July 28, 2008

MEMORANDUM

TO: Stephen Halperin
    Dean, College of Computer, Mathematical and Physical Sciences

FROM: Phyllis Peres
       Associate Provost for Academic Planning and Programs

SUBJECT: Proposal to establish M.S. and Ph.D. degrees in Biophysics (PCC log no. 07039)

On June 20, the Board of Regents approved your proposal to establish new M.S. and Ph.D. degree programs in Biophysics. On July 15, the Maryland Higher Education Commission gave final approval to the creation of these degree programs. Copies of their approval letters and the proposal documents are attached.

The approval is effective Fall 2008. The College should ensure that the degree programs are fully described in the Graduate Catalog and in all relevant descriptive materials, and that all advisors are informed.

CWR/

Enclosure

cc: Carmen Bathrop, Chair, Senate PCC Committee
    Sarah Bauder, Office of Student Financial Aid
    Reka Montfort, University Senate
    Barbara Hope, Data Administration
    Denise Nadasen, Institutional Research & Planning
    Anne Turkos, Archives
    Linda Yokoi, Office of the Registrar
    Charles Caramello, Graduate School
    Jim Purtilo, College of Computer, Mathematical and Physical Sciences
    Rajarshi Roy, Institute for Physical Science and Technology
    Devarajan Thirumalai, Institute for Physical Science and Technology
    Norma Allewell, Dean, College of Chemical and Life Sciences
    Herbert Rabin, Interim Dean, A. James Clark School of Engineering
THE UNIVERSITY OF MARYLAND, COLLEGE PARK
PROGRAM/CURRICULUM PROPOSAL

DIRECTIONS:
- Provide one form with original approval signatures in lines 1 - 4 for each proposed action. Keep this form to one page in length.
- Early consultation with the Office of the Associate Provost for Academic Planning & Programs is strongly recommended if there are questions or concerns, particularly with new programs.
- Please submit the signed form to Claudia Rector, Office of the Associate Provost for Academic Planning and Programs, 1119 Main Administration Building, Campus.
- Please email the rest of the proposal as an MSWord attachment to pcc-submissions@umd.edu.

DATE SUBMITTED: 11/29/07

PCC LOG NO. 07039

COLLEGE/SCHOOL: CMPS

DEPARTMENT/PROGRAM: IPST/Biophysics

PROPOSED ACTION (A separate form for each) ADD [X] DELETE [ ] CHANGE [ ]

DESCRIPTION (Provide a succinct account of the proposed action. Details should be provided in an attachment. Provide old and new sample programs for curriculum changes.)

The proposed Graduate Program in Biophysics will be part of the Institute for Physical Science and Technology. The Program will be highly interdisciplinary by its very nature and it will take advantage of the University’s strengths in the life sciences, physical sciences, and engineering.

JUSTIFICATION/REASONS/RESOURCES (Briefly explain the reason for the proposed action. Identify the source of new resources that may be required. Details should be provided in an attachment.)

The growing interest in disciplines that are directly related to biology is reflected in the number of existing academic units that have aggressively recruited new faculty in a number biology related disciplines including biophysics. The proposed Biophysics Program, with emphasis on the fundamental aspects of molecular, structural, and cell biology, will draw upon existing resources in the College of Computer, Mathematical and Physical Sciences, the College of Life Sciences, and the Clark School of Engineering. The Biophysics faculty who are members of departments in all three colleges will form the core of the program.

APPROVAL SIGNATURES - Please print name, sign, and date

1. Department Committee Chair
   
2. Department Chair
   
3. College/School PCC Chair

4. Dean

5. Dean of the Graduate School (if required)

6. Chair, Senate PCC

7. Chair of Senate

8. Vice President for Academic Affairs & Provost

VPAAP 8-05
July 15, 2008

Dr. C. D. Mote, Jr.
President
University of Maryland, College Park
Main Administration Building
College Park, MD 20742-5025

Dear Dr. Mote:

The Maryland Higher Education Commission has received and reviewed a request from the University of Maryland, College Park to offer both a new Master of Science (M.S.) and Doctor of Philosophy (Ph.D.) in Biophysics. On the recommendation of the Assistant Secretary for Planning and Academic Affairs, Dr. George W. Reid, the new programs have been approved. This decision was based on an analysis of the proposal in conjunction with the Maryland Higher Education Commission's Policies and Procedures for Academic Program Proposals, and the Maryland State Plan for Postsecondary Education. The programs demonstrate potential for success, an essential factor in making this decision.

For purposes of providing enrollment and degree data to the Commission, please use the following HEGIS and CIP codes:

<table>
<thead>
<tr>
<th>Program Title</th>
<th>Degree Level</th>
<th>HEGIS</th>
<th>CIP</th>
</tr>
</thead>
<tbody>
<tr>
<td>Biophysics</td>
<td>Ph.D.</td>
<td>0415-01</td>
<td>26.0203</td>
</tr>
<tr>
<td>Biophysics</td>
<td>M.S.</td>
<td>0415-01</td>
<td>26.0203</td>
</tr>
</tbody>
</table>

Should the programs require any substantial changes in the future, please keep the Commission apprised. I wish you continued success.

Sincerely,

James E. Lyons, Sr.
Secretary of Higher Education

cc: Ms. Theresa Hollander, Associate Vice Chancellor for Academic Affairs, USM
Dr. George W. Reid, Assistant Secretary for Planning and Academic Affairs, MHEC
June 30, 2008

Dr. C.D. Mote, Jr.
University of Maryland, College Park
1101 Main Administration Building
College Park, MD 20742

Dear Dan:

This is to officially inform you that the Board of Regents, meeting in public session on Friday, June 20, 2008 at Salisbury University, approved the following new academic program proposals for UMCP:

- B.A. in Arabic Studies
- B.A. in Persian Studies
- PBC in Assessment and Evaluation
- M.S. in Couple and Family Therapy
- M.S. and Ph.D. in Biophysics

The Education Policy Committee, meeting on June 4, 2008, recommended approval.

