

# **School of Natural Sciences**

## **Strategic Plan for AY 11 - 14**

### **February 4, 2011**

#### **VISION AND MISSION**

The University of California has a tripartite mission of research, teaching and public service. The School of Natural Sciences is committed to excellence and equity in every facet of its mission. Research excellence forms the foundation upon which academic programs flourish in all of the campuses of the University of California system. Research excellence translates to excellence in graduate education and undergraduate experiences. The School of Natural Sciences is developing stellar academic programs for discoveries and applications in science and technology and for graduate and undergraduate education. The academic programs will serve as an economic engine for the region and the state of California and contribute to development of a college-going culture in the San Joaquin Valley.

*The vision of the School of Natural Sciences is to develop multidisciplinary and inter-disciplinary research programs and innovative undergraduate and graduate curricula, to distinguish itself among established science programs, to provide the best possible preparation for its students as they address the many scientific challenges of the 21<sup>st</sup> century, and to address the needs of its stakeholders in the region and the state of California.*

- Multidisciplinary and inter-disciplinary research programs***

The programs in the School of Natural Sciences are categorized into Applied Mathematical Sciences, Environmental Sciences, Ecology, Integrative Biology and, Environmental Health Sciences, Biomedical/Biological Sciences, Chemistry, and Physics. Thematic groupings within these broad programs emphasize research initiatives that encourage cooperation and collaboration across disciplines recognizing that finding solutions to complex problems often requires multi-disciplinary expertise and that the most rapid advances often occur at the interface of disciplines.

- Innovative undergraduate and graduate curricula***

Curricular innovations in degree programs and foundational courses for science and engineering students are highly valued by the School. The faculty and school administration are committed to development and implementation of innovative pedagogies that increase the recruitment and retention of students in mathematics, the sciences and engineering. The faculty of the School of Natural Sciences has taken advantage of its “blank slate” to create and shape curricular programs and offerings that provide both the scientific breadth and the depth required for graduates in the 21rst century.

- *Provide the best possible preparation for all students as they address the many scientific challenges of the 21st century*

The School is committed to excellence, inclusivity and diversity for all of its students,, and advancement of equitable access and diversity in education within the School and the University. As of Fall 2010, 32.2% of the students on campus declared majors in the School of Natural Sciences, providing enormous opportunities to develop a diverse workforce with a strong science and mathematics preparation. Development and implementation of effective strategies for the educational advancement of students, including those from groups traditionally underrepresented in the sciences and mathematics, are highly valued.

- *Contribute to addressing the needs of stakeholders and constituents in the San Joaquin Valley and the state of California*

The San Joaquin Valley has been underserved in access to higher education and in reaping the economic and intellectual benefits of a research university. The School of Natural Sciences recognizes its responsibility and value to the public and is committed to addressing the needs of its stakeholders in the State and in the San Joaquin Valley region. Equity in access to education and research opportunities for residents in the San Joaquin Valley and the State is a product of the School of Natural Sciences academic programs. Graduates of degree programs in mathematics and sciences will be well- prepared to contribute to solving complex problems that face our region, state, nation and the world. The research programs of faculty in the School of Natural Sciences have far reaching implications to advance the health and well-being of humans and the environment, while making fundamental discoveries about the world in which we all live.

## **VALUES**

### **Excellence in Scholarship**

*A top priority of the School of Natural Sciences is scientific excellence.* Programs of scientific excellence form the foundation for continued success in recruiting the best faculty, encouraging students, and providing multiple pathways to improve higher education and economic opportunities. The School recognizes the value of disciplinary depth, as well as interdisciplinary and multidisciplinary academics and research.

### **Academic excellence in training scientists and citizens**

The School of Natural Sciences places a high priority on increasing the scientific literacy of all students on campus and increasing the pool of students in UC Merced's academic programs in math, science and engineering. There is an increasing need for well-trained scientists, for scientifically trained decision makers, and for a scientifically literate public to meet the global and technological challenges of the 21st century. Academic programs that encourage recruitment and retention of students into math and sciences, while maintaining the highest academic standards, are a high priority. Innovative curricula and commitment to teaching excellence in Natural Science courses are essential for student success.

## **Recognition of the special responsibilities incumbent on a new school of sciences**

*The School of Natural Sciences recognizes that as the first new school of sciences in the 21<sup>st</sup> century it has a special responsibility to be innovative in its research, teaching and relationships with its partners and communities.* The School is committed to developing unique multi- and inter-disciplinary research and academic programs and recognizes that partnerships with higher educational institutions and communities leverage resources across the region, state and nation, enabling new synergies and promoting progress. The School is committed to equity, diversity, and inclusion for all members of our community — faculty, students, and staff.

## **GOALS**

The overall goal of the recommendations described in this strategic plan for the School of Natural Sciences is the development of outstanding research and academic programs, spanning the full range of scientific disciplines. Achieving this goal is dependent on success in a number of more specific objectives including intertwined objectives. These objectives include:

- Success of junior faculty in establishing excellent research programs -- requires sufficient space and facilities, a pool of high-quality graduate students, reasonable teaching loads, and effective mentoring.
- Continued recruitment of excellent faculty -- requires sufficient space and facilities, competitive start-up packages, reasonable teaching loads and strong graduate programs.
- Recruitment and retention of top quality graduate students -- requires strong research programs, sufficient faculty to form effective graduate groups, and a diversity of graduate courses.
- Successful implementation of a broad range of innovative undergraduate programs in science and mathematics that attract and graduate excellent students – requires sufficient faculty to teach a breadth of subject matter, reasonable class sizes, an adequate number of qualified teaching assistants, and access to undergraduate research opportunities.
- Continued commitment to diversity among faculty and staff to opening doors to higher education for all students, including those that traditionally have not had opportunities in science and math careers.

Below you will find plans representing the 6 distinct discipline areas in the School of Natural Sciences. The groups are as follows:

Applied Math  
Chemistry  
Environmental Systems  
Molecular and Cell Biology/Health Sciences  
Physics  
QSB

## **Applied Mathematical Sciences**

Faculty providing input to this portion of the School Strategic Plan included Harish Bhat, François Blanchette, Boaz Ilan, Arnold Kim, Roummel Marcia, Avi Shapiro, Mayya Tokman, and Lei Yue.

Mathematics is a subject of great depth and beauty. Mathematics is also crucial for developing new theories in natural sciences, engineering and social sciences. The application of mathematics to other disciplines is a particularly rich area for research and education.

Applied mathematical science involves the use of analytical and computational mathematics to solve real-world problems. Its core is comprised of modeling, analysis and scientific computing. Using these tools, applied mathematical scientists study a broad spectrum of problems across a number of disciplines. In fact, applied mathematicians are connected more closely through their shared approach and attitude toward interdisciplinary research rather than a shared interest in any particular set of problems. An explicit goal of applied mathematical sciences is to contribute significantly to other disciplines and foster interdisciplinary and multidisciplinary research and education. The absence of disciplinary barriers at UC Merced is an ideal environment for multidisciplinary research and education. Hence, UC Merced has an excellent opportunity to develop top-notch academic programs in applied mathematical science. Because applied mathematical scientists contribute to other disciplines through their research, the development of applied mathematical sciences contributes to the growth of other programs.

**Research:** Applied mathematicians are inherently interdisciplinary. They must be well trained in fundamentals of mathematics to model, analyze and compute solutions to real-world problems. Applied mathematics research is usually assessed through two criteria: (1) sophistication of the mathematics used and (2) novelty and importance of the application. A strong group of applied mathematicians can be a great asset to any number of scientific and engineering programs within the university where they can provide the theoretical/quantitative support or foundation.

