

Department Update

Plant Molecular Genetics Lab Research

2013 Research Partners

Animal Physiology Lab

Student News

Faculty Publications and Seminars

Faculty Teaching Awards

Spring Phonathon

April 6-10, 2014

Your chance to update your contact info, share your thoughts and news, talk with current BioSci students, and contribute to the Biological Sciences department.

Gene Family Evolution in Plants

Students in **DR. RONALD FRANK'S** Plant Molecular Genetics Lab use a variety of bioinformatics tools to study the structure, expression, and evolution of gene families in soybean. The soybean genome sequencing project was completed in January 2010 and researchers estimate that among the more than 46,000 protein-coding genes, about 32,000 of them belong to one of 9-12,000 gene families.

Students in **DR. FRANK'S** lab begin by identifying each member gene in the family and its location in the genome. The origins of these gene families, whether by whole genome duplication or individual segmental duplications, is one of the aspects of gene family evolution that students are able to investigate. They can accomplish this by a number of strategies including phylogenetic analysis, calculating synonymous substitution rates in the encoded proteins, and by searching for clues among the neighboring genes flanking each family member.

To gather information on the expression levels of each family member, students take advantage of the fact that over 1 million ESTs (expressed sequence tags) have been deposited in a database at NCBI (National Center for Biotechnology Information). Students can screen the ESTs for those that belong to individual family members, and then examine the cDNA library from which each EST originated. This provides some insight as to the particular tissue or environmental condition in which that particular gene family member is expressed. Further alignment of the ESTs with the gene family member indicates the location of introns and possible instances of alternative splicing.

Clues to the actual function of the protein product come from bioinformatics tools that are able to compare not only primary structure (amino acid sequence) but the predicted secondary and tertiary structure with those of proteins whose function is known.



Graduate Student Lisa Snoderly-Foster performs calculations

Along the way students have also discovered many fossil genes (pseudogenes). These are genes that at one time produced functional protein products, but through millions of years of mutations have caused it to decay into something that resembles the original but is no longer transcribed and translated.

DR. FRANK has been studying the PAL (phenylalanine ammonia lyase) gene family for some time. He has discovered eight family members, three of which appear to be pseudogenes. Among the other five, only three are expressed to any significant levels and one gene accounts for over 80% of all expression from this family. Each family member except one has a sister gene that can be traced back to a whole genome duplication that took place in soybean about 13 million years ago. **KENT LIN**, an undergraduate student currently working in the lab, is investigating the hypothesis that the sister gene was lost when the end of the chromosome on which it was located broke off, thereby eliminating all genes on the segment. **LISA SNODERLY-FOSTER**, a graduate student working in the lab since 2012, is studying a family that appears to have expanded in the soybean lineage. She has identified five family members in soybean but no more than one in other legumes or more distantly related plant species.

Department Update

The Missouri S&T Department of Biological Sciences is an academic community focused on learning and discovery. The S&T BioSci community provides a supportive, collegial, challenging and rewarding environment for its faculty, students and staff.

Strategic Plan: The Board of Curators fully funded the Missouri S&T Strategic Plan that had been under development for the last 18 months. As part of an initiative to hire 100 new faculty members, the BioSci department has initiated a search for a faculty member in the area of synthetic biology. We have also requested a new faculty position in metagenomics as well as a technical support person.

The BioSci faculty developed a departmental strategic plan that is consistent with the institution's plan. Our Strategic Statement is as follows: **To become the school of choice for 450 biology majors by 2020 by offering outstanding learning and research opportunities and career preparation in an inclusive and interactive academic community.**

The BioSci plan is comprehensive and aggressive, and envisions growth and improvements in student body, faculty, research-productivity, and teaching effectiveness. The complete plan will be posted on our web site when it is has been approved by the school. Our plan encompasses 30 specific actions in 4 areas: 1) Involving all students in experiential learning, 2) increasing research productivity, 3) increasing the number of students, and 4) improving instruction by enhancing teaching labs and incorporating active learning strategies and educational innovations in delivery and assessment.

Among the important actions incorporated in the plan are:

- 1) increasing student participation in research
- 2) expanding student scholarships
- 3) offering more field courses
- 4) establishing doctoral level training in life sciences
- 5) increasing extramural funding
- 6) recognizing student leaders
- 7) developing a biology field station
- 8) improving core research facilities
- 9) increasing the number of scientific publications
- 10) hiring additional faculty
- 11) increasing the number of undergraduate majors to 250
- 12) reducing the student:faculty ratio
- 13) establishing a nursing school affiliation
- 14) increasing support from alumni.

