Biosciences at Berkeley

GRADUATE PROGRAMS

Welcome to

Mark Schlissel M.D., Ph.D.
Dean of Biological Sciences

In the past fifty years, the biological sciences have seen two major revolutions and are in the early days of a third. The first revolution started with the determination that DNA was the genetic material and how the structure of DNA revealed its function as an information storage and transmission vehicle. The second began with the discovery of restriction enzymes leading to the recombinant DNA revolution. The current revolution is being fueled by high throughput DNA sequencing, mass spectroscopy and computational biology, allowing scientists to address issues at the whole genome, transcriptome or proteome level with single nucleotide or amino acid precision. Researchers with backgrounds in physics, chemistry, engineering, mathematics and computer science are making increasingly important contributions to our understanding of biological systems. Biology has become the most interdisciplinary of the natural sciences.

Berkeley is home to over five hundred faculty researchers studying biology. Fields of study range from the atomic scale structure of macromolecules to the logic of information storage in the brain; from the protein machinery that recognizes and transcribes genes to the mechanisms that target proteins to specific places inside and outside of cells; from the physiology of muscle to the evolutionary origins of classes of genes; from signal transduction cascades to the effects of environmental change on ecosystems; and from how geckos climb on ceilings to the origins of man. Berkeley bioengineers are inventing new ways to analyze macromolecules, new materials to support the growth and differentiation of stem cells, and new devices to image physiological activity within living animals and human patients. Our computational biologists are writing new algorithms to assemble whole genome sequences from enormous numbers of overlapping fragments, to study human evolution in response to environmental stress, and to resurrect the genomes of early human progenitors. Berkeley biophysicists use atomic force microscopy to measure the physical properties of single protein or DNA molecules and invent nanoscale probes and sensors to reveal the mechanical properties of cells. Our chemical and cellular biologists combine the explosive advances in microscopic imaging with novel methods for genetic targeting to determine the functions of individual molecules in living cells and even intact animals. The breadth and depth of biological science at Cal is unmatched.

And all of these investigations critically involve our graduate students. Drawn from amongst a spectacular applicant pool, students apply to any of 19 individual departments and interdisciplinary training programs. Graduate training at Berkeley involves coursework, teaching apprenticeship and independent, mentored research. Students are supported during their studies by a combination of training grants, individual fellowships, faculty research funds and teaching stipends. They leave Berkeley prepared to go on in academic or biopharmaceutical industry research, teaching, government service, and a wide array of other rewarding professions.

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UC Berkeley

The Berkeley campus is home to a graduate population of over **10,000** students, with **5,959** of those pursuing PhDs*. They represent **108** different countries and all **50** states (plus Guam and Puerto Rico). Graduate students in fields related to biological science make up approximately **20%** of the doctoral candidates at Berkeley. Within the biological science student population, over **50% are women**, nearly **10%** come from underrepresented backgrounds and **11%** from abroad. With such a large and diverse graduate population, and with **48 PhD programs** ranked in the **top 10 nationwide****, Berkeley understands the importance of creating a supportive environment. There are extensive campus resources for graduate students, including: **the Graduate Student Instructor Teaching and Resource Center, Career Center, Health Services, Disabled Student Program, graduate student housing, and the Graduate Diversity Program,** among others.

*data based on Fall 2009 enrollment figures ** NRC rankings, 2010

Diversity

The University of California, Berkeley and the biological sciences graduate programs have a strong commitment to promoting and ensuring ethnic diversity in graduate education and to training students from diverse backgrounds for science careers. Berkeley maintains a consistent effort in the recruitment of underrepresented students in the sciences to its graduate programs through its Biological Sciences Graduate Diversity Director, who develops and implements programs to yield a more diverse and competitive applicant pool and to increase enrollment of underrepresented populations. Our faculty, staff and current graduate students actively seek to enhance graduate student diversity to benefit the biological sciences graduate programs and the entire campus community. Annual recruitment efforts include participation in national undergraduate research conferences and scientific meetings (such as SACNAS, ABRCMS and SfN), campus visits throughout the nation including minority serving institutions, and a national email marketing recruitment campaign that targets faculty, program directors, students, and staff in the sciences at various colleges and universities.

