

Department Update

Microbiology Lab Research

2012 Research Partners

New Scholarship Endowment

Nanobiotechnology and Molecular Toxicology Lab

Student News

Faculty Publications and Seminars

Spring Phonathon

April 21-25, 2013

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

Students Learn That Even Glass Can Have a Silver Lining

Antibiotic resistant bacteria are a growing health problem as infections with these bacteria lead to increased cost of treatment, extended hospital stays and increased risk of death. Therefore, the development of new materials to minimize infections and reduce the spread of resistant bacteria could have significant health implications. The goal of one of the research projects in the **Westenberg lab** is to evaluate the antibacterial properties of bioactive glasses. Metal ions such as silver are also effective antibacterial agents and can enhance the killing of important pathogens by bioactive glass.

For the past several years students in the **Westenberg lab** have been testing various glass formulas made by the laboratory of Dr. Delbert Day of the S&T Graduate Center for Materials Research. Dr. Day's group has synthesized several bioactive borate glass formulations containing different metal ions with a primary focus on silver. Students in the **Westenberg lab** have shown that all of these silver-releasing glasses are effective at inhibiting the growth of each organism tested. Borate has well known antibacterial properties but, while borate glass alone is sufficient to kill each organism, the silver doped glass results in increased inhibition.

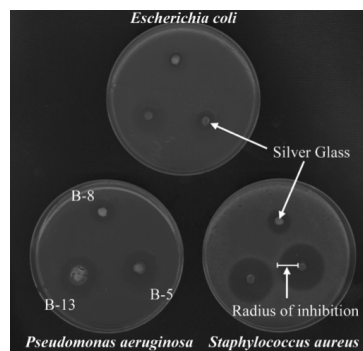
Currently, **Megan Ottomeyer**, a graduate student in the **Westenberg lab**, is investigating the mechanism behind how the glass kills bacteria. She has been trying numerous assays to determine if the glass with or without silver alters membrane integrity, DNA stability, cellular metabolism or a combination of



Graduate Student Megan Ottomeyer adds glass to a bacteria culture

all three. **Megan** and undergraduate students **Michael Lockett**, **Brianna Kroeger** and **Nicholas Staufenbiel** have also been testing the glass against different bacteria and trying out alternative metals to determine their antibacterial effectiveness. So far, the students have demonstrated that gallium and iodine are effective additions to the bioactive glass. A recent graduate, **Kristin Kelly**, tested silver containing glass against almost 40 bacteria showing that it can kill all of them and now the new glasses are being tested against the same wide range of bacteria.

Metal containing bioactive glasses have a potential for use in several industries that require effective control of microorganisms (such as the medical device, dental, pharmaceutical and cosmetic industries). One concern in these industries is the build-up of biofilms on devices. Therefore, undergraduate student, **Keara Pringle**, has begun testing the ability of bioactive glass to inhibit biofilm formation using a biofilm reactor and comparing the number of bacteria that accumulate on different glasses. Since starting this collaboration, over a dozen students have worked on various aspects of this project with seven earning OURE fellowships to support their research. This collaboration has been a great training ground for students who have gone on to success in medical school, graduate school and professional careers and we look forward to continuing this tradition.



Plates showing radii of inhibition around glass. The bacteria are unable to grow in a ring around the antibiotic glass. Three species of bacteria are shown.

Department Update

The Missouri S&T Department of Biological Sciences embodies 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. Economic conditions are slowly improving, and we are heartened by the campus- and system-wide strategic planning efforts that will direct our operations and initiatives for the next several years. As always, we plan to continue our consistent focus on maintaining and enhancing the quality of our programs.

Faculty: BioSci faculty were honored with numerous notable and appointments and awards in 2012. Three faculty members received Faculty Achievement Awards: **Dr. Ronald Frank** received a Faculty Teaching Award, **Dr. David Westenberg** received a Faculty Service Award and **Dr. Katie Shannon** received a Service Learning Award. **Dr. Westenberg** and **Ms. Terry Wilson** earned CERTI (Center for Educational Research and Teaching Innovation) awards based on student evaluations, while **Mr. Adam Martin** earned a CERTI commendation.

Dr. Katie Shannon was promoted to Associate Teaching Professor. **Dr. Shannon** joined the BioSci faculty in 2005 and leads the Laboratory of Cytokinesis. **Dr. Shannon** will provide leadership for the undergraduate teaching committee and will continue her research on the molecular control of cytokinesis. **Dr. Shannon** also received an institutional grant to incorporate e-Learning technology into her Cell Biology class.