Sincerely,

William E. Kirwan
Chancellor

WEK/tm

cc: Irwin Goldstein
    Janice Doyle
PROPOSAL FOR
NEW INSTRUCTIONAL PROGRAM IN BIOPHYSICS
UNIVERSITY OF MARYLAND AT COLLEGE PARK, MARYLAND

COLLEGE OF COMPUTER, MATHEMATICAL AND PHYSICAL SCIENCES
DR. STEPHEN HALPERIN, DEAN

COLLEGE OF CHEMICAL AND LIFE SCIENCES
DR. NORMA M. ALLEWELL, DEAN

A. JAMES CLARK SCHOOL OF ENGINEERING
DR. HERBERT RABIN, INTERIM DEAN

M.S. AND PH.D. DEGREES TO BE AWARDED
FALL, 2008 PROPOSED INITIATION DATE
I. Overview and Rationale

A. Nature of Proposed Program
Advances in biomedical sciences require interdisciplinary research that pools knowledge from several traditional disciplines. The large quantities of data generated with sophisticated experimental techniques in biological research have created an unprecedented need to integrate the quantitative methods of the physical sciences with the concepts and models of biological sciences. Currently, research scientists, working on interdisciplinary problems in biology, obtained their graduate training in a single traditional discipline within the physical sciences, biological sciences, or engineering. However, rapid progress in the fundamental understanding of biological processes and the transfer of this knowledge to biomedicine requires researchers trained in interdisciplinary research. To meet this need, it is proposed that a graduate program in biophysics be established at the University of Maryland at College Park. This program will integrate core concepts in biology and the physical sciences in such a way that graduating students will have the knowledge, training, and experience to be leading researchers in established as well as emerging fields of biological research. The proposed program has been designed so that students with undergraduate degrees in the physical sciences, biological sciences and engineering will receive the education necessary to solve key problems in biology and biomedicine where a fundamental understanding of biological processes at the molecular level is increasingly important. There is demand at academic institutions, industrial laboratories and government laboratories for those capable of applying quantitative approaches to the solution of cutting edge problems in biology.

Students interested in interdisciplinary research in the physical and biological sciences at the graduate level are drawn to biophysics. A survey of the applicants to the Chemical Physics Program over the last two years shows that over 75% of the applicants listed biophysics among their principal research interests. While students interested in biophysics have been accommodated within existing graduate programs, such as the Chemical Physics Program, a biophysics graduate program specifically designed to meet the needs of such applicants is in the best interest of the students and faculty. Such program fulfills the educational mandate of a first rate research university.

B. Existing Institutional Strengths
Reputation
UMCP is considered among the top ten public research universities in the physical sciences.
Facilities
Full range of modern analytical and structural instrumentation to support biophysics research
Faculty
Highly qualified and motivated, biophysics faculty with a high level of external funding
Administration
Enthusiastic and committed support from Deans of CMPS, CLFS, and ENGR
Students
Academically talented and motivated graduate students with expressed interests in biophysics
Synergy with the following existing departments, programs, centers, and institutes:

Departments and Programs
- Bioengineering
- Biology
- Chemical Physics
- Chemistry and Biochemistry
- Mathematics
- Materials Engineering
- Molecular and Cell Biology
- Neuroscience and Cognitive Science
- Physics

Centers and Institutes
- Bioinformatics and Computational Biology
- Center for Comparative and Evolutionary Biology of Hearing
- Biomolecular Engineering
- Cell Biology and Molecular Genetics
- Center for Biomolecular Structure and Organization
- Maryland NanoCenter
- University of Maryland Biotechnology Institute
- Center for Biosystems Research
- Center for Advanced Research in Biotechnology

The Bioengineering Program and the Chemical Physics Program are two interdisciplinary programs with which there will be a close synergistic relation with the proposed Biophysics Program. The Bioengineering Program emphasizes the use of engineering principles in molecular and cell biology with a focus on biotechnical applications. The Biophysics Program, on the other hand, will emphasize a fundamental understanding of biochemical, biophysical, and cellular processes using fundamental chemical and physical principles to address major problems in molecular biology. The proposed Biophysics Program will have a structure similar to the Chemical Physics Program with an interdisciplinary approach to the education of the students with backgrounds in a variety of disciplines.

Relation to other Biophysics programs.

The diversity of the biophysics research area prevents us from making specific comparisons with other related programs in other universities. We have designed a unique program that exploits the strengths of the faculty at the University of Maryland, College Park. Our strengths in theoretical and computational studies, applications of single molecule methods to biological problems, structural and biophysical studies of proteins, membranes, protein-protein interactions set us apart from biophysics programs within the state of Maryland as well as nationally.

C. Program Size

It is anticipated that the Biophysics Program will enroll eight to ten students per year and have a steady-state student population of forty students. The small number of student will ensure the individualized training necessary for interdisciplinary research. These numbers are consistent
with those of similar interdisciplinary programs. We anticipate that applicants to the Biophysics Program will be non-traditional students with interests that span conventional academic disciplines. In recent years this kind of undergraduate student has become more common as statistics from University of Maryland undergraduates show. By concentrating recruiting efforts on students interested in interdisciplinary studies we will be bringing to campus students who otherwise would not come to Maryland. At present, approximately nineteen Chemical Physics students work with faculty with research interests in biophysics. Most of the students will come from the substantial national and international population of undergraduates interested in obtaining an advanced degree in Biophysics. Some students from other departments and programs such as Physics, Biology, Chemical Engineering, Chemistry and Biochemistry, Chemical Physics, Bioengineering, and Applied Mathematics and Scientific Computation may choose to do collaborative research work with faculty members from the Biophysics Program. We believe that outstanding students, who cannot normally be accommodated into more traditional degree granting programs, will enroll in the proposed program. These new students will enhance the intellectual vitality of all the participating units and the University in general. The proposed program will be a part of the institution-wide emphasis on biologically related fields that includes bioengineering and the statewide initiative on nanoscience. The average time to obtain a Ph.D. degree is estimated to be between four and five years. This is based on the experience of other interdisciplinary programs such as Chemical Physics.