Biological Sciences Summer Research Opportunities

Applicants with prior research experience are usually successful candidates to Berkeley's graduate programs in the biological sciences. Berkeley offers various summer research programs that provide undergraduates with direct participation in research with a UC Berkeley faculty member and his/her research team. One research program is the NSF Summer Research Experience for Undergraduates (REU) Program in Cell, Developmental, and Evolutionary Biology. This program promotes diversity in the national biosciences workforce. Students who share this goal, especially from underrepresented minority groups, economically disadvantaged backgrounds, or who are the first generation in their families to attend college, are encouraged to apply.

Another summer program that encompasses most science research fields is the Amgen Scholars Program, a national program that provides summer research opportunities for all students interested in obtaining a doctorate degree and pursuing a science career. The UC Berkeley Amgen Scholars Program offers outstanding undergraduates a summer research experience that increases participants' competitiveness as candidates for admission to prestigious graduate schools.

Berkeley also offers additional summer research opportunities, which include the Synthetic Biology Research Program (iGEM), UC LEADS (Leadership Excellence through Advanced Degrees) for UC undergraduates in mathematics, engineering, and science and BioChIP (Biology on a Chip Internship Program), an NSF funded REU Program. For more information on these programs visit **http://research.berkeley.edu/index.php**

Designated Emphases and Specializations

In response to the interdisciplinary challenges of 21st century biological and biomedical research, UC Berkeley faculty collaborate across departmental lines to provide interdisciplinary training programs bridging the biological, computational, engineering, mathematical, and physical sciences to augment doctoral training. Requirements for these programs are fulfilled in addition to those of the home program, and, for Designated Emphases (DE), completion of the program is recorded on the diploma and transcript. Existing programs include:

Computational and Genomic Biology DE: provides doctoral students with a solid foundation in the different facets of modern genomics research, which requires interdisciplinary expertise and the close collaboration of biologists, statisticians, and computer scientists to analyze and interpret large and complex genomic data sets. **ccb.berkeley.edu/ccb/research-education/decgb**

Computational Science and Engineering DE: spans fields in science, engineering, finance, and social science to provide training combining high-performance computing, mathematical modeling, scientific and engineering theory, and large scale analysis of data base observations. **cse.berkeley.edu**

Nanoscale Science and Engineering DE: provides training focused on the basic themes of synthesis, characterization, fabrication, and modeling of nanostructured materials and devices that is crafted around a set of educational principles that motivate physical science and engineering students to acquire an understanding of the capabilities and limitations of each other's fields. **nano.berkeley.edu/educational/DEGradGroup.html**

Chemical Biology Graduate Program: provides rigorous training to doctoral students in four programs in the application of chemical principles and techniques to the investigation and modulation of biological systems, leading to new understandings at the molecular level. **cbgp.cchem.berkeley.edu/index.htm**

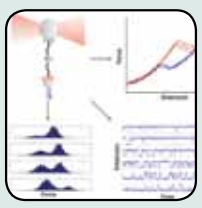
Bioscience Ph.D. Programs–Departments and Graduate Groups

Graduate Application Process

UC Berkeley allows only one application from a candidate per application cycle. Applicants should review the different programs in biological sciences to clarify which program most closely fits their interests. Application deadlines start on December 1 each year; for the exact date, applicants must check the web site of their program of interest (find the full list of programs and links at: **biology.berkeley.edu**; individual links, below). The online application system at: **http://www.grad.berkeley.edu/admissions/grad_app.shtml** opens in early September.

Bioengineering

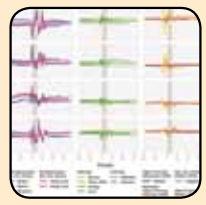
Bioengineering integrates engineering, biological and medical sciences with advanced technology to help people lead longer, healthier, and more productive lives. Graduate degrees in bioengineering are granted jointly by UC Berkeley and UC San Francisco,combining the excellence in engineering, physical and life sciences at UC Berkeley with UC San Francisco's distinction in the biomedical sciences. The resulting intercampus, interdisciplinary program is anchored by the experience and resources of two world-class universities, and offers students the flexibility to work with a choice of outstanding faculty in a variety of fields at either school. Our program offers students unparalleled opportunities for basic and applied bioengineering research in a wide variety of related fields. Major areas of research include: Biomaterials, Biomechanics, Biomedical Imaging & Instrumentation, BioMEMS & Nanotechnology, Computational Biology, Drug Delivery Systems & Pharmacogenomics, Neural Systems Engineering & Vision Science, Systems & Synthetic Biology, and Tissue Engineering & Regenerative Medicine. **http://bioegrad.berkeley.edu**



