

**2009 STUDENTS & TEACHERS AS RESEARCH SCIENTISTS (STARS)
MENTOR SELECTION FORM**

"Experiencing the Scientific Enterprise"

June 8 – July 17, 2009

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, SIU-Edwardsville,
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. The Research Interest Areas Below (1-9) are for Illinois Students ONLY

Rank your top five choices (1 = high, 5 = low). Put an X on the choices you absolutely would NOT consider.

A. Biological Science

1. ____ Dr. David Duvernell: This summer my students and I will be involved in several field and lab based studies of the ecological, behavioral and genetic relationships among a group of locally abundant topminnow species in the genus *Fundulus*. Students will have the opportunity to engage in field studies that involve marking and recapturing fish to study movement patterns in local streams, perform mate selection experiments in outdoor artificial stream environments on the SIUE campus, and use molecular techniques to genotype individuals and conduct genetic paternity analyses.

2. ____ Dr. Faith Liebl: My lab is interested in the expression, trafficking, and localization of glutamate receptors. This is an important neurobiological question because glutamate neurotransmission is thought to be involved in processes such as learning and memory as well as pathological processes such as epilepsy, neurodegeneration, and excitotoxic cell death. I use the model organisms *Drosophila melanogaster* (i.e. fruit fly) to study glutamate receptors. The fly which are closely related to mammalian non-NMDA receptors. The *Drosophila* NMJ is a powerful system with readily available molecular, cellular, and physiological tools and allows one to determine the function of specific molecules by analysis and investigation of mutant synapses.

3. ____ Dr. Kevin Rowland: My laboratory is involved in investigating new methods to treat agonizing pain. We will investigate an experimental new drug that targets ionic channels on nerve membranes. The drug may be a novel, non-addicting method for reducing pain after injury. (Student will be working at the Alton campus.)

B. Chemistry

4. ____ Dr. Robert P. Dixon: Dr. Dixon's research interests lie at the interface of chemistry and biology. He seeks insights into biological processes and macromolecular structure by employing probes at the molecular level. His modus operandi consists primarily of using the tools of chemistry to understand biochemical processes.
5. ____ Dr. Kevin A. Johnson: Dr. Johnson's research interests are in environmental chemistry and toxicology. A current area of interest is the presence of pharmaceuticals, veterinary antibiotics, and /or endocrine disrupting compounds in surface and ground water supplies. Some summer projects will involve either determining water extraction techniques to test for these compounds or conducting aquatic toxicity tests (standardized 48- and 96-hr toxicity tests with *D. magna*) with these compounds.
6. ____ Dr. Chin-Chuan Wei: Our research primarily uses biotechnology to generate human gene proteins using bacteria. Following biochemistry principles, bacteria acts like a factory to generate these proteins in large quantity. The protein generated in such manner is known as recombinant protein. It can be applied to therapeutic agents and chemical catalysts. More importantly, it helps us to understand the complexity of biomolecules in our body. Students will have the opportunity to clone gene, express and purify recombinant proteins, and characterize their activities using spectroscopy.

C. Computer Science / Engineering / Earth & Atmospheric Science / Physics

7. ____ Dr. Chris Gordon: I am investigating applications of waste materials in concrete mix designs. The summer research project will focus on researching the lifecycle of plastic materials and evaluating the properties and performance of several types and amounts of recycled plastic as part of concrete mixes.
8. ____ Dr. Susan Morgan: I am involved in research to reduce the impact of stormwater from developed areas, such as parking lots. You can take part in ongoing research on green roofs and green walls (<http://www.green-siue.com/>), new research on bioretention and porous pavement, or explore another aspect of stormwater management that interests you.

D. Psychology / Pharmaceutical Science

9. ___ Dr. Maria Konotoyianni: My work is basically computational. So this summer, my students and I will focus on figuring out what the requirements are for certain drugs to bind to specific targets (receptors) in the human body in order to elicit a biological response. We will select a few receptors at first, extract from the literature and the World Drug Index the drugs that act on these receptors and develop hypotheses for which parts of these compounds are important for binding. Once we have that, we will first validate the hypotheses by using a test set to see if they fit the hypotheses and then proceed with more receptors. In doing so, the students will learn how to extract information from several resources, understand the principles governing drug action, learn how to use at least a couple of software algorithms, critically evaluate the results, and overall engage in an integrated approach to drug discovery including understanding of basic principles of chemistry, biology, and computers.

