

Department Update
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Research Focus: Aquatic Fungi
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New Center: CSCMBC
Project Lead the Way

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Homecoming game
Saturday, October 19

Graduation Reception
Southwestern Bell Cultural Center
December 19, 3-5 PM

Graduation Ceremony
December 19, 6 PM

Introducing Dr. Julie Semon and the Laboratory of Regenerative Medicine

Mesenchymal stem / progenitor cells (MSCs) have been used for cell therapy and in tissue engineering because of their ability to differentiate into multiple mesenchymal and non-mesenchymal lineages, their immune modulatory effects, and their ability to home to sites of tissue damage. MSCs have been isolated from several tissues, including the bone marrow, adipose tissue, umbilical cord blood, liver, synovium, skeletal muscle, kidney, skin tissue, lung, and intestinal tract. Currently, MSCs derived from different sources are being utilized in clinical studies for the treatment of several diseases and have been shown to be effective against many autoimmune diseases, such as graft-versus-host disease, Crohn's disease, multiple sclerosis, and diabetes.

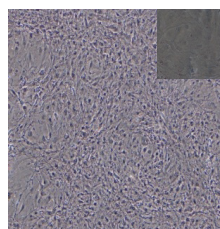
Our new assistant professor of Biological Sciences, **DR. JULIE SEMON**, brings her expertise in MSCs to Missouri S&T. **DR. SEMON** earned a Ph.D. degree in Molecular and Cell Biology from Tulane University in 2009. **DR. SEMON'S** thesis work investigated the ability of MSCs to traffic through the vasculature and extracellular matrix to damaged tissues and organs. Her research led to a new paradigm to explain the low engraftment levels of MSCs in damaged tissue: MSCs are unable to cross the endothelium under shear flow conditions.

DR. SEMON'S postdoctoral research was performed at the Center for Stem Cell Research and Regenerative Medicine at Tulane University. Her research examined the therapeutic potential of adipose derived MSCs (AD-MSCs) in multiple sclerosis. The frequency of MSCs in adipose tissue is much higher than the more commonly studied source of bone marrow, yielding

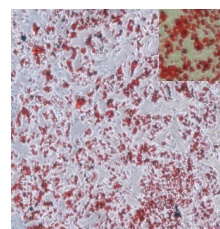
100 to 500 times more cells per tissue volume. These AD-MSCs have similar self-renewal abilities, common surface epitopes, growth kinetics, and cytokine expression profiles to bone-derived MSCs, but they are not associated with the morbidity, pain, or low yield. In addition, recent data indicates that AD-MSCs are potentially immunomodulatory, induce angiogenesis, and are multipotent, making them an appealing alternative to bone-derived MSCs. **DR. SEMON'S** results suggest that AD-MSCs, and their uncultured counterpart, the stromal vascular fraction (SVF) can ameliorate a mouse model of multiple sclerosis before the onset of symptoms but are less effective once symptoms are evident.

At Missouri S&T, **DR. SEMON** will continue to study the different sources and preparations of MSCs and examine how they affect clinical outcomes. The current paradigm in the clinic is to treat the patient with autologous cells, meaning cells from the patient. However, **DR. SEMON'S** work has shown that MSCs from multiple autoimmune diseases, older donors, or obese donors are less efficient at reducing clinical symptoms than MSCs from normal, healthy donors.

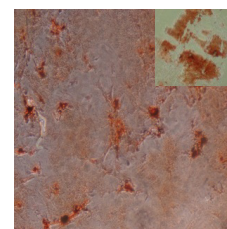
DR. SEMON moved with her husband and two children to Rolla in August.



Undifferentiated
MSCs



Oil Red O stains MSCs
differentiated into fat



Alizarin Red stains MSCs
differentiated into bone

Department Update

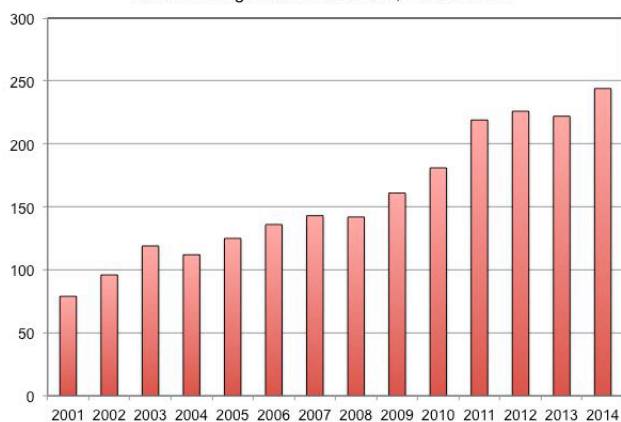
The Missouri S&T Department of Biological Sciences is an academic community focused on learning and discovery. The S&T BioSci community provides a supportive, collegial, challenging and rewarding environment for its faculty, students and staff.