Students: A record 49 students graduated from the BioSci department in 2013, including 18 in December. More than half graduated with honors, and 78 BioSci students were named to the Provost's Academic Scholars List (which we recognize with a certificate and a large chocolate bar). Other records set include, the number of students with OURE research grants (19), student enrollment, and the number of student credit hours. **SIERRA COMER, KATE MENKE** and **SERENA AUSTIN** shared the second annual Troutbuster Scholarship.

Research: In 2013, BioSci faculty members published 17 (vs. 12 in 2012) peer reviewed research publications, 4 book chapters (vs. 0), presented 25 (vs. 12) papers at national and international meetings, and were invited to give 16 (vs. 9) talks in various professional venues. Clones sales from the cDNA Resource Center have totaled over \$2.1 million since FY2005.

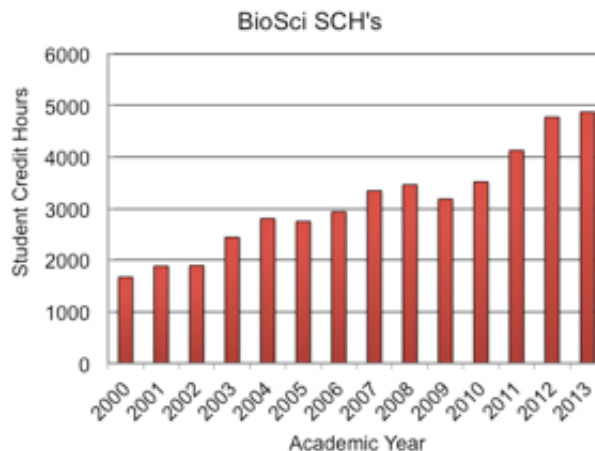
Ensuring continuous research support for our students and faculty is one of our greatest priorities. While faculty members actively pursue extramural finding opportunities, we are exploring ways to develop additional sources of support. Accordingly, three years ago the department established faculty research accounts funded with income from 1) summer session tuition, 2) grant overhead incentives, 3) donations, 4) biotech sales, 5) research endowment income, and 6) PLTW course credits. In 2013 the amount of distributed money increased to >\$62,000. This is an innovative approach that we seek to expand.

Alumni and Development: We are pleased to recognize in this newsletter those who generously supported the department in 2013. Donations to the department increase to a record \$16,385. The consistent support we receive from our alumni and friends provides the means to strengthen our academic community and support innovation in both teaching and research.

As always, I am pleased to provide you with this update. Many further details on our activities are available on our website (biosci.mst.edu), look under the "Useful Links" section to access our Annual Report, and our FaceBook Page ("Missouri S&T Biology"). Your comments and suggestions are welcome. And of course, I invite you to visit the department for a tour and update.



Robert S. Aronstam, Ph.D.
Professor and Chair, Biological Sciences



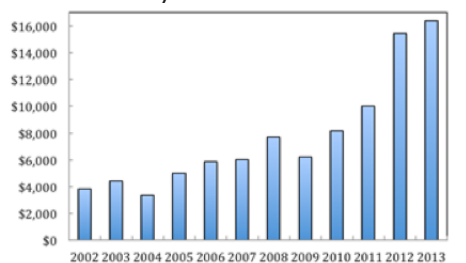
Graph above shows rising student credit hours, which represents the total number of lecture and lab credit hours taught by Biological Sciences

2013 Research Partners

We are pleased to recognize those who generously supported the department in 2013. Donations to the department increase to a record \$16,385. The consistent support we receive from our alumni and friends provides the means to strengthen our academic community and support innovation in both teaching and research. Finally, TroutBusters of Missouri renewed their funding of scholarships for S&T Ecology students.

Contributions are welcome at any time and can be made on the S&T web site (giving.mst.edu) (be sure to designate Biological Sciences as the recipient fund). The cadre of BioSci alumni continues to grow, although half have graduated in the last 10 years, reflecting our recent consistent growth.

We appreciate all you do to support the department and its students and hope you will continue to be able to do so. We welcome your feedback on any of our activities or plans, and invite you to visit when you are in Rolla.



Donations to the BioSci department. Excludes donations to specific programs and gifts in kind.

