

**2010 STUDENTS & TEACHERS AS RESEARCH SCIENTISTS (STARS)  
MENTOR SELECTION FORM**

"Experiencing the Scientific Enterprise"

June 7 – July 16, 2010

Sponsored by

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Office of the Chancellor UM-St. Louis, Saint Louis University, Washington University,  
the Green Foundation, and the Solae Company  
in partnership with  
Donald Danforth Plant Science Center, Saint Louis University,  
Washington University, and University of Missouri-St. Louis

**I. Applicant Information**

Name: \_\_\_\_\_

Address: \_\_\_\_\_

City: \_\_\_\_\_ State: \_\_\_\_\_ Zip Code: \_\_\_\_\_ - \_\_\_\_\_

School Attending: \_\_\_\_\_

Telephone Number: Home ( \_\_\_\_\_ ) \_\_\_\_\_

E-mail: \_\_\_\_\_

**II. Research Interest Areas Available for Study**

Please look at the entire list of research topics and **rank your top seven choices** (1 = high, 7 = low). Put an **X** on the choices you absolutely would **NOT** consider.

**A. Biological Science**

1. \_\_\_\_ Dr. Robert D. Aldridge: This project involves studying the role of sex pheromones in the behavior of African Brown House Snakes. Students will isolate the pheromone from females and assist in identifying the chemical nature of the pheromone. Project includes maintaining a captive population of house snakes and designing experiments to test for the presence of sex pheromones. Students will also participate in a histological study of the reproductive anatomy of snakes.
  
2. \_\_\_\_ Dr. Rajeev Aurora: Our lab works on the cross-regulation between the immune and the skeletal system. This is an emerging field known as osteoimmunology. Osteoclasts are the body's sole bone resorbing cells. It is known that immune cells, specifically T-cells, secrete factors in inflammation that persistently activates osteoclast activity. The increased activity is responsible for the bone erosion in diseases such as rheumatoid arthritis and osteoporosis. We have found that subsets of T-cells, called regulatory T-cells can regulate osteoclasts. Interestingly, under non-inflammatory conditions, osteoclasts can also recruit and convert naïve T-cells to become regulatory T-cells, indicating bidirectional regulation.

3. \_\_\_ Dr. Mariana M. Beltcheva: Considerable effort has been recently devoted to characterize intrinsic and extrinsic factors regulating neural differentiation of stem cells. Our group studies the role of opioids on embryonic stem (ES) cell and neural progenitor proliferation and neural differentiation. We are interested in characterizing opioid regulation of extracellular signal regulated protein kinase (ERK), the MAP kinase isozyme that promotes cell proliferation and differentiation, to understand how opioid-ERK interactions likely underlie basic neurobiological mechanisms that modulate ES cell division and neural differentiation.
4. \_\_\_ Dr. Joseph C. Eissenberg: Mechanisms by which cells sort proteins for degradation; we use *Drosophila* as a model genetic organism.
5. \_\_\_ Dr. Decha Enkvetchakul: Ion channels are proteins that control the passage of ions into and out of the cell, which in turn is important in a vast array of physiological phenomena, e.g. the electrical activity of neurons and muscles that allow us to think and move. My lab is interested in the structure of ion channels, i.e. the shape and form of an ion channel, and how their structure allows them to control the flow of ions. Students will have a chance to make and purify proteins that form an ion channel, manipulate DNA to make mutant ion channels, and study ion channel protein properties in artificial membranes.
6. \_\_\_ Dr. Robert E. Fleming: The relationship between iron metabolism, infection, and inflammation using transgenic mouse model systems.
7. \_\_\_ Dr. Amy Harkins: My lab studies how calcium regulates the release of synaptic vesicles during synaptic transmission. We study which transmitters are released and different proteins that control the release of the vesicles. This allows neurons to communicate with one another. For more information on topics and general research interests of the lab, as well as people currently in the lab, go to the website: <http://medschool.slu.edu/pharmphys/harkinslab/index.phtml?page=main>  
A STARS person would be involved in all aspects of laboratory life with an undergraduate student, a graduate student, two research assistants, and myself, the mentor.
8. \_\_\_ Dr. Der-Chyan Hwang: A background of over 20 years protein and enzyme research experience in both academic and industrial settings. My research interest is to apply various technologies to modify plant proteins to improve their molecular, chemical, physical and functional properties. The end goal of my research is to apply these modified proteins in various industrial applications.
9. \_\_\_ Dr. Jack Kennell: The study of pathways involved in communication between the mitochondrion and nucleus.
10. \_\_\_ Dr. Sergey Korolev: Structural and biochemical studies of DNA repair and recombination proteins; studies of eukaryotic and pathogenic phospholipases.