III. 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

10. ___ Dr. Robert D. Aldridge: This project involves studying the natural behavior of snakes in the wild and interpreting the data in the laboratory. Students will use radio telemetry to monitor the mating activities of female watersnakes in the wild then, in the laboratory, use DNA analysis to determine the paternity of the offspring.
11. ___ Rejeev Aurora: Systems Biology and Immunology.
12. ___ 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 modulates ES cell division and neural differentiation.
13. ___ 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.
14. ___ Dr. Joseph C. Eissenberg: Genetics, molecular and cell biology.

15. ____ 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.
16. ____ Dr. Jon Fisher: We are currently studying the role of a protein called ataxia telangiectasia mutated (ATM) in regulation of metabolism in skeletal muscle. In particular, we are looking for basic information that could eventually be used to increase mitochondrial function or to counteract diabetes.
<http://pages.slu.edu/faculty/fisherjs/>
17. ____ 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.
18. ____ Dr. Joseph Jez: Research in the Jez lab uses chemical and biological approaches to understand how plants generate an arsenal of molecules with interesting biological activities. Currently, we are focusing on the biosynthesis of molecules involved in protecting plants from heavy metal, i.e., cadmium, mercury, arsenic, and lead, toxicity. By understanding this system, our long-range goal is to engineer plants for environmental clean-up.
19. ____ Dr. Jack Kennell: The study of genetic elements that reside in mitochondria and the effects they have on their hosts.
20. ____ Dr. Sergey Korolev: Protein biochemistry and structural analysis. Studies of proteins involved in DNA repair and combination. Second class of proteins we study is phospholipases which found both in eukaryotes and prokaryotes and which play important function in cardiovascular processes and in bacterial pathogenesis.
21. ____ Dr. Toni Kutchan: Many of the modern medicines used today come from plants. We investigate how selected plants make these medicinal compounds and use to knowledge to improve upon the medicinal plant or develop alternate biological sources for the medicine. Our work is multidisciplinary and involves the techniques of chemistry, enzymology and molecular biology.

22. ___ 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”).
23. ___ 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 nutrition 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.
24. ___ 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.
25. ___ Dr. Wendi Neckameyer: Our lab focuses on the development and function of neural circuits using the fruit fly, *Drosophila melanogaster*, as a model system. Project may include behavioral and genetic studies.
26. ___ Dr. J. Gail Neely: This research employs very sophisticated computed measure of facial movement to explore facial expressions in human communication. It also is connected to an international think tank and task force in the USA and other countries.

27. ___ Dr. Colin Nichols: My research group is focused on the molecular and cellular regulation of potassium channels, and their role in linking metabolism to electrical activities in various tissues. We have developed detailed understanding of the molecular basis of potassium channel function, as well as clinically relevant understanding of several potassium channel diseases. Our latest efforts are directed towards a complete understanding of the molecular details, the physiological role, and clinical relevant, of potassium channel activity, using combinations of biochemical, genetic, physiological and biophysical approaches. Students coming in to the lab will probably work closely with a post-doc or graduate student in some aspect of these projects.
28. ___ Dr. Richard Ostlund and Dr. Chaya Gopalan: We are interested in understanding the relationship between diabetes, glucose uptake and the role of insulin in regulating the transport of glucose at the cell membrane level. Our lab is studying the role of inositols which are known to mimic the actions of insulin. The key transporter of some of the isomers of inositols is a sodium-dependent myo-inositol-2 (SMIT-2) protein and our current focus is on interfering with the uptake of inositols via this transporter and its relation to diabetes and Alzheimer's disease.
29. ___ Dr. Paul Schlesinger: Apoptosis and the mechanism of regulating cell death at a molecular level. Intracellular ion channels and bone metabolism. Biophysical approach to medicine. Our lab tries to present beginning students a useful way to approach and understand biologically and technologically complex concepts.
30. ___ 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 mechanisms(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.
31. ___ Dr. Laurie P. Shornick: My laboratory has two areas of research. The first project is aimed at defining the neonatal immune response to viral infection. The second area of research is aimed at understanding the mechanisms for impaired wound healing in diabetic patients. We are examining macrophage activation in normal and diabetic wound healing. Both of these projects utilize mouse models of human disease.
32. ___ 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).

