MRU Grant Application; For IRPEE Application Development; M.R. Rose, Director

"Real-Time Biological Evolution in Society"

Introduction:

IRPEE has a variety of missions relating to research about, and utilizing, experimental evolution. Many of these missions will be served by the formulation of group grant applications for research or the development of new courses at the University of California. Connecting these missions is the support of graduate students interested in experimental evolution. Graduate students are expected to do the bulk of the research work and to take graduate-level courses in experimental evolution. The IGERT program of the NSF is particularly well-suited to help with the development of graduate programs.

In this application, we seek support for a part-time assistant and intercampus/inter-MRU workshops to help in the development of an IGERT application in the area of experimental evolution. At the core of this application is the goal of producing experimental evolutionists who are cognizant of the cultural and social significance of Darwinism, scientists who will play a larger role in society than that of past experimental evolutionists. Our plan is to involve colleagues from the humanities and social sciences, including such disciplines as philosophy, history, sociology, and political science. These disciplines have long been interested in biological evolution and the ideas associated with it. Our proposal is strongly interdisciplinary in a manner that has deep historical roots, but is largely unprecedented.

Intellectual Rationale:

Biological evolution is one of the most controversial scientific ideas of the last two centuries, if not THE most controversial scientific idea of our time. Millions of American citizens have strong opinions about biological evolution, whether or not it occurs, whether it operates at the direction of a deity or two, whether or not it was predestined to produce human beings. These issues have become central to the explanation of Darwinian thought to the reading, and even television-viewing, public. Major figures of our time, including Daniel Dennett, Stephen Jay Gould, and Richard Dawkins, have produced books explaining the meaning and importance of biological evolution. These writers are characteristically eloquent, but another attribute that they usually have in common is that they have never studied the operation of biological evolution experimentally. At most, they have studied the results of evolution, such as long-differentiated species, including humans. Biological evolution is expounded primarily by people who have little hands-on expertise in real-time evolution.

This leaves the public focused on metaphors and philosophies. The fact that evolution is much more observable than electrons or market-clearing prices is lost to view. Galileo helped found modern science not by formulating grand philosophies, the approach of Francis Bacon, but by showing his readers how they could observe simple principles of physics by experimenting with water in household containers. Modern-day exponents of Darwinism tend to follow the precedent of Bacon, offering metaphors ("The Blind Watchmaker," "The Selfish Gene," "sky-hooks," etc.) in place of data.

This is natural. People who are *not* architects, builders, or contractors discuss buildings in terms of metaphors, not the specifics of construction. But this does not pose difficulties for the erection of buildings, because no one doubts the need for the engineering that goes into construction.

Experimental evolution is basic to agricultural breeding, the use of antibiotics, the development of viral vaccines, and the treatment of HIV, among other applications. Despite this, experimental evolution is NOT accepted in the same spirit as architecture or civil engineering. Yet what could be more natural, when the public experiences Darwinism primarily as a controversy about the evolution of dinosaurs and humans, even the origin of life?

Many things need to be done to remedy this situation, including the improvement of science education during the K-12 period, not to mention the teaching of evolution in colleges and universities. Yet at the core of improvements in all these areas must be scientists and educators who themselves have an excellent understanding of two things. First, how evolution actually works, away from the metaphor grinders. Second, the practical significance of evolution for the concerns of contemporary society, from agriculture to ideology to medicine. At present, individuals with such two-fold understanding are rare adventitious combinations of scientific education and larger interests. Graduate programs in evolutionary biology don't teach their students the importance of biological evolution for Mary Shelley's *Frankenstein* nor do they explain the fear of stem cell technologies among many federal and state politicians.

Our proposal is simple: to produce biology Ph.D.s who have acquired a breadth of interdisciplinary knowledge that would enable them to bring a living, concrete understanding of evolution to educational, industrial, and governmental institutions. With that understanding, they can thereby foster the integration of evolutionary methods with other basic technologies, from agriculture to computer design. Society's use of science and technology will be improved, with benefits ranging from the management of the environment to the practice of medicine.

Overall IGERT Plan:

Our goal is to offer students at the five southern UC campuses a program in "Real-Time Biological Evolution in Society." This program would expand the emphasis of graduate student development from lab research and teaching undergraduates to performing a larger role in the debate about evolution in society as a whole. Their normal research would continue unimpeded, along with courses in the background knowledge required for their degrees. Added to those components of the doctoral degree would be courses in the humanities and social sciences, research on the wider impact of biological evolution, and outreach programs that take them to high schools, corporations, and government bureaus.

Participating UC Bodies:

The Proposed IGERT Program would be administered and sometimes taught by the faculty of IRPEE. They would be in charge of ensuring that the students developed their scientific research. IRPEE faculty would also ensure that the students receive the scientific background for work in the area of experimental evolution.

