

**BOARD OF HIGHER EDUCATION**  
**REQUEST FOR BOARD ACTION**

**NO.:** BHE 06-13

**BOARD DATE:** April 20, 2006

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**MOVED:** The Board of Higher Education hereby approves the expedited application of the **University of Massachusetts Boston** to award the **Doctor of Philosophy in Biology**.

One year after graduating the program's first class, the University shall submit to the Board a status report addressing its success in reaching program goals as stated in the application and in the areas of enrollment, curriculum, faculty, resources, and program effectiveness.

**Authority:** Massachusetts General Laws Chapter 15A, Section 9(b)  
**Contact:** Aundrea Kelley, Associate Vice Chancellor for Academic Policy

## **BOARD OF HIGHER EDUCATION**

April 2006

### **University of Massachusetts Boston**

#### Doctor of Philosophy in Biology

#### **INTENT**

The University of Massachusetts Boston (UMB) has filed an expedited application to offer the Doctor of Philosophy in Biology. UMB presently offers a Ph.D. in Environmental Sciences with tracks in Environmental Biology; Molecular, Cellular, and Organismal Biology; Environmental, Coastal, and Ocean Sciences; and Green Chemistry. Prospective students with interest in molecular or biomedical biology, however, seek degrees that originate in programs with titles clearly associated with these disciplines. According to UMB's proposal, despite the University's continuing internal commitment to an interdisciplinary model for instruction and research, inclusion under the rubric "Environmental Sciences" obscures the disciplinary focus and rigor of the two biology-based tracks in the program and detracts from the department's ability to recruit competitively. Moreover, this problem is about to be made acute by an imminent initiative of the National Research Council (NRC), which seeks to rank all Ph.D. programs nationally. NRC's initiative will divide programs between the Life Sciences and the Physical Sciences and will not allow for an independent rubric for the field of Environmental Sciences. As a result, UMB's current nomenclature would disqualify the program from an NRC ranking and further compromise recruiting efforts.

The Ph.D. in Environmental Sciences will continue as a separate entity comprising the present tracks in (a) Environmental, Coastal, and Ocean Sciences; and (b) Green Chemistry. Authorization to grant a Ph.D. in Biology with tracks in (a) Environmental Biology and (b) Molecular, Cellular, and Organismal Biology will, therefore, reflect a more traditional disciplinary Life Science-Physical Science taxonomy and better serve students.

Since the content of the proposed program currently exists as two tracks within the existing Ph.D. in Environmental Sciences, there are no substantive philosophical, curricular, or resource changes associated with the request. The proposed Ph.D. in Biology has the full support of the College of Science and Mathematics, the Provost and Chancellor, and has obtained all necessary governance approvals on campus. An external review was conducted in January 2005. The University Board of Trustees approved the program on February 15, 2006. A Letter of Intent was distributed on March 9, 2006. No comments were received.

#### **MISSION**

This proposal supports the goals of the 2003 University of Massachusetts Boston Strategic Plan, wherein environmental study is featured as one of the campus' two signature programs for instruction and research. Elevating the biology tracks in the Environmental Sciences program to full-degree status to better reflect the traditional Life Science-Physical Science divide is a preliminary step that addresses the goals outlined in the Strategic Plan. Goal IV of the plan, for example, centers on "achieving excellence in faculty research, scholarship, and creative activity with a special focus on interdisciplinary work responsive to 21<sup>st</sup> century global issues." The action pursuant to this goal is "to become competitive for large programmatic grants, to increase

the regional impact of our environmental programs and to bring national and international prestige to the University,” as well as to expand and strengthen the graduate program in Environmental Sciences. The Strategic Plan also calls for the University to pursue national rankings for its outstanding programs.

UMB is an urban commuting campus with an unusually diverse student population (13,348 students; 39% minority; 59% women; 21% of all students are graduate students). Over 40% of the students recently surveyed do not use English as their first language, not because they are international students, but because they are sons and daughters of recent immigrants. The National Science Board (NSB) states, “Cultivating an increasingly diverse student body to renew the workforce of a global economy requires quality science education.” (National Science Board, Science and Technology Policy: Past and Prologue. [NSB 00-87]). The proposed program can expand the pool of Ph.D. graduates prepared in biology for academic careers by supporting students who might otherwise not pursue the highest degree available.