Dr. Katie Shannon and **Mr. Adam Martin** were named S&T eFellows, receiving support to redesign their courses to incorporate new educational technology. These efforts include the adoption of online access tools.

Students: Degrees were awarded to 36 undergraduates and 4 graduate students at our May and December 2012 commencement ceremonies. This brings the number of BioSci graduates to 568 since the department was formed in 1978. Our entering class of first year students was the second highest in history, while the number of transfer students (23) set a new record. The BioSci department continues to enjoy steady increases in undergraduate enrollment. The official fall semester 4th week enrollment was 226 students. In terms of enrollment, we are now the 6th largest department on campus. The downside to this growth is illustrated in the graph on the right: The BioSci student: faculty ratio has risen to > 21:1, well above the S&T average. In the short run this poses a number of problems, especially as we strive to provide meaningful research opportunities for our undergraduate students (a critical feature of our active learning program). In the somewhat longer run, this growth will occasion the addition of faculty lines to the BioSci department, broadening our intellectual resources.

Teaching: Really Big Deal: In AY2012, weighted student evaluations of the teaching efforts of BioSci faculty averaged 3.47 (47% response rate). This is outrageously high; the average BioSci faculty teaching score was on the threshold required for teaching award recognition.

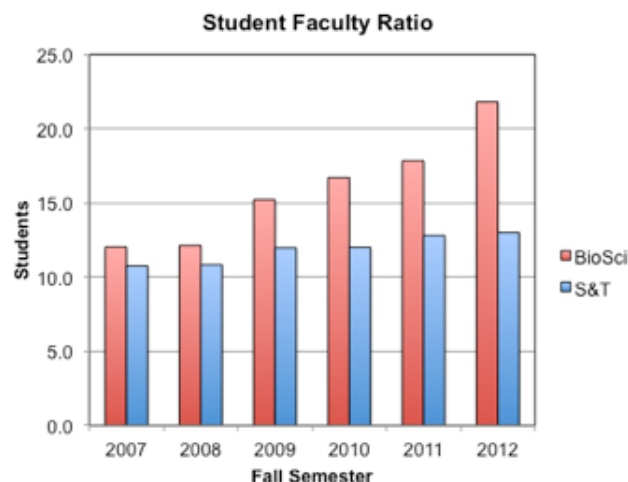
Research: In 2012 BioSci faculty members published 11 peer reviewed research publications, presented 12 papers at national and international meetings, and were invited to give 9 talks in various professional venues. Six visiting scholars from Taiwan National Normal University spent part of 2012 in our department; others will join us in the spring semester of 2013. Clones sales from the cDNA Resource Center have totaled Over \$2 million since FY2005. The sequences of 24 signaling proteins were submitted to GenBank, and 31 clones were introduced to the collection and made available to the scientific community.

Strategic Plan: Among the strategic plan goals receiving particular attention at our most recent (August 2012) retreat were 1) defining curriculum learning objectives, 2) improving our research infrastructure, 3) increasing scientific publication, 4) developing a doctoral training program, 5) increasing faculty research/development funding from internal sources by at least \$1,000/year, and 6) strengthening funding streams from PLTV activity, summer teaching, donations, and endowments. Progress has been made in most of these areas. Notably, we are pleased with increases in our faculty research funding, development efforts, and in our research infrastructure (new space, HPLC, flow cytometer). A faculty group has been meeting regularly to examine teaching objectives and initiatives.

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 enrollment and faculty members

Faculty News

Faculty Publications, 2012

Begemann M.B., **Mormile, M.R.**, Sitton, O.C., Wall, J.D. and Elias, D.A., A streamlined strategy for biohydrogen production with *Halanaerobium hydrogeniformans*, an alkaliphilic bacterium. *Frontiers in Microbiology* 3:93. doi: 10.3389/fmicb.2012.00093, 2012

Bromage, T.G., Hogg, R., Lacruz, R.S., and **Hou, C.**, Primate enamel evinces long period biological timing and regulation of life history. *Journal of Theoretical Biology* . 305: 131-144, 2012.

Donlea, J., Leahy, A., **Thimman, M.S.**, Suzuki, Y., Hughson B.N., Sokolowski M.B., Shaw P.J., Foraging alters resilience/vulnerability to sleep disruption and starvation in *Drosophila*. *Proc Natl Acad Sci USA*. 2012 Feb 14;109(7):2613-8, 2012.