II. Curriculum

A. Catalog Descriptions
The proposed Biophysics Program will offer M.S. and Ph.D. degrees. Students will be trained to apply the quantitative methods of engineering and the physical sciences to biological problems. This will be accomplished with a combination of existing courses, weekly seminars, and workshops at the interface between physics, chemistry, engineering, and biology. The participating faculty are drawn from three colleges. Their research interests include applications of single molecule spectroscopy to biological systems, investigations of the working mechanism of biological nano-machines including molecular motors, structural and dynamical aspects of proteins and RNA, membrane transport and ion channels.

Academic departments participating in the program include, but are not limited to Biology, Materials Engineering, Physics, and Chemistry and Biochemistry. Graduate students entering the program will be exposed to interdisciplinary research in a number of biological areas. The Biophysics faculty are all actively engaged in collaborative research and there is ready exchange of ideas and research information among existing biophysics groups. This ease of communication among the various units and the realization that the expertise of the faculty from different disciplines can be harnessed to address important problems is essential for training students for interdisciplinary research of significance in biology.

B. Formal Courses
A central element of the curriculum is the development of a coherent set of courses built on, but not confined to, the research strengths of the participating faculty and designed to expose the students to a broad range of topics in biophysics. These courses will prepare the students to understand research at the interface between the physical and biological sciences. Existing
courses form the core curriculum of the proposed program and it is anticipated that new courses will be developed and the contents of existing courses modified and enhanced to match the educational goals of the program. All the courses will emphasize connections between experiments and theory. The faculty have already taught courses in their respective academic units that cover a broad range of topics in biophysics. Detailed descriptions of the courses are given in the Appendix.

C. Weekly Seminars
A very successful weekly seminar series in biophysics has been operating for over three years (for a list of speakers see www.marylandbiophysics.edu.) To increase the visibility of the seminar series a named lectureship will be sponsored once a semester. The Department of Chemistry and Biochemistry regularly sponsors the Russell Marker Lecture series that includes Biophysics. In recent years Professors Carlos Bustamante (University of California, Berkeley), Carol Robinson (Cambridge University, England), and Harry Gray (California Institute of Technology) have been Marker lecturers and given a number of talks that have drawn attendance from NIH, NIST, and Johns Hopkins as well as Maryland.

D. Workshops
Research in many areas of biophysics progresses rapidly and it is important to conduct focused workshops on current topics by inviting world experts to the University of Maryland to present their research. In the spring of 2005 a workshop entitled “Biophysics of Membranes” was organized by Professors S. Sukharev and M. Colombini. In subsequent semesters there have been workshops on "Molecular Chaperones", organized by Professor G.H. Lorimer and "Allosteric in Biology", organized by Professor D. Beckett in conjunction with Biophysics Day 2006. On March 19, 2007 a symposium on "Molecular Motors" was organized by Professor M. E. Fisher. A symposium on the use of NMR in biology took place on November 7, 2007. These workshops are attended by students and faculty from several departments as well as researchers from neighboring institutions (Johns Hopkins University, National Institutes of Health, and National Institute of Standards and Technology). The informal atmosphere of the workshops encourages profitable exchanges between speakers and the attendees. The workshops are important elements in the education of graduate and postdoctoral students.

III. Admissions Information
Admission to the Graduate Program in Biophysics will require a B.S. degree in a physical or biological science or engineering discipline from a recognized academic institution. Because of the interdisciplinary nature of research in biophysics it is anticipated that students in the course of their graduate education will take appropriate courses to remedy any deficiencies in their backgrounds. For example, students with physics or chemistry backgrounds will take 400 level or higher courses in biological sciences.

A. Application Requirements
- GRE General scores
- GRE Subject scores, optional, but recommended
- Three Letters of Recommendation
- Official Undergraduate Transcripts
Statement of Purpose
Personal Statement
TOEFL and TWE scores, international students only

B. Application Deadlines
Applications must be received by February 1 for fall admission.
Applications must be received by September 1 for spring admission.
The program will not accept applications for summer sessions.

IV. Degree Requirements.

A. Master of Science (M. S.)
Admission to the program will be generally limited to students seeking the Ph.D. degree.
Students will be able to earn a thesis or a non-thesis M.S. degree while working towards the
Ph.D. degree. The requirements for the thesis M.S. degree will be 30 credit hours, 24 of which
must be in regular courses and 18 of which must be at the 600 level or above. The regular
courses must include an advanced biophysics laboratory course. Two one-credit seminars will
also be required along with a written thesis that will be reviewed by three faculty members. In
order to earn a non-thesis M.S. degree in Biophysics, a student will have to complete 30 credit
hours of which 24 must be in regular courses and 18 of which must be at the 600 level or above.
The regular courses must include an advanced biophysics laboratory course. Two one-credit
seminars will also be required along with a scholarly paper. The Ph.D. written qualifying
examination must be passed at the M.S. degree level. For both the thesis and non-thesis M.S.
degrees a B average in the regular courses will be required. The M.S. degree can be obtained in
two years. Students are not required to obtain an M. S. degree in the course of their studies for
the Ph.D.

B. Doctor of Philosophy (Ph.D.)
There will be few formal course requirements for the Ph.D. degree, however it is expected that
only those students who take the recommended courses are likely to pass the required qualifying
examination. The recommended courses will depend on the undergraduate background of the
student. Students proficient in the physical sciences will be advised to take classes in biological
sciences while students whose strengths lie in the life sciences will take courses that emphasize
the physical sciences. The Ph.D. program will require passing both a written qualifying
examination and an oral qualifying examination at the Ph.D. level. These examinations will
normally be taken by students at the beginning of their second year. Two one-credit seminars, an
advanced biophysics laboratory course, an advanced course outside of the student's main field of
research, a scholarly paper in the area of intended thesis research, and a formal research
presentation with faculty in attendance will also be required. Once these requirements have been
met the student will be able to advance to Ph.D. candidacy. Ph.D. candidates will be required to
take 12 credits of BIPH899, Ph.D. research, and write a Ph.D. thesis based on original research.
A thesis examining committee consisting of the student's advisor, three other members of the
Biophysics faculty and a representative of the Dean of the Graduate School will examine the
student on the research presented in the written thesis. Students must also satisfy all general
requirements of the Graduate School, including a B average in all regular courses.
Summary of Degree Requirements