## **NEED and DEMAND**

According to the U.S. Department of Labor (Bureau of Labor Statistics [*Occupational Outlook Handbook, 2004-05 Edition, Biological Scientists*]), job growth for biological scientists over the 2002-12 period will increase 10-20%. “Biological scientists enjoyed very rapid gains in employment between the mid-1980s and mid-1990s, in part reflecting increased staffing requirements in new biotechnology companies. Biological scientists will be needed to take this knowledge to the next stage, which is the understanding of how certain genes function within an entire organism, so that gene therapies can be developed to treat diseases. Even pharmaceutical and other firms not solely engaged in biotechnology use biotechnology techniques extensively, spurring employment increases for biological scientists. In addition, efforts to discover new and improved ways to clean up and preserve the environment will continue to add to job growth.” More biological scientists, including field biologists, “will be needed to determine the environmental impact of industry and government actions and to prevent or correct environmental problems, while some will find opportunities in environmental regulatory agencies.” These scientists “will use their expertise to advise lawmakers on legislation for environmental protection and for ways to save environmentally sensitive areas.” “Biological scientists are less likely to lose their jobs during recessions than are those in many other occupations because many are employed on long-term research projects.”

Similarly, the US Department of Education has acknowledged several areas of national need at the Ph.D. level (Title VII, Part A, Subpart 2, Section 711 of the Higher Education Act of 1965, 1998 Amendment [[www.ed.gov/legislation/FedRegister/announcements/2005-3/082205b.html](http://www.ed.gov/legislation/FedRegister/announcements/2005-3/082205b.html)]). These areas include Biology, Chemistry, Computer and Information Sciences, Engineering, Geological and related sciences, Mathematics, Nursing, and Physics). This proposal will directly improve the capacity for teaching and research at local, regional and national levels in an area of national need: Ph.D.-trained biologists.

Locally, the last decade has witnessed the transformation of the Massachusetts economy from one dominated by a few large defense and electronics industries to a more diverse economy consisting of many smaller, skills-intensive industries, such as software, telecommunications, financial services, consulting, biotechnology, and health sciences (Index of the Massachusetts Innovation Economy, Massachusetts Technology Collaborative <http://www.mtpc.org>). The local diversification parallels a national trend toward an increasingly skilled workforce and substantial investment of government and venture capital into research and development. The “Innovation Economy” has increased the number of high-paying, technology-based jobs and has buffered

the Massachusetts economy from cyclic variations in the national and world economies. Recent studies show that Massachusetts residents do not meet current labor needs and that many positions are filled by individuals coming from other states and foreign countries. The proposed UMB Biology program can contribute to solving this problem by increasing the supply of locally trained scientists, because the proportion of UMB alumni who remain in the metropolitan area after graduation is much higher than the proportion from private universities. The local opportunities in this area are accentuated by the recent (July 23, 2000) decision by *The Boston Globe* to start to feature an entire section of its classifieds devoted to biotechnology. More than 60 Ph.D./M.S. positions were advertised in a recent issue.

The best evidence of student demand for the Environmental Biology and Molecular, Cellular and Organismal Biology tracks has been the number of applications received since the inception of the programs. Applications have risen over the past five years (from 14 applicants in 2001 to 29 in 2005). Additionally, the number of research-supported students (via faculty research grant support) and female students have risen in the past five years. The ethnic mix of students in these tracks has been steadily increasing over the past several years as well.

### **PROGRAM EFFECTIVENESS**

The metrics that had been used to evaluate the Ph.D. in Environmental Sciences will continue to be utilized for the proposed Ph.D. in Biology. They include the quality and quantity of publications, external grant support, enrollment, matriculation success, and student employment.

### **ADMISSION**

Admissions requirements for the proposed Ph.D. in Biology degree include an application fee, official transcripts, Graduate Record Examination scores, three letters of recommendation, a statement of interests and intent, an overall undergraduate GPA of 3.0, a GPA in all undergraduate science and math courses of 3.0, and minimum TOEFL scores (if applicable) of 550 paper-based/213 computer-based. Students who do not present a full undergraduate major in Biology may be admitted provisionally and required to complete additional work at the undergraduate level before full admission to the program. The stated research interests of a prospective student must also coincide to an acceptable degree with faculty specialties represented in the program.