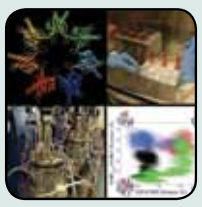
Biophysics

The goal of the Biophysics Graduate Program at Berkeley is to train students to bring a physical approach to the study of biological processes that range in scale from the sub-molecular (studying the interplay of the inter-atomic forces that give proteins their particular shape, motion and function) to the systems level (studying the concerted activity of neural and genetic circuits). Study in these research areas employs X-ray diffraction, NMR, fMRI, EPR, computer modeling, and several single molecule methods including spectroscopy, imaging, force microscopy, cryo-EM and electrophysiology. Students admitted to this program have backgrounds in either the physical or biological sciences. In some cases, students have an undergraduate degree in physics, chemistry, engineering, mathematics, or computer science, and may have limited coursework in biology, but have an interest in applying physical and computational approaches to biology. In other cases, students have an undergraduate degree in the biological sciences, with an interest in bringing a quantitative approach to their research. **http://biophysics.berkeley.edu**

Biostatistics



Research and teaching activities in the Interdepartmental Group in Biostatistics broadly concern the development and application of statistical methods and software for the analysis of biological data. We are collaborating closely with biologists, epidemiologists, and clinicians at UC Berkeley and other Bay Area institutions to address questions related to cancer genomics, HIV mutation resistance, neurobiology, and stem cell biology. These projects involve the development of high-dimensional inference methods for novel high-throughput biotechnologies, such as microarrays and second/third-generation sequencing. Our collaborators are using these assays in context of whole-genome investigations of transcriptional regulation, alternative splicing, genotype-phenotype associations, biomarker discovery, systems biology, population genetics, phylogenetics, metagenomics, and adductomics. Specific methodological interests include causal inference, model selection, multiple hypothesis testing, resampling, semi-parametric inference, statistical computing, and survival analysis. We are actively engaged in the Center for Computational Biology and have collaborations with interdisciplinary centers such as the Berkeley Cancer Genome Center, the Berkeley Stem Cell Center, and the Helen Wills Neuroscience Institute. **http://www.stat.berkeley.edu/biostat/**

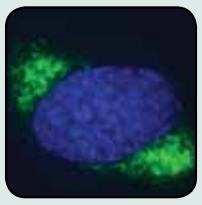


Chemical and Biomolecular Engineering

Chemical engineers with expertise in biotechnology will be key players in the transformation of basic research results into manufacturing processes and/or commercial products. For example, the microbial production of pharmaceuticals, fuels, and specialty chemicals are industrial processes that require chemical engineering development and design approaches, but practitioners must possess a strong understanding of biochemistry and microbiology. Similarly, rational design of enzymatic processes demands an understanding of the molecular properties of enzymes and mechanisms of enzymatic catalysis. The Ph.D. Program is designed to enlarge the body of knowledge of the student and, more importantly, to discover and develop talent for original, productive, and creative work in Chemical & Biomolecular Engineering. Research interests include protein engineering of both enzymes and macromolecular structures, metabolic engineering, stem cells, and the development of tools for synthetic biology. Additional topics under investigation include the study of aqueous-polymer solutions that partition biological molecules, the development of gels for biomolecule selection, and molecular protein modeling. **http://cheme.berkeley.edu**

Chemistry

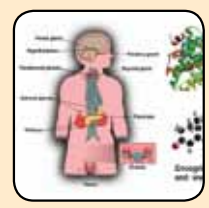
Biological research is a major part of the Berkeley Department of Chemistry's Ph.D. program. Over 30 Chemistry labs study biology's complexity through an interdisciplinary approach that incorporates new ideas in chemistry with advances in chemical biology, molecular biology, biochemistry, biophysics, systems biology, and synthetic biology. Systems studied include signaling proteins, enzymes, DNA, RNA, membranes, and carbohydrates, with research ranging from the behavior of single molecules to the interactions between cells in living animals. One of the most diverse and highly regarded chemistry departments in the world, Berkeley Chemistry is a home for passionate students looking for unparalleled faculty and facilities to support their personal research interests. Examples of current student research in this program include: developing new ways to analyze, diagnose, and treat pathogens; finding new strategies for the creation and storage of alternative fuels and biofuels; and exploring biological processes to synthesize new materials and nanomaterials. We welcome students interested in breaking traditional divisions between disciplines. **http://chem.berkeley.edu/**