Faculty: The department was pleased to welcome new faculty member **DR. JULIE SEMON** in August. **DR. SEMON** received her graduate and postdoctoral training at Tulane University. **DR. SEMON'S** research interests encompass the origin, trafficking and fate of stem cells, and she is establishing a Laboratory of Regenerative Medicine in Schrenk Hall. More information about her research is available elsewhere in this newsletter. This faculty line was made available as part of the University's strategic plan. Also joining the Department is the founding Dean of the College of Arts, Sciences and Business, **DR. STEPHEN ROBERTS** (see article elsewhere). **DR. YI CUI** joined the department as a postdoctoral fellow, and is working with **DR. MELANIE MORMILE** in the Laboratory of Environmental Microbiology.

Schrenk Hall: Chemical Engineering will finish its move (to Bertelsmeyer Hall) by the end of the semester. The remaining tenants of Schrenk Hall, the Departments of Chemistry and Biological Sciences, will eventually occupy the vacated space. A top priority is to bring faculty members scattered across the campus back to Schrenk Hall. This will strengthen our academic communities and allow us to make more efficient use of shared equipment. BioSci will also be able to develop about 6,000 sq. ft. of new laboratory space. This will require a good deal of renovation (including updating the building's infrastructure), the funds for which have yet to be identified.

Students: Change is the most dependable aspect of university life, and this is most readily apparent in the turnover of our students. Our community is enriched and renewed each year as we graduate and welcome new classes of students. This year the BioSci department produced 41 new graduates and welcomed 51 first year students (both numbers are the 2nd highest ever). Meanwhile, overall enrollment reached a new high, and we set

BioSci Undergraduate Enrollment, 4th Week FS



records in the numbers of transfer students, credit hours taught, and summer school enrollment.

Development: Biology is an old academic discipline, but a relatively young enterprise at Missouri S&T; BioSci became an independent department only 30 years ago. However, with our 29 May graduates, we now have 643 BioSci alumni. Paralleling this increase, unrestricted donations to the department have doubled over the last five years. Coupled with a 10% rise in endowment income, this now represents a significant source of operation support. Contributions from our alumni and friends are particularly useful since they allow us to do new things, notably to incorporate new technologies into our research and to explore novel instructional modalities. Thank you.

Strategic Plan: S&T's strategic plan has been guiding all of our program development efforts for the past two years. The major themes incorporated into this year's plans are to: 1) Increase number of students; 2) Involve all students in experiential learning; 3) Increase research productivity; and 4) Improve teaching by improving instructional labs, incorporating active learning strategies, and evaluating assessment methods. I will be reporting to you on each of these efforts in upcoming newsletters.

BioSci Strategy Statement:

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.

I am pleased to provide you with this update. Please visit our website (biosci.mst.edu) and our FaceBook Page ("Missouri S&T Biology") for more information about our department. Your comments and suggestions are welcome. I am especially interested in receiving your input on our strategic directions. As always, I invite you to visit the department for a personal tour and update.

Sincerely,



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

Academic Scholars

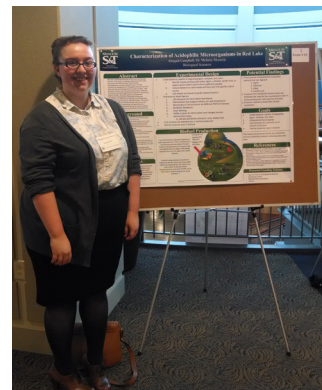
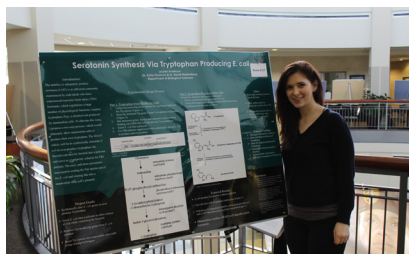
Congratulations to the following Bio Sci students for making the Academic Scholars' List.