Combining the Environmental Biology track and the Molecular, Cellular, and Organismal Biology track into an independent Biology Ph.D. degree program is expected to boost each track's annual new student enrollment targets to 7 and 4, respectively.

### **CURRICULUM (Attachment A)**

Students will be required to complete 64 credits for the proposed Ph.D. in Biology/Environmental Biology track and 62 credits for the proposed Ph.D. in Biology/Molecular, Cellular and Organismal Biology Track. The curriculum includes core courses, elective courses, journal readings, and research. Students must also pass written comprehensive and oral qualifying examinations before they undertake research at the doctoral level to test the student's command and knowledge of four specific areas of biology and a defense of the student's dissertation proposal.

## **RESOURCES AND BUDGET (Attachment B)**

No faculty, philosophical or curricular changes are anticipated in the two current biology-based tracks, with the result that their transformation into an independent Biology Ph.D. will be revenue-neutral. The Biology Department's current facilities support a broad spectrum of research interests within the biological sciences. For example, the research laboratories contain facilities for automated DNA sequencing and analysis, light and fluorescence microscopy, filmless autoradiography and fluorescence imaging, protein analysis and chromatography, electrophysiology, video analysis, and animal care.

## **EXTERNAL REVIEW AND INSTITUTIONAL RESPONSE**

The proposal was reviewed by Dr. Subhash Minocha, Professor of Plant Biology and Genetics, at the University of New Hampshire; and Dr. Stanley Hillman, Chair, Biology Department, at Portland State University. The reviewers found that the proposed program change is in line with national as well as local trends and will provide a structure with both depth and flexibility. They also commented on the solid history of faculty success in publishing and in securing external funding. One reviewer observed that the proposed curriculum may be overly course-intensive, while another raised a concern over the low number of grant-supported research assistantships and faculty publication records. (The Biology Department was also reviewed in October 2005 as part of the periodic Academic Quality Assessment and Development (AQAD) process. The AQAD review also included two external reviewers.)

The University responded that although the curriculum has been in place for a long time, the Graduate Committee would evaluate options and report back to the Department in the near future. In regard to faculty publication records and the number of research assistantships, the University noted that in the last few years, the Biology Department has been making progress in hiring faculty who will work on coherent themes. This has already resulted in the building of strong research groups that will be successful in securing external research funds. This progress will positively affect the development of student research assistantships as well.

## **STAFF ANALYSIS AND RECOMMENDATION**

Board staff thoroughly reviewed all documentation submitted and concurs with the reviewers' assessment that the proposed Doctor of Philosophy in Biology is in line with national as well as local trends and will enlarge the pool of potential graduate applications.

The staff recommendation is for approval of the Doctor of Philosophy in Biology at the University of Massachusetts Boston. Upon graduating the first class for this program, the University shall submit to the Board a status report addressing its success in reaching program goals as stated in the application and in the areas of enrollment, curriculum, faculty resources, and program effectiveness.

## **Attachment A**

### **Curriculum**

#### **Environmental Biology Track**

For the proposed PhD in Biology/Environmental Biology Track, 64 credits are required, distributed as follows:

Required core courses: Students take four courses (12-13 credits) in the core course area. All students take Scientific Communication (BIOL 650) and at least one of the following three courses:

- Applied Statistics (ECOS 611)
- Biological Diversity and Evolution (BIOL 652)
- Environmental Policy and Administration (ECOS 616)

Students may also choose to take one or two of the following courses as part of the core:

- Molecular Genetics of Bacteria (BIOL 626)
- Computer Analysis of DNA and Protein Sequence (BIOL 664)
- Advanced Molecular Biology (BIOL 675 or 676)
- Advanced Eukaryotic Genetics (BIOL 677)

Each student takes at least 20 additional elective credits subject to the approval of the student's dissertation committee.

Journal readings: In addition to their 20 elective credits, students are required to take at least five credits of appropriate seminar and journal-reading courses (BIOL 653, Current Literature in Biology). These one-credit courses focus on subfields within biology and are designed to enable students to stay abreast of recent scientific developments in the current literature and to provide opportunities for oral presentations.

Research: Students must take a minimum of 27 dissertation credits (BIOL 899).

## Environmental Biology Concentration Electives

Fifteen credits from the following courses are required as electives.