33. ___ Dr. Phyllis Stein: Our laboratory does research based on continuous electrocardiograms from 24-hour Holter recordings in different populations and also from overnight sleep studies. We examine heart rate patterns, do measurements from the actual shape of the electrocardiogram and also calculate various measures of heart rate variability. We also can detect sleep-disordered breathing (sleep apnea). We have thousands of recordings which we can apply our techniques. This coming summer I am especially interested in looking more closely at a new set of Holter recordings of 186 Gulf War Veterans who do and do not have Gulf War Illness to see if there are any patterns that might be different between the groups.
34. ___ Dr. Michael Tomasson: Our research involves understanding the molecular mechanisms that drive cancers of the bone marrow (acute myeloid leukemia, AML, and multiple myeloma, MM). We have several projects designed to identify mutations that occur in the DNA of patients with AML and MM, and we are actively involved in the evaluation of new DNA mutations using cell culture and mouse model systems. Our goal is to develop new therapeutic strategies for these deadly diseases based on a detailed understanding of cancer genetics.
35. ___ Dr. Xiemin (Sam) Wang: Plant biochemistry and molecular biology: membrane lipids as regulators in plant production and quality.
36. ___ Dr. Wenyan Xiao: Cytosine methylation is one of the major mechanisms to silence transposons and retroviruses, control genomic imprinting, and regulate reproduction in both mammals and plants. *Arabidopsis thaliana* is an excellent system to investigate epigenetic mechanisms, which are evolutionarily conserved between mammals and plants. In *Arabidopsis*, DEMETER (DME) belongs to a family of DNA glycosylases that excise damaged or mismatched bases in the base excision DNA repair. DME demethylates and activates the maternal allele of imprinted genes. DME-INTERACTING PROTEIN 1 (DIP1) is a putative ubiquitin-conjugating enzyme 7-interacting protein 4 that has a RING domain. We will carry out experiments using the genetically tractable *Arabidopsis* to elucidate mechanisms that link ubiquitination via a RING domain protein to DNA demethylation, gene imprinting, and gene expression – processes that are evolutionarily conserved and integral to the pathology of human diseases such as cancer.
37. ___ Dr. Peter Zassenhaus: 1) Detection of DNA at ultrahigh sensitivity, 2) Mitochondrial DNA mutations and aging.

B. Chemistry

38. ___ John Bleeke: Our research is in the area of chemical synthesis, particularly the synthesis of new organometallic catalysts. Catalysis is a key technology to achieve the objectives of sustainable (green) chemistry. The student involved in this project will learn the technique of air-sensitive organometallic synthesis and will also learn how to characterize new compounds using NMR spectroscopy and X-ray crystallography.

39. ___ Dr. Steven Buckner: We are interested in the production of nanoscale architectures for applications in high energy materials, hydrogen storage, and solar energy conversion. Work involves synthesis of new core-shell nanostructures and characterization of the resulting nanostructures with electron microscopy, x-ray diffraction, spectroscopy, and wet chemical methods including hydrogen evolution.
40. ___ 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.
41. ___ Dr. Sophia Hayes: We conduct research at the boundary of chemistry and physics, investigating semiconductors with NMR spectroscopy. Our goal is to observe defect sites in the semiconductors which affect their optical and electronic performance – key parameters for their application in devices (computers) and in photovoltaics (solar cells). Students will be exposed to solid-state NMR, semiconductor materials, and optical techniques. Our faculty to contact concerning possible involvements in STARS includes: Richard Loomis, pchem; Kenya Powell, chemistry education.
42. ___ 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.
43. ___ 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.
44. ___ Dr. Ryan McCulla: Computational and experimental studies of the photocatalytic decomposition of non-toxic chemical weapon stimulants.
45. ___ Dr. Shelley Minter: Alternative energy/bioenergy: production and utilization of biofuels via immobilized enzymes; Biosensors; sensing concentration of metabolites and drugs in-vivo and in the environment.

