UNDERGRADUATE RESEARCH Highlights

Overholt, E.P., Hall, S.R., Williamson, C.E., Meikle, C.K.*, Duffy, M.A. and Caceres, C.E. Solar radiation decreases parasitism in Daphnia. *Ecology Letters*. 2012;15. http://www.wiley.com/WileyCDA/WileyTitle/productCd-ELE.html. (Miami University Oxford Ohio)

This article is significant because water transparency is decreasing in many lakes and rivers in the USA and other parts of the world, and it suggests that decreases in the penetration of light will reduce the natural disinfection abilities of sunlight not only for Daphnia parasites, but potentially human pathogens. Craig Williamson is a Professor of Zoology and Ohio Eminent Scholar. Claire Meikle has contributed substantially to this project, starting as a high-school student, and more recently as a freshman in Zoology at Miami. In addition to contributing to the experiments, she provided input to the writing of the manuscript. She continues her work in Craig Williamson's lab, exploring the interactions of UV and parasites, including the possibility that UV may have some beneficial effects for Daphnia, which is far less sensitive to UV than is the parasite. This project was funded through the Eminent Scholar fund and USS and undergraduate research awards.

Winland C, Bolton JL, Ford B, Jampana S, Tinker J, Frohardt RJ, Guarraci FA, Zewail-Foote M. "Nice guys finish last": influence of mate choice on reproductive success in Long-Evans rats. *Physiol Behav.* 2012;105: 868-876. (Southwestern University)

The present study was designed to investigate the relationship between physiology and mating behavior, and how these relationships predict reproductive success in Long-Evans rats. Mating behavior was observed in female rats that were given the opportunity to mate with two males simultaneously. Behavioral and physiological measures were assessed for each pair of potential fathers and DNA paternity was assigned for each pup. Our results show that although one male rat in each pair was preferred by a female rat, none of the measures tested (e.g., urinary testosterone, testicular weight, mating behavior) predicted which male had a reproductive advantage. Maha Zewail-Foote is associate professor of Biochemistry. Fay Guarraci is an associate professor of Psychology.Russell Frohardt is an associate professor of psychology at St. Edward's University. Psychology majors, Carissa Winland and Sumith Jampana, and Animal Behavior majors, Jessica Bolton, Brittany Ford and Jade Tinker, conducted this research in 2010-2011 as part of their senior capstone projects. Carissa is currently a doctoral student at Georgetown University in Neuroscience. Jessica is currently a doctoral student at Duke University in Neuroscience and was awarded an NSF Graduate Research Fellowship. Brittany is employed as an environmental scientist at Conestoga-Rovers and Associates. Sumith is a graduate student at the University of Medicine and Dentistry of New Jersey. Jade is a graduate student at the University of Utah in Genetic Counseling. The research was supported by grants from the Associated Colleges of the South Andrew W. Mellon Faculty Renewal Program and the Andrew W. Mellon Integrated Scholarly Community Program.

Bendorf HD, Ruhl KE, Shurer AJ, Shaffer JB, Duffin TO, LaBarte TL, Maddock ML, Wheeler OW. Amine-directed intramolecular hydroacylation of alkenes and alkynes. *Tetrahedron Lett.* 2012; 53:10:1275-1277. (Lycoming College)

Benzazepines are biologically active and, as such, are of interest as pharmaceutical agents. However, the medium-ring moiety that is present in these compounds presents a synthetic challenge. This paper reports a method for the rapid and efficient synthesis of benzazepines and related medium-ring nitrogen heterocycles via heteroatom-directed rhodium-catalyzed intramolecular hydroacylation. Holly Bendorf is an associate professor of chemistry. Kyle Ruhl conducted much of this research for his senior honors thesis. He is enrolled in the Ph.D. program in chemistry at Colorado State. Chemistry majors Andrew Shurer, Tess Duffin, Theresa LaBarte, Michelle Maddock, and Oscar Wheeler each completed at least one semester of research as part of their senior capstone experience. Jennie Shaffer, a chemistry minor, completed a semester of research as an independent study. Andrew is employed at Martek Biosciences, Tess is pursuing a Masters in chemistry at Villanova University, Theresa is completing her medical residency, Michelle

works for Covance, Inc., Oscar is in the chemistry Ph.D. program at the University of Utah, and Jennie is employed by Susquehanna Health Services. We are grateful for support from the Petroleum Research Fund (ACS-PRF #49342-UR1) and by the alumni-supported Lycoming College Chemistry Research Fund. KER acknowledges a Joanne and Arthur Haberberger Fellowship.