<b>Course</b>	<b>Course Title</b>	<b>Credits</b>
Biol. 602	Plant Molecular Biology and Physiology	3
Biol. 612	Advanced Cell Biology	3
Biol. 615	Immunology	3
Biol. 627	Bacterial Physiology	3
Biol. 628	Microbial Ecology	3
Biol. 630	Evolutionary Bioinformatics	3
Biol. 635	Population Genetics and Diversity	3
Biol. 639	Conservation Biology	3
Biol. 641	Quantitative Population Modeling	3
Biol. 642	Biogeography	3
Biol. 666	Mammalian Toxicology	3
Biol. 670	Tissue Culture	3
Biol. 672/673	Directed Readings in Biology	3
Biol. 678	Protein Chemistry and Enzymology w/lab	3
Biol. 679	Protein Chemistry and Enzymology	3
Biol/Chem L680	Physical Biochemistry	3
Biol. 685	Biomedical Tracers	3
Biol. 690	Advanced Ethology	3
Biol. 691	Seminar in Developmental Biology	3
Biol. 692	Advanced Physiology	3
Biol. 693	Seminar in Neurobiology	3
	With approval, other electives in other science departments	

## **Molecular, Cellular and Organismal Biology Track**

For the proposed Ph.D. in Biology/Molecular, Cellular and Organismal Biology Track, the student must complete 62 credits, distributed as follows:

The student must take five courses (15-16 credits) in the core course area. All students must take Scientific Communication (BIOL 650) and a course in molecular, cellular and environmental biology. Students must also take three courses selected from the following:

- Advanced Cell Biology (BIOL 612)
- Molecular Genetics of Bacteria (BIOL 626)
- Computer Analysis of DNA and Protein Sequences (BIOL 664)
- Advanced Molecular Biology (BIOL 675 or 676)
- Advanced Eukaryotic Genetics (BIOL 677)
- Environmental Physiology (BIOL L658/ECOS L658)

A minimum of 15 additional elective credits must be taken, subject to approval of the student's dissertation committee.

Journal readings: In addition to their 15 elective credits, students are required to take at least five credits of appropriate seminar and journal-reading courses (BIOL 653, Current Literature in Biology). These one-credit courses focus on subfields within biology and are designed to enable students to stay abreast of recent scientific developments in the current literature and to provide opportunities for oral presentations.

Research: Students must take a minimum of 27 dissertation credits (BIOL 899).



## Molecular, Cellular and Organismal Biology Concentration Electives

Fifteen credits from the following courses are required as electives.

<b>Course</b>	<b>Course Title</b>	<b>Credits</b>
Biol. 602	Plant Molecular Biology and Physiology	3
Biol. 612	Advanced Cell Biology	3
Biol. 615	Immunology	3
Biol. 627	Bacterial Physiology	3
Biol. 628	Microbial Ecology	3
Biol. 630	Evolutionary Bioinformatics	3
Biol. 635	Population Genetics and Diversity	3
Biol. 639	Conservation Biology	3
Biol. 641	Quantitative Population Modeling	3
Biol. 642	Biogeography	3
Biol. 666	Mammalian Toxicology	3
Biol. 670	Tissue Culture	3
Biol. 672/673	Directed Readings in Biology	3
Biol. 678	Protein Chemistry and Enzymology w/lab	3
Biol. 679	Protein Chemistry and Enzymology	3
Biol/Chem L680	Physical Biochemistry	3
Biol. 685	Biomedical Tracers	3
Biol. 690	Advanced Ethology	3
Biol. 691	Seminar in Developmental Biology	3
Biol. 692	Advanced Physiology	3
Biol. 693	Seminar in Neurobiology	3
	With approval, other electives in other science departments	

**Attachment B**

**Biology Departmental Budget  
AY 06-07**

The proposal to approve an independent Ph.D. in Biology is revenue-neutral, as there are no additional resources sought, and no resources will need to be transferred between academic units to effect this elevation into a full degree of the two biology-based tracks in the Environmental Sciences Ph.D. Program, which are already administered out of the Biology Department.

Below is an abbreviated version of the present Biology Department budget:

Item	#	\$
Faculty	23.00	1,833,821
Professional staff	1.87	79,736
Classified staff	8.00	304,706
Graduate Assistants		364,000
<i>Total Staff</i>		2,582,263
Curriculum Trust Fund		249,693
Research Trust Fund		296,324
<i>Total Trust Funds</i>		546,017
TOTAL		3,128,280