11. \_\_\_ Dr. Toni Kutchan: We use biochemical and molecular genetic techniques to understand how selected medicinal plant species make bioactive natural products. A better understanding of the enzymes and underlying genes of plant natural biosynthesis will facilitate the development of improved sources of medicine through metabolic engineering of medicinal plants and heterologous systems. Current research in the lab investigates emetine formation in *Psychotria ipecacuanha* and morphine biosynthesis in *Papaver somniferum* and in mammals.
12. \_\_\_ Dr. Robert Marquis: My lab studies the ecology of tritrophic interactions, that is, interactions among plants, herbivores, and the carnivores that eat herbivores. These interactions have been found to be important in a wide variety of ecosystems, from open ocean, marine tide pools, and freshwater streams, to savannas and forest. We focus on the herbivores and carnivores associated with oak trees in the St. Louis region. We combine lab and field work to determine which natural enemies influence the abundance of insect herbivores, and how their impact varies with oak species. This summer we will be studying bird predation on caterpillars (think "The Birds") and parasitism of caterpillars by parasitic wasps and flies (think "Alien").
13. \_\_\_ Dr. Amit Mathur and Dr. Terrie Inder: The Washington University Neurodevelopment Research (WUNDER) group co-directed by Drs. Terrie Inder and Amit Mathur (Associate Professor of Pediatrics), is interested in understanding human brain development and injury using novel magnetic resonance imaging (MRI) techniques including diffusion tensor imaging (DTI), brain metrics, and surface based morphometry. The number of premature births in the US continues to increase and prematurity is the leading cause of developmental delay and cerebral palsy in children. While there have been significant advances in neonatal care, the cause and timing of brain injury in premature infants is unclear. Using non-invasive MRI techniques we are conducting clinical studies to evaluate the impact on neonatal factors on brain growth. We are also studying brain surface folding as it evolves from a relatively smooth surfaced organ in the fetus (or premature infant) to a complexly folded structure by the time a mature infant is born. Understanding these biological mechanisms is key to improving the long term outlook for this vulnerable population.
14. \_\_\_ Dr. Steven Mumm and Dr. Michael Whyte: We study molecular genetics of rare inherited bone diseases, such as hypophosphatasia, juvenile Paget's disease, and many others. The major goal is to identify specific gene mutations in patients' DNA as the cause of their bone disease.
15. \_\_\_ Dr. Wendi Neckameyer: We study the development and function of neural circuits in the fruit fly. Students and teachers can learn design, set up and execution of behavioral assays.
16. \_\_\_ Dr. J. Gail Neely: Quantitative human observer and computer analysis of facial movement in health and disease.

17. \_\_\_ Dr. Sona Pandey: The primary area of the Pandey lab research is elucidating abscisic acid (ABA) signaling with the ultimate goal of engineering drought tolerance in plants. We are using molecular genetics, biochemistry, genomics, proteomics, protein-protein interactions, site directed mutagenesis, and cell biology-based techniques to identify novel proteins and decipher their roles and mechanism of action towards engineering plant drought tolerance.
18. \_\_\_ Dr. Richard Sayre: Biofortification and Metabolic Engineering of Cassava: Our lab coordinates the BioCassava Plus Program for bio-fortification of cassava. This program is funded by the Grand Challenge in Global Health Program of the Bill and Melinda Gates Foundation. Our lab's specific research objectives include; increasing bio-available levels of iron in roots, reducing cyanogen toxicity, increasing root protein content, reducing root post-harvest physiological deterioration, and developing root-specific promoters for transgene expression in cassava. Additional research programs focus on starch metabolism and biofuel production from cassava.

#### Center for Advanced Biofuel Systems (CABS)

The objective of CABS is to increase the thermodynamic and kinetic efficiency of select plant- and algal-based fuel production systems using rational metabolic engineering approaches grounded in modern systems biology. Our overall strategy is to increase the efficiency of solar energy conversion into oils and other specialty biofuel components by channeling metabolic flux toward products using advanced catalysts and sensible design. Information obtained from these studies will direct engineering strategies for enhanced biofuel production systems. A unique feature of our program is the integration of all aspects of metabolism, from the earliest events in photosynthesis to the synthesis and accumulation of oils and novel biofuel products. Using a "systems" approach, we will continuously improve our strategy and inputs for biofuel production and product development.