In addition, we will join with humanities and social science units, such as UCHRI (Director David Goldberg has authorized this, email May 11, 2004), to develop course material and research opportunities which will enable the students to become well-versed in the larger implications and connections of biological evolution to society. Of particular importance are programs that connect minority cultures with science, because Darwinism had its origins in Anglo-American culture, leaving it disconnected from many of the non-Anglo cultures. This disconnection cannot endure, if American society is to make full use of its intellectual resources.

Program Outline:

Year One:	**Core curriculum, including evolutionary science, plus the History, philosophy, and sociology of evolutionary biology**
Year Two:	**A. Beginning experimental evolution research**
	B. Start research project on history, sociology, etc.
Year Three:	**A. Continuing experimental evolution research**
	B. Finish research project on history, sociology, etc.
Year Four:	**A. Continuing experimental evolution research**
	B. Outreach in government, industry, or education
Year Five:	**A. Conclude experimental research; write thesis**
	B. Outreach in government, industry, or education

Possible research areas:

A. Experimental evolution: fitness, adaptation, speciation, sex, mating, etc in viruses, bacteria, insects, fish, and small mammals.

B. Humanities and social sciences: philosophy, ethnic issues, racial issues, class structure, etc with relevance to evolutionary biology

Possible areas for outreach:

A. Governmental programs using biological technology, from pest control to disease control to drug management to food management

B. Educational programs, from science curriculum in primary and secondary education to community colleges, focusing on minority outreach [See attached statement from Director Luis Mota-Bravo concerning outreach activities at UC Irvine.]

C. Industrial research using technologies affected by evolutionary processes, such as pharmaceutical development using model species [Several IRPEE faculty consult for Biotech corporations that would be suitable for placement of students during outreach activities.]

Minority Issues:

Evolutionary biology has been dominated by Anglo-American culture from its inception. Nonetheless, the political and cultural impact of evolutionary biology has been greater in Mediterranean countries, such as Spain, Italy, and Greece. This suggests that evolution could be an excellent entrance to natural science for some groups who have not participated in science in proportion to their numbers.

BUDGET DETAILS:

We seek support for a part-time Administrative Assistant to help with the development of an IGERT application to NSF. While a grant announcement for 2005 has not yet been made, we anticipate a preliminary review around April, 2005, followed by full submission in June or July 2005. Therefore, we seek funding for the period July 1, 2004, to June 30, 2005.

Specific tasks: The Administrative Assistant will help coordinate communications within IRPEE and with other entities contributing to the IGERT proposal. This would include paper mailings, email, and website maintenance. The AA would also help coordinate a workshop in the Fall of 2004 (see below), in which the IGERT participants would meet to develop the grant application materials. Finally, the AA would help bring together all the application materials for both the initial round of review and the final submission.

Expenditures: Hourly wage and benefit costs: $8.00, approximately.
Number of hours per week: 8-12, average 10.
Total expenditure: $8/hr x 10 hr x 50 weeks = $4,000.

At present, IRPEE has no paid staff whatsoever, making it very difficult to sustain the clerical effort required for an IGERT application.

Additional work: additional IRPEE grant proposals that arise during the funded period could also be facilitated by the AA.

We also seek $1,000 in supplementary funds to help organize and support workshops between IRPEE, HRI, and other potentially interested UC bodies. Expenditures: food, room access on weekends, minor travel costs.

Total Funding Request (7/04-6/05): $5,000.

Appendix: Experimental Evolution Outreach

Michael,

Below please find a paragraph for your proposal. If you need more information about the programs please let me know.

Luis Mota-Bravo

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Minority Issues:
There is a significant under-representation of African Americans, Hispanic Americans, Native Americans, and citizens of the US Pacific Islands in scientific research careers. The under-representation of these minority groups starts in K-12 at it increases in the educational pipeline. According to the 2000 census reports, 33.5% of the population in Orange County (the county where UC Irvine is located) is composed of underrepresented minorities (URM) who are considered underserved in higher education: 30.8% Hispanic/Latino, 1.7% African American, 0.7% Native American (including Alaskan Native) and 0.3% Pacific Islanders. About 14% of the undergraduates and 11% of the graduate students enrolled in the UCI School of Biological Sciences are URM.

During the last two decades, faculty from the UCI School of Biological Sciences developed the Minority Science Programs (MSP) to increase the number and academic preparation of URM, from high school and community college to baccalaureate, master's degrees and Ph.D. careers in biological sciences. These programs receive support from five competitive federal grants: one NSF K-12 outreach grant and four NIH research training grants. Since 1997, MSP undergraduates have received nearly 50 research awards at national conferences and they have been co-authors of 31 papers published in prestigious journals (two of them in the *Proceedings of the National Academy of Sciences*).

Training in experimental evolution is an excellent entrance to natural science for URM. We propose to integrate experimental evolution as a key topic of the K-12 outreach efforts and the Minority Science Programs.

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