

UNDERGRADUATE RESEARCH Highlights

Helms CC, Marvel M, Zhao W, Stahle M, Vest R, Kato GJ, Lee JS, Christ G, Gladwin MT, Hantgan RR, Kim-Shapiro DB. Mechanisms of Hemolysis-associated Platelet Activation. *Journal of Thrombosis and Haemostasis* 2013;11: 2148-2154. (Wake Forest University)

Red-blood-cell hemolysis occurs in many pathological conditions, including in hemolytic anemias such as sickle cell disease and in transfusion of older stored. In this work, we determined that hemolysis leads to platelet activation via release of ADP and nitric-oxide-scavenging, cell-free hemoglobin. Platelet activation in hemolysis contributes to pathology through thrombotic and inflammatory pathways. Daniel Kim-Shapiro is a professor of physics and holds the Harbert Family Distinguished Chair at Wake Forest University. Madison Marvel worked on this project during her sophomore and junior years at Wake Forest. She was scheduled to graduate in May and then attend medical school at Southern Illinois University. This work was supported by the National Institutes of Health (grant HL058091).

Wise Jr., JP, Wise JTF, Wise CF, Wise SS, Gianio, J C, Xie H, Thompson WD, Perkins C, Falank C, Wise Sr., JP. Concentrations of the Genotoxic Metals, Chromium and Nickel, in Whales, Tar Balls, Oil Slicks, and Released Oil from the Gulf of Mexico in the Immediate Aftermath of the Deepwater Horizon Oil Crisis. *Environmental Science & Technology*. 2014;48:5: 2997-3006. (University of Southern Maine)

This publication is the first in an ongoing research project in our laboratory investigating the toxicological impact of the Deepwater Horizon oil crisis on the environment. Here we present the levels of chromium and nickel in oil collected from the oil well's riser, oil slicks collected from the ocean surface, and tar balls collected from the beach. We also present information on the significantly higher levels of both metals in the skin of sperm whales resident in the Gulf of Mexico when compared to the global average. Within the Gulf of Mexico, those whales sampled closest to the epicenter of the oil crisis typically had the highest levels of the metals. We discuss our concerns about the long-term impact of this exposure to heavy metals.

John Pierce Wise, Sr., is a full professor of toxicology and molecular epidemiology. The student who was first author on this paper, John Wise, Jr., led student efforts to collect environmental and biological samples from July

2010 through November 2010 in his junior year, and he prepared the manuscript in his final year in 2013. He has now graduated and is pursuing a PhD in neurotoxicology at Purdue University. James Wise aided in sample collection and constructed the GIS images within the manuscript in his senior year in 2012; he is now pursuing an MS in aquatic toxicology at the University of Southern Mississippi. Catherine Wise aided in sample collection and provided essential intellectual input while preparing the manuscript in her senior year in 2013; she is currently finishing her BS in biology at USM and intends to enroll in a PhD program in toxicology this coming fall semester. This work was funded by the University of Southern Maine, the Maine Center for Toxicology and Environmental Health, The Albemarle Corporation, the Campbell Foundation, the Ocean Foundation, Quiznos, NIEHS grant ES016893 (J. Wise, Sr., PI), ARO grant no. W911NF-09-1-0296 (J. Wise, Sr., PI), Ocean Alliance, and many individual and anonymous Wise Laboratory donors.

Stout D, Apel J, Commander J, Roberts M. Late Acheulean Technology and Cognition at Boxgrove, UK. *Journal of Archaeological Science* 2014;41: 576-590. (Emory University)

This study examined ancient (500,000-year-old) stone tools from the site of Boxgrove in order to draw inferences about the skill, understanding, and cognitive capacities of pre-modern (*Homo heidelbergensis*) tool-makers. Qualitative and quantitative (size and shape) attributes of the Boxgrove artifacts were compared to the experimental products of modern inexperienced, novice, and expert stone tool-makers. Results demonstrate the expert application of relatively complex tool-making techniques at Boxgrove and have implications for understanding the neurocognitive substrates, social transmission, and spatiotemporal distribution in this pre-human technology. Dietrich Stout is an assistant professor of anthropology. Julia Commander participated in this research as a volunteer for several years in Stout's lab, including academic 2011-12 as a Scholarly Inquiry and Research at Emory (SIRE) Research Partner. An anthropology major, she graduated in 2013 and is currently applying to graduate programs in museum conservation. This research was funded by the European Union project HANDTOMOUTH and by research grants from the Wenner-Gren and Leakey Foundations awarded to Stout.