<table>
<thead>
<tr>
<th></th>
<th>Ph.D.</th>
<th>M.S. without thesis</th>
<th>M.S. with thesis</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pass Qualifying Exam</td>
<td>Pass Qualifying Examination at the Ph.D. level</td>
<td>Advanced biophysics lab</td>
<td>Oral Presentation</td>
</tr>
<tr>
<td>Advanced biophysics</td>
<td>Advanced biophysics lab</td>
<td>M.S. level</td>
<td>Oral Presentation</td>
</tr>
<tr>
<td>Scholarly Paper</td>
<td>Scholarly Paper</td>
<td>2 Semesters of seminars</td>
<td>30 credit hours, 24 in regular courses, 18 at the 600 level or above</td>
</tr>
<tr>
<td>Oral Presentation</td>
<td>Oral Presentation</td>
<td>M.S. level</td>
<td>Advanced course</td>
</tr>
<tr>
<td>2 Semesters of seminars</td>
<td>2 Semesters of seminars</td>
<td>M.S. level research</td>
<td>Written M.S. thesis</td>
</tr>
<tr>
<td>Advanced course</td>
<td>Advanced course</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Ph.D. research</td>
<td>30 credit hours, 24 in regular courses, 18 at the 600 level or above</td>
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<td></td>
</tr>
<tr>
<td>Written Ph.D. thesis</td>
<td>6 credit hours BIPH 799</td>
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V. Financial Assistance
Initially, students will receive financial support in the form of teaching assistantships or research assistantships. Once the program is established, fellowship funds will be sought from the colleges and cooperative arrangements negotiated with NIST and NIH to support students working on joint research projects.

VI. Non-Catalog Curriculum Information
The degree requirements for the Biophysics Program will be similar to those of existing interdisciplinary programs. The written and oral qualifying examinations will emphasize research aptitude and will test understanding of the fundamental issues in biophysics. The oral examination will emphasize basic concepts that are nominally covered in the recommended courses. Satisfactory completion of the written and oral qualifying examinations, in addition to a scholarly paper and an oral presentation are the main requirements for admission to Ph.D. candidacy.

All incoming students will be assigned a three-member Advisory Committee. The faculty members, who will be from different academic units, will meet with the student twice a semester. The composition of the committee will depend on the student’s interest and background. At the initial meeting, at the beginning of the fall semester, a course of study will be recommended.
When possible, the Director will also attend the meetings. While there will be few course requirements beyond a graduate biophysics laboratory, students will be advised to take a set of courses during their first year of graduate study, determined by their backgrounds and interests.

For students with a physical science background the typical recommended courses during their first year will include BIOL622, CHEM684, BIOL708, PHYS603, PHYS622 and/or PHYS623, CHEM689, and PHYS789N. Students with life sciences backgrounds will normally take BIOL622, CHEM684, two 400 level physics courses, and two of the following: BCHM461, CHEM687, CHEM689, and CHEM669D. The course work, which will cover the core concepts in physical and biological sciences, should be completed by the end of the first year. At the end of the first year we expect all entering students to have a firm working knowledge of thermodynamics, statistical mechanics, and the basic aspects of cell and molecular biology. The Qualifying Examination will assess this.

After the basic courses, students will typically spend at least six weeks in each of three research groups. Upon completion of each six-week rotation, the student will prepare a report in consultation with the faculty supervisor of the laboratory. The rotations are to be completed by the end of the third semester at which time the student should be ready to choose a research advisor. Since many of the biophysics faculty members collaborate on joint research projects, it is possible that a student can have both experimental and computational components in his/her doctoral work. The Advisory Committee will monitor the progress of the student until the doctoral work is completed. Normally, we expect that a student will complete a Ph. D. degree in no more than five years from entry to the Program. Theses terms are typical of other interdisciplinary programs, for example Chemical Physics.

All students will be expected to attend the weekly Biophysics seminar. There will be a Qualifying Examination that will be the principal formal requirement in the Program. The examination will consist of a written part with questions testing knowledge in physics, chemistry and biology. Students with a physics science background will be required to answer three of the physics department graduate student qualifying exam questions, plus two biology and chemistry questions at the advanced undergraduate level. Students with life sciences backgrounds will be required to answer graduate level questions in chemistry and biology, plus at least two questions on thermodynamics, statistical mechanics, or quantum mechanics at the advanced undergraduate level. The courses listed below offered by the physics, chemistry and biology departments will help the students prepare for the qualifying examination. The material in the qualifying examination will test fundamental understanding of physical aspects that are covered in the courses offered by the physics and chemistry departments as well as concepts in biology courses. There will also be an oral examination conducted by a three-person committee to test general knowledge as well as knowledge of biophysics. When possible the Director of the program will also be present for the oral examination. The oral examination will cover the material of the courses taken by the student as well as general biophysics material including such topics as diffusion, electrostatics, DNA, RNA, proteins, and methods for biomolecule structure determination.

VII. Courses
A. Existing Core Courses

- BCHM461, Protein Folding/Dynamics, 3 Credits
- BIOL622, Membranes and Ion Channels, 3 Credits
- BIOL708, Cell Biology for Physicists, 3 Credits
- BSCI426, and BIOL622, Membrane Transport Phenomena, 3 Credits
- CHEM669D, Protein Structure, Folding and Dynamics, 3 Credits
- CHEM684, Thermodynamics, 3 Credits
- CHEM687, Statistical Mechanics, 3 Credits
- CHEM689, Introduction to Biological Physics, 3 Credits
- PHYS374, Introduction to Theoretical Methods, 4 credits
- PHYS401, Quantum Physics I, 4 credits
- PHYS402, Quantum Physics II, 4 credits
- PHYS404, Introduction to Statistical Thermodynamics, 3 credits
- PHYS789N, Basic Biophysics for Motion in Cells, 3 Credits
- PHYS601, Theoretical Dynamics, 3 Credits
- PHYS603, Methods of Statistical Physics, 3 Credits
- PHYS604, Methods of Mathematical Physics, 3 Credits
- PHYS606, Electrodynamics, 4 Credits
- PHYS622, Introduction to Quantum Mechanics I, 4 Credits
- PHYS623, Introduction to Quantum Mechanics II, 3 Credits