Donations up to \$100

Dr. Kathleen B. Bottroff D.O.
Rachel Lee Carter
John Gerald Cooley
Gerald Alan Griffith
Taylor A. Hahn
George W. Karr
Jonathan Kwantes
Lisa and Stanley Lindesmith
Sara J. Stephans
Susan Nickols
Steven C. Peppers
Christina Marie and Richard Alan Schmidt
Joseph G. Sueme III
Erica K. Shannon
Drs. John Joseph and Julie Deles Stansfield
Julie Sellmeyer Townsend
Matthew F. Vogel

Donations of \$100 to \$499

Michael C. Abernathy
Michelle R. Brosnahan
Ann M Caudill
Betsey Marie Dampier
Dr. Brian Edward Haggard PhD.

Amy Marie Johnston
Anthony and Julie Kaczmarek
Anthony C. and Christiane Kay Korba
Helen P. Law
Dr. Paula M. and Leonard Lutz
Michael W. McMenus
Monsanto Fund*
Leslie Wayne Moody
Brad Alan and Marcie Lanette Rucker
Anne Schumer
Dr. Paul Stricker

Donations of \$500 to \$999

Dr. James and Rebecca Flechtl
Midwest Science (MIDSCI)

Donations > 1,000

Robert S. and Joan Aronstam
Amedica
Joseph A Safron
Baxter International Foundation*
Dr. Melanie R. Mormile
Stacy Lynd Story
Troutbusters of Missouri

* Matching Gift Companies

Teaching Awards for the Biological Sciences Department

DR. ANN WEST, adjunct professor of Biological Sciences, was recently honored with a Teaching Commendation from the Missouri S&T Committee on Effective Teaching. These awards are based solely on student evaluations. **DR. WEST** teaches a problem-based learning class, Biomedical Problems. **DR. WEST** will probably be offering multiple new courses in the near future. Former student Kelsey Hunt said "Biomedical Problems was a fantastic class! It taught you to think outside your realm of knowledge and learn information on your own. It was great to work in groups to solve a case, just like you will have to in the medical field."



Dr. Ann West, adjunct Professor in Biological Sciences



MS. TERRY WILSON received an Outstanding Teaching Award from Provost Kent Wray at a ceremony on Monday, November 18th. These awards are based on student evaluations of teaching effectiveness. **PROFESSOR WILSON** teaches Principles of Biology and Biodiversity, as well as the laboratories for Cell Biology, General Biology and Biodiversity. "Professor Wilson is great at presenting information in a way that makes it easy to understand. I have learned and continue to learn a substantial amount of information in her classes," said student Jordan Powell.

Faculty News

Faculty Publications, 2013

Chusuei, C.C., C.-H. Wu, S. Mallararapu, J.G. Winnariz, J.-S. Moon, **R.S. Aronstam** and **Y.-W. Huang**, Cytotoxicity in the age of nano: cell toxicity reflects certain physicochemical properties of fourth period of metal oxide nanoparticles, *Chemico-Biological Interactions*, 205(2) 319-326, 2013.

Hou, C., The energy trade-off between growth and longevity, *Mechanisms of Ageing and Development* 134:373-380, 2013.

Liou, J.-S, B.R. Liu, Y.-H. Che, **Y.W. Huang** and H.-J. Lee, Delivery of nucleic acids, proteins, and nanoparticles by arginine-rich cell-penetrating peptides in rotifers. *Marine Biotechnology* doi:10.1007/s10126-013-9509-0, 2013.

Liu, B.R, H.-J. Chiang, **Y.-W. Huang**, M.-H. Chan, H.-H. Chen and H.-J. Lee, Cellular internalization of quantum dots mediated by cell-penetrating peptides. *Pharmaceutical Nanotechnology* 1(2): 151-161, 2013.

Liu, B.R., S.-Y. Lo, C.-C. Liu, C.-L. Chyan, **Y.-W. Huang**, **R.S. Aronstam** and H.-Jung Lee, Endocytic Trafficking of Nanoparticles Delivered by Cell-penetrating Peptides Comprised of Nona-arginine and a Penetration Accelerating Sequence, *PLOS One*, June 26 8(6):e67100. DOI:10.1371/journal.pone.0067100, 2013.

Liu, B.R., S.-Y. Lo, **Y.-W. Huang**, **R.S. Aronstam** and H.-Jung Lee, Intracellular Delivery of Nanoparticles and DNAs by IR9 Cell-penetrating Peptides, *PLOS One*, May 28;8(5):e64205. doi: 10.1371/journal.pone.0064205, 2013.