Gillooly, J., Hayward, A., and **Hou, C.**, Burleigh, G., Explaining differences in the lifespan and replicative capacity of cells: a general model and comparative analysis of vertebrates *Proc. Royal Society B* . 279: 3976-3980, 2012.

Greenwood, M.J., Harding, J.S. **Niyogi, D.K.** and McIntosh, A.R., Improving the effectiveness of riparian management for aquatic invertebrates in a degraded agricultural landscape: stream size and land-use legacies. *Journal of Applied Ecology*. 49:213-222, 2012.

Lee L, Leopold JL, **Frank RL.**, 2012, Protein secondary structure prediction using BLAST and exhaustive RT-RICO, the search for optimal segment length and threshold. *Proceedings of the IEEE Symposium on Computational Intelligence in Bioinformatics and Computational Biology (CIBCB)* 2012, 35-42, 2012.

Lee, L., Leopold, J.L., **Frank, R.L.**, 2012. Exhaustive RT-RICO algorithm for mining association rules in protein secondary structure. *Proceedings of the IEEE Symposium on Computational Intelligence in Bioinformatics and Computational Biology (CIBCB)* 2012, 260-266, 2012.

Liou, J.-S., Liu, B.R., Martin, A.L. **Huang, Y.-w.**, Chiang, H.-J., and Lee, H.-J., Protein transduction in human cells is enhanced by cell-penetrating peptides fused with an endosomolytic HA2 sequence. *Peptides* 37:273-284, 2012.

Mayo, M., Pfeifer, P., and **Hou, C.**, Reverse engineering the robustness of mammalian lung. *Reverse Engineering*, ed. A.C. Telea. InTech Publisher, Boston, P243-262, 2012.

Modglin, V.C., **Brown, R.F.**, Fu, Q., Rahaman, M.N., Jung, S.B. and Day D.E. In Vitro Performance Of 13-93 Bioactive Glass Fiber And Trabecular Scaffolds With MLO-A5 Osteogenic Cells, *Journal of Biomedical Materials Research* 100A:2593-2601, 2012.

Shannon, K.B., IQGAP family members in yeast, Dictyostelium, and mammalian cells. *International Journal of Cell Biology Focus Issue on Cytoskeletal Proteins* vol. 2012, Article ID 894817, doi:10.1155/2012/894817, 2012.

Shik, J., **Hou, C.**, Key, A., Kaspari, M., and Gillooly, J.F., Toward a general life history model of the superorganism: predicting the survival, growth, and reproduction of ant societies. *Biology Letters* . doi: 10.1098/rsbl.2012.0463, 2012.

Presentations at Professional Meetings, 2012

Aronstam, R.A., K.Z. Williams, H.L. Chambers, R.A. Reichard, E.K. Shannon, H.-J. Wang, A.G. Martin, and **A.L. Martin**, Orphan G protein coupled receptors: signaling pathways, Annual Meeting, American Society for Neurochemistry, Baltimore, MD, 2012.

Huang, C.-H., M. Ponzer, Y.-C. Yu, M. Choudhry, **K. B. Shannon** (2012) Interaction of Iqg1 with formins in budding yeast cytokinesis, Dec. 16, 2012, American Society for Cell Biology Annual Meeting, San Francisco, CA

Huang, Y.-w., A. G. Martin, H.-J. Wang, P.-K. Chao, **A. L. Martin**, E. K. Shannon, R. A. Reichard, M.-H. Chan, **Robert S. Aronstam**, Biphenols block calcium entry in response to activation of the M3 muscarinic receptor. Annual Meeting of the Federation of American Societies For Experimental Biology San Diego, CA, USA, April 21-24, 2012.

Huang, Y.-w., Charles C. Chusuei, Shravan Mallavarapu, **Robert S. Aronstam**, Mechanisms of action of cytotoxicity of Transition metal oxide nanoparticles in human lung cells, Annual Meeting of the Federation of American Societies For Experimental Biology San Diego, CA, USA, April 21-24, 2012.

Paul, V., D. Wronkiewicz, and **M.R. Mormile**, Sulfate Reducing Bacteria and Their Potential Role in CO₂ Sequestration. (Platform) Missouri Branch Meeting of ASM. St. Joseph, MO, March 30-31, 2012.