B. Courses To Be Developed

Graduate Laboratory Course in Biophysics, 4 Credits, Biophysics Staff Biophysics students must be acquainted with experimental techniques, data analysis, and the use of standard software in interpreting data. The proposed laboratory course will introduce students to current research techniques at the interface between the physical sciences and biology. The course will be designed for students in the Biophysics Program, but enrollment of students from Chemical Physics, Biology, Chemistry and Biochemistry and Physics will be encouraged. The course will be offered every semester once it is established and will meet two afternoons per week for four hours per afternoon. Students will work in groups of 2-3. Experiments will cover protein folding, membrane and ion channels, laser tweezers and molecular dynamics. By the end of the course students will have gained experience with experimental methods for the study of proteins, membranes and cells. Funds from outside sources such as NIH and HHMI will be sought for the course materials and staff salary. In the interim we expect the students to satisfy the laboratory requirement by performing experiments in the laboratories of the participating biophysics faculty. These rotations will give them the valuable laboratory experience necessary to carry out graduate Ph.D. research at the highest levels. Until such time as external funding is obtained we will not be seeking additional financial commitments from the university.

C. Other Courses

Students, especially those earning M.S. degree, can take courses from other departments or units. Only one course can be at the top level partial list of course that will be beneficial to students in biophysics are:

- BIOE601 Biomolecular and Cellular Rate Process
VIII. Student Learning Outcomes and Assessment

A. M.S. Degree

Program Goals:

The Biophysics M.S. degree prepares students for research and scholarship in biophysics. This preparation is achieved through a combination of advanced coursework, seminars, and research in experimental and/or computational biophysics. Students are exposed to a broad range of modern theories and experimental methods in order to enable them to address broad issues and problems in biophysics. Students are expected to develop strong written and oral communication skills during the course of their education. Students are taught to initiate solve scientific problems and document the scientific results. Biophysics is a cross discipline program and students enter the program with a wide range of backgrounds and interests and experiences in the physical and life sciences. To accommodate these students and at the same time furnish them with a solid foundation in both biology and the physical sciences, the formal course curriculum requires the individual attention that is possible because of the moderate size envisioned for the program.

The mission of the College of Computer, Mathematical and Physical Science (CMPS) is to "advance modern science through its nationally competitive research and educational programs," and in particular to pursue scientific research at the forefront of knowledge, produce a stream of superbly qualified graduates at the masters and doctoral levels who will help build the future of Maryland, and show by example the value of diversity in a scientific community. The Biophysics M.S. program goals directly address these goals through research, classroom instruction and advising activities. There is an M.S. degree without a written thesis and an M.S. degree with written thesis. The Qualifying Examination is required for the non-thesis M.S. degree and a written thesis is required for the thesis M.S. degree. The Learning Outcomes, Assessment Measures and Criteria, and Assessment Schedule below distinguish between the two M.S. degrees.

<table>
<thead>
<tr>
<th>Student Learning Outcomes</th>
<th>Assessment Measures and Criteria</th>
<th>Assessment Schedule</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Students will demonstrate that they have developed the intellectual</td>
<td>Students take core graduate courses in biology, physics and chemistry. The core courses cover topics on the Qualifying</td>
<td>Performance in the courses necessary for the Qualifying</td>
</tr>
</tbody>
</table>

The engineering courses bridge the differences between nanoscale structure in materials and the biological sciences.
<table>
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<tr>
<th>Foundation for their proposed line of work. This is done through formal coursework, in which they acquire the factual and theoretical knowledge that form the basis for understanding biological systems and for carrying out research in biophysics.</th>
<th>Examination that non-thesis M.S. degree students are required to pass. The results of the Qualifying Examination are tabulated and each of the questions assessed by the Qualifying Examination Committee in terms of effectiveness in reflecting the knowledge and understanding of the students. The Committee makes recommendations for changes in the Examination based on the annual assessments. Individual student results are assessed by the Director and Associate Director. Deficiencies or weaknesses will be remedied by changes in curriculum including, but not limited to, course work and supervised individual studies.</th>
<th>Examination are inspected by the Director and Associate Director each semester until the examination is successfully passed, and annually thereafter. The Qualifying Examination is given once a year and the results assessed annually by the Qualifying Examination Committee. Changes are taken before the Biophysics Committee in one of its twice-yearly meetings.</th>
</tr>
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<tr>
<td>2. Students will demonstrate knowledge of the modern experimental methods needed to investigate biological systems.</td>
<td>Students will be required to complete an advanced biophysics laboratory course. Laboratory reports from the courses are submitted to the Director and Associate Director for them to evaluate student progress in experimental chemical physics. Deficiencies in the laboratory courses will be taken up with those responsible for the organization of the courses and suggestions for changes made.</td>
<td>Annually by the Director and Associate Director</td>
</tr>
<tr>
<td>3. Students will demonstrate skill at critically evaluating and communicating scientific ideas and results through written and oral means.</td>
<td>A scholarly paper and a formal oral presentation are required. The scholarly paper is read and approved by two faculty members in addition to the Director. The readers provide short critical reviews and comments that are collected and analyzed in order to determine the degree of understanding by the student and the student's ability to write clearly and effectively. The oral presentation must have at least two faculty members present. Their evaluation of the content and form of the presentation will be collected and analyzed.</td>
<td>The scholarly paper is read and approved by the research advisor and a second faculty member in addition to the Director. The formal presentation is to faculty and students. There are yearly assessments by the Director and Associate Director.</td>
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</table>
reviewed by the Director and Associate Director who will discuss the results with the advisor of the student. The advisor will be responsible for improving instruction in writing and the oral presentation of scientific information.

| 4. Students have the option of either a thesis or non-thesis M.S. degree. M.S. thesis degree students carry out research with experimentalists learning to design and perform experiments efficiently, analyze data and interpret the results using applicable theory. Theory students learn to formulate research problems in the context of current theory, and, when applicable, compare the theoretical results to experimental measurements. Computational skills are developed. | The M.S. thesis for thesis degree students is defended at an oral examination before a 5-member committee. The time-to-degree, retention rate, and publication rate will be analyzed for all M.S. recipients. All graduating M.S. students complete exit interview forms followed by a formal exit discussion with the Director. The results are the basis for evaluating the various parts of the program and making appropriate changes. | Research progress for each M.S. student is reviewed annually in a research advisors meeting. There will be exit interviews with all graduating students |