Comparative Biochemistry

The Comparative Biochemistry Graduate Program provides students with a unique opportunity to pursue interdisciplinary research spanning all major topics in the field of the biological sciences with emphasis on biochemical mechanisms. Students are trained to elucidate fundamental mechanisms governing biological processes and to identify and illuminate problems in the biological sciences using biochemical and molecular approaches. The Group is composed of faculty from a diverse array of departments on campus including Chemistry, Chemical Engineering, Environmental Science, Policy, and Management, Molecular and Cell Biology, Nutritional Science and Toxicology, Plant and Microbial Biology, the School of Public Health, as well the Lawrence Berkeley National Laboratory. The interdisciplinary nature of the program offers the student a wide range of research and educational opportunities. Students are admitted directly into the lab of a faculty member who acts as the student's sponsor/research mentor. Students are able to immediately begin their research, while they complete a flexible schedule of course work tailored to their individual needs. **http://compbiochem.berkeley.edu/**

Endocrinology



The faculty associated with the Graduate Group in Endocrinology leading to the M.A. and the Ph.D. degrees have diverse interests representing endocrinology in the broadest sense: chemical mediators in the living world directed by autocrine, paracrine, endocrine and ectohormonal factors. The main goal of our program is to engage students in the interdisciplinary aspects of the field of Endocrinology through seminars, courses and our diverse faculty research perspectives that range from structural, molecular and cellular endocrinology through organismal and comparative endocrinology to chemical ecology. Our program faculty encompasses hormone-oriented research programs such as cancer biology, signal transduction, drug design, membrane biology, virology, metabolism, differentiation, morphogenesis, toxicology and gene transcription. Graduates from our Endocrinology program have transitioned into careers in a variety of fields including education, research in both academic and industry settings, government regulation, and private business. **http://endo.berkeley.edu/**

Environmental Health Science

Environmental factors are estimated to be responsible for 25-40% of the burden of human ill-health around the world and often most seriously affect the most vulnerable members of society, such as young children, pregnant women, and the poor. In EHS, we focus on the human health impacts of physical, biological, and chemical agents in the community and workplace. In particular, our interest is the quantitative evaluation of these environmental risks and the means of their control. Environmental health is a truly interdisciplinary field. It draws on virtually all the natural sciences, as well as content from professional areas like engineering, to address the assessment of exposures, mechanisms of biological response, and their interconnections to estimate the health risk arising from environmental contaminants. The field is closely allied to environmental and occupational epidemiology and interfaces with policy analysis. We are committed to creating a culture in which students receive rigorous training for professional careers and/or develop the skills for perspective careers in research. **http://ehs.sph.berkeley.edu/**

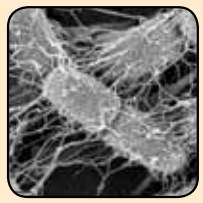
Environmental Science, Policy, and Management

The Environmental Science, Policy, and Management department integrates the biological, physical, and social sciences to provide advanced education in these fields. We develop critical analytical skills and the ability to conduct ecosystems research at molecular, organismal, and global scales and within interlinked human social systems. ESPM encourages an inclusive atmosphere and is committed to attracting a wide range of talented students. ESPM currently has over 200 graduate students and offers a Ph.D. as well as a joint M.S./Ph.D. (You do not need a Masters Degree to apply to the Ph.D. program.) ESPM graduate students conduct research in a multitude of areas. They work with top-ranked Faculty and Specialists and have access to world-renowned Research Sites and Facilities in Berkeley and other locations. **http://espm.berkeley.edu/**