Huang, Y.-w., B. R. Liu, Han-Jung Lee, Routes of Cellular Uptake of Nano-sized Materials Depend on Compositions of Cell-Penetrating Peptides. The 1st Annual Meeting of Sustainable Nanotechnology Organization, Arlington, VA, USA, Nov. 4-6, 2012.

Lee L., Leopold J.L., **Frank R.L.**, Protein secondary structure prediction using BLAST and exhaustive RT-RICO, the search for optimal segment length and threshold. *IEEE Symposium on Computational Intelligence in Bioinformatics and Computational Biology (CIBCB)*, San Diego, CA, 2012.

Miller, D. and **Shannon, K.B.**, Phosphorylation of Iqg1 by Cyclin Dependent Kinase (CDK), Cdc28, Temporally Regulates Actin Ring Formation, American Society for Cell Biology Annual Meeting, San Francisco, CA, Dec. 16, 2012

Rivera, C., Kress, N., Gottschalk, L., Shaw, P., and **Thimman, M.S.**, "Disruption of a Lipid Metabolism Gene Results in Decreased Sleep and Longevity" Midwest *Drosophila* Conference, 2012.

Shannon, E.K., **A.L. Martin**, V.A. Kaighin, A.G. Martin and **R.S. Aronstam**, Transcriptional regulation mediated by muscarinic acetylcholine receptors with native and constitutively active phenotypes, Annual Meeting, American Society for Neurochemistry, Baltimore, MD, 2012.

Westenberg, D.J., 2012, ASM's K-12 Outreach: Connecting and Raising Awareness. ASM Conference on Undergraduate Education. San Mateo, CA

Westenberg, D.J. and **Shannon, K.**, 2012 The Positive Impact of Synthetic Biology in the Biology Curriculum. 14th Annual Danforth Center Fall Symposium: Exploration in Synthetic and Systems Biology, St. Louis, MO.

Invited talks, Seminars, 2012

Hou, C., Effects of caloric restriction on health maintenance and aging: Insight from metabolic theory. International Symposium on Biomathematics and Ecology Education and Research; St. Louis, Missouri, November, 2012.

Hou, C., Energy tradeoffs between growth and longevity. Gordon Research Conference: Metabolic Basis of Ecology; Biddeford, Maine, July, 2012.

Hou, C., How food restriction extends lifespan. Target Meeting Aging Online Symposium; November, 2012.

Hou, C., Metabolic Scaling Theory: From the Colonial Life of Social Insects to the Mammalian Pulmonary System. Dept. of Biological Sciences, MST, Rolla, Missouri, March, 2012.

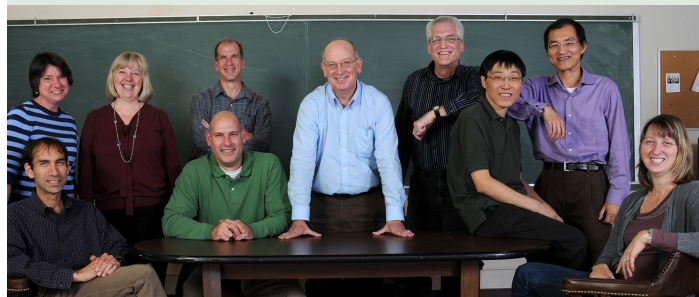
Huang, Y.-w., Cytotoxicity of Transition Metal Oxide Nanoparticles Depends on Certain Physicochemical Properties. US EPA, Research Triangle Park, NC, USA, August 7, 2012.

Huang, Y.-w., Nanodelivery Depends on Types of Cell-penetrating Peptides and Cargos, NIBIB/NIH, Laboratory of Molecular Imaging and Nanomedicine. Presentation title: Bethesda, MD, USA, March 19, 2012.

Mormile, M. Are There Martians in Australia? American Society for Microbiology, Michigan Branch Meeting, Central Michigan University, Mount Pleasant, Michigan, March 24, 2012.

Mormile, M., Biohydrogen Production from Cellulosic Material by an Halophilic Bacterium. Department of Earth and Atmospheric Sciences and the Department of Biology, Central Michigan University, Mount Pleasant, Michigan, March 22, 2012.

Westenberg, D.J., Synthetic Biology Explained: Benefits, Risks, Ethics. Missouri Food Safety and Food Defense Task Force, Missouri Department of Health and Senior Services. Jefferson City, MO February 9, 2012.