We do not seek to build a program comprised of a specific set of sub-fields. Instead, we seek to build a stellar program comprised of world-renowned researchers, who contribute to the applied mathematical sciences program and a number of other programs at UC Merced. Hence, the over-arching theme encompassing the research of the Faculty is mathematics applied to real-world phenomena. This brings applied mathematicians together with the intent to contribute to other programs of study on campus. There are many opportunities at UC Merced for interdisciplinary research under this research theme. There are several large funding sources for applied mathematics research and education. Federal sources provide funding for both education and research programs. The current group members, 8 ladder-rank faculty + 2 VAPs (see below) + 1 FTE search in progress are well on their way toward developing a strong research program including undergraduates, graduate students and postdoctoral researchers.

Although the Faculty has deep expertise in the applied mathematical sciences and breadth across several disciplines, new faculty hires are needed to deepen the base of expertise and broaden the range of application areas. For example, we are seeking new hires in stochastic modeling, mathematical biology, mathematical economics and atmospheric science, among others, to forge new links with economics and management, environmental systems, the Sierra Nevada Research Institute and the developing Systems Biology Institute and Energy Institute.

**Teaching:** All applied mathematics Faculty contribute to delivering undergraduate and graduate curricula. New faculty hires are needed to deliver and support the curricula as the demand due to our growing student population increases (see academic programs section). At present, 77 students have declared Applied Mathematical Sciences as their major. In addition, In AY 2009-10 Applied Mathematics courses accounted for more than 11,800 Student Credit Hours (SCHrs) taught – this is approximately 25% of all UC Merced SCHrs in AY 2009-10, of which the Applied Math Senate Faculty taught

approximately 3,000 SCHrs. This large number of enrollments requires a sufficient number of faculty members to maintain a low student-to-faculty ratio in these classes. This situation is not limited to lower division courses alone. Upper division courses and graduate courses serve a number of other programs such as physics and engineering. We may be able to depend on faculty from other programs to help contribute to the teaching needs, but mathematics courses are absolutely critical to nearly all of the majors at UC Merced. Furthermore, individuals, who have both rigorous training in the subject and use the methods being taught in their research, best achieve the effective teaching of mathematics courses. Being an active user is an invaluable asset in conveying the “why one should care” when discussing seemingly abstract mathematical concepts. Therefore, the delivery of the mathematics curricula requires dedicated faculty support.

New FTE lines will be used for the following purposes:

1. We have two mandatory upper division courses (Math 126 and Math 132) that are only offered every other year. It will become necessary within the next couple of years to offer those courses every year.
2. We may need to offer certain upper division courses more frequently. A good example is Math 131, which had an enrollment of approximately 80 students in Fall 2010 and will be offered in Spring 2011. Based on projected enrollments, we may need to offer three sections of Math 131 in AY 2011-12.
3. We have new courses in the works.

**Cross-disciplinary and Cross-School Linkages:** The applied mathematics Faculty is dedicated to interdisciplinary applied mathematical science, which seeks to build linkages across disciplines and schools. The Faculty is already involved with other programs on campus. Graduate Studies in Applied Mathematics is highly interdisciplinary; the Core Faculty is comprised of 7 Natural Sciences Faculty, and its Affiliate Faculty is comprised of four members from School of Engineering, two from Social Sciences Humanities and Arts Faculty, and two from Natural Sciences. We seek to strengthen current linkages and to form new ties with other programs. In particular, we are interested in forming new linkages with colleagues in electrical engineering, mechanical engineering, computer science and engineering, life sciences, environmental systems, economics and management.

There also exists potential to form collaborations with social science programs at UC Merced, most notably econometrics, management and public policy. These collaborations represent relatively new areas for applied mathematic science research. Nonetheless, the “open door” organizational structure at UC Merced facilitates exploring connections among colleagues that may become substantial collaborations in the future.

**Resources:** Faculty, Lecturers, Visiting Assistant Professors, space/facilities and computational administrative support are needed for academic success.

**Faculty:** At a bare minimum, 20 FTEs will be needed for the applied mathematical sciences program including the undergraduate and graduate academic programs. We propose a growth rate of hiring between one and two Applied Mathematics Faculty per year until that number is reached. Below is a table that shows this proposed growth beyond our current Faculty and assuming that our current search is successful.

Our top priority for AY 2013-14 is to hire world-class Faculty, who can actively contribute to the development of Applied Mathematical Sciences. We are seeking mathematicians with expertise in modeling, applied analysis, scientific computing, or related areas. Some particular areas of interest include Computational Mathematics, Fluid Mechanics, Nonlinear Waves, Dynamical Systems and Inverse Problems. Special attention will be paid to applicants participating in interdisciplinary research, who could contribute to one or more of the campus research initiatives in Natural Sciences, Engineering and/or Social Sciences, including the Sierra Nevada Research Institute.

**Lecturers and Visiting Assistant Professors:** Currently, and in future years, the number of mathematics courses, in particular, the number of undergraduate service courses offered to students not majoring in applied mathematics, exceeds the teaching capacity of our FTEs. To fill this gap, we currently rely on 10 Lecturers, of which 8 are full-time, teaching lower-division courses. Lecturers are highly qualified teachers who take on a heavy teaching load and thus help ensure that our students are provided with the best possible education. We project that at least two Lecturers will be needed for the next five years to allow us to offer all of the required service courses.

In keeping with the research mission of the university, we established a Visiting Assistant Professor (VAP) program for AY 2010-11 and hired Dr. Avi Shapiro (Fall 2010) and Orkan Umurhan (beginning Spring 2011). The two Visiting Assistant Professor positions have proven their value to this program already through their research, teaching and service. The applied mathematics faculty would like to have these positions committed to an individual for two years. We feel that this two-year commitment is crucial to the success of our Visiting Assistant Professor program. However, the administration has committed only one year with a possible renewal for another year. We hope that the administration is open in the near future to considering a two-year commitment to individuals in this position.

**Space and Facilities:** Applied mathematicians do theoretical and computational research. Hence, new applied mathematics hires typically only need office space for their group. However, it should be noted that for applied mathematicians office space also doubles as “lab space”: the office is where applied mathematicians spend nearly 100% of their research time. It is also where office hours are conducted. Therefore, it is essential for Applied Mathematical Sciences to have offices that are conducive for doing research, computing, and office hours. This includes office space for summer undergraduates, graduate students and postdoctoral fellows. Currently, our eighteen graduate students (11 Ph.D. and 7 Masters) are occupying offices in the Academic Offices Building (the trailer). Over the next four years, we plan to admit 20-30 graduate students, of which approximately 15 will be Teaching Assistants. Both Teaching Assistants and Graduate Research Students in Applied Mathematics will need access to a secure office or common space that is conducive for doing their research and holding office hours. The ability to offer adequate space is extremely important when recruiting both graduate students and faculty.

Because high-performance computing is a rich area for applied mathematical sciences research, planning is required for space, hardware-acquisition, and administration. Our faculty together with Professor Lara Kueppers has purchased a 66-node/264-processor parallel-computer cluster. This cluster will become an integral part of our graduate course MATH 233 “Scientific Computing.” Sufficient space has been allocated for the cluster in the Science & Engineering building.

Undergraduate and graduate studies in applied mathematics also require open access to a computer lab for course work and research. Currently, our students have open access to the instructional computer lab in the Science and Engineering building. In the future, an open access workstation-based computer lab for graduate studies would best accommodate the computing needs of our graduate students, other students enrolled in our computational courses, and potentially other courses as well.

**Computational Administrative Support:** While faculty start-up funds have been used for building a modern parallel-computation cluster, long-term financial support for its administration is required. Having an Information Technology person on-site to support the computational administration of the Applied Mathematics cluster, and potentially others, will ensure an optimal use of our resources and will benefit both our educational and research missions. The School of Natural Sciences has hired a full-time system administrator, Joseph Norris, to set up databases and infrastructure for all academic programs. Faculty research grants and start-up funds are being used to help pay for around 10% of the system administrator’s time for administration of the cluster.