Sinclair J, Walhout M. Dielectric-barrier discharges in two-dimensional lattice potentials. *Phys Rev Lett*. 2012;108:3:035005-(1-4).(Calvin College)

This work connects the study of pattern formation in dielectric-barrier discharge (DBD) systems with areas of physics involving particles and interactions in two-dimensional (2D) lattice potentials. To date there have been many investigations of how plasma filaments in a DBD can arrange themselves in various 1D and 2D patterns. The present study introduces a nonuniform electric-field profile that has the form of a 2D square lattice and provides a template for various filament patterns. The observed patterns are reminiscent of those found in many other physical systems. Matthew Walhout is a professor of physics and the dean for research and scholarship at Calvin College. Josiah Sinclair is an undergraduate student at Calvin College. He undertook this project as a summer research fellow after his sophomore year. The research was supported by Calvin College and the National Science Foundation (Grant PHY-1068078).

Miller CJ, Gounder SS, Kannan S, Goutam K, Muthusamy VR, Firpo MA, Symons JD, Paine R, Hoidal JR, Rajasekaran NS. Disruption of Nrf2/ARE Signaling Impairs Antioxidant Mechanisms and Promotes Cell Degradation Pathways in Aged Skeletal Muscle. *Biochem. Biophys. Acta- Molecular Basis of Disease*. 2012;1822:1038-1050. (University of Utah, Salt Lake City, UT)

Our recently published study was to understand the role of Nrf2, a master transcription factor that regulates a majority of antioxidant/cytoprotective genes. Activation of Nrf2-antioxidant response element signaling is protective against reactive oxygen species/free radicals. The study had used wild-type (control) and Nrf2-knockout (Nrf2-/-) mice at 2 and >22 months of age. A number of biochemical and molecular biology techniques were used to analyze the mechanisms for age dependent Nrf2 regulation. Our findings reveal that the levels and stability of Nrf2 and antioxidnat genes were decreased on aging and induces cell degeneration/death pathways in skeletal muscles. This is significant as Nrf2 could be a potential therapeutic target to protect the skeletal muscle from age-dependent accumulation of free radicals. Rajasekaran N. Soorappan (supervisor) is an Assistant Professor of Medicine in the Division of Cardiology, Department of Medicine at the University of Utah. Corey Miller is a senior Exercise Physiology major and a pre-medical student who has been involved in mouse breeding, genotyping, harvesting tissues and biochemical analysis. Corey worked part-time since June-2010 to present. The co-first author Sellamuthu S. Gounder had performed molecular biology analysis, immunology, statistical analyses and prepared figures for the manuscript since May 2011. Corey received support from the Undergraduate Research Opportunities Program (UROP) and the Division of Cardiology. This research was supported by Center on Aging, University of Utah and American Heart Association.

Urity VB, Issaian T, Braun EJ, Dantzler WH, Pannabecker TL. Architecture of kangaroo rat inner medulla: Segmentation of descending thin limb of Henle's loop. *Am J Physiol Regul Integr Comp Physiol*. 2012;302: R720-R726. (University of Arizona)