Lauren Anderson
Carol Baker
Kaleb Bassett
Anthony Bitar
Damien Bizeau
Elizabeth Black
Melissa Cambre
Abigail Campbell
Alyssa Castro
Craig Clark
Rachel Clark
Kyle Clinton
Sierra Comer
Rachel Connell
Kelsey Crossen
Elizabeth Deister
Cydney Denning
Corinna Edwards
Chelsea Ehret
Ethan Engel
Logan Featherton
Elena Fisher
Samantha Friederich
Rachel Glenn
Nikki Gomez
Chelsea Gordon
Nina Govalla
Victoria Grill
Caron Harada
Carolyn Harper
Rosamond Hoyle
Samantha Huckuntod
Helena Hudson
Ava Hughes
Sahitya Injamuri
Trevor Karbowski
Hannah Kim

Kathryn Koerperich
Lindsay Koerperich
Rebekah Larimore
Desirae Lavatai
Sharon Lee
Denise Leiferman
Kent Lin
Michael Lockett
Anna Luce
Darius Mann
Kaitlyn McDonald
Katlyn Meier
Kate Menke
Danielle Meyer
Candace Miller
Sarah Mouser
Allyson Myers
Katherine Nelson
Emily Nethington
Kiran Patel
Sarah Paunicka
Andrew Pestle
Jamie Phelps
Bethany Rader
Jenae Rankin
Michelle Rojo
Donald Roshan
Kayli Sharpell
Zachary Siegel
Amity Sparkman
Elizabeth Thoenen
Charles Threadgill
Chad Verweyst
Chance Walker
Thomas Warner
Karen Weber
Caitlin Wilkes

Undergraduate Research

Biological Sciences students won several awards at the Annual Undergraduate Research Symposium in April 2014. In the Research Proposal Poster Session, **ABAGAIL CAMPBELL** (below, right) won first place, and **LAUREN ANDERSON** (below, left) won third place. Advisors for the proposal winners were **DRS. MORMILE, WESTENBERG**, and **SHANNON. CLAYTON BUBACK**, who was mentored by Dr. Daniel Forciniti, won second place in the Engineering oral presentation category. Congratulations to all our students who presented research!



Four Biological Sciences students also earned Opportunity for Undergraduate Research Experience (OURE) Fellow awards for 2014-2015. Congratulations to **ADRIAN BLACK, RACHEL CONNELL, ANTHONY BITAR, USTIN LOVELADY**, and

Bio Star Award Winners

The annual Bio Star awards are designed to recognize outstanding achievements of our BioSci undergraduate and Masters students. Nominations are submitted by students and faculty, and the winners are chosen by a faculty committee. Congratulations to all the winners!

The 2014 Bio Star Winners are:

First Year Student - **ABAGAIL CAMPBELL**
Undergraduate Research - **ADRIAN BLACK**
Graduate Research - **LISA SNODERLY-FOSTER**
Graduate Teaching Assistant - **TIFFANY EDWARDS**
Graduating Senior - **TONI KNAR** and **CLAYTON BUBACK**
Campus or Community Service - **LINDSAY KOERPERICH**



2014 BioSci Graduates

Twenty three Missouri S&T students received a B.A. or B.S. in Biological Sciences during the spring of 2014

Stephen Roberts named College Dean

In a major administrative reorganization, the academic programs of Missouri S&T were divided this year into two colleges: the College of Engineering and Computing and the College of Arts, Sciences and Business. **STEPHEN ROBERTS, PH.D.** was recruited as the founding Dean of the College of Arts, Sciences and Business. **DR. ROBERTS'** academic appointment is as a professor in the Department of Biological Sciences.



DR. ROBERTS earned B.S. and M.S. degrees in biological sciences from Illinois State University, and a Ph.D. degree in biology from Arizona State University. Following postdoctoral training in organismal biology at the University of Chicago, **DR. ROBERTS** joined the biology department of the University of Nevada at Las Vegas, where he also served as director of core facilities in genomics, bioinformatics, cytometry and confocal microscopy. In 2009, **DR. ROBERTS** joined the faculty of Central Michigan University as professor and chair of biology. The biology program at CMU flourished under **DR. ROBERTS'** leadership. Within 4 years, the biology faculty grew by 36%, the number of undergraduate majors increased by 115%, and the number of graduate students increased by 40%.