## CHEMISTRY

SNS faculty contributing to this plan are Anne Kelley, David Kelley, Matt Meyer, Tao Ye, Meng-Lin Tsao, Erik Menke, and Erin Johnson.

### 2012 (position to be searched in 2011-2012)

**Theoretical chemist, assistant professor:** Most chemistry programs have several theoretical chemists, and building strength in this area makes sense for UC Merced at this time given our severely limited laboratory facilities. We have just hired our first theoretical chemist at the Assistant Professor rank, Erin Johnson. We would like to add a second person who could help build a more diverse program in theory and attract graduate students with interests in theory and computation. Most theoretical chemists consider themselves physical chemists, but some who work on organic reactions consider themselves organic chemists. A theoretical chemist has the potential to establish strong collaborations with other UC Merced chemistry faculty, faculty in other areas (biology, physics, materials science), and faculty at other institutions. This person could teach undergraduate core courses in general chemistry (CHEM 2 and 10), physical chemistry (CHEM 112 and 113), possibly organic chemistry (CHEM 8 and 100), one or more of the graduate core courses, and various undergraduate and graduate electives. A theoretical chemist requires minimal space—an office, a small amount of space for computational facilities, and some office space for students and postdoctorals.

### 2013 (position to be searched in 2012-2013)

**Theoretical chemist, assistant professor:** By 2013 we expect that there will be no laboratory space available for an experimental chemist, yet we need to continue growing the chemistry faculty in order to establish a viable graduate program, handle the increased number of undergraduates in both the lower-division service courses and the upper-division courses for majors, and provide graduate teaching assistants for the associated laboratory sections. Addition of another theoretical/computational chemist in 2013 makes sense for the same reasons given above. We would attempt to focus the area of the search somewhat to bring in a person whose research interests have some synergy with those of the existing theorists but does not strongly overlap theirs. Although addition of a tenured person in theory would be highly desirable, even theorists at the senior level require start-up packages and amounts of office space that are not likely to be forthcoming at this time.

### 2014 (position to be searched in 2013-2014)

**Materials chemist, assistant professor:** This position was originally approved and searched at open rank during 2008-2009. Several excellent candidates were identified, but one junior and two senior offers were made and declined and the search was never reinstated. A materials chemist, broadly defined, is still the chemistry group's top experimental priority. The completion of SE2 in 2014 will provide new laboratory space for a materials-oriented organic chemist and/or free up some laboratory space in SE1 for a materials-oriented chemist in a different area. However, given the likely limitations in startup funds we consider it unlikely that a search at a tenured level will be successful, so we propose this position at the Assistant Professor level only. This hire could have research interests in inorganic and/or organic materials, with an emphasis on either synthesis or characterization. We would seek someone whose research interests are complementary to those of our current faculty to broaden and diversify our research programs in materials chemistry. Any materials chemist could teach general chemistry (CHEM 2 and 10) and a variety of other core and elective undergraduate and graduate courses depending on research area. Most materials chemists will require some wet lab facilities and some instrumentation space, with the exact mix being determined by the specifics of the research.

**General justification for new positions in chemistry:** Chemistry is often known as “the central science” because of the key position it occupies in modern science and engineering. Most phenomena in

the biological and earth sciences can be described in terms of the chemical and physical behavior of atoms and molecules, and chemical principles also underlie much progress in medicine and engineering. In addition, chemical systems are fascinating and often beautiful in their own right. Because of the indispensable role of chemistry as a core discipline in science, one would be hard-pressed to think of any highly respected comprehensive research university that does not have strong chemistry programs at both the undergraduate (B.S.) and graduate (Ph.D.) levels. Chemical Sciences is currently the second most popular major in the School of Natural Sciences, with 155 declared majors as of October, 2010. The chemistry faculty also have a large service teaching load, as all Natural Sciences majors and many Engineering majors also require one to three semesters of lower-division chemistry. During Fall 2010 enrollment in undergraduate CHEM courses was more than 1000, requiring 22 graduate teaching assistant equivalents (50% appointment) to support. Merced also has a small but robust graduate program in chemistry, administered as a joint graduate emphasis with physics. At present there are 16 graduate students in chemistry, most of them in the Ph.D. program.

*Note regarding LPSOEs: The chemistry faculty discussed the possibility of listing an LPSOE as one of our FTE requests. We would, of course, be happy to have an additional, permanent lecturer who could teach multiple large lower-division courses and help with WASC paperwork. However, we are not willing to prioritize such a hire over additional research-active ladder-rank faculty. Our greatest need is to reach a critical mass of faculty such that we can have a graduate program that is respected by our peers at other institutions and is attractive to students. An LPSOE could free up faculty to teach more graduate courses, but that is not helpful unless we have enough students to fill those courses. Chemistry currently uses a number of lecturers and course assistants to meet its teaching needs, but a majority of those people are substituting for graduate students doing TA work. Therefore, adding more research-active faculty will allow us to reduce the number of lecturers we need to hire. We would be willing to consider postponing a ladder-rank faculty position in favor of an LPSOE only if this were a spousal appointment needed for us to recruit a highly sought-after faculty hire. Our willingness to advocate for an LPSOE position in such a case would have to be determined by the particulars of the situation.*

## Environmental Systems

The following plan is similar to last years' (2009-2010) ES strategic plan. In December 2010, the current ES chair (Stephen C. Hart) emailed last years' plan and a draft update of the ES requested FTEs for the next three years (AY2012-2015) to all ES graduate program members and asked for comments. Only a few graduate group members provided comments, and these were incorporated into this draft. The draft FTE list sent to graduate group members was revised initially from last years' request to reflect changes that occurred through the closely related Sierra Nevada Research Institute (SNRI) strategic planning process (2009-2010 Strategic Plan), as well as changes in the prioritized requests from the Environmental Sciences, Integrative and Evolutionary Biology, Environmental Health Sciences planning area as part of the School of Natural Sciences. The following positions emerged as priorities for strengthening the ES group's position in terms of graduate research quality and competitiveness, from the perspective of near-term and longer-term Central Valley, California, national, and global research issues and opportunities.

The ES program strives to equip graduate research students with the knowledge and skills necessary to improve the scientific understanding of coupled Earth systems---atmosphere, hydrosphere, lithosphere, and biosphere---and to use this understanding to: (1) manage natural resources, (2) engineer the restoration of impaired environments, and (3) inform environment-public health decisions. This improvement in understanding is gained through the systematic study of biological, chemical, and physical processes, and through rigorous individualized research programs in natural and engineered

environments. Courses are designed to provide the scientific principles underlying the function and sustainability of natural and engineered environmental systems and the socioeconomic and political forces that shape decisions about these systems. The ES program places the principles of natural science and engineering in the context of: (1) ascertaining fundamental processes and properties of environmental systems, (2) integrating physical, chemical and biological cycles, (3) pollution prevention, treatment and ecosystem restoration, and (4) resource management and decision making.

Our decadal vision for ES is to be an internationally recognized research and graduate program and our graduate students are known for their innovative and interdisciplinary approach to solving environmental issues. In addition, Environmental Systems is poised to contribute to the stated goals of the campus to increase our recognition as a research institute, promote the success of our junior faculty and to increase graduate student enrollment.

