Sophomore Early Research Program 2012-2013
Natural Science Faculty Projects

Natural Sciences: Projects in Astronomy, Biological Sciences, Chemistry, Computer Science, and Neuroscience.

Astronomy

Wendy Bauer

Python programming in astronomy: My research uses ultraviolet spectra of eclipsing binary systems to observe mass loss from supergiant stars. I am in the process of moving from the IDL computer language to the open source python language (which is now being taught in introductory physics) to analyze my spectra. The student will gain familiarity in programming in python while helping to translate my programs and using them to analyze spectra.

Biological Sciences

David Ellerby

My research lies at the intersection of physics, physiology and behavior, exploring the energetics and mechanics of animal locomotion. For many animals, effective and economical locomotion is an essential component of survival and fitness. Students participate in all aspects of the research program: learning and implementing experimental and analytical techniques; presenting data at professional conferences and in publications; and contributing to the day to day running of the lab.

Chemistry

Chris Arumainayagam

Electron-Induced Reactions Relevant to the Semiconductor Industry

We propose to study the low-energy (0–100 eV) electron-induced decomposition of the organometallic precursor molecules $Mo(CO)_6$ and MoF_6 under ultrahigh vacuum conditions ($p \sim 1 \times 10^{-10}$ Torr) using post-irradiation temperature programmed desorption (TPD), a well-established surface science technique, and isothermal electron-stimulated desorption (ESD) experiments. These studies will allow us to examine the hypothesis that dissociative electron attachment is the primary mechanism leading to radiation-induced damage in organometallic precursor molecules relevant to electron-beam-induced deposition (EBID), a promising technique for fabricating nanoscale structures.

Dora Carrico-Moni

The Carrico-Moniz lab would welcome a sophomore student interested in conducting a multidisciplinary project at the interface of chemistry and biology. The work will give the student the opportunity to learn about and apply techniques used in medicinal chemistry and drug discovery, including organic synthesis, structure-activity relationship (SAR) studies, lead compound optimization, and assay development.

Don Elmore

Students working in the Elmore lab would learn to use experimental techniques and/or computational molecular modeling to investigate biochemical processes on a molecular level. In particular, student projects will most likely focus on antimicrobial peptides, which are small proteins that are active against bacteria. Students in the lab have the opportunity to learn how data from a variety of different methods, from cellular assays and microscopy to spectroscopic measurements to computational modeling, can be combined to address biochemical questions.

Nancy Kolodny

The research opportunity in my laboratory centers around a collaborative, interdisciplinary project in which we are synthesizing and characterizing a nanoparticle with an iron oxide core (for magnetic resonance imaging (MRI) tracking), coated with gold (for biocompatibility), that will carry boron atoms (as therapeutic targets) and be directed toward pancreatic cancer cells (via an antigen-antibody recognition process). The student involved in this project will investigate the magnetic properties of nanoparticles during each step of this multi-step synthesis. She will participate with a team of students and faculty who bring a variety of expertise to this collaborative effort.

Didem Vardar-Ulu

Vardar-Ulu lab would be very happy to have a sophomore who is interested in learning about how to make proteins using *E.coli* expression systems present in the lab, carry out complete purification of these expressed proteins and then use them to investigate the molecular details of the interactions within the Negative Regulatory Region (NRR) of the Notch receptor that acts as the activation switch for this evolutionarily conserved biosignaling pathway. They long term goal of this project is to provide the structural insight needed to validate or refute the multitude of current models in literature, as well as test novel models that attempt to explain how the Notch receptor is ensured in an "OFF" state prior to ligand binding under normal conditions, as well as how Notch activation becomes ligand independent in cancer associated mutations. The studies planned for this project are designed to expose the undergraduate researcher joining the lab to a multitude of interdisciplinary research at the boundaries of chemistry, biology and physics

Computer Science

Panagiotis Metaxas

Social Media Analysis

How Social Media affects the US electoral process? Can it become a substitute for polling? When political information propagating through Social Media affects citizens' perceptions more than traditional media? These are some of the questions we try to address by collecting Google, Twitter, Facebook data, and there are lots of opportunities for Social Science students to help us analyze them.

Neuroscience

Bevil Conway

The Conway lab would like to host a SERP student in the coming year to work on projects aimed at characterizing the neural basis for visual perception, with a focus on color. Students working in the lab are involved in all aspects of lab's activities, including work with a range of techniques

and interdisciplinary approaches consisting of functional magnetic resonance imaging (fMRI), micro-electrode recording in animal subjects, psychophysics in animals and humans, and computational modeling. Through laboratory experiences at both locations of the lab (the Wellesley Science Center and the Department of Neurobiology at Harvard Medical School), students working the Conway lab receive broad mentorship from a diverse group of scientists including leading research scientists, post-doctoral fellows, graduate students, research technicians and other undergraduate students.

Sharon Gobes

In the Gobes lab, birds (zebra finches) are used to investigate the neural mechanisms underlying learning and memory and specifically the role that sleep plays to consolidate memory. Research assistants are expected to have a strong intellectual input in the design of current studies that are undertaken in the laboratory and will acquire a number of techniques such as behavioral tests and analysis of behavioral data, histological processing of brains, light microscopy and image analysis, wet-lab procedures (immunocytochemistry and other chemical procedures to highlight structures on the brain) etc. After initial training, the SERP student will become responsible for running one aspect of a larger study independently, including time planning of experimental procedures, purchasing and maintaining the required materials, running experiments, collecting and analyzing the data, and co-authoring an abstract & preparing a poster to present the results of the study at a scientific conference.