Smith AL, Roobol MJ, Mattioli GS, Fryxell JE, Daly GE, Fernandez LA. *The Volcanic Geology of the Mid-Arc Island of Dominica, Lesser Antilles—The Surface Expression of an Island-*

Arc Batholith. Boulder CO: Geological Society of America, 2013: 1-249. (California State University, San Bernardino)

This study of the geology of the island of Dominica in the Lesser Antilles was a combination of extensive field and extensive laboratory work that resulted in the generation of a new geological map of the island; an extensive revision of the volcanic hazards on this island of more than 75,000 people; and the geochemical and mineralogical analysis of more than 300 rock samples. This combination of field and laboratory work resulted in a new approach to the interpretation of the geological and petrological evolution of a complex volcanologic and plutonic magmatic system over time. Alan Smith is with the Department of Geological Sciences at Cal State San Bernardino. George Daly participated in the field work as part of a Research Experiences for Undergraduates (REU) program and also undertook this research (field and lab) as his senior research project. He is currently in a doctoral program at Miami University of Ohio. The research was supported by an NSF REU grant (Smith), McNair grants (Daly), and a Summer Research grant from Cal State San Bernardino (Smith and Daly).

Rosenbaum AR, Juers DH, Juhasz MA. Copper-Promoted Cyanation of a Boron Cluster: Synthesis, X-ray Structure, and Reactivity of 12-CN-closo-CHB11H10-. *Inorganic Chemistry*. 2013; 52(19):10717-10719 (Whitman College)

The study explored carboranes, molecules that have potential uses as pharmaceuticals, advanced materials, and catalysts for industrial-scale chemical reactions. A copper catalyst combined with microwave heating was found to efficiently attach cyano (CN) groups to carboranes. The reaction method allowed three new carborane compounds to be prepared and characterized. Marcus Juhasz is an assistant professor of chemistry and Douglas Juers is an associate professor of physics. Aaron Rosenbaum, a senior chemistry major, carried out this research as part of a senior honors thesis. The research was supported by a Whitman College Louis B. Perry Research Award to Rosenbaum and Juhasz; a New Faculty Start-Up Award from the M. J. Murdock Charitable Trust; and funds from the National Science Foundation (Grant CHE-0922775). Rosenbaum is currently employed as a science teacher and is applying to graduate programs.

Uphouse L, Hiegel C, Adams S, Murillo V, Martinez M. Prior Hormonal Treatment, but Not Sexual Experience, Reduces the Negative Effect of Restraint on Female Sexual Behavior. *Behavioural Brain Research*. 2014;259: 35-40. (Texas Woman's University)

The effects of prior sexual experience or prior hormonal priming, without sexual experience, were compared in their ability to reduce the negative effects of restraint on female rat sexual behavior. Prior hormonal treatment reduced the impact of the stressor but prior sexual experience did not. Lynda Uphouse is a professor of biology. Sarah Adams, currently in the doctoral program at the University of North Carolina, contributed to this project in 2011. Vanessa Murillo worked on the project in 2011 and 2012 and is entering medical school. Monique Martinez contributed to the project in 2011 and is currently employed. The research was supported by NIH HD28419.

Fredman LA, Prohaska V. The Terror of Pregnancy: The Origin of Ambivalent Attitudes. *Psi Chi Journal of Psychological Research*. 2013;18:4: 176-183. (City University of New York - Lehman College)

Both terror management theory (TMT) and ambivalent sexism theory (AST) offer explanations of people's ambivalence and prejudice toward pregnant women. Extensions of each theory were examined. Negative attitudes toward menstrual blood were found to be similar to attitudes toward semen. But priming the similarities of humans and animals did not produce the expected increased offensiveness and lower competence evaluations of a pregnant woman. Overall, AST may provide a stronger conceptual framework for the explanation of ambivalent attitudes toward pregnant women than TMT. Vincent Prohaska is an associate professor of psychology. This project was Leah Fredman's undergraduate honors project in psychology. Fredman is currently enrolled in the doctoral program in social psychology at the University of Texas at Austin. This project was supported by a Psi Chi Association for Psychological Science Summer Research Grant awarded to Fredman.