### **Goals 2010-2014**

Issues of environmental sustainability of climate, ecological and energy systems have been highlighted in the proposed campus-wide Strategic Plan. Environmental Systems is poised to lead UCM in these areas. To that end, ES faculty have developed some short-term goals:

- Increase graduate enrollment 20% and expand our course offering to meet the breadth and depth that address our graduate student needs [*Note: to support more rapid graduate student enrollment growth, the ES faculty strongly endorses attainment of a graduate student fellowship endowment as a priority campus-wide development effort.*]
- Maintain sustained growth in research activity and to expand the ecology and ecosystems research to a level comparable to the climate, hydrology, and biogeochemistry research
- To increase the presence of our atmospheric dynamics/air pollution research efforts in California, nationally, and internationally (see addendum for confirmation of prior FTE allocation in Air Pollution/Atmospheric Dynamics at the end of this document)
- Increase the base for graduate student support and improve administrative support for graduate program
- Continue to build links with other graduate programs and lay the foundation for the development of new graduate programs (e.g., management and public health) as well as enhance the profile of the Sierra Nevada Research Institute

To achieve these goals, we request the following three new positions:

**Ecological or ecosystem modeling:** We recommend that a faculty member at the assistant or associate level be hired in this area. There are several researchers within both ES and QSB graduate groups that would benefit from collaborations with a faculty member with strong quantitative expertise in computer simulation of ecological and/or environmental systems. Frequently, ecological and ecosystem modeling are used for scaling up in space and integrating across time phenomena observed at small spatial scales and over short periods of time. Currently, these faculty members have to form long-distance collaborations in order to complement their research programs with this skillset. This person would also contribute to the Earth Systems Science degree in the School of Natural Sciences (SNS) and to a Center for Spatial Analysis that is being investigated by faculty in School of Engineering (SE), SNS, and the School of Social Sciences, Humanities, and Arts (SSHA). At the graduate level, this person would teach a course in ecological simulation modeling that would strengthen the quantitative and analytical skills of graduate students in the ES and QSB graduate groups

Rationale and Potential School Affiliation(s): UC Merced has several experimentalists in the ecological and environmental scientific fields, but no faculty member has the expertise needed for the extrapolation of their research to larger spatial and temporal scales. Such extrapolation is critical for research areas such as Climate and Global Change Science, an area of strength within the ES group. Furthermore, the low space requirements of faculty in this research area should make it easier for recruiting in this research area given the current constraints on research space within the campus. Relevant faculty would reside primarily in SNS or SE. The graduate and upper division courses taught by this faculty member would contribute to the ES and QSB programs, as well as Earth Systems Science and Ecology and Evolutionary Biology courses.

Draft Position Description. We seek an outstanding individual with research interests and expertise in modeling of ecological or environmental systems. This hire is intended to add research expertise in modeling that will serve as an integrator of current multi- and inter-disciplinary interests across environmental and ecological research areas. The successful candidate is anticipated to contribute to undergraduate teaching primarily in either Earth Systems Science (ESS) and/or Biological Sciences (BIO), in particular the Ecology and Evolutionary Biology track. In addition to lower division courses in ESS, the successful candidate would be expected to develop new, upper division courses with a strong quantitative focus in topical areas such as “Quantitative Analysis of Global Environmental Problems,” or “Computer Simulation of Ecological and Environmental Systems,” or potentially courses related to quantitative spatial/temporal analysis and remote sensing. The successful candidate is anticipated to contribute to graduate teaching and mentoring primarily in the Environmental Systems graduate program, but may also contribute to the Quantitative and Systems Biology graduate group depending on their interests. The successful candidate may teach the existing (but never offered) Ecological Modeling (ES 228) course, as well as develop new graduate courses in their research specialty.

**Ecological engineering or ecohydrology:** We recommend an assistant or associate level search for a faculty member who uses engineering principles to design sustainable systems that integrate human activities with the natural environment, with particular emphasis on the linkage between hydrologic and ecological systems. Possible areas of research emphasis include interactions among hydrologic, biogeochemical, physiological, and soil processes; hydrologic ecosystem services, integrating water quality, water cycling, spatial analysis and scaling. Remote sensing, field-based measurements, laboratory experiments and modeling are all of interest. As a discipline, ecohydrology addresses the bi-directional regulation of hydrologic and ecological processes, e.g. the flow regime and pollutant levels of water in wetlands regulate the species and the populations that live in the ecosystem, while ecological processes in the wetland regulate the timing and magnitude of water and nutrient fluxes through the system. Ecological engineering involves the design, construction, restoration and management of aquatic and terrestrial ecosystems that have value to both humans and the environment, using principles from engineering, ecology, economics, and natural sciences. The extensive and large-scale ecosystem restoration efforts planned in the Central Valley provide excellent opportunities for both natural laboratories, and research support through applications partnerships with local landowners and conservation entities. Similar efforts are being carried out and across the Western U.S. This position would have collaborative opportunities and synergy with Bales, Conklin, Harmon, Guo, and Traina in SE and Aguilar, Beman, Dayrat, Duffy, Ghezzehei, Hart, Kueppers, and O’Day in SNS.

Rationale and Potential School Affiliation(s). A large number of faculty in ES are actively engaged in national observatory initiatives which are already bringing long-term, high-impact projects to UC Merced (e.g., NEON, Critical Zone Observatories, and WATERS Network Test Bed projects). The ES Group sees this hire as necessary to position the campus competitively in this new research domain. Major initiatives, including investments in research institutes and academic units, are currently being launched at several major research universities, another sign of the increasing prominence of this subject. Such an individual could reside in any of the Schools, or jointly between schools, depending on their specific expertise. The graduate and upper division teaching contribution by this faculty member would

be within the ES program as well as in fundamental engineering, environmental engineering, and Earth systems science courses.

There are major opportunities for research on topics pertaining to ecohydrology concerned with habitat restoration and related issues in California, nationally, and internationally. In California alone, for example, continued allocations to the CALFED program (see website: <http://www.calwater.ca.gov/index.aspx>) and new allocations to the San Joaquin River Restoration, in support of the 2006 SJR Settlement Agreement ([http://www.lao.ca.gov/analysis\\_2007/resources/res\\_05\\_anl07.aspx](http://www.lao.ca.gov/analysis_2007/resources/res_05_anl07.aspx)), will likely exceed \$250 million over the next few years. Given our strategic location and the current ES faculty makeup, an ecohydrologist would be well-positioned to play a major role in this work, bringing both state and national attention to the ES program and UC Merced as a whole.

**Environmental health or epidemiology:** This position contributes to an environmental health/air pollution focus. This person should be either a biostatistician/epidemiologist and/or molecular epidemiologist. Priorities would be for research focusing on asthma, lung cancer or cardiovascular disease as these are major problems associated with air pollution, which are the leading causes of health problems with major financial impact on the San Joaquin Valley. This position is an excellent complement to research of Forman, Traina, Leppert, and as well as the two other proposed environmental health positions. The teaching role for this person could be in statistics, molecular biology or physiology dependent upon their expertise. As this would be the first epidemiologist, a senior position is recommended.

**Rationale and Potential School Affiliation(s):** A significant air pollution-related research effort aimed at the understanding and mitigating the escalating air quality problems in the Central Valley, Sierra Nevada, and elsewhere is expected from UC Merced and has already been initiated in the ES group (Professors Rogge, Chen, and Leppert, and a proposed air pollution/atmospheric dynamics hire; see addendum below) and in SNS (Professor Forman). Professor Chen focuses on modeling spatiotemporal emissions distributions under various air pollution control policies. Professor Leppert examines physical-chemical properties of particulate pollution, while NS Professor Forman examines the physiological effects of air pollution on lung tissue. Epidemiology is clearly a gap in this cluster of activity. ES envisions that this position would reside in SNS or SNS-School of Management (when in place).

#### ***Addendum: Confirmation of Prior FTE Allocation: Air Pollution/Atmospheric Dynamics***

The ES Group wishes to reconfirm its support for a previously allocated cross-school search in the area of atmospheric dynamics. This search has resulted in strong applicant pools in the past, owing to the extensive and unique opportunities for researchers here in the Central Valley. Offers to both a senior and junior candidate were declined, and the ES group voices a strong consensus that this position be searched again in order to build critical mass in this area as quickly as possible.