**B. Ph.D.**

Program Goals:

The Biophysics Ph.D. degree prepares students for original research and scholarship in biophysics. This preparation is achieved through a combination of advanced coursework, seminars, and original research in experimental and/or theoretical biophysics. Students are exposed to a broad range of modern theories and experimental methods in order to enable them to address broad issues and problems in biophysics research. Students are expected to develop strong written and oral communication skills during the course of their education. Students will be taught to initiate original research problems, develop plans to solve the research problems, execute the plans, and document the scientific results in scientific publications and through participation in regional, national and international meetings and conferences. Biophysics is a cross discipline program and students enter the program with a wide range of backgrounds, interests and experiences. The course curriculum will be tailored to each student individually in order to furnish them with a solid foundation in both the physical and biological sciences.
The mission of the College of Computer, Mathematical and Physical Science (CMPS) is to "advance modern science through its nationally competitive research and educational programs," and in particular to pursue scientific research at the forefront of knowledge, produce a stream of superbly qualified graduates at the masters and doctoral levels who will help build the future of Maryland, and show by example the value of diversity in a scientific community. The Biophysics Ph.D. program directly addresses the CMPS goals through research, classroom instruction and advising activities.

<table>
<thead>
<tr>
<th>Student Learning Outcomes</th>
<th>Assessment Measures and Criteria</th>
<th>Assessment Schedule</th>
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<tbody>
<tr>
<td>1. Students will demonstrate that they have developed the intellectual foundation for their proposed field of research. This is done through formal coursework, in which they acquire the factual and theoretical knowledge that form the basis for understanding biological systems and for carrying out original research in biophysics</td>
<td>Students take core graduate courses in the physical sciences and biology to prepare for the comprehensive Qualifying Examination. Ph.D. students are required to pass a comprehensive Qualifying Examination that is based on material in core graduate courses. The results of the Qualifying Examination are tabulated and each of the questions assessed by the Qualifying Examination Committee in terms of effectiveness in reflecting the knowledge and understanding of the students. The Committee makes recommendations for changes in the Examination based on the annual assessments. Individual student results are assessed by the Director and Associate Director. Deficiencies or weaknesses will be remedied by changes in curriculum including, but not limited to course work and supervised individual studies.</td>
<td>Performance in the courses necessary for the qualifying examination are scrutinized by the Director and Associate Director each semester until the Qualifying Examination is successfully passed, and annually thereafter. The Qualifying Examination is given once a year and the results assessed annually by the Qualifying Examination Committee. Changes are taken before the Biophysics Committee in one of its twice-yearly meetings.</td>
</tr>
<tr>
<td>2. Students will demonstrate knowledge of the modern experimental methods needed to investigate chemical physics systems.</td>
<td>Students are required to complete an advanced biophysics laboratory course and an advanced course in an area outside of their thesis research. Laboratory reports from the courses are submitted to the Director and Associate Director for them to evaluate student progress in experimental biophysics. Deficiencies in the laboratory courses will be taken annually by the Director and Associate Director</td>
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<tr>
<td>3. Students will demonstrate skill at critically evaluating and communicating scientific ideas and results through written and oral means.</td>
<td>A scholarly paper and a formal oral presentation are required. The scholarly paper is read and approved by two faculty members in addition to the Director. The readers provide short critical reviews and comments that are collected and analyzed in order to determine the degree of understanding by the student and the student's ability to write clearly and effectively. The oral presentation must have at least two faculty present. Their evaluation of the content and form of the presentation will be collected and reviewed by the Director and Associate Director who will discuss the results with the thesis advisor of the student. The thesis advisor will be responsible for improving instruction in writing and the oral presentation of scientific information.</td>
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<tr>
<td>4. Students carry out original research. Experimentalists learn to design and perform experiments efficiently, analyze data and interpret the results using applicable theory. Theory students learn to formulate research problems in the context of current theory, and, when applicable, compare the theoretical results to experimental measurements. Computational skills are developed.</td>
<td>It is expected that 100% of the original research will result in publication in the peer-reviewed literature. In addition, each student will make at least one oral presentation at a professional meeting. The Ph.D. thesis research is defended at an oral examination before a 5-member examination committee. The time-to-degree, retention rate, and publication rate will be analyzed for all Ph.D. recipients. All graduating Ph.D. students complete exit interview forms followed by a formal exit discussion with the Director. The results are the basis for evaluating the various parts of the program and making appropriate changes.</td>
<td></td>
</tr>
<tr>
<td>The scholarly paper is read and approved by the research advisor and a second faculty member in addition to the Director. The formal presentation is to faculty and students. There are yearly assessments by the Director and Associate Director.</td>
<td></td>
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</tr>
<tr>
<td>Research progress for each Ph.D. research student is reviewed annually in a research advisors meeting. There will be exit interviews and exit questionnaires.</td>
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</tbody>
</table>
C. Additional Educational Opportunities.
The Biophysics graduate program is part of a wide array of educational offerings in both the biosciences and in nanotechnology at the University of Maryland. The very successful graduate program in Bioengineering has been admitting students for three years. There is also a graduate certificate program in nanotechnology that started in fall 2005. These programs provide increased flexibility in designing a customized graduate curriculum for biophysics students that extends beyond the core courses. For example, courses listed below are available as electives from both the bioengineering and nanotechnology programs.

Bioengineering Graduate Program:
- BIOE601 Biomolecular and Cellular Rate Processes
- BIOE602 Cellular and Tissue Biomechanics
- BIOE603 Electrophysiology of the Cell
- BIOE604 Cellular and Physiological Transport Phenomena

Graduate Certificate Program in Nanotechnology:
- ENMA620 Polymer Physics
- ENMA627 Nanotechnology Characterization
- ENMA650 Nanostructure Physics of Engineering Materials

D. Program Impact and Outcomes
There are a number of programs on the University of Maryland that will benefit from the proposed program. Of note is the potential synergy between the Biophysics Program and the Bioengineering Department that focuses on research in a number of areas including signal processing, imaging, and metabolic engineering. The fundamental emphasis of our program will complement the applied focus of the Bioengineering Department. In the long run we believe that the features of the proposed program will serve as a model for interdisciplinary education in biophysics.