19. \_\_\_ Dr. Vijay Sharma: His research interests are at the interface of radiopharmaceutical chemistry, medicinal chemistry, and biology, to discover and develop molecular probes, for addressing important biological questions across multiple disciplines. Specific emphasis is towards the design of small organic molecules and peptides including their radiolabeled counterparts of diagnosis of diseases (Alzheimer's disease); to understand protein-protein interactions via imaging of reporter gene expression *in vivo*; and to investigate biological mechanism(s), using agents designed and developed within their group. Our group continues to discover and validate diagnostic agents for rapidly emerging field of molecular imaging.
20. \_\_\_ Dr. Laurie P. Shornick: Infants are very susceptible to infection. My laboratory is interested in understanding the differences between the neonatal and adult immune response to respiratory viral infections.
21. \_\_\_ Dr. Dorota Skowrya: 1) Principles of protein structure-function analysis (biotechnology); or 2) regulation of the cell division cycle in yeast *S. cerevisiae* (cell biology); or 3) characterization of new pharmacological regulators of the 26S proteasome (drug discovery).

22. \_\_\_ Dr. Phyllis Stein: Our laboratory analyzes information from heart rate patterns on long-term continuous electrocardiograms, usually 24-hour ambulatory recordings or overnight sleep studies. These patterns can be quantified mathematically as heart rate variability measures or analyzed graphically in different ways. What I have in mind for this summer is the performance of graphical heart rate pattern analysis from a set of 24-hour recordings on people who served in the first Gulf War and either have or do not have Gulf War illness. We noticed some unusual heart rate patterns in the group of subjects, but we do not know whether these patterns are associated with Gulf War illness. Thus, the student will be working on methods to find and quantify these unusual heart rate patterns and once this is done, we will send the results to the data coordinating center (who does know which group each person is in) and find out if, as I suspect, these patterns represent a kind of abnormality of the functioning of the autonomic nervous system that has something to do with why these people are feeling so sick.
23. \_\_\_ Dr. Michael Tomasson: Human genetics, cancer biology, leukemia, and multiple myeloma.
24. \_\_\_ Dr. Xiemin (Sam) Wang: Plant response to nutrients (N,P), molecular biology, biochemistry, and biotechnology.
25. \_\_\_ Dr. Katherine Weilbaecher: The skeleton is the organ most commonly affected by metastatic cancer in humans. Mechanisms by which skeletal metastases are established are unclear; however, osteoclast activation plays a critical role in the pathogenesis of bone metastases. Our laboratory focuses on the molecular mechanisms through which tumor cells metastasize to bone.
26. \_\_\_ Dr. Wenyan Xiao: Genetics and Plant Biology.
27. \_\_\_ Dr. Oliver Yu: The Yu lab has two major areas of interest. One is to study plant metabolic mechanisms that produced thousands of plant natural products which are important for human health and agriculture. The other is to study the developmental regulations of plant organogenesis by genetics and functional genomics. Yu lab has participated in STARS program since 2004.

## **B. Chemistry**

28. \_\_\_ Dr. Eike Bauer: Energy conservation has become an area of concern in recent years. Catalysts are compounds that speed up chemical reactions without being consumed and help save energy and resources. Our research is directed towards the development of new catalyst systems based on ruthenium and iron. If successful, the research may lead to catalysts which might find applications in pharmaceutical production. The project involves setting up catalytic reactions on a small scale and applying instrumental analysis: gas chromatography (GC), gas chromatography coupled to mass spectrometry (GC/MS) and High Performance Liquid Chromatography (HPLC). Students will gain hands-on experience with these instruments, which are frequently applied in forensic medicine or sports doping analysis.