DR. ROBERTS' research interests include comparative and integrative physiology, the aerodynamics and energetics of flight in bees, stress tolerance, learning and memory, and aging and senescence. **DR. ROBERTS** has published scores of research articles and attracted several million dollars in research and training funding from the National Science Foundation and the National Institutes of Health.

"Missouri S&T and the Department of Biological Sciences are fortunate to have been able to attract such a renowned scholar. **DR. ROBERTS'** training, expertise, collegiality and enthusiasm make him an ideal candidate to lead our new College" said **DR. ROBERT ARONSTAM**, chair of Biological Sciences.

Alumni Spotlight: Jared Strasburg



I was an undergraduate at Missouri S&T (then UMR) from 1993-1997. I'm grateful for my experiences with a number of excellent instructors in the Biology Department and with the opportunity **DR. RONALD FRANK** gave me to take part in research in his lab. From Rolla, I went to St. Louis and got my PhD at Washington University in Ecology, Evolution, and Population Biology. While at WashU I became very interested in the evolutionary consequences of hybridization between different species, and part of my thesis dealt with a complex of Australian geckos in which some populations are all-female parthenogens – that is, they reproduce clonally, mothers creating daughters that are genetically identical to them. These parthenogenetic populations were created via hybridization between two sexually reproducing races.

From St. Louis, I moved to Indiana University for a post-doc position studying sunflowers, which are a classic model system for understanding hybridization as an evolutionary phenomenon. I also developed an interest in using data simulation approaches to answer evolutionary questions, which I still use. I'm starting my third year on the faculty of the Biology Department at University of Minnesota-Duluth. I still study sunflower hybridization, and have also gotten involved in moose and wolf population genetics work, both here in Minnesota and at Yellowstone National Park (for moose). I also teach Evolution, Genomics, and Population Genetics.

Graduate Student News

Two new graduate students joined the department: **MICHAEL SADLER** is working with **DR. RONALD FRANK** and **CRYSTAL MEEKS** is working with **DR. DAVID WESTENBERG**.

One graduate student, **LESLIE KRAMER**, received an M.S. in Biological Sciences, and four graduate students defended their theses in May:

LISA SNODERLY-FOSTER Characterization of a Plant Gene Family Expanded in Glycine Max, advisor **DR. RONALD FRANK**
LIHONG JIAO "Energy Tradeoffs Between Fuel Assimilation Growth, Metabolism, and Maintenance, advisor **Dr. CHEN HOU**
DAN MILLER "Dephosphorylation of Iqg1 by Cdc14 Temporally Regulates Actin Ring Formation, advisor **DR. KATIE SHANNON**
RICHARD WATTERS "Investigation of Angiogenic Effects of Bioactive Borate Glass Microfibers and Beads in a Rodent Model, advisor **DR. ROGER BROWN**

Center for Statistical and Computational Modeling of Biological Sciences

Nature is complex, yet clearly patterns exist. These patterns can be described using mathematical modeling and computational techniques to understand the underlying rules and complexity that govern life. The newly chartered Center for Statistical and Computational Modeling of Biological Complexity (CSCMBC), directed by **DR. RONALD FRANK**, aims to use these patterns to understand and better address health, industrial, and environmental problems. The CSCMBC will be housed in Biological Sciences and is a joint venture between the departments of Biological Sciences, Mathematics and Statistics, and Computer Science. Primary data will be gathered in labs in the Biological Sciences Department and then analyzed using the expertise that exists throughout Missouri S&T to increase our understanding of biological systems. Equations that model the biological phenomena can be used to understand the kinetics of response and identify new influences on these processes to understand the biological world around us.

The CSCMBC will have both a research and teaching mission at Missouri S&T. Initial research projects affiliated with the Center include using novel time series, clustering, and Markov modeling to determine variables and transition patterns that define adequate and refreshing sleep. Another project has employed computational methods to generate rules for protein folding and then uses those rules to predict secondary structure in newly discovered proteins of unknown function. Computer science techniques can also bridge with genomic analysis to better define and interpret genomes. With the advent of genome science, these techniques may help people better understand the phenotypic outcomes of small genetic changes throughout the genome. Moreover, the coupling of computational

analysis with bacterial metabolic data will help improve the industrial production of necessary chemicals through biological processes, saving money and potentially reducing waste products. Finally using large sensor data sets from sensors placed in plants, computational and statistical analysis will lead to a better method of detecting the source of pollution as well as a great way to clean up a waste site. As the CSCMBC grows, it hopes to use the research of the each member of the Biological Sciences department as the starting point for sophisticated analysis and innovative approaches to each system.