One of the major functions of the mammalian kidney is to maintain body salt and water balance. The kangaroo rat is a desert species that rarely drinks water and therefore provides a good model for understanding the process of water conservation by the kidney. This study highlights several features of kangaroo rat kidney architecture and protein expression patterns involved with water and solute flows through renal tubules that may underlie the exceptional ability of the kangaroo rat kidney to minimize water loss. Drs. Thomas Pannabecker, Eldon Braun, and William Dantzler are professors in the Dept. of Physiology, University of Arizona. Vinoo Urity and Tadeh Issaian participated in this research for independent study credit during academic year and summer semesters – Vinoo for 4 years and Tadeh

for 2 years. Vinoo was supported in part by the University of Arizona Undergraduate Biology Research Program and wrote an Honors thesis based on his contribution to the project. Vinoo is currently a graduate student at the University of Texas. Tadeh teaches in Tucson elementary schools. This research is supported by the National Science Foundation, Grant IOS 0952885.

Glazier DS, Butler EM, Lombardi SA, Deptola TJ, Reese AJ, Satterthwaite EV. Ecological effects on metabolic scaling: amphipod responses to fish predators in freshwater springs. *Ecol Monogr.* 2011;81:4: 599-618. (Juniata College)

This article describes the effect of fish predators on the body-mass scaling of metabolic rate in a freshwater amphipod crustacean. We tested several hypotheses to explain this ecological effect, and conclude that it is most likely the result of size-selective predation altering the ontogeny of growth, a metabolically expensive process. We show that ecological factors may significantly influence metabolic scaling, contrary to common belief. Our results may have consequences for theoretical models that use metabolic scaling to predict the rates of various biological and ecological processes. Doug Glazier is a professor of biology. The other coauthors participated in this project as undergraduate students during 2004-2010. Eric Butler received his PhD in zoology at North Carolina State Univ.; Sara Lombardi is presently completing the requirements for a PhD in marine biology at the Univ. of Maryland; Travis Deptola obtained a MS in geological sciences at the Pennsylvania State Univ.; Andrew Reese is working as a laboratory technician; and Erin Satterthwaite is currently a marine ecology graduate student at the Univ. of California, Davis. The research was supported by grants from the Kresge Foundation and William J. von Liebig Foundation awarded to Juniata College.

Durig JR, Panikar SS, Obenchain DA, Bills BJ, Lohan PL, Peebles RA, Peebles SA, Groner P, Guirgis GA, Johnston MD. Microwave, infrared and Raman spectra, r0 structural parameters, ab initio calculations and vibrational assignment of 1-fluoro-1-silacyclopentane. J Chem Phys. 2012; 163:4: 044306/1-044306/10. (College of Charleston, University of Missouri-Kansas City and University of Eastern Illinois)

The microwave spectrum of 1-fluoro-1-silacyclopentane, c-C4H8SiHF has been recorded and 87 transitions for the 28Si, 29Si, 30Si, and 13C isotopomers have been assigned for a single conformer. IR spectra of the gas and solid and Raman spectra of the solid and liquid indicated the presence of a single conformer with no symmetry which is consistent with the twist form conformation which is contrary to the prediction from ab initio calculations that the envelope axial and equatorial conformers should be most stable. Gamil A. Guirgis is a University Professor of Chemistry Michael D. Johnston participated in the research for Introductory Research credit and he is currently a graduate student at the University of Massachusetts at Amherst

Blaser RE, Goldsteinholm K. Depth preference in zebrafish (Danio rerio): control by surface and substrate cues. *Anim Behv.* 2012;83:953-959. (University of San Diego)

Depth preference of zebrafish was measured using a modified visual cliff apparatus. Zebrafish expressed a preference for the deeper side of a tank when they could escape to the deeper side, but also when one side only appeared deeper using a visual cliff illusion. Fish expressed no preference for locations in which they could approach the substrate, indicating that escape from the surface, rather than approach to the substrate, motivates fear-induced diving in zebrafish. Rachel Blaser is an assistant professor of psychology. Kelly Goldsteinholm is currently a junior psychology major, and assisted with the research during her sophomore year for course credit. She is planning to apply to graduate programs in clinical psychology following graduation. The study was supported by a University of San Diego faculty research grant.