**Atmospheric Dynamics:** Atmospheric dynamics will continue to be a long term research driver in the context of climate change and air quality management issue atmospheric dynamics involves observational and theoretical analysis of all motion systems of meteorological significance, including global- to regional-scale circulations. Research problems include many topics related to climate change, climate variability, stratospheric dynamics, and the general circulation. Problems in atmospheric chemistry evolve due to natural events, biological and anthropogenic activities, and are linked to the oceans, the solid earth and the biota. Anthropogenic perturbations such as land-use and industrial activities have profoundly modified the chemical composition of the troposphere and stratosphere, with potentially important consequences on future climate and living organisms. Examples of such changes including the formation of an ozone hole over Antarctica since the late 1970s, the observed trends in long-

lived greenhouse gases, the change in the concentrations of tropospheric ozone and acidic deposition due to growing emissions of hydrocarbons, nitrogen oxides and persistent chemicals in industrialized regions.

**Rationale and Potential School Affiliation(s).** UC Merced has the nucleus for a strong atmospheric dynamics group, but more FTEs are needed if ES is to develop a major research thrust in this area. Relevant faculty would reside primarily in SE or NS, depending on their specific expertise. The graduate and upper division teaching contributions by this faculty member would contribute to the ES program as well as to fundamental engineering, environmental engineering, and Earth systems science courses.

**Teaching Contributions:** As discussed previously, this position would teach in the environmental engineering and Earth systems science undergraduate programs in addition to the Environmental Systems graduate program.

**Resource Needs:** Researchers in this area typically use computation models to understand and predict reactive atmospheric transport behavior. Hence, this faculty member would need support for postdoctoral staff to help initiate his/her research program, computational facilities and workspace (400 sq ft), and office space for his/her graduate students and staff.

## Molecular and Cell Biology/Health Sciences

This portion of the School of Natural Sciences Strategic Plan covers the life sciences related to Biochemistry, Molecular and Cell Biology, and Biomedicine. This plan addresses the following goals for biology at UC Merced: adapting to space and start-up limitations affecting hiring for the foreseeable future, correcting a disproportionately large student/faculty ratio within the Biological Sciences major, filling teaching needs in both the Biology major and QSB graduate program, building the necessary expertise in the new Biological Sciences Research Institute and strengthening the short- and long-term research profiles of Biology/Biomedical Sciences at UC Merced.

**Size and Growth of Biological/Biomedical Science at UC Merced:** Biological Sciences is currently the largest major at UC Merced with 979 undergraduate students (fall, 2010). The Quantitative and Systems Biology graduate emphasis has the largest number of doctoral students (35) among all graduate groups at UC Merced, in addition to 11 Masters Degree students. Projected undergraduate enrollment will be at least 1200 students in Fall 2011. At that point the biology major will reach the capacity of its teaching lab facilities for the foreseeable future, which are already running at more than 100% of CPEC capacity. With currently about 17 faculty teaching in the MCB/Health Sciences, we currently have more than 57 undergraduates per faculty head which is much larger than biology programs on other campuses and all other science and engineering majors at UC Merced. This ratio is leading to disproportionate teaching loads for life sciences faculty and is crowding out needed graduate courses for life sciences graduate students. One partial solution to this problem, already underway by the Life Sciences Curriculum Committee, is to make Biology a more selective major with higher standards for admission to the major, progress-to-degree controls on student performance, and continued or increased emphasis on quantitative biology. However, even with such higher standards in place, additional faculty lines will be required to ensure equitable teaching loads to life sciences faculty and a good educational experience to life sciences graduate and undergraduate students. UC Merced distinguishes itself state-wide and nationally with its strong emphasis on quantitative skills in its Biology major and further development of this aspect will help address the swamping of our major while improving the competitiveness of our students after graduation.

**Quantitative and Interdisciplinary Biology:** Biology is on the brink of a fundamental transformation from a primarily “descriptive” study of individual components of biological systems, to a model- and high-throughput data-driven science yielding quantitative and predictive understanding. This so-called “systems” approach to biology is already dramatically changing how biological research is done, leading to new connections with the physical, mathematical, and computational sciences. This new biology offers the promise of a much more complete understanding of living systems and ultimately new treatments for complex diseases such as asthma, diabetes, and cancer.

This new biology is built on several themes: First, the acquisition of comprehensive, quantitative data sets on living systems, such as whole genome sequences, protein expression rates, on and off rates of protein modifications during signal transduction, and complete maps of metabolic and regulatory pathways. Second, the development of mathematical models for integrating and evaluating such data, with the goal of building models that can predict novel or unexpected properties of biological systems. Third, the recognition of the central role of evolution in studying and understanding organisms, pathways, genes, and disease. Finally, this “new biology” requires very close partnerships with the physical and mathematical sciences. This need for a highly multidisciplinary approach constitutes an important barrier to progress in quantitative systems biology; many universities have highly compartmentalized research programs and few undergraduate or graduate programs provide truly multidisciplinary training.

This provides UC Merced with an excellent opportunity to develop biological and biomedical sciences research and academic programs at the forefront of this field. UC Merced has already been fostering a number of multidisciplinary research programs (see below). Furthermore, this new biology will be greatly enabled by many of the other initial academic programs and research efforts at UC Merced, such as the Applied Mathematics, Earth Systems Science and Bioengineering programs, the Health Sciences Research Institute, the Sierra Nevada Research Institute, and the Center for Computational Biology.

**Biological/Biomedical Sciences Research Programs:** The biological and biomedical sciences at UC Merced encompass several research themes described below. Linking these themes is the strategy of using methods that integrate large data sets, such as genomic or proteomic data, or produce quantitative data at the single cell or even single molecule level. Another linking theme is the goal of quantitative characterization of biological processes with ultimate aim of predictive models.

### ***Research Themes***

**Predictive Understanding of Cellular Interactions and Cell Fate Decisions:** An ultimate goal of cell biology is to achieve a complete understanding of the biochemical pathways underlying cellular decisions, including developmental choices and response to outside stimuli. Research in cell biology at UC Merced spans a wide range of specific research topics, from the development of immune system cells, to the evolution of bacterial antibiotic resistance to symbiosis in marine systems. New research questions are being made accessible by technologies that allow comprehensive genomic, proteomic, and metabolomic characterization, in some cases down to the single cell level. A combination of experimental investigation using these new tools and computational modeling of the interacting pathways will provide data to determine the mechanisms of cellular responses to exogenous factors such as infection, oxidative stress, growth factors, as well as internal factors such as epigenetic state or cell age. This knowledge will allow the development of new therapies to treat diseases, including the potential of chemoprotective agents against inflammation and aging.

The understanding of cell signaling and cell fate decisions also has important biomedical applications because the ontogeny and maintenance of multicellular life depends on exquisitely complex developmental process in which undifferentiated stem cells give rise to specialized cell types. Understanding this process promises to provide new treatments for many complex disease states related to developmental failures. Moreover, because of their ability to generate new specialized cells, stem cells hold the potential to treat a vast array of health problems, including spinal cord injuries, Parkinson’s

disease, diabetes, and many others. Elucidating the complex mechanisms by which extrinsic and intrinsic signals determine the proliferation or differentiation of stem cells is inherently a systems-level challenge, and will require new technologies for collecting data on cell populations and individual cells, and new methods to build models of cell decision processes.

**Complex Diseases:** Complex diseases are defined as diseases that are influenced by the actions of multiple genes, their interactions with each other and with the environment. Examples include metabolic disease, cardiovascular disease, Alzheimer's disease, Crohn's disease, persistent infection, cancer, diabetes and asthma. These diseases can only be fully understood in multidisciplinary approaches that include: identifying communities with increased risk due to their genetic backgrounds, determining the environmental factors that increase disease risk and understanding the cellular and molecular mechanisms underlying the increased susceptibility that can offer possible treatments.