The outcome of the program will be the production of students who will be well educated in both the physical and biological sciences equipping them to deal effectively with emerging problems in the bio and biomedical sciences. There have been former students who have worked with participating faculty to cross the boundaries separating various disciplines and are now productive scientist in the pharmaceutical industry, medicine and in academic units that are far removed from their formal undergraduate education. These successful experiences give us confidence that the courses, seminars, workshops, and the completion of doctoral work in an atmosphere that fosters interdisciplinary research will prepare students to address issues the biological sciences. It is important to advise and follow the progress of graduating students so that they realize their goals and fulfill their potentials. To this end we will follow their career path as they enter the work force either in universities or in biology and bio medical laboratories. The rigorous preparation in our program will provide a firm footing from which to attack problems that arise in academic, pharmaceutical, or medical settings.

IX. FACULTY AND ORGANIZATION
A. Director, Associate Director, Executive Committee
The administrative structure reflects the interdisciplinary nature of the program with participating faculty from different departments and three separate colleges. The Biophysics Program will be based in the Institute for Physical Science and Technology (IPST) that is providing administrative support and space for administrative and student offices. The Director and Associate Director will be appointed by the Director of IPST in consultation with the chairs of the participating departments. The current program Director, Prof. D. Thirumalai, and the current Associate Director, Prof. G.H. Lorimer, hold joint appointments in IPST and the Department of Chemistry and Biochemistry. The Director will report to the chairs of the participating departments and the IPST Director. In addition, formal presentations to IPST faculty and staff during the assembly meetings (held twice a year) and to the participating departments will also be made. Faculty associated with the program will maintain their status in the academic departments within which their tenure resides. The faculty will receive departmental credit for teaching and course development within the Biophysics Program.

The Director and Associate Director will have full responsibility for the administration of the program. This includes the distribution of information about the program, the recruiting and admission of graduate students, the organization of biophysics courses, monitoring of the evolving content and emphasis of the courses, the advising and counseling of students enrolled in the program with regard to courses, university and program requirements, financial support and, upon graduation, employment. They will track student progress, establish a regular weekly biophysics seminar series with internal as well as external speakers, and organize workshops once a semester in emerging topics in biophysics.

Because of the interdisciplinary nature of the program and rapid evolution of the field, it is anticipated that changes to the program will be made to accommodate emerging research areas. An Executive Committee composed of the Director, Associate Director and three members of the Biophysics faculty will be established. The three Biophysics faculty will be appointed by the Director and will serve three year terms. There will be regular annual meetings of the Executive Committee. Additional meetings will be scheduled when necessary.

B. Administrative Support

Assisting the Director and Associate Director will be a one third time Administrative Assistant who will be responsible for the details of the program. This includes the organization and distribution of printed and electronic material about the program. The Administrative Assistant will have the responsibility of organizing student applications to the program as well as the scheduling of biophysics courses and the keeping of student records. The Assistant will also have responsibility for the organizational details of the weekly biophysics seminars and workshops. This will include the circulation of announcements and travel arrangements for invited speakers and guests.

In due course, an external advisory committee will be appointed. It is expected that the members of the external advisory committee will be drawn from neighboring academic and research institutions such as Johns Hopkins University, NIH, and NIST. The external advisory board and the internal committee will provide written reports based on annual visits. The reports will be
made available to the members of the biophysics program as well as to the Deans of the three colleges participating in the program.

The faculty members in the program are drawn from a number of departments that reside in three colleges. The participating units are the Department of Biology, the Department of Chemistry and Biochemistry, the Department of Material Science Engineering, and the Department of Physics. The three colleges are the College of Chemical and Life Sciences, the Clark School of Engineering, and the College of Computer, Mathematical, and Physical Sciences.

It is essential that the Biophysics Program grow to have an international reputation for the highest quality graduate education and research. To achieve this goal it is important that the participating faculty members be recognized nationally and internationally for their scientific contributions to research and that they participate regularly in the activities of the Program. Some of the activities are listed below:

• Advise entering students  
• Prepare and grade Qualifying Examination  
• Assist with web site management  
• Attend and encouraging students to attend weekly Biophysics Seminars and Symposia  
• Arrange for seminar speakers  
• Advise students with off-campus research projects  
• Recruit new students  
• Assist with Program publications  
• Sponsor summer interns  
• Organize visits for potential students  
• Offer advanced courses within the Program  
• Assist in the preparation of grant applications for external support

A committee of existing Biophysics faculty appointed by the Director and the Director will review faculty applications to the Program and may solicit advice from external sources regarding the applicants.

A committee appointed by the Director and having the Director as ex-officio member will decide on admissions. A separate committee will organize and supervise the Qualifying Examination and review student progress to candidacy and Ph.D. degree.

There will be an Oversight Committee that will be made up of the Director of the Chemical Physics Program, the Director of the Materials Engineering Department and the Director of the Materials Research Science and Engineering Center, and the Director of the Bioengineering Program. The Committee will meet once a semester with the Director and Associate Director as well as with the faculty and students of the program. The purpose of the meeting will be to track the effectiveness of the program and provide advice and assistance in the development of the program as it evolves.

For the most part, the courses that are taught by the participating faculty are part of the graduate curriculum in the respective departments. The courses, especially those most appropriate for the
Biophysics students, will be cross-listed. Because the courses are normally taught in the respective departments of the faculty, teaching credits will be assigned in the conventional manner. An exception will be the new laboratory course, which will be taught by a team of the Biophysics faculty. As summarized in the Curriculum Section, each student will be expected to spend a total of eighteen weeks in the laboratories of at least three faculty members. The faculty members are responsible for their supervision.