Yahdi M, Abdelmageed S, Lowden J, Tannenbaum J. Vancomycin-resistant enterococci colonization–infection model: parameter impacts and outbreak risks. *Journal of Biological Dynamics*. 2012;6:2: 645–662. (Ursinus College)

Vancomycin-resistant enterococci (VRE) infections have been linked to increased mortality and costs.A new model of a VRE-infested intensive care unit (ICU) is introduced. It incorporates new factorsincluding the difference between colonization and infection, the role of special preventive care treatment cycles and antibiotic use. Strategies to minimize VRE infections and outbreak risk are explored with a focus on the level of special preventive care and ICU compliance rate. Mohammed Yahdi is an associate professor of mathematics and computer science at Ursinus College Part of this work was undertaken through the NSF-REU site in mathematical sciences at Ursinus College. Other parts of this work were undertaken through independent research and senior research projects.Sara Abdelmageed is currently in a doctoral program in Mathematical Biology at the University of Tennessee. Jon Lowdenb is currently in a doctoral program in Computational Mathematics at Duquesne University. Lloyd Tannenbaum is currently in a medical program at the Jefferson Medical School. This project is based upon the work supported in part by the National Science Foundation under Grant No. 1003972.

He Z, Xiao K, Durant W, Hensley DK, Anthony JE, Hong K, Kilbey II SM, *Chen J, and Li D. Enhanced performance consistency in nanoparticle/TIPS pentacene-based organic thin film transistors. Adv. Funct. *Mater.* 2011;21:19:3617–3623. (The University of Alabama and Oak Ridge National Laboratory)

In this study, we take a novel approach to manipulate the morphology of 6,13-bis(triisopropylsilylethynyl)-pentacene (TIPS pentacene) thin film by blending inorganic silica nanoparticles and study the performance of solution-processed organic thin film transistors (OTFTs). The resultant drop-cast films yield improved morphological uniformity at ~10% SiO2 loading. We conclude that the blending of SiO2 and TIPS pentacene is an effective way to reduce the crystal anisotropy and enhance device performance uniformity. Dr. Dawen Li is an Assistant Professor in the Department of Electrical and Computer Engineering at The University of Alabama. Currently Mr. William Durant is still enrolled as an undergraduate student in Electrical and Computer Engineering at UA. Mr. Durant conducted the research under supervision of Dr. Li as a summer intern student at Oak Ridge National Laboratory. Supported by summer intern program from the Oak Ridge National Laboratory and Alabama DOE EPSCoR travel fund at UA

Qiu Y, Seager M, Osman A, Castle-Miller J, Bevan H, Tortonese DJ, Murphy D, Harper SJ, Fraser HM, Donaldson LF, Bates DO. Ovarian VEGF165b expression regulates follicular development, corpus luteum function and fertility. *Reproduction*. 2012;143:501-11. (University of Bristol)

To determine the role of the VEGF165b isoforms in the ovulatory cycle, VEGF165b expression in marmoset ovaries was measured by immunohistochemistry and ELISA, demonstrating that the anti-angigoenic VEGF165b was expressed in the marmoset ovaries in granulosa cells and theca, and the balance of VEGF165b:VEGF165 was regulated during luteogenesis. Transgenic mice over-expressing VEGF165b in the ovary were less fertile than wild-type littermates, had reduced secondary and tertiary follicles after mating, increased atretic follicles, fewer corpora lutea and generated fewer embryos in the oviduct after mating, and these were more likely not to retain the corona radiata. These results indicate that the balance of VEGFA isoforms controls follicle progression and luteogenesis, and may regulate fertility in mammals, including in primates. David Bates is Professor of Microvascular Biology and Medicine and director of the Microvascular Research Laboratories in the School of Physiology and Pharmacology at the University of Bristol. Ahmed Osman and Matt Seager were undergraduate Physiology students working with the postdoc first author Dr Yan Qiu in prof Bates' group in the MVRL for a 12 week research project that they wrote up for their final year honours project. They are now both completing medical degrees at the University. Research was supported by the Wellcome Trust and the School of Physiology and Pharmacology