The Central Valley has a high rate of such diseases and provides a microcosm of the health challenges of the entire state and nation. A strong research program on complex disease would foster collaborations with healthcare providers in the Central Valley. Conversely, the local community would provide unique cohorts for studying strategies for treating or reducing the incidence of these diseases. This program would have strong synergies with emerging UC Merced programs in environmental science, psychology, sociology, and economics and would have many links to future health professional programs.

**Quantitative, Computational and Systems Biology and Biomedicine:** Across the nation, UC Merced has attracted attention with its early establishment of a Quantitative Systems Biology graduate group. It is widely recognized that the incredibly rapid and wide-spread development of high-throughput experimental technologies for sequencing, expression, genotyping, proteomics, phenotyping and more have instigated a new era that demands quantitative approaches to biology. The development of quantitative biology requires a quantitative mindset from all practitioners, from the experimentalist interested in testing and refining models through the adoption of high-dimensional techniques with ever-increasing experimental precision and accuracy, engagement with emerging public standards for data curation, and engagement with the theoreticians and computational biologists who complement the experimentalist with data analysis, simulation and data integration.

Computational biology is the scientific investigation of biological hypotheses by computer, through analysis, simulation, modeling, machine learning, and creative data integration. Its orientation is the discovery and advancement of biological knowledge. Computational medicine is an allied field specifically applied to developments in health sciences. Although very powerful when allied with experimentalists and unpublished data, computational biology and medicine can be prosecuted independently of any experimental collaboration over the entire life cycle of scientific or medical research: from funding to discovery to high-impact publication. Although computational biology and medicine are cheaper and less resource-intensive than experimental biology and medical research, they share the most expensive cost with other modalities of research — that of human resources — while having unique needs more like those of mathematicians and theoreticians, of group and individual office space that encourage creative social discussions at some times and intense independent work at others.

Although different definitions of “systems biology” have been proposed, in modern parlance this field largely concerns whole cells and/or organisms or large systems within cells or organisms, at molecular resolution. More specifically Systems Biology measures, analyzes and integrates large, typically high throughput, biochemical, genetic and molecular biological data to model, simulate, and predict the state and dynamics of whole cells and organisms, or large parts thereof. The phenomena studied in systems biology are typically emergent characteristics of assemblies of many interacting parts. These emergent characteristics are properties of the assembly as a whole: like robustness, physiological adaptation, regeneration, and phenotypic plasticity. Systems Biology and Biomedicine encompass many modalities of science. The precepts and analysis of theoretical systems biology, the predictive simulation and modeling results of computational systems biology, high-dimensional non-parametric statistics, and the technical sophistication of whole cell measurements of gene expression, proteomics, metabolomics and molecular

interactions of experimental systems biology, collaboratively combine to move whole cell- or organismal systems biology beyond descriptive science towards hypothesis-driven science. Systems biology has meaningful and productive interfaces with other sub-disciplines of biology such as evolutionary biology, ecology, population biology, development, genetics and others.

**FTE Requests and Justification:** The Molecular and Cell Biology/Health Sciences group plans to stay with the faculty requests for AY11-12 and AY12-13 approved by CAPRA in spring 2010. These requests include a biology LPSOE to be searched in AY11-12. Additionally, for AY13-14, the group proposes to re-open the search for a faculty member in infectious disease which was a search that was advertised in AY0809, but then that search was killed (along with 2 other biology searches) due to budget limitations. The group will retain the position description from the AY08-09 search:

*We seek applicants studying human infectious diseases, including emerging infections, zoonoses, and persistent infections, caused by viral, fungal, bacterial or protozoan pathogens. Highest consideration will be given to candidates with a strong background in cellular and molecular biology. The candidate should be able to teach undergraduate courses in microbiology and immunology required for several majors, possibly courses on environmental effects on health, and specialized graduate courses.*

## Physics

Physics is the study of the properties of nature at their most fundamental. It ranges from the study of the very tiniest pieces of matter and energy, including molecules, atoms, photons, and subatomic particles, to the study of the entire universe. Insights in physics have revolutionized our society. It is hard to imagine an area of science or engineering that has not been profoundly affected by fundamental developments in physics. One need only think of the harnessing of electricity, the invention of the transistor, and the discovery of the laser. The present strength in physics at Merced is centered on three broad areas of research, Condensed matter physics, Atomic, Molecular and Optics physics (AMO) and Biophysics. In the future we plan to grow an emphasis in astrophysics. To both provide our undergraduates with more diverse course offerings (astronomy courses are typically very popular) and to leverage the research opportunities available as a member of the UC system in obtaining telescope time.

**Atomic, Molecular, and Optical Physics:** UC Merced is building a strong research emphasis in atomic, molecular, and optical (AMO) physics. Interest and developments in this field have surged in the last ten to fifteen years, primarily due to advanced experimental techniques. These developments have been recognized by several recent Nobel prizes: for ion trapping and atomic clocks (1989; Ramsey, Dehmelt, Paul), for atomic cooling and trapping techniques (1997; Chu, Cohen-Tannoudji, Phillips), for the creation of Bose-Einstein condensates (2001; Cornell, Ketterle, Wieman), and most recently for advances in quantum optics (2005; Glauber, Hall, Haensch).

The modern trend in AMO science is toward greater control over quantum systems such that quantum coherence is maintained and quantum processes can be resolved. This includes working at very low temperatures, at ultra short time scales, and with very high spectroscopic precision. Modern techniques can now routinely address single atoms, single photons, and single qubits (the quantum analog of a bit). The technological implications for such precise control over the fundamental building blocks of ordinary matter are as yet unimagined, but the promise is great. By analogy, the laser, which in some sense is a “Bose-Einstein” condensate of photons, has impacted almost every area of technology and medicine. The program in AMO physics complements the research programs in condensed matter physics and chemistry.

**Condensed Matter Physics:** The Condensed Matter Physics program in Natural Science is a broad, interdisciplinary program focusing on “condensed” phases of matter. These phases range from simple solids and liquids to metallic and semiconductor nanomaterials to exotic condensed phases such as the superconducting phase exhibited by conduction electrons in certain materials, and the ferromagnetic and antiferromagnetic phases of spins on atomic lattices. The intellectual scope of this program is vast, and includes an understanding of the optical, electrical, mechanical, and transport properties of materials, encompassing the nano- to the macro-scale. Research in condensed matter can be harnessed to design new materials such as magnets, semiconductors, ferroelectrics, superconductors, polymers, and liquid crystals, used for applications in a wide variety of disciplines including efficient energy conversion, ultra-fast optics, quantum information processing, and structural materials, to name a few.

**Space and Facilities Needs:** In a well balanced department a three to one ratio between experimental physicists and theoretical physicists is typical. Thus, most physics hires should be experimentalists. Although the nature and configuration of the space required by different types of physicists is quite different, all of the experimentalists are likely to require an average of at least 1000 sq. ft. of lab space each, plus office space for the PI, postdocs, and graduate students. A junior experimental astrophysicist may not require as much space however as many of their experiments will take place remotely. We anticipate that theoretical/observational astrophysicist will need just office space for themselves and group members. Established senior faculty will require more space than this. Start-up costs for experimentalists depend on specific research needs but typically fall in the \$500k-\$750k range for a junior hire and 700k-1.5M for a senior established hire.