29. \_\_\_ Dr. Dana Baum: We are interested in using DNA as a catalyst for a variety of applications. DNA is known for its coding role in cells, but DNA also has properties that make it a useful tool outside of the cell. Possible projects involve using DNA as a catalyst in biofuel cells and using DNA in sensors for pollutants in the environment.
30. \_\_\_ Dr. Steven Buckner: We are working on novel nanomaterials for applications in dye-sensitized solar cells. Researchers work on synthesis on new nanomaterials. Further work involves characterization using electron microscopy and spectroscopy, and application in solar cells.
31. \_\_\_ Dr. James Chickos: The projects center around the measurement of physical properties of interest to chemical engineers, environmentalists and those working in the thermochemical community using gas chromatography and differential scanning calorimetry. The projects involved measurements of phase change enthalpies and vapor pressures of materials that often cannot be measured by other means.
32. \_\_\_ Dr. Peter Gaspar: We are studying a new class of highly reactive species that has the potential to participate in novel and useful chemical reactions that form three new bonds at the same time. A STARS participant could engage in experiments generating such species or in computational modeling of their reactions. This work can be described as mechanistic organic or inorganic chemistry.
33. \_\_\_ Dr. Sophia Hayes: Our research is primarily focused on materials science, specifically looking at the structure of materials and properties using a technique called NMR (related to MRI's) done on humans). Our studies focus largely on semiconductors and other solids, including molecular crystals. Students with a strong background in physics and chemistry are the best fit. We have hosted students interested in physics, engineering and chemistry.
34. \_\_\_ Dr. Istvan Kiss/Mahesh Wichramasinghe: Complex Electrochemical Dynamics – Synchronization and Chaos. Current generating chemical reactions produce a variety of dynamical responses that exhibit striking similarities to living systems. These abiotic systems can produce, for example, synchronization similar to those observed with flashing fireflies and chirping crickets. Our research group investigates self-organization in electrochemical systems and how such critical behavior could affect our present and future fuel cell and battery technologies.
35. \_\_\_ Dr. Michael Lewis: How aromatic molecules bind certain molecules is important for enzyme-substrate recognition and catalyst development. Our research lab explores the binding properties of aromatic molecules. We are interested in a student researcher performing computational modeling studies to investigate novel binding of aromatics with biological and chemical significance.

36. \_\_\_ Dr. Richard Mabbs: Using mass spectrometry, ultrahigh vacuum equipment and pulsed lasers, we image photoelectrons to probe molecular electronic structure. STARS participants will experience state of the art physical chemistry research techniques and develop simple qualitative models to explain experimental results. These will serve to provide better understanding of the fundamentals of chemistry. Participants will also explore methods of incorporating this material into pedagogical tools aimed at illustrating and clarifying essential basic concepts of quantum chemistry.
37. \_\_\_ Dr. Ryan McCulla: The McCulla lab is broadly interested in the use of photocatalysts to neutralize or degrade chemical and biological toxins. To these ends, we use computational chemistry, synthetic organic chemistry, and physical organic chemistry techniques to create and explore the properties of new photocatalysts. Other projects include the investigation of reactive intermediates in physiology.
38. \_\_\_ Dr. Shelley Minter: Alternative energy sources, solar cells, fuel cells, and bioenergy.
39. \_\_\_ Dr. James J. O'Brien and Dr. Leah C. O'Brien: Studies of the high-resolution, electronic spectra of diatomic transition metal containing species created in a hollow cathode plasma discharge. Species intended for study include: Palladium Platinum and Titanium containing species. The technique to be employed in this work is Intracavity Laser Spectroscopy, which is a special, ultra-sensitive method for recording the absorption spectra of gas phase species. The plasma discharge where the species are formed is contained inside the laser cavity. Because of laser amplification, the effective path-length used in this work is about 1 mile. Over the past several years, STARS students have been engaged in studies of species such as Nickel Chloride, Nickel Hydride, Gold Oxide, and Platinum Carbide examined in a similar manner, and such students (~8 of them) have been co-authors of papers published in prestigious journals (*Journal of Molecular Spectroscopy* and the *Astrophysical Journal*). In summer 2009, STARS students studied the species TiF, PtF, and the Pd dimer.
40. \_\_\_ Dr. Nigam Rath: X-ray diffraction is one of the important physical methods for solid state structure determination. Single crystal X-ray diffraction and crystallographic methods will be used for elucidation of three dimensional molecular and crystal structures of novel organic and organometallic compounds.
41. \_\_\_ Dr. Keith Stine: The research project will involve aspects of nanomaterials chemistry and biochemistry. The goal of developing immunoassays for disease biomarkers will be pursued using nanoporous gold as a support for immobilized antibodies and enzymes. These materials will be used to detect disease related antigens using optical or electrochemical methods. Students involved in this project will learn some basic aspects of nanomaterials chemistry, biochemical interactions, and chemical analysis using instrumentation. Some of the particular antigens of interest include those related to early detection of different forms of cancer.

42. \_\_\_ Dr. Chung F. Wong: To stimulate the effects of drugs applying to proteins in the Epidermal Growth Factor Receptor signaling pathway on tumor cell growth.
43. \_\_\_ Dr. Brent M. Znosko: Our laboratory is interested in the stability of nucleic acids (DNA and RNA). The primary focus is on three projects; understanding the stability and structure of RNA secondary structure motifs; thermodynamic, energetic, and structural characterization of short RNA oligomers containing non-standard nucleotides, and investigating the role of substituent-substituent interactions in DNA/RNA base stacking and in DNA/RNA-intercalator stacking. We utilize chemical, biochemical, UV/visible spectroscopic and nuclear magnetic resonance techniques, in addition to various computer programs and molecular visualization software.