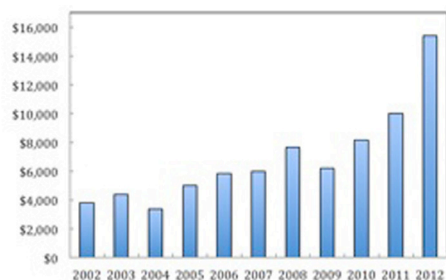
Biological Sciences Faculty 2012 From left to right-front row, Dev Niyogi, Katie Shannon, second row, Melanie Mormile, Terry Wilson, Matt Thimman, Robert Aronstam, Chen Hou, third row, Dave Westenberg, Ron Frank, Yue-wern Huang

2012 Research Partners

We are pleased to recognize those who generously supported the department in 2012. Donations to the department jumped 54%. 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.

Contributions are welcome at any time and can be made on the S&T web site (givingtomst.missouri.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

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Dr. George Karr '92 BioSci plans legacy for Biological Sciences

Dr. George W. Karr, S&T graduate and long-time Rolla dentist, has given a Charitable Gift Annuity to establish the George W. Karr Fund for Pre-Dental Students at Missouri S&T.

Dr. Karr has the distinction of being “the only dentist to graduate from Missouri S&T.” **Dr. Karr** practiced dentistry in Rolla from 1963 to 1996. Beyond his local dentist practice, **Dr. Karr** has given his time and expertise to help thousands of people at home and around the world who could not afford dental care and as he says, “fixing smiles.”

Dr. Karr grew up in Girard, Kansas, and moved to Lawrence to attend Kansas University. He is a graduate of Western Dental College (now the University of Missouri-Kansas City School of Dentistry), Class of 1960. Following his service in the U.S. Navy, he practiced dentistry in the Rolla area for 33 years. He says he has fixed teeth or pulled them in 31 different countries and refers to himself as the “fanged ferrier” and the “molar mechanic.”

Dr. Karr joined The Stricker Clinic in Rolla in 1963. In 1970 **Dr. Karr** moved his practice to a new building on Forum Drive which had three dentist offices and became the Forum Dental Clinic. He retired from dentistry in 1996 but not before returning to college at Missouri S&T to earn a bachelor's degree in Life Sciences in 1992. Upon retirement, **Dr. Karr** became the dentist for the Mercy Ship, a Christian hospital ship with headquarters in Newcastle, Australia.

For 2-1/2 years, his wife, Joyce, accompanied him as his dental assistant in Fiji, Vanuatu, Tonga, Solomon Islands, Guadalcanal, Papua New Guinea and a part of New Zealand. When doing volunteer missionary dentistry in the Philippines, the Rolla Rotary Club bought toothbrushes and **Dr. Karr** bought a gallon of very concentrated fluoride gel. He worked with a team of young people from Youth with a Mission to brush the teeth of 1,122 children between the ages of four and eleven. Each child left with their own toothbrush. For many of them, it was the first toothbrush they ever owned.

Dr. Karr has also offered his services to children in Missouri whose families could not afford dental care. Working for a mobile dental clinic, he pulled a trailer behind a pick-up truck and traveled to surrounding schools in small towns to fix children's teeth.

Dr. Karr now spends his time working with the Rotary Club and participating in the Silver Eagles continuing education program at The Centre, a community facility dedicated to improving and maintaining the quality of life in Rolla. He enjoys sharing his photos from his world travels with friends and family.

Congratulations to the winners of the Troutbusters scholarship



Sierra Comer was presented with the scholarship by Troutbuster members Jim Marstiller (left) and Dr. George Bohigian (right) and Dr. Dev Niyogi



Chelsea Ehret was presented with the scholarship by Troutbuster members and Dr. Aronstam

Biological Sciences Students Organize Fall Walking Challenge



Brittany Brand, Dr. Westenberg, Alexandria Lore from the Fall Walking Challenge

For one of this year's Senior Seminar service learning projects, a group of Biological Sciences students worked with the campus Health for Life program to organize a Fall Walking Challenge. For three weeks, teams of faculty and staff wore pedometers to keep track of steps taken.

The Fall Walking Challenge included 14 teams, 114 participants and more than 3 million steps walked collectively. The chemistry department was the winning group with more than 300,000 steps. The psychological science department was a close second, only 15,000 steps behind. This challenge was a great way to encourage healthy behaviors, build camaraderie and get the campus talking. Healthy for Life thanks all participants and the following students for their involvement: **Grace Bay, Shelby Emmett, Brittany Brand and Alexandria Lore.**

December 2012 Graduates

Ten Missouri S&T students received a B.A. or B.S. and three received an M.S. in Biological Sciences during the Dec. 2012 Missouri S&T Commencement ceremony.