Barnes T, Shulman A, Farone A, Farone M, Erenso D. Assessment of the Elasticity of Erythrocytes in Different Physiological Fluids by Laser Traps. *Optics and Photonics Journal* 2013;3:2: 211-216. (Middle Tennessee State University)

This article presents a study of the effects of physiological fluids commonly used to suspend red blood cells (RBCs) on the cells' elasticity. By suspending the RBCs in fetal bovine serum (FBS), newborn bovine serum (NBBS), and phosphate buffer saline (PBS) solution, and deforming the cells using two laser traps, we have studied the elasticity of cells in each of these fluids. The result for the NBBS is not statistically different from the PBS solution; however for FBS the elasticity is significantly higher. Daniel Erenso is a professor of physics, and Anthony Farone and Mary Farone are professors of biology at Middle Tennessee State University. Two undergraduate students participated in the research in

2006 and 2012: Taylor Barnes is currently a graduate student at the California Institute of Technology, and Adam Shulman is a medical physicist at Overlook Hospital in Jersey City, New Jersey. The research was supported by Middle Tennessee State University Undergraduate Research Experience and Creative Activity Grants, which provided summer stipends to the students.

Cunningham CN, Schmidt CA, Schramm NJ, Gaylord MR, Resendes KK. Human TREX2 Components PCID2 and Centrin 2, but not ENY2, Have Distinct Functions in Protein Export and Co-localize to the Centrosome. *Experimental Cell Research*. 2014;320:2: 209-18. (Westminster College)

Regulation of nuclear entry and exit via the various mechanisms of nuclear transport is critical for a plethora of cellular functions, including regulated gene expression and cell cycle progression. Alterations of nuclear transport pathways have been linked to various genetic diseases, and deregulation of nuclear transport factors can contribute to the progression of cancer. This research characterized the role of the protein PCID2 in the nucleus and beyond. Specifically, our results represented the first discovery of specific novel functions for PCID2 other than its known function in mRNA export and suggested that PCID2 along with another mRNA export factor, centrin 2, serve alternative shared roles in the regulation of nuclear protein transport and cell cycle progression. Karen Resendes is an assistant professor of biology. Corey Cunningham, now a first-year graduate student at the University of Michigan, worked on this project to fulfill his capstone research requirement in biology and continued on the project as an independent study. Casey Schmidt, now a second-year graduate student at the University of North Carolina Chapel Hill, and Nathaniel Schramm, a junior at Westminster, both contributed work from their honors research projects to this publication. The research was supported in part by the Westminster College Drinko Center.

Camenga K, Rault PX, Rossi D, Sendova T, Spitkovsky I. Numerical Range of Some Doubly Stochastic Matrices. *Applied Mathematics and Computation*. 2013;221: 40-47. (State University of New York, College at Geneseo)

A classification of all possible shapes is given for numerical ranges of 4-by-4 doubly stochastic matrices. The tests determining the shape are also provided, along with illustrative examples. Kristin A. Camenga is an associate professor of mathematics at Houghton College; Patrick X. Rault is an assistant professor of mathematics at the SUNY College at Geneseo; and Tsvetanka Sendova is an assistant professor of mathematics at Bennett College. Daniel Rossi

completed an honors thesis in mathematics in 2012. Work on this paper began during the REUF workshop at the American Institute of Mathematics in July 2011, supported by the National Science Foundation.