Epidemiology

Ph.D. degree recipients in epidemiology, offered by the Division of Epidemiology, in the School of Public Health, are preparing to assume academic and/or public health careers in research and teaching. Students should be able to do the following upon completion of the Ph.D. degree in epidemiology: **a)** Demonstrate a high degree of mastery of epidemiologic research design and methods by successfully designing and carrying out original research to discover new knowledge in epidemiology and the biological or social sciences related to human health or making advances in methodologic theory or applications. **b)** Demonstrate an in-depth knowledge and understanding of theoretical concepts and practical applications of epidemiology and biostatistics, as well as the principles underlying the ethical conduct of human research. **c)** Communicate and present epidemiologic research findings in their area of expertise to peers and fellow students in a lucid, understandable manner. **d)** Demonstrate competence in a third area of public health or science appropriate to their research in addition to epidemiology and biostatistics (e.g. anthropology, virology, sociology, health policy, demography, etc.) **http://epi.berkeley.edu/Contact_Us.html**

Infectious Diseases and Immunity



The goal of the Infectious Diseases and Immunity Ph.D. Program is to produce independent research scientists with a strong scholastic background in infectious diseases and a firm grounding in fundamental biochemical and molecular research methods. The program trains students to design and implement independent investigations focusing on infectious disease agents and their interactions with the human host. The program's over arching mission is to develop new approaches for the diagnosis, prevention, surveillance and control of infectious disease in humans, by integrating basic research and applied technologies. The training program crosses traditional departmental boundaries to combine laboratory, epidemiological, and clinical research strategies and apply them to specific infectious disease problems affecting human populations. The students are trained to implement medical and public health agendas regarding current infectious disease problems, and to be positioned to respond to emerging and re¬emerging infectious disease threats and challenges domestically and abroad. **http://microbe.berkeley.edu/idgroup/index.html**

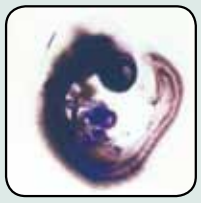
Integrative Biology

Biological phenomena occur at various levels of structural organization, ranging from molecules to organisms, and from populations to the global ecosystem. Integrative Biology takes a whole-organism approach, extending from the genome and proteome through organismal traits (phenotypes), to communities and ecosystems. Through the coordinated study of multiple levels of biological organization over a broad range of spatial and temporal scales, Integrative Biology offers a unique approach to understanding fundamental questions concerning the evolution and maintenance of biological diversity, including organismal form and function, and ecological and ecosystem processes. This multidimensional approach underpins our graduate program, where students combine observational, experimental, and comparative approaches with the development of theory, and apply concepts and techniques from the biological sciences and other disciplines. Students in the PhD program generally apply to work with one or two faculty members whose research interests match those of the applicant. Some groups in the department employ a system of rotation among several labs. **http://ib.berkeley.edu/**

Microbiology

The discipline of microbiology at UCB encompasses biochemistry, physiology, molecular biology, genetics, cell biology, developmental biology, pathogenesis, ecology, and evolution. The Graduate Group in Microbiology (GGM) provides access to these diverse disciplines through an integrated program of study oriented towards each student's special interests, and awards the Ph.D. degree in Microbiology. Microbiology students develop an understanding of microbial biology from the molecular to the cellular organization levels, and of beneficial and pathogenic microbes' interactions with other organisms. GGM faculty encourage students to develop critical and creative thinking, organizational and communication skills. Our program allows students to experience the excitement of discovery in fundamental and applied research, and the satisfaction of teaching in the classroom. Upon graduation the students should have the skills to establish innovative and effective research and teaching programs in academic, industrial or government environments. **http://pmb.berkeley.edu/**

Molecular & Biochemical Nutrition

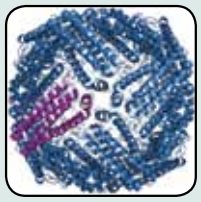


The interdisciplinary graduate program in Molecular and Biochemical Nutrition (MBN) studies mechanisms whereby nutrients, phytochemicals and toxicants (NPT) affect human health and disease risk. Issues addressed by this research area, also known as Metabolic Biology, include the interdependence of NPT, genetics and chronic diseases, such as cancer, diabetes and metabolic syndrome, how NPT affect fetal and post fetal development and metabolism and stemcell differentiation, how organisms absorb NPT, and how NPT regulate metabolism and either act as hormones or support hormone biogenesis. Metabolic Biology in MBN relies on a variety of techniques, including "designer" mice, analytical chemistry, biochemistry, bioimaging and cell and molecular biology. The MBN faculty have the common goal of improving human health through providing mechanistic insight into the biology of NPT. **http://nst.berkeley.edu/mbn.html**