From left to right: back row: Thomas Hilderbrand, Stephanie Voertman, Olutosian Ajakaiye, Chris Elliot, Micheal Saputo, Dr. Aronstam, Yinan Lin
Front row: Alicia Whitbeck, Grace Bay, Christie Koch, Gena Robinson, Kristin Kelly

Graduate Student News

One Graduate Student received a M.S. with thesis in Biological Sciences this December.
GENA ROBINSON-Thesis title was "Analysis of a Wound-Induced Gene Family in Glycine Max"

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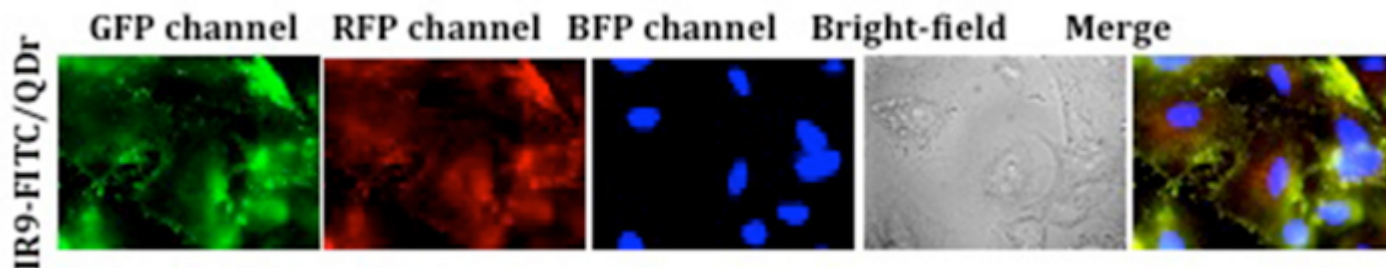
Bionanotechnology: a double-edged sword

Dr. Yue-Wern Huang's Nanobiotechnology and Molecular Toxicology Laboratory focuses on two research directions: nanotoxicity and nanodelivery. **Dr. Huang** has elaborated toxic effects of many nano-sized materials including transition metal oxide nanoparticles. Using these nanomaterials, he has identified inter-relationship among oxidative stress, intracellular calcium homeostasis, and types of cell death. In particular, he discovered that as atomic number of four period of transition metals (Ti, Cr, Mn, Fe, Ni, Cu, Zn) increases, the toxicity of their oxides increases. While he continues to assess toxicity of nanomaterials, he is asking an important question: what are the physical and chemical properties of nanomaterials that lead to cytotoxicity? The answers to this question can lead to design of safer nanomaterials and reduce risk to human health.

Dr. Huang has created a system that combines cell-penetrating peptides (CPPs) with fluorescent nanomaterials for nanodelivery. He has revealed mechanisms of CPP-mediated quantum dots/ DNAs uptake using live cell imaging, flow cytometer, and siRNA technology. In the second half of 2012, he took a sabbatical leave to collaborate with Dr. Xiaoyuan (Shawn) Chen, Chief and Senior

Investigator of the Laboratory of Molecular Imaging and Nanomedicine (LOMIN) at National Institutes of Health (NIH). During the stay, he learned applications of various animal models for nanodelivery and biomedical imaging. Currently he is re-designing his established delivery system for targeted delivery of biologically active molecules such as siRNA, small proteins, and DNAs to cancer microenvironment. The re-designed delivery system includes activatable CPP, double stranded siRNA binding domain, and nanodiamond. The rationale behind the design is as follows. The activatable CPP can be recognized by MMP-9 that is overexpressed in cancer microenvironment. The double strand siRNA binding domain can bind to double strand siRNA. The nanodiamond can emit fluorescent so that the delivery system can be tracked in cell culture setting or whole body. The improved system can reduce non-specific uptake by non-cancerous cells to achieve the so-called targeted delivery for biomedical purposes.

Dr. Huang also took the research leave opportunity to complete writing of eleven manuscripts. To date of this year, he has published five peer-reviewed journal papers and one book chapter. The remaining manuscripts are in review.



GFP, RFP and BFP channels revealed the distribution of IR9-FITC, QDr and nuclei, respectively. Overlaps between peptides and QDr were yellow in merged GFP and RFP images