Liu, B.R., Winiarz, J.G., Moon J.-S, Lo, S.-Y., **Huang, Y.-W.**, **Aronstam, R.S.**, and Lee, H.-J., Synthesis, characterization and applications of carboxylated and polyethylene-glycolated bifunctionalized InP/ZnS quantum dots in cellular internalization by cell-penetrating peptides, *Colloids and Surfaces B: Biointerfaces* 111C:162-170, doi: 10.1016/j.colsurfb.2013.05.038, 2013.

Liu, B.R., **Y.-W. Huang**, H.-J. Chiang and H.-J. Lee, Mechanistic studies of intracellular delivery of proteins by arginine-rich cell-penetrating peptides in cyanobacteria, *BMC Microbiology* 13:57, 2013. doi:10.1186/1471-2180-13-57. (Highly accessed)

Liu, B.R., **Y.-W. Huang**, H.-J. Chiang and H.-J. Lee, Primary effectors of transmembrane delivery of arginine-rich cell-penetrating peptides *Advanced Studies in Biology* 5(1):11-25, 2013.

Thimgan, M.S., L. Gottschalk, C. Toedebusch, J. McLeland, A. Rechtschaffen, M. Gilliland-Roberts, S.P. Duntley and P.J. Shaw, Cross-translational studies in Human and Drosophila identify markers of sleep loss. *PLoS ONE* 8(4):e61016, 2013.

Madria, N., N. Nair, A. Vadapali, **Y.-W. Huang**, S. Jones and V.P. Reddy, Ionic liquid electrolytes for lithium batteries: Synthesis, electrochemical, and cytotoxicity studies. *J. Power Sources* 234:277-284, 2013.

Modglin, V.C., and **R.F. Brown**, Performance of surface immobilized RGDC 13-93 bioactive glass fiber rafts and scaffolds with MLO-A5 osteogenic cells, *J. Mater. Sci. Res.* 2(4):53, 2013.

Modglin, V.C., **R.F. Brown**, S.B. Jung and D.E. Day, Cytotoxicity assessment of modified bioactive glasses with MLO-A5 osteogenic cells in vitro, *J. Mater. Sci. Mater. Med.* 24(5):1191-1199, doi: 10.1007/s10856-013-4875-8, 2013.

Niyogi, D.K., J.S. Harding, and K.S. Simon, Organic matter breakdown as a measure of stream health in New Zealand streams affected by acid mine drainage. *Ecological Indicators*. 24:510-517, 2013.

Stockstill, K.E., **J. Park**, **R. Wille**, **G. Bay**, **A. Joseph** and **Shannon, K.B.**, Mutation of Hof1 PEST domain phosphorylation sites leads to retention of Hof1 at the bud neck and a decrease in the rate of myosin contraction, *Cell Biology International Article* first published online : 29 JAN 2013, DOI: 10.1002/cbin.10042, 2013.

Tang, T.-H., C.-T. Chang, H.-J. Wang, J. Erickson, R.A. Reichard, **A.G. Martin**, **E.C. Shannon**, **Y.-W. Huang**, and **R.S. Aronstam**, Influence of tert-butyl hydroperoxide on muscarinic signaling pathways and store-operated calcium entry, *J. Biomed. Sciences*, 20(1):48. DOI:10.1186/1423-0127-20-48, 2013.

Wang, H.-J., **A.G. Martin**, P.-K. Chao, R.A. Reichard, A.L. Martin, **Y.-W. Huang**, M.-H. Chan and **R.S. Aronstam**, Honokiol blocks store operated calcium entry in CHO cells expressing the M3 muscarinic receptor, DOI: 10.1186/1423-0127-20-11, *J. Biomed. Sciences*, 20:11, doi: 10.1186/1423-0127-20-11, 2013.

Book Chapters, 2013

Huang, Y.W., H.-J. Lee, B. R. Liu and C.-H. Wu. Chapter 23: Cellular Internalization of Quantum Dots. In *Cellular and Subcellular Nanotechnology: Methods and Protocols*. Weissig, V.; Elbayoumi, T.; Olsen, M. (eds.); Humana press, New York, pp. 249-259, 2013.

Liu, B.R., M.-H. Chan, H.-H. Chen S.-Y. Lo, **Y.-W. Huang** and H.-J. Lee, Chapter 3: Effects of Surface Charge and Particle Size of Cell-penetrating Peptide/Nanoparticle Complexes on Cellular Internalization. In *Cell Membrane: Molecular Structure, Physicochemical Properties and Interactions with the Environment*, L. Mandraccia and G. Slavin (eds.); Nova Science Publisher, Hauppauge, New York, pp. 43-57, 2013.