To better train students in computational biology problems, the CSCMBC will develop coursework and student interactions that will promote education that bridges these disparate disciplines. The Center will fund an OURE supplement to encourage undergraduates to team up and undertake projects that have both a biological and quantitative component. It will also bring in faculty from outside Missouri S&T to help teach and motivate students on the applicability of these techniques as well as publicize the existing program. In addition, faculty affiliated with the Center are developing new courses to teach students how to gather, analyze, and interpret biological data using these techniques. The CSCMBC was made possible through the support of Chancellor Schrader and the financial support of the Vice Provost of Research, Dr. Krishnamurthy. Computational and statistical modeling of aspects of life has the potential to unravel many mysteries that had previously been unapproachable. The CSCMBC will provide a home to bring together the minds that may be able to crack these codes.

Project Lead the Way



TERRY WILSON, Associate Teaching Professor, hosted six Project Lead the Way (PLTW) Biomedical Core Training Workshops for eighty-one high school teachers during June and July. The teachers were trained to teach at least one course in a series of four in the PLTW Biomedical Sciences curriculum. The intensive two week courses included Principles of Biology (PBS), Human Body Systems (HBS), Medical Interventions (MI) and Biomedical Innovations (BI). The program focuses on activity-based, project-based and problem-based learning. PLTW is a national, not-for-profit education program whose mission is "to create dynamic partnerships with our nation's schools to prepare an increasing and more diverse group of students to be successful in science and engineering." As a leading affiliate university, Missouri S&T not only provides summer teacher training but professional development and information for counselors and administrators throughout the Midwest. Since 2009, Missouri S&T has trained over 400 science teachers including 118 Missouri teachers. Sixty-six Missouri schools now offer the PLTW Biomedical programs across 36 districts.

Aquatic fungi: underappreciated organisms that warrant more research

DR. DEV NIYOGI, director of the Freshwater Ecology lab in the Biological Sciences Department, has examined aquatic fungi in streams and lakes in Missouri and elsewhere, attempting to understand what organisms are present and what they do in these ecosystems.

In streams and lakes, fungi break down plant material such as leaves and wood. They, along with bacteria, metabolize the complex organic chemicals in plant material to simpler compounds and eventually to carbon dioxide. These microbes not only decompose the plant detritus themselves, but they also make it more palatable to animal consumers. Animals that eat decomposing leaves, known as shredders, get some of their energy from the microbes themselves in addition to the plant material.

DR. NIYOGI has worked with several graduate and undergraduate students to examine fungi in a variety of streams and lakes. In Colorado and New Zealand, **DR. NIYOGI** and students have looked at fungi on leaves in streams affected by mining. Even after mining has ended, acid mine drainage can flow from

abandoned mines and affect aquatic systems downstream. Acidity, dissolved metals, and metal hydroxides can all affect aquatic fungi and other biota in such systems.

In Missouri, **DR. NIYOGI** and S&T students have looked at fungi in an acidic lake near Columbia. A visiting student from National Taiwan Normal University, **YU-YUN HUANG**, conducted experiments in the lab to look at fungal communities as they are affected by the different stressors from mine drainage. Her results, using DNA-based methods, showed that pH was the most important control on fungal community structure, while fungal activity was resilient under the different stressors.

Another project has examined stream fungal communities along Missouri streams with varying amounts of streamflow. Because of the severe droughts in recent summers, several streams have had reduced streamflow and in some cases had no water present. This change in hydrology acts as a stress to the native biota, and could become more common in the future with climate change. **KELE THRAILKILL**, who graduated with a MS degree in 2014, found that fungi in the streams were relatively resilient to the effects of drying.

Future research in the Freshwater Ecology Lab at S&T will continue to study aquatic fungi affected by different stressors from humanity. These organisms, although less studied than others, play a key role in most ecosystems and warrant further study.



Field site and leaf processing



“Red Lake”, an acidic pond near Columbia, Missouri