46. ___ Dr. James J. O'Brien and Dr. Leah C. O'Brien: Studies of the high-resolution, electronic spectra of diatomic species created in a hollow cathode plasma discharge. Species intended for study this summer include: Palladium Fluoride (PdF), carbide (PdC), Nitride (PdN), Chloride (PdCl) and Hydride (PdH). The technique to be employed in this work is Intracavity Laser Spectroscopy, which a special ultra-sensitive method for recording absorption spectra of gas phase species. Because of laser amplification, the effective path-lengths employed in this work are 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 (~6 of them) have been co-authors of papers published in prestigious journals (*Journal of Molecular Spectroscopy* and the *Astrophysical Journal*).
47. ___ 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.
48. ___ 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.
49. ___ Dr. Chung F. Wong: To perform computer simulation to study the role of drug-binding kinetics on influencing Epidermal Growth Factor Receptor Signaling in non-small cell lung cancer.

C. Computer Science / Engineering / Earth & Atmospheric Science / Physics

50. ___ Dr. Ramesh K. Agarwal: Aerodynamics of Cars and Wings, Wind Turbines, Zero Energy Buildings, Fuel Cells, Blood Flow in Arteries and Valves.
51. ___ Dr. Jeffrey Catalano: 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 term modify the ways these minerals affect inorganic contaminants in the environment.
52. ___ Dr. Shirley Dyke: We are developing a series of online teleoperation experiments involving earthquake simulator tables. This would involve designing and building models for demonstrating complex behaviors in structures when subjected to earthquake loading. We will build the models, use sensors to capture their behavior, and will then implement this over the internet for teleoperation experiments.

53. ___ Dr. Daniel Giammar: Chemical reactions that protect drinking water quality. Research in the Aquatic Chemistry Laboratory is investigating reactions that control dissolved lead concentrations measured in tap water.
54. ___ 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 CO₂ sequestration strategies to mitigate climate change.
55. ___ Dr. Istvan Kiss, Dr. Sridhar Condoor, and Dr. Gregory Yablonsky: Development of combined hybrid electrolysis – windmill technologies: Design of an electrochemical interface for power storage generated by windmill shall be performed. Combined mentoring of chemistry and engineering faculty will be provided for this strongly interdisciplinary design project that covers electrochemical and fluidics/engineering concepts.
56. ___ Dr. Henry Kang: Computer Graphics: Research on image processing and stylization.
57. ___ Dr. Tim Kusky: Geological hazards (flood, volcano, earthquake), remote sensing (satellite imagery), geographic information systems (GIS), plate tectonics.

D. Psychology / Public Health

58. ___ Dr. Michael Anch: Our lab focuses on neural mechanisms that control sleep. Our research looks at electrophysiological indicators of sleep in rodents as a function of brain lesion and sleep deprivation. The student will be exposed to sterile surgical techniques, histology, sleep stage scoring, electrode construction and many other procedures.
59. ___ Dr. David Balota: Cognitive Psychology: Attention and memory in Healthy Young Adults and Older Adults.
60. ___ Dr. Gregory Evans/Dr. Rachel Schwartz: Student will work on developing, distributing, and analyzing a survey of public health preparedness among high school students. It is important that potential students understand that this is not a laboratory position. Dr. Evans/Dr. Schwartz do survey research in the area of public health.

**PLEASE RETURN THIS MENTOR SELECTION FORM - WITH YOUR APPLICATION
(Application form, complete transcript, essay,
one letter of recommendation, and \$60.00 application fee,
please make checks payable to UM-St. Louis)
NO LATER THAN POSTMARKED MARCH 27, 2009 TO:**

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