### **C. Engineering / Earth & Atmospheric Science**

44. \_\_\_ Dr. Ramesh K. Agarwal: Aerospace Engineering, Energy & Environment.
45. \_\_\_ Dr. Jeffrey Catalano and Dr. Yun Luo: My group investigates chemical and biological processes that control how contaminants like arsenic, uranium, and mercury migrate in the environment. We are currently focused on how biological and geochemical processes alter iron and manganese minerals, common constituents in soils and aquatic systems, and how these changes in turn modify the ways these minerals affect inorganic contaminants in the environment.
46. \_\_\_ Dr. Timothy Eichler: My research focuses on studying extreme weather linked to mid-latitude cyclones in current and future climate. Higher resolution data is making it feasible to study the structure of these storms, which is important in assessing impacts from extreme winds and precipitation. A student/teacher could participate in analyzing the data to learn more about what makes “these storms tick.” It is expected that the results from this phase of research will be used as a baseline for studying the potential impacts of climate change on storm tracks.
47. \_\_\_ Dr. Young-Shin Jun: The Environmental Nanochemistry lab (PI: Young-Shin Jun) is conducting highly interdisciplinary researches which aims to explore the environmental impacts of human activities through improved understanding of the fate and transport of contaminants and nanoparticles. In addition, our group is performing a comprehensive analysis of the potential risks associated with CO<sub>2</sub> sequestration strategies to mitigate climate change.
48. \_\_\_ Dr. Abuduwasiti Wulamu: My research interests include remote sensing, geographic information system (GIS) and applications of geospatial technologies in monitoring of environmental issues, e.g. droughts, earthquake destruction & deformation. This summer, I will be involved in the following projects: 1) monitoring the health and status of critically endangered lowland rainforest habitat in Madagascar using integrated remote sensing and GIS in which satellite data including synthetic aperture radar (SAR) data will be used to measure tree height and health; 2) Deformation estimation and hazard assessment from the 2010 Haiti Earthquake using ALOS/PALSAR Images; 3) Web GIS, enterprise (relational) databases development and maintenance, and developing intuitive and interactive map editing tools.

49. \_\_\_ Dr. Grigoriy Yablonsky/Eugene Redekop: Our area is related to the development of green engineering processes, particularly catalytic processes with participation of CO<sub>2</sub> and CO gases. Typical problems are both experimental and theoretical. Our group is working at the boundary of chemical engineering and mathematics, based on the advanced non-steady-state experimental technique (Temporal Analysis of Products/TAP). Our goal is to develop new chemico-mathematical approaches and apply them to decoding the mechanisms of complex chemical reactions and constructing the new highly selective catalytic systems.

#### **D. Psychology / Public Health**

50. \_\_\_ Dr. Michael Anch: Our lab studies the basic brain mechanisms that control sleep. This involves recording sleep in rats after lesioning, by implanting epidural electrodes. The student would learn sterile surgical techniques, electrode construction, sleep stage scores, and rat handling.

51. \_\_\_ Dr. Christy Hoehner/Dr. Ross Brownson: Obesity and physical inactivity are at epidemic rates. The students will work on one or more studies of the effects of the built environment (land use and transportation planning) on health. Work may include background research, data collection, data editing, and/or data analysis.

52. \_\_\_ Dr. Terri Rebmann: The Institute for Biosecurity in the School of Public Health at Saint Louis University focuses on preparing for bioterrorism, pandemics, and outbreaks of emerging infectious diseases (such as SARS, monkeypox, avian flu, etc.). Ongoing research projects include examining pandemic preparedness of local businesses, schools, healthcare providers, and response agencies in the St. Louis region and across the United States. A new research project involves the assessment of physiological and psychological effects of wearing N95 respirators (i.e., masks) by healthcare workers in a hospital intensive care unit for long periods of time. A variety of research practices are used: focus groups, surveys, interviews, physiological and psychological monitoring, etc., allowing students to experience multiple types of approaches.

**PLEASE RETURN THIS MENTOR SELECTION FORM - WITH YOUR APPLICATION  
(Application form, complete transcript, essay,  
one letter of recommendation, and \$65.00 application fee,  
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NO LATER THAN MARCH 26, 2010 TO:**

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