C. Faculty List

<table>
<thead>
<tr>
<th>FACULTY</th>
<th>DEPARTMENT/COLLEGE</th>
<th>RESEARCH INTEREST</th>
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<tbody>
<tr>
<td>Prof. N. Allewell</td>
<td>Chemistry and Biochemistry/CLFS</td>
<td>Protein structure, function, and design</td>
</tr>
<tr>
<td>Prof. D. Beckett</td>
<td>Chemistry and Biochemistry/CLFS</td>
<td>Complex Biological Circuits</td>
</tr>
<tr>
<td>Prof. R. Briber</td>
<td>Material Engineering/CSEN</td>
<td>Scattering Techniques in RNA and Polymers</td>
</tr>
<tr>
<td>Prof. M. Colombini</td>
<td>Biology/CLFS</td>
<td>Membrane Transport Phenomena</td>
</tr>
<tr>
<td>Prof. M. Fisher</td>
<td>Physics/IPST/CMPS</td>
<td>Theory of Matter and Molecular Motors</td>
</tr>
<tr>
<td>Prof. D. Fushman</td>
<td>Chemistry and Biochemistry/CLFS</td>
<td>Structural Properties of Proteins using NMR</td>
</tr>
<tr>
<td>Prof. A. LaPorta</td>
<td>Physics/IPST/CMPS</td>
<td>Single Molecule Methods in Biology</td>
</tr>
<tr>
<td>Prof. G. Lorimer</td>
<td>Chemistry and Biochemistry/IPST/CLFS</td>
<td>Methods in Enzymology</td>
</tr>
<tr>
<td>Prof. W. Losert</td>
<td>Physics/IPST/CMPS</td>
<td>Non Linear Dynamics and Optical Tweezers</td>
</tr>
<tr>
<td>Prof. S. Sukharev</td>
<td>Biology/CLFS</td>
<td>Ion Channels</td>
</tr>
<tr>
<td>Prof. Victor Munoz</td>
<td>Chemistry and Biochemistry/CLFS</td>
<td>Protein Structure and Dynamics</td>
</tr>
<tr>
<td>Prof. D. Thirumalai</td>
<td>Chemistry/IPST/CLFS</td>
<td>RNA and Protein Folding</td>
</tr>
<tr>
<td>Prof. A. Upadhyaya</td>
<td>Physics/IPST/CMPS</td>
<td>Biophysics</td>
</tr>
<tr>
<td>Prof. J. Weeks</td>
<td>Chemistry/IPST/CLFS</td>
<td>Study of Liquids</td>
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</table>

X. Off Campus Programs (not applicable)

XI. Other Issues

The program will be solely administered by the faculty members at UMCP. The program is not required to seek accreditation. Neither certification nor licenses are required for the graduates.
XII. Commitment to Diversity

In keeping with established tradition at the University of Maryland every effort will be made to attract minority students to the program through participation in summer training programs organized by the Biophysical Society and NIH. In addition, the successful strategies employed by the associated departments and programs (Chemistry and Biochemistry, Physics, Biology, Bioengineering, Materials Science and Engineering, and Chemical Physics) will be used in the admission process. At present there are a number of women students enrolled in the Chemical Physics program with specific interest in Biophysics. Several of the current faculty in Biophysics are training future women scientists who will soon receive their degrees and begin careers in biophysics and biomedical research. We expect to apply to the National Science Foundation for Research Experience for Undergraduate (REU) grants to recruit talented minority undergraduate students for summer research projects with the goal of having them apply to the Biophysics Program.

XIII. Required Physical Resources

A. The Graduate Program in Biophysics will require library and other information sources largely in the form of peer-reviewed journals and reference texts. The current holdings of the University of Maryland system is adequate. As the need for new and important journals arise we expect to work through the Library System to procure them.

B. No additional facilities are required for the program. Existing faculty research facilities are sufficient to accommodate the research activities of incoming graduate students. In addition, IPST has fully renovated space for the two new faculty members who have been appointed jointly with Physics.

C. There will be no impact on existing facilities and equipment. The seminar room in IPST is already being used on a regular basis and will continue to be the venue for future seminars, oral examinations, and meetings.

XIV. Resource Needs and Sources

During the first five years of the Biophysics Program, students will enroll in courses that are already in existence. Because of the modest number of entering students, it will not be necessary to expand the number of sections of the courses. It is anticipated that, from time to time faculty will offer advanced courses in their research specialties. These will be part of the course listings of the academic departments and will be cross-listed with the Biophysics Program. Administrative responsibilities for the Biophysics Program are listed below:

Recruiting
Admission
Advising
Qualifying Examination Preparation and Grading
Thesis Examination
General Administration
The Director and Associate Director will be responsible for recruiting new students and administering the admission process. With the centralization of admission applications in the Graduate School and ready electronic access to applicant files, admission is no longer the time consuming process of past years. A steady state student population of thirty-five to forty is expected. Each student will have a committee of three faculty advisors. This means that each of the current thirteen biophysics faculty will be members of nine student advising committees. While this appears to impose a large administrative load on the faculty, it is important to note that the committees are most active in the students' first year. With an incoming class of five to eight students, each current faculty member would serve on at most two advising committees.

APPENDIX

A. Descriptions of Current Biophysics Courses

BCHM461, Protein Folding and Dynamics, 3 Credits, G. Lorimer and D. Fushman
The course teaches students the approaches and techniques for the study of protein conformational dynamics using a variant of the small globular protein ubiquitin as an example. NMR relaxation experiments are performed on the NMR facility of the Chemistry and Biochemistry Department in native-like conditions so that a high-resolution picture of the equilibrium dynamics of the functional state of the protein is obtained. Conformational fluctuations leading to unfolding are explored close to equilibrium at different temperatures using fluorescence and NMR experiments. The results of these experiments provide a map of the folding-unfolding equilibrium of the protein and are compared and analyzed in conjunction with the nanosecond-microsecond folding dynamics obtained with a laser-induced temperature-jump instrument specifically built for this laboratory. Experimental results are compared to molecular dynamics simulations in the nanosecond time-scale.

BCHM675 Biophysical Chemistry, 3 Credits, D. Beckett
Conformation, shape, structure, conformational changes, dynamics and interactions of biological macromolecules and complexes or arrays of macromolecules. Physical techniques for studying properties of biological macromolecules.

BIOL622, Membranes and Ion Channels, 3 Credits, S. Sukharev and M. Colombini
Channel-forming membrane proteins such as porins, VDAC, KcsA or mechanosensitive channel MscL are isolated and purified from a bacterial, yeast or mammalian tissue source using methods that require two class