Experimental condensed matter and AMO physicists sometimes need bench and fume hood space but typically have large pieces of specialized equipment such as cryostats, vacuum chambers, and laser-based setups on large optical tables. They often also have specialized requirements for the space in which these instruments are housed, such as high temperature stability, low vibration, isolation from sources of electrical noise, and light-tightness. Because of the specialized nature of the instrumentation it is often not possible for a single room to be shared by multiple investigators. Experimental biophysicists tend to have research groups that require a mixture of wet lab space, with fume hoods, and dry space for specialized instruments and depending on the specific field they may require access to core facilities for confocal microscopy, in-house x-ray diffraction, or lithography facilities. Theoretical and computational hires will require office space and computational facilities for the PI, postdocs, and graduate students.

**Faculty Needs:** At a bare minimum twelve FTEs will be needed to teach the core of the undergraduate and graduate physics curriculum, with more faculty needed to provide depth in our course offerings and to provide a critical mass for an effective research environment. Primarily we aim to grow the current research emphases of condensed matter physics and AMO physics, while gradually broadening the scope of our program to other areas. To achieve this goal we require a hiring rate of at least two faculty per year. We currently have 7.5 FTEs dedicated to teaching physics (Profs. Chiao and Winston at 0.5 FTE each and Profs. Mitchell, Ghosh, Gopinathan, Sharping, Hirst, Scheibner and Tian at 1 FTE each.)

### **Proposed hiring priorities for 2011-2014**

Here we propose a hiring plan for the next three years. The proposed positions are flexible depending on hiring outcomes for the preceding years and represents a general guide on how the dept will grow over the next three years. The primary goals of this hiring plan are to **cover teaching requirements** for our major and graduate programs, to **build current research strengths** and to **establish an astrophysics program** with the goal of providing undergraduate classes in astrophysics. We recognize the space limitations on campus over the next two years and therefore plan to focus primarily on theoretical/computational candidates until S&E2 is available.

## **2012-2013**

- 1) ***Condensed matter theoretical/experimental physicist:*** This position seeks applicants who are trained in physics with research interests in condensed matter physics. Fields of interest include Photonic materials, nanoscale electronics, quantum information and photovoltaics. We seek candidates whose research is complementary to the work of existing faculty in the School of Natural Sciences.
- 2) ***Atomic, Molecular and Optical (AMO) theoretical/experimental Physicist:*** This position seeks an experimental physicist trained in atomic and molecular or optical physics. The areas of research of interest include ultrafast optical phenomena, attosecond studies, fundamental quantum processes and engineering, atomic cooling and trapping, precision measurement, and novel imaging techniques, quantum information in quantum many body systems and semiconductor photonics. New programs as well as research in areas complimentary to existing UC Merced faculty are welcome.

## **2013-2014**

- 1) Condensed matter/AMO theory
- 2) Astrophysics (observational)

## **2014-2015**

- 1) AMO Experiment
- 2) Condensed Matter Experiment

## **QSB**

### **2012 (position to be searched in 2011-2012)**

***Biostatistics, associate/full professor:*** The problem of analyzing enormous sets of data in modern experimental biology has sparked new growth in the field of biostatistics, especially in such areas as multiple hypothesis testing, Bayesian estimation and model selection, Markov Chain Monte Carlo, machine learning and other areas. The successful candidate is expected to have a productive and highly-recognized record of accomplishments as a principal investigator, and a well-funded research program. S/he is expected to garner and cultivate collaborative research relationships not only with existing biology faculty, but provide a complementary and bridging research expertise and rapport with our applied mathematics faculty.

***Justification:*** Currently, UC Merced does not have any faculty in the requisite areas of statistics, probability modeling, or allied areas such as applied discrete mathematics. Current and future research activities and investments at UC Merced — such as in expression analysis, genomics, bioinformatics and proteomics — warrants biostatistics as a priority area of hiring. A biostatistician would expand the QSB research and teaching portfolio. Aside from the benefits that a biostatistician would require no wet or dry lab space and less startup costs, UC Merced with its internationally recognized applied math faculty and very strong interdisciplinary focus on biomedicine has the potential to attract excellent applied biostatisticians who may not otherwise fit in conventional statistics departments. The senior hire will provide leadership and mentorship to the many junior faculty in this and related disciplines.

### **2013 (position to be searched in 2012-2013)**

***Evolutionary Biology, associate/full professor:*** We are searching for an outstanding individual with research expertise in a field of evolutionary biology that complements and coalesces the talents of the existing faculty at UC Merced. The successful candidate is expected to have a productive and highly-recognized record of accomplishments as a principal investigator, and a well-funded research program.

Considering the central role of evolution in the biological sciences, pure and applied, we seek an individual with broad vision who can engage evolutionary biology with related disciplines (particularly in environmental and organismal systems) thus building an innovative program. The successful candidate will have opportunities to use evolutionary biology to bridge and integrate conventionally disparate biological problems. S/he will bring distinction and help establish an internationally visible program identifiable from our highly respected sister campuses and in line with UC Merced's Strategic Vision. We particularly recognize the large contributions made in evolutionary biology through theoretical advances and their interplay with empiricism, the latter of which is already diverse and strong at UC Merced. In emphasizing theoretical contributions in the search, we prefer not to exclude completely experimentalists who are transformational leaders of the highest standing; our goal is to hire the best candidate to advance evolutionary biology and enhance its application in the sustainability of human and environmental systems. Current faculty research interests include phylogeography, evolutionary ecology, population and conservation genetics, evolutionary genomics and metagenomics, systematics, molecular evolution, evo-devo, astrobiology, and mathematical and computational biology. Faculty can interact and ally with the Sierra Nevada Research Institute (SNRI) and the Center for Computational Biology.

**Justification:** The successful candidate is anticipated to contribute to undergraduate teaching primarily in Biological Sciences (BIO), in particular the Ecology and Evolutionary Biology track (e.g. BIO141 Evolution), and may also teach in Applied Mathematics (MATH) or Earth Systems Science (ESS), teaching existing and/or developing new courses that meet the missions stated above. The successful applicant will also share teaching responsibilities for QSB 247 Advanced Ecology and Evolution with current faculty. The senior hire will provide leadership and mentorship to the many junior faculty in this and related disciplines.

#### **2014 (position to be searched in 2013-2014)**

***Stem Cell Biologist, associate/full professor:*** This position seeks a senior-level hire with training in molecular, cell and developmental biology who applies their expertise to studying stem cell biology. The successful candidate is expected to have a productive and highly-recognized record of accomplishments as a principal investigator, and a well-funded research program. This position will be part of the Stem Cell Consortium group of faculty (<http://stemcells.ucmerced.edu/>). Areas of particular interest include embryonic and adult stem cell biology, epigenetics, reprogramming, and applications for regenerative medicine using appropriate model organisms. Expertise in human ESC culture and differentiation and humanized mouse models would be a plus. This senior-level hire would provide leadership to junior level faculty, would be expected to lead initiatives such as training grant applications for graduate students in stem cell biology, and also to create and teach upper division and graduate level courses specifically on stem cell biology. The CIRM has been generous to UC Merced faculty in the awarding of over \$9M in research and facility grants since 2006. This hire could fall under the SNS hires projected for 2009 and later in cell biology, cancer biology, and developmental biology. This position is synergistic with the stem cell research interests of the BEST Graduate Group.

**Justification:** The QSB GG is requesting this new senior level position to 1) raise our university to international prominence, and 2) meet the growing teaching needs of our graduate and undergraduate students. The QSB GG proposes to attract an internationally recognized senior faculty member in stem cell biology for several reasons. First, the \$9M awarded to UC Merced from the California Institute of Regenerative Medicine (CIRM) and the new Stem Cell Research Facility will attract the interest of top flight senior investigators, giving QSB an excellent chance to hire someone with international prominence in spite of current space and startup fund limitations. The new Stem Cell Facility and Stem Cell Consortium will significantly reduce the startup and space needs of a senior hire. Second, the senior hire will provide leadership to the many junior faculty in stem cell research. He/She will organize the junior faculty to submit proposals for federally funded training grants, program project grants, and shared instrumentation grants. Finally, this senior hire will help develop needed graduate courses and relieve the growing burden of teaching undergraduate biology courses.