Banait A, Vishwakarma V, Choobineh L, Jain A. Thermally-assisted Spatially-directed Pore Formation in Polydimethylsiloxane (PDMS). *Applied Physics Letters*. 2013;103: 1-5. (The University of Texas at Arlington)

This research presents a means to achieve spatially controlled self-assembly of micropores in the soft polymer Polydimethylsiloxane (PDMS). The proposed method utilizes thermocapillary effect, which causes bubbles in uncured PDMS to migrate toward a hot region created by a micro-scale heating device on a micro-fabricated chip. As a result, pores can be formed in different patterns by controlling the shape of the microheater. Linear and C-shaped pore formation was demonstrated, and it was observed that pore formation mechanism is governed by microheater temperature. Ankur Jain is an assistant professor in the Department of Mechanical and Aerospace Engineering at UT Arlington. This research was undertaken during Arya Banait's junior year and is now the topic of her senior honors thesis. Banait is a senior in mechanical engineering at UT Arlington and will be attending graduate school at Stanford University in fall 2014. Jain is currently mentoring Vivek Vishwakarma and Leila Choobineh on their doctoral degrees at the Microscale Thermophysics Laboratory, part of the Department of Mechanical and Aerospace Engineering, at UT Arlington. A part of this research was funded by the UT Arlington Honors College through an Undergraduate Research Assistantship awarded to Banait in Summer 2013.

Arena, CM, Galebach, JL, Engle, JM, Anderson, MG. Impact of Acid Mine Drainage (AMD) on Diatom Populations in a Pennsylvania Stream. *Microbe Library Digital Gallery*. 2013;12. <http://microbelibrary.org/library/microscopy/3813-impact-of-acid-mine-drainage-amd-on-diatom-populations-in-a-pennsylvania-stream>. (Mount Aloysius College)

The study was undertaken to collect water-quality and diatom samples from one healthy stream site and three sites affected by drainage from abandoned mines. Permanent diatom mounts were created to form slide sets for use in introductory microbiology and water-ecology courses. Diatoms were identified, counted, and documented using the SPOT software system. The micrographs were submitted to the Microbe Library for use by educators at other institutions to enhance lecture or laboratory courses. Analysis of differences in diatom populations at the four sites, and seasonal population changes, are ongoing and

involve several more undergraduate students. Michael Engle is an associate professor of science and mathematics, and Merrilee Anderson is professor of science and mathematics and department chair. Two undergraduates, Chris Arena and John Galebach, are both biology majors who undertook the research during summer 2013 and independent study during regular semesters. Arena is now a junior student and Galebach, who graduated in December 2013, is currently applying to graduate school. The research was supported by NSF grant 1226175, Expanding and Refining the Application-Based Service-Learning Pedagogy, with principal investigator Nancy Trun from Duquesne University.

Solomon R, Cooper J, Aguilar E, Welker J, Pennycuff C, Scott D, Flanagan B, Erenso D. Physical and Mechanical Properties of the Human Red Blood Cells with Different Hemoglobin Types. *Proceedings of the National Conference on Undergraduate Research (NCUR)*. 2013. <http://www.ncurproceedings.org/ojs/index.php/NCUR2013/article/view/459/387>. (Middle Tennessee State University)

This article reports an experimental study conducted on the response of the human red blood cells (RBCs)

from blood samples with different types of Hemoglobin (HbAS), (HbSS), (HbAA), and (HbFF) to direct laser trap. The hemoglobin quantitation study was conducted using Ultra2-High Performance Liquid Chromatography. The response was analyzed using size changes of the trapped cells relative to the corresponding free size in relation to the hemoglobin quantitation for each blood sample. Daniel Erenso is a professor of physics. Anthony Farone and Mary Farone are professors of biology. Robert Mushi is the director of the laboratory and Maria del Pilar Aguinaga is the associate director and a professor at the Sickle Cell Center. Seven undergraduates participated in the research over the summer of 2012: Rance Solomon, James Cooper, Gabriel Welker, Elaura Aguilar, Brooke Flanagan, Chelsey Pennycuff, and David Scott. Solomon, Cooper, and Welker are currently seniors majoring in physics. Aguilar, Flanagan, Pennycuff, and Scott are seniors currently majoring, respectively, in nursing, biology, mathematics, and English. The research was supported by grants from the National Science Foundation and by Middle Tennessee State University Undergraduate Research Experience and Creative Activity Grants, which provided some student summer stipends.