Research Experiences Especially for Freshmen (REEF)

At Stanford University's Hopkins Marine Station in Pacific Grove, CA

Applications due March 1, 2016

SUMMER AT HOPKINS MARINE STATION, PACIFIC GROVE, CA

Physiology and Biomechanics of Endothermic Bluefin Tuna
Professor Barbara Block, http://www.tunaresearch.org/
Time commitment: 10 weeks / 1 position available
Bluefin Tuna display an array of morphological and physiological specializations associated with their high-energy demand lifestyle. The Tuna Research and Conservation Center (TRCC) at Hopkins Marine Station is the only facility to keep captive Bluefin Tuna in North America for research purposes. The TRCC is currently investigating the organismal physiology of Bluefin tunas using a combination of archival tagging technology, measuring swimming activity via accelerometers and body temperatures by implanting temperature sensors and measurements of oxygen consumption in a swim-tunnel respirometer. The VPUE intern will assist in the day to day running of the TRCC and learn the fundamentals of tuna biology, while gaining an understanding in the analysis of data-sets related to physiological measurements in live fish.

White Sharks
Professor Barbara Block, http://www.tunaresearch.org/
Time commitment: 10 weeks / 1 position available
California white sharks are visitors in our coastal waters for half the year. We have tagged and photographed sharks for over a decade and will have a project that focuses on creating a census of the central coast white shark population from fin photographs. The project will involve maintaining our catalogue of fin photos from the field season that will be used to update the census of white shark numbers and also be used in a public IOS App called Sharknet. The work will involve examining fins, looking at past photos- and helping to create the data base for our white shark research team.

Models of optimal control and disease dynamics: control and elimination of a human disease, schistosomiasis
Professor Giulio De Leo, http://sites.stanford.edu/deleolab
Time commitment: 10 weeks / 1 position available
We are looking for a modelling/computer science proficient, highly motivated student in biology, Engineering, Applied Mathematics or Physics who will help us to analyze the effectiveness of alternative strategies for disease control and elimination by using mathematical models of disease dynamics and computer simulations. We will preferably consider application from students with a solid background in applied mathematic or environmental engineering, or computer science, better if with some experience in working with Optimal Control theory/modeling, ODEs or discrete time models, or stochastic Montecarlo simulations by using Matlab, R or other computer simulation tools. The selected student will contribute to a B&M Gates Foundation and NSF supported project on biocontrol of schistosoamisis through the reintroduction of a native predator species.

The bio-economics of human parasite control and eradication and the analysis of disease driven poverty traps
Professor Giulio De Leo, http://sites.stanford.edu/deleolab
Time commitment: 10 weeks / 1 position available
We are looking for a student with a background in economics interested in poverty traps of infectious disease to work on the economic impact and cost-effective approaches to disease control and elimination of human parasitic diseases, with a special emphasis on schistosoamisis - one of the most important among the so-called neglected tropical diseases. The selected student will contribute to a NSF supported project in the program line: "Coupled natural and Human systems" aimed at addressing the socio-economic impact of schistosoamisis control and elimination and to the FSI-SEED supported program in Disease Ecology, Health and Development directed by Giulio De Leo and Sanna Sokolow

Assessing the impact of Ocean Acidification and Climate Change on important calcifying species
Professor Giulio De Leo, http://sites.stanford.edu/deleolab
Time commitment: 10 weeks / 2 positions available
Acidification, hypoxia, and ocean warming are escalating threats in the world's coastal waters, with potentially severe consequences for marine life and ocean economies. A common assumption in the assessment of climate change (CC) impacts on marine species and fishery output is that all individuals have similar responses to changes in CC. In contrast, analyses of the transcriptome have detected loci that respond to pH or temperature in sea urchins, corals, and abalone (Pespeni et al. 2013, Palumbi et al. 2014, De Witt and Palumbi 2014). Given variation in the response to ocean pH and a high production of recruits (high fecundity) with respect to carrying capacity, few individuals with high fitness under the altered environmental conditions may still produce a sufficient number of recruits for the population to persist or recover, ultimately showing only minor or negligible abundance and reproduction decrements. If this is the case, fishery output could be maintained, at l east to some extent, in spite of CC. Goal of this project is to develop a hybrid genetic/demographic model to explore the long-term demographic effects of the interaction among the mean decrease in fitness, the variance in fitness, fecundity and the strength of density dependent survival, and to assess their potential consequences for fishery management.

The role of multiple environmental stressors in animal performance
Professor Mark Denny, http://www.stanford.edu/group/denny/cgi-bin/wordpress/
Time commitment: 10 weeks / 1 position available
Tigriopus californicus is a tide-pool copepod found commonly along the west coast of North America. It lives in a dynamic environment where temperature, salinity, oxygen concentration and pH can undergo drastic, potentially stressful, variation on a daily basis due to changes in solar irradiance and the balance between precipitation and evaporation. For example, temperatures can be as high as 45oC during daytime low tides, but decrease to 10oC when the tide is in. Salinity can vary from near 0 after a rain to 3-4 times the salinity of seawater. We will use Tigriopus as a model organism to study the effect of multiple stressors on an organism's performance. For example, our preliminary studies show that these copepods can survive higher temperatures when they are also stressed by high salinities. Summer research will involve a mixture of field work (characterizing the environment in tide pools) and lab work (measuring various aspects of performance as a function of controlled stressors).