Molecular & Cell Biology

The Department of Molecular and Cell Biology (MCB) offers outstanding opportunities for scientific training in a highly interactive environment that enables doctoral students to pursue any of a wide range of modern fields of biological research. The Department includes over 90 faculty, 250 graduate students, and more than 250 postdoctoral fellows and researchers. MCB is organized into five Divisions (Biochemistry and Molecular Biology; Cell and Developmental Biology; Genetics, Genomics and Development; Neurobiology; and Immunology and Pathogenesis) offering the advantages of mid-sized, thematically focused, scientific groupings within the larger, more diverse academic environment in molecular and cell biology. The types of living organisms from which the departmental faculty draws its working materials are as diverse as its disciplinary specializations, ranging from viruses and microbes through plants, roundworms, annelids, arthropods, and mollusks to fish, amphibia, and mammals. **http://mcb.berkeley.edu/grad**

Molecular Toxicology



The demand for trained scientists to determine the present risk to human health and the environment presented by toxics is increasing. New molecular technologies have revolutionized the field of Toxicology. They have made it possible to safely study the effects of toxic substances and toxic modulators in people instead of experimental animals; to use transgenic animals to speed up safety assessment and answer key basic research questions; and, have led to the rapid development of economical and highly informative short-term toxicity testing systems in cultured cells and microorganisms. Increasing knowledge of the human genome allows for the identification of susceptible individuals and better understanding of gene-environment interactions. Molecular Toxicology graduate program is designed to provide students with rigorous training in Molecular Toxicology. **http://nst.berkeley.edu/moltox.html**

Neuroscience

Understanding the brain and mind is one of the great frontiers in modern science. Neuroscience, the interdisciplinary effort to explore this frontier, has two main goals: to develop a detailed biological understanding of the brain and how it generates behavior and cognition, and to better understand, diagnose, and treat neurological disorders. The Neuroscience Graduate Program is a highly selective Ph.D. training program offering intensive training in neuroscience research, coursework, and professional development. More than 50 faculty provide expertise in molecular/cellular, systems/computational, behavioral and human cognitive neuroscience, including sophisticated biological, computational, and imaging techniques. Specific areas of research include analysis of ion channels, signal transduction mechanisms, and gene regulation; development of neurons, synapses and circuits; synapse function and plasticity;mechanisms of sensory processing; principles of function of cerebral cortex; neural basis for learning, attention, and sleep; and neural basis for human emotion, language, motor control, and other high-level cognitive processes. **http://neuroscience.berkeley.edu/grad/home/**

Plant Biology

With an increasing awareness of environmental problems, global changes, and emerging food needs, plants have emerged as a focal point for new research initiatives and educational training programs. The challenges of understanding the biology of plants, their development and responses to the environment, and human impacts on the biosphere will continue to fuel the expansion of plant research well into the future. The Plant Biology program focuses on contemporary basic plant research and design of biotechnologies. New discoveries have broadened our understanding of plant development and function, and provided tools for engineering plants that produce novel compounds and new crops with enhanced resistance to pathogens and insects. This department trains students in modern research areas of plant biology concentrating in molecular, cellular, genetic, biochemical, physiological, developmental, and structural biology;as well as plant microbe interactions. **http://pmb.berkeley.edu/**

Vision Science

Vision Science is an exciting and expanding field at the crossroads of modern biology. Vision is for most people their most valuable sensory modality. It is also the source of a rich array of research questions relating to how we see, how and why vision fails, and what can be done about it. To seek answers to these questions and others, the Vision Research community offers students an opportunity to investigate, probe and analyze the mysteries of vision. Investigators in Vision Science conduct human and animal research and modeling. Currently, vision research projects in molecular and cell biology include investigations into gene therapy, neurobiology, infectious diseases, membrane biophysics, corneal physiology, ocular disease processes, myopia, and eye growth regulation. Building on an unsurpassed range of strengths in the visual health sciences, Berkeley researchers have introduced impressive advances in the understanding and improvement of human visual health. The Vision Science program provides a cohesive home for these wide-ranging efforts to develop and the resources for ground breaking research and the translation of discoveries into clinical practice. **http://vision.berkeley.edu/vsp/index.html**

Visit **biology.berkeley.edu/graduate** for more information, including a full list of programs and links.

University of California
Berkeley

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