**2015 (position to be searched in 2014-2015)**

***Experimental/Applied Systems Biologist, associate/full professor:*** This position seeks a senior-level hire with training that integrates the tools of systems and synthetic biology toward genetic, metabolic, and/or biochemical engineering. The ideal candidate has experience applying these skills in areas of direct relevance to global challenges, including (though not limited to): directed synthesis of high-value secondary metabolites; biofuel or bioenergy production from renewable sources; bioremediation of contaminated environments; and improvements of agricultural processes.

***Justification:*** This new hire aims to directly expand the expertise of QSB in systems biology. This discipline continues to develop rapidly at research universities around the world and has seen strong growth in federal and private funding opportunities. The new faculty hire would help address a pressing need for development and teaching of graduate level QSB courses. Finally, the senior faculty would be a leader and mentor for several junior faculty of QSB, Environmental Systems, and BEST.

## CAPRA Tables – FTE AY 2012-2014

### Applied Math FTEs

	2009- 2010	2010- 2011	2011- 2012	2012- 2013	2013- 2014
FTE	8*	9	10	11	12
VAP	2†	2	2	2	2

\* Included is Prof. Kevin Mitchell, who is a Core Member of Graduate Studies in Applied Mathematics.

† Avi Shapiro started in Fall 2010 and Orkan Umurhan started in Spring 2011.

### Applied Mathematical Sciences CAPRA table of requested FTEs

Priority	Name of Position	Level	Primary Major	Secondary Major	Primary Grad Group	Secondary Grad Group	Estimated startup	Estimated space	Special needs and strategic considerations
<i>Year 4 (starting Fall 2013)</i>									
1	Applied Math	Open Rank	Applied Math		Applied Math		150K	Office	

CAPRA Tables – FTE AY 2012-2014

**Biological/Biomedical Sciences CAPRA table of requested FTEs**

Priority	Name of Position	Level	Primary Major	Secondary Major	Primary Grad Group	Secondary Grad Group	Estimated startup	Estimated space	Special needs and strategic considerations
<b><i>Year 1 (starting Fall 2011) Search underway</i></b>									
1	Molecular Biology	Open	BIO		QSB		\$300 – 500K	Office + 600 sf wet lab	Could make use of MS facilities at Castle
<b><i>Year 2 (starting Fall 2012) Approved by CAPRA 2010</i></b>									
1	Biostatistics	Open	BIO	Math	QSB	AM/ES	\$200 – 300K	Office + 100 sf office space	Teaching priority
1	Cell Biology	Open	BIO		QSB		\$300 – 500K	Office + 600 sf wet lab	
<b><i>Year 3 (starting Fall 2013) Approved by CAPRA 2010</i></b>									
1	Evolutionary Biology	Open	BIO	ESS	QSB	ES	\$300 – 500K	Office + 600 sf wet lab	
1	Mathematical/Computational Systems Biology	Open	BIO		QSB	AM/ES	\$200 – 300K	Office + 100 sf office space	
<b><i>Year 4 (starting Fall 2014) New Recommendation</i></b>									
1	Infectious Disease	Open	BIO		QSB		\$300 – 500K	Office + 600 sf wet lab	

CAPRA Tables – FTE AY 2012-2014

**Environmental Sciences, Integrative and Evolutionary Biology, and Environmental Health Sciences CAPRA table of requested FTEs**

Priority	Name of Position	Level <sup>†</sup>	Primary Major	Secondary Major	Primary Grad Group	Secondary Grad Group	Estimated startup	Estimated space	Special needs and strategic considerations
<b><i>Year 1 (starting Fall 2012)</i></b>									
1	Ecological or ecosystem modeling	Open	ESS	BIO	ES	QSB	\$200 – 300K	Office + graduate student and computational workspace (400 sf)	Possible use of GIS facility, parallel computer cluster
2	Atmospheric dynamics	Open	ESS	Management	ES		\$200 – 300K	Office + graduate student and computational workspace (400 sf)	Possible use of GIS facility, parallel computer cluster
<b><i>Year 2 (starting Fall 2013)</i></b>									
1	Earth Surface processes/Ecohydrology	Open	ESS	BIO	ES		\$300 – 800K	Office + 1,200 sf wet/dry lab	Possible use of GIS, field facilities, EAL
2	Environmental management	Open	ESS	Management	ES	SCS	\$200 – 300K	Office + graduate student space	Possible use of GIS or field facilities
<b><i>Year 3 (starting Fall 2014)</i></b>									
1	Conservation biology / Evolutionary biology	Open	BIO	ESS	ES	QSB	\$300 – 800K	Office + 1,200 sf wet/dry lab	Possible use of GIS facility, EAL
2	Global change ecology / Paleoecology	Open	BIO	ESS	ES	QSB	\$300 – 800K	Office + 1,200 sf wet/dry lab	Possible use of GIS, field facilities, EAL
3	Environmental health or epidemiology	Open	BIO	ESS	QSB	ES	\$300 – 500K	Office + 1,200 sf wet or 800 sf dry lab	Possible use of GIS facility, EAL

<sup>†</sup>All searches are designated as open because of the strong need of more senior faculty in all of these programmatic areas, and the low probability of successfully recruiting senior candidates in any of these positions.

CAPRA Tables – FTE AY 2012-2014

**Environmental Systems CAPRA table of requested FTEs**

Priority	Name of Position	Level†	Primary Major	Secondary Major	Primary Grad Group	Secondary Grad Group	Estimated startup	Estimated space	Special needs and strategic considerations
<b><i>Year 1 (starting Fall 2012)</i></b>									
1	Ecological or ecosystem modeling	Open	ESS	BIO	ES	QSB	\$200 – 300K	Office + 1,200 sf dry lab	Possible use of GIS facility
2	Air pollution / atmospheric dynamics <sup>†</sup>	Open	ESS	Management	ES		\$200 – 300K	Office + 400 sf dry lab	Possible use of GIS facility
<b><i>Year 2 (starting Fall 2013)</i></b>									
1	Ecological engineering or Ecohydrology	Open	ESS	BIO	ES		\$300 – 500K	Office + 1,200 sf wet/dry lab	Possible use of GIS or field facilities
2	Environmental management	Open	ESS	Management	ES	SCS	\$200 – 300K	Office + graduate student space	Possible use of GIS or field facilities
2	Environmental/Ecological biostatistics	Open	BIO	ESS	ES	QSB	\$200 – 300K	Office + 1,200 sf dry lab	Possible use of GIS facility
<b><i>Year 3 (starting Fall 2014)</i></b>									
1	Environmental health or epidemiology	Open	BIO	ESS	QSB	ES	\$300 – 500K	Office + 1,200 sf wet or 800 sf dry lab	Possible use of GIS facility
2	Conservation biology	Open	BIO	ESS	ES	QSB	\$200 – 300K	Office + 1,200 sf dry lab	Possible use of GIS facility
2	Global change ecology or paleoecology	Open	BIO	ESS	ES	QSB	\$300 – 800K	Office + 1,200 sf wet/dry lab	Possible use of GIS or field facilities

<sup>†</sup> All searches are designated as open because of the strong need of more senior faculty in all of these programmatic areas, and the low probability of successfully recruiting senior candidates in any of these positions.

CAPRA Tables – FTE AY 2012-2014

**Summary of proposed Physics faculty hires for the next five years**

	2010-2011	2011-2012	2012-2013	2013-2014	2014-2015	2015-2016	2016-2017
FTEs already hired	7.5	9.5	9.5	10.5	11.5	13.5	15.5
Active searches	2	0	1	1	2	2	2
Cumulative	9.5	9.5	10.5	11.5	13.5	15.5	17.5