Physiology and behavior of coastal marine fishes
Professor Jeremy Goldbogen, http://goldbogen.stanford.edu/
Time commitment: 10 weeks / 1 position available
The selected student will help investigators conduct whole animal metabolic experiments using state-of-the-art respirometry equipment to analyze fish energetics. In addition to the laboratory experiments, there will be chances to participate in ongoing fieldwork, such as collection of environmental data and tagging of kelp forest fishes. There also is an opportunity to dive as part of the internship if properly qualified.

Evolution of Cellular Adhesion Mechanisms in Early Animals
Professor Chris Lowe, http://lowe.stanford.edu
Time commitment: 10 weeks / 1 position available
Cell adhesion, the capacity for cells to stick to neighboring cells, is a basic requirement for multicellularity, and the evolution of adhesion mechanisms was necessary for the evolution of the first multicellular animals. Surprisingly, we know very little about how the earliest animals held their cells together. We know a great deal about the proteins necessary for cell adhesion in complex animals such as mammals and insects, but very little about early animal lineages, including sponges, ctenophores, and cnidarians (jellies, corals, and anemones). Thus, we are unable to reconstruct what adhesion mechanisms were present in the last common animal ancestor. In this project, students will have the opportunity to generate a loss-of-function mutant in a sea anemone to study the role of a newly described gene that may have an essential role in cnidarian cell adhesion. Students will then aid in the subsequent description of mutant phenotypes using state-of-the art confocal and live-cell microscopy. In generating the reagents for these experiments, students will also receive training in fundamental molecular biology techniques, including molecular cloning, DNA assembly, and PCR.

Development and regeneration of the echinoderm radial nervous system
Professor Chris Lowe, http://lowe.stanford.edu
Time commitment: 10 weeks / 1 position available
A complex central nervous system (CNS) is a hallmark of our own phylum, the chordates, but the evolution of the chordate CNS is poorly understood due to a lack of basic comparative data on neural development in closely related groups of invertebrate animals. As a sister group to chordates within the deuterostome clade, echinoderms represent a key phylum to understanding common mechanisms of nervous system development in early deuterostomes. Additionally, understanding similarities between the echinoderm and chordate CNS may prove important, as echinoderms are capable of complete CNS regeneration. In this project, students will work to develop transgenesis techniques to label and trace neurons through echinoderm development. Students will gain a functional understanding of cutting-edge transgenesis techniques, including the CRISPR/Cas9 system, and work independently to apply them to answer a basic question in neural development. The project will emphasize hands-on training in marine animal husbandry as well as developing proficiency in fundamental molecular biology techniques including molecular cloning, DNA assembly, and PCR.

Assessing the impacts of climate change on species interactions within kelp forests
Professor Fiorenza Micheli, http://micheli.stanford.edu
Time commitment: 10 weeks / 1 position available
The intern will work with a graduate student on research examining the impacts of climate change stressors on the interactions between invertebrate grazers and giant kelp. He or she will be involved in various aspects of the project, including culturing kelp, collecting study organisms near the Hopkins Marine Station, and performing experiments in the outdoor aquaria facility. There is also an opportunity to dive as part of the internship.

Hopkins' Marine Life Observatory
Professor Fiorenza Micheli, http://micheli.stanford.edu
Time commitment: 10 weeks / 1 position available
As an intern with the Marine Life Observatory Program, the student will work with research coordinator Steven Litvin, along with faculty members from the program (http://mlo.stanford.edu/people.htm). The research is focused on examining how environmental variability shape nearshore marine communities using a interdisciplinary approach, including the use of acoustic imaging technologies and oceanographic observing. There is an opportunity to participate in analysis of existing data as well as fieldwork and laboratory experiments. Scientific diving certification is not needed, but there is an opportunity to dive as part of the internship.

Investigating the consequences of Ocean Acidification on marine populations andhabitats
Professor Fiorenza Micheli, http://micheli.stanford.edu
Time commitment: 10 weeks / 1 position available
Ocean acidification (OA) is expected to profoundly alter the diversity and function of marine ecosystems, as well as the services they provide to society. Thus, understanding how future oceans will function in the face of OA represents one of the main challenges and needs for marine science and management. The research will address the possible impacts of OA on organisms, their behavior and their ecological roles. The student will conduct laboratory and field experiments investigating the impacts of OA in seagrass ecosystems, water chemistry analyses, and will be involved in data analyses and presentation of results.

Genome sequencing and annotation
Professor Stephen Palumbi, http://palumbi.stanford.edu
Time commitment: 10 weeks / 1 position available
Students will learn bioinformatics of genome sequencing and assembly by comparing new genome data sets for fish, corals and sharks. The period of time will be divided up into lab work to produce the data, assembly of data to generate a draft genome sequence, and bioinformatic work to identify genes and ascertain their function.

ABROAD OPPORTUNITIY

Coral conservation and genomics of climate change in American Samoa
Hopkins Marine Station and American Samoa
Professor Stephen Palumbi, http://palumbi.stanford.edu
Time commitment: 10 weeks/ 2 positions available
The Project will involve measuring growth of reef building corals in American Samoa for a two week period, preceded and followed by lab based analyses of coral skeletal patterns at Hopkins Marine Station. Students will need to be able to participate until Sept 10.