internship from the Incorporated Research Institutions for Seismology at Miami University of Ohio.

Moreno D, Zunino F, Paul A, Lopez M. High strength Lightweight Concrete (HSLC): Challenges When Moving from the Laboratory to the Field. *Construction and Building Materials*. 2014; 56: 44–52. (Pontificia Universidad Católica de Chile)

High strength lightweight concrete (HSLC) has been studied extensively in the laboratory and used in projects over the last decade. Few studies have focused on the issues associated with the field implementation of HSLC, and these issues are explored and addressed in this study. There are small differences in the compressive strength, unit weight, modulus of elasticity, tensile strength, and bond strength of HSLC between the laboratory and the field. Special considerations during mixture design, careful moisture control of the lightweight aggregates, and consolidation are crucial for minimizing variability and maintaining performance in the field. Lopez is an associate professor in the School of Engineering at the Pontificia Universidad Católica de Chile. Moreno developed this research as part of his thesis work for a master's of science at the university. Zunino is currently a graduate student in the master's program at the institution. He collaborated on the data analysis and writing of this research paper as undergraduate in civil engineering through an undergraduate-research opportunity offered by professor Lopez. Paul is currently a PhD student at the Georgia Institute of Technology and collaborated on this research after completing his studies for a master's of science at the Chilean university. The research was funded by INNOVA-CORFO (07CT7PCT-09).

Frank MG, Hershman SA, Weber MD, Watkins LR, Maier SF. Chronic Exposure to Exogenous Glucocorticoids Primes Microglia to Pro-inflammatory Stimuli and Induces NLRP3 mRNA in the Hippocampus. *Psychoneuroendocrinology.* 2014; 40: 191-200. (University of Colorado)

Chronic stress, as well as chronic treatment with glucocorticoids (GCs), primes the neuroinflammatory response to a subsequent pro-inflammatory challenge. However, it remains unclear whether chronic GCs sensitize the response of key CNS immune substrates (i.e., microglia) to pro-inflammatory stimuli. In the study, chronic exposure to GCs induced a primed immunophenotype in microglia and sensitized microglia to pro-inflammatory stimuli. this work adds to a growing body of evidence suggesting that a permissive function of GCs is that of an endogenous danger signal. Frank is a senior research associate in the laboratory of Maier and Watkins in the Department of Psychology and Neuroscience. Hershman graduated from the University of Colorado Boulder in 2014 with a bachelor's degree in integrative physiology. She worked on this project as an undergraduate research assistant from 2012 to 2014, and she is currently applying to medical school while employed as a research assistant. The research was supported by fellowship awards to Hershman from the Undergraduate Research Opportunity Program and Biological Sciences Initiative at the University of Colorado Boulder in partnership with Howard Hughes Medical Institute.

Krall EM, Klein TW, Andersen RJ, Nett AJ, Glasgow RW, Reader DS, Dauphinais BC, Mc Ilrath SP, Fischer AA, Carney MJ, Hudson DJ and Robertson NJ. Controlled Hydrogenative Depolymerization of Polyesters and Polycarbonates Catalyzed by Ruthenium(II) PNN Pincer Complexes. *Chemical Communications*. 2014; 50: 4884-4887. (Northland College and University of Wisconsin-Eau Claire)

Billions of pounds of plastics are discarded each year, often after a single use. This study led to a new process for harvesting valuable chemicals from used plastics. Ruthenium(II) PNN catalysts hydrogenate polyesters to diols and polycarbonates to glycols plus methanol. Many of these dialcohols and glycols, which are currently derived from petroleum, are used in large amounts by chemical producers. Nicholas Robertson is an assistant professor of chemistry at Northland College, and Michael Carney is a professor of chemistry at University of Wisconsin-Eau Claire. Ten undergraduate students performed all of the laboratory work for this project over two years (2012-2013): seven at Northland College (Eric Krall, Tyler Klein, Ryan Andersen, Diana Reader, Brian Dauphinais, Sean McIlrath and Dylan Hudson) and three at UW-Eau Claire (Alex Nett, Ryley Glasgow and Anne Fischer). Krall is pursuing graduate school in coatings and polymeric materials at North Dakota State University. Andersen is employed and considering graduate school. Reader is pursuing graduate work in physical therapy.

McIlrath is enrolled in a doctoral program in chemistry at Northern Illinois University. Klein and Hudson are chemistry majors at Northland College in their junior years and are continuing on this project. Nett and Fisher are enrolled in PhD chemistry programs at the University of Michigan and Marquette University, respectively. Glasgow is a junior with a double major in chemistry and computer science at UW-Eau Claire. This work was supported by a Cottrell College Science Award from the Research Corporation for Science Advancement to NJR, and by the UW-Eau Claire Office of Research and Sponsored Programs.

Vaughan MB, Odejimi TD, Morris TL, Sawalha D, Spencer CL. A New Bioassay Identifies Proliferation Ratios of Fibroblasts and Myofibroblasts. *Cell Biology International*. 2014; 38 : 981-986. (University of Central Oklahoma)

This study tested a new method to visualize proliferation and differentiation of myofibroblasts; the assay allows the user to identify four different cell types within a population of cells. Treatments that target one of these cell types may now be monitored using this staining assay. Vaughan is a professor of biology; Morris is an associate professor of mathematics and statistics. Both Odejimi and Spencer were sophomores with student RCSA grants when they began this project and received additional support to continue work as juniors. Sawalha was a master's student in biology. Odejimi will enter Creighton Dental School next semester; Spencer is currently a senior in biomedical engineering. The research was supported by a UCO faculty RCSA grant to Vaughan, student RCSA grants to Odejimi and Spencer, a McNair Scholar award to Odejimi, and an NSF-OK-LSAMP grant to Spencer.