Liu, B.R., M.-H. Chan, H.-H. Chen, **Y.-W. Huang** and H.-J. Lee, Chapter XX: Protein Transduction in Human Cells Mediated by Arginine-rich Cell-penetrating Peptides in Mixed Covalent and Noncovalent Manners. In *Cell Membrane: Molecular Structure, Physicochemical Properties and Interactions with the Environment*, L. Mandraccia and G. Slavin (eds.); Nova Science Publisher, Hauppauge, New York, 2013.

Thimgan, M.S. and **K.D. Schilli**, The role of metabolic genes in sleep regulation, In *Medhi Tafti, Paul J. Shaw, and Michael Thorpy (Eds.) Genetics of Sleep and Sleep Disorders*. (pp. 91-103). Cambridge: Cambridge University Press, 2013.

Invited talks, Seminars, 2013

Frank, R.L., Effective teaching: Tips from award winning faculty. Focus on Teaching and Technology Conference, St. Louis, MO, 2013..

Hou, C., Energy tradeoffs between metabolism, growth, and longevity: from insects to mammals, Colloquium seminar, Albert Einstein School of Medicine, New York, November, 2013.

Huang, Y.-W., Academia Sinica Institute of Atomic and Molecular Science. Cytotoxicity is a Function of Multiple Physical and Chemical Properties of Nanomaterials: Implications for Design of Safer Nanomaterials. Taipei, Taiwan, July 4, 2013.

Mormile, M., Going from microbial ecology to genome data and back again: Studies on a haloalkaliphilic bacterium isolated from Soap Lake, Washington State. Halophiles 2013. University of Connecticut, Storrs, Connecticut, June 23-27, 2013.

Mormile, M., It Came From Soap Lake: Industrially Relevant Metabolic Activities of a Haloalkaliphilic Bacterium. Department of Biology, Missouri State University, Springfield, Missouri, March 8, 2013.

Shannon, K., Building Models to Understand Cell Function, Microbrew Presentation, American Society for Microbiology Conference for Undergraduate Educators, Englewood, CO, May 16-19, 2013.

Shannon, K., Design and Implementation of a Study to Determine if a Cell Model Project Attains Desired Learning Outcomes, Presentation at the Teaching and Learning Technology Conference, Missouri S&T, Rolla, MO, March 14-15, 2013.

Shannon, K., How do cells know when it's time to divide? Regulation of cytokinesis in budding yeast, Seminar Speaker Biology Department, Missouri State University, March 1, 2013.

Thimgan, M.S., Detection and Prevention of Sleepiness, Saint Louis University, Department of Biology, 2013.

Thimgan, M.S., Detection and Prevention of the Consequences of Sleep Deprivation, University of Missouri, Kansas City, Department of Biology, 2013.

Thimgan, M.S., Genetics of Sleep in Animals and Humans, American Professional Sleep Societies national meeting, Basics of Sleep postgraduate course, Baltimore, MD, 2013

Westenberg, D.J., Broad spectrum antibacterial properties of metal-ion doped borate bioactive glasses for clinical applications, Feng Chia University, Taichung, Taiwan, July 3, 2013.

Westenberg, D.J., Broad spectrum antibacterial properties of metal-ion doped borate bioactive glasses for clinical applications, Providence University, Taichung, Taiwan, July 10, 2013

Westenberg, D.J., Evaluation of Glass and Polymers as Delivery Agents for Antibacterials, China Medical University, Taichung, Taiwan, July 9, 2013

Westenberg, D.J., Flipping your lab to increase student engagement, ASM Conference on Undergraduate Education, Denver, CO May 16 - 19, 2013

Westenberg, D.J., Integrated Math and Science Education Through Science Education and Quantitative Literacy (SEQL), NSTA National Conference. San Antonio, TX, April 13, 2013.

Bio Sci Senior Seminar Students Send Shoes to Africa

The Biological Sciences Department incorporates a service-learning project for the required senior capstone course. Students work in groups to propose, research, develop, complete, and present service-learning projects that are related to the biological sciences. There were many excellent projects this past fall, including numerous presentations at local schools.

One group of students was inspired to help combat the problem of jiggers in Africa. Jiggers are flea-like organisms that burrows into the feet of people and can lead to the rotting of limbs and even death. Providing shoes to people in affected areas improves their health and gives the children a chance to attend school.



Senior seminar group members direct volunteers at a shoe cutting party



Tara Voyles, Taylor Buescher, Brianna Kroeger, Jeremiah Herbert and Toni Knar pose with donated denim for making shoes.

The senior seminar students collected donations of sturdy fabric such as denim and old plastic folders to be used for the shoes. Patterns for the shoes were obtained from the organization Sole Hope. The senior seminar group advertised its project and hosted “shoe cutting parties” around campus. A benefit of the project was raising awareness of the problem of jiggers and the Sole Hope organization.

The senior seminar students and volunteers used the patterns to cut the shoes from the donated materials. Sole Hope employs widows in Africa to assemble the shoes and therefore the project also helps to provide income to these women. The outcome of the senior seminar group project was that 256 pairs of shoes were cut and donated to the Sole Hope organization.

December 2013 Graduates

Eighteen Missouri S&T students received a B.A. or B.S. and three received an M.S. in Biological Sciences during the Dec. 2013 Missouri S&T Commencement ceremony.



From left to right: Dr. Aronstam, Charles Stephens, Ashley Shockly, Kyesha Hall, Andrew Jones, Andrew Lott, Alexandria Lore, Kyle Rich, Brianna Kroeger, Michael Jennings, Hannah Barber, Mathew Hayes, Kelsey Hunt, and Dr. Westenberg

Graduate Student News

Two Graduate Students received a M.S. with thesis in Biological Sciences this December.

DANIEL ROUSH-Thesis title was “Production of 1,3-propanediol from Glycerol Under Haloalkaline Conditions by Halanaerobium Hydrogeniformans” Advisor **DR. MORMILE**

KELE THRAILKILL “Wetting-Drying Cycles and the Fungal Communities on Leaf Litter in Streams” Advisor **DR. NIYOGI**

One new M.S. student joined the department in January, **COURTNEY ANN FIBLEMAN** in the lab of **DR. THIMGAN**



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Exploring the relationship between food restriction and lifespan extension

Extending lifespan and slowing aging is of great interest to the general public. In the last few decades, numerous studies have shown the tradeoffs between growth, health, and longevity, and the positive effects of food restriction (FR) on health maintenance and lifespan extension. But the role of metabolic rate (MR) in these tradeoffs still remains unclear and controversial.

DR. CHEN HOU'S lab consists of undergraduate researchers **KATHRYN KOERPERICH, CAITLIN WILKES, JULIE PETRU, LINDSAY KOERPERICH, AZRIEL DOMINGO** and newcomer **SARAH MADDEN**, as well as graduate researchers **LIHONG JIAO** and **KAUSHALYA AMUNUGAMA**. The basic idea of the current project is to understand the controversial correlation between metabolic rate and health maintenance in both free fed and food restricted (FR) animals from the viewpoint of energetics and the life history theory. Food restriction (FR) has been shown to be the major environmental intervention to extend the lifespan of a diverse set of animals. Numerous field and laboratory studies have shown that in free-fed animals, low Metabolic Rate (MR) is beneficial for health maintenance and longevity. Based on these observations, it was postulated that lowering MR may also be one of the underlying mechanisms of FR, which keeps animals in relatively healthy states and extends their lifespan. However, this idea is challenged by the empirical data from animals under FR. The unclear role of MR in the health maintenance and longevity of FR animals has been a long-standing question in the field.

The preliminary results obtained suggest that food restriction (FR) alters animals' energy budget and induces energy tradeoffs between metabolic rate (MR), growth, and health maintenance. Lab members are testing the hypothesis that lowering MR in animals that are under FR may diminish FR's effects on suppressing growth, and results in less energy for health maintenance.

So, for animals under FR, lowering MR may have negative effects on health maintenance, opposite of what have been observed in free fed animals. Lab researchers measure the rates of growth, food assimilation, and metabolism of the *Manduca sexta* larvae (hornworms) with different metabolic rates and food supplies. We measure two types of cellular damage and the activity of an anti-oxidant enzyme as the proxies of health maintenance.

In an exciting development, this research will be presented to state lawmakers during the Undergraduate Research Day at the Capitol by **KATHRYN KOERPERICH, CAITLIN WILKES**, and **LINDSAY KOERPERICH** in early March. Continued research in this field will hopefully garner more publications and serve as a tool to reach out to the community, as well as fellow scientists.



*Kaushalya weighs out food for the *Manduca sexta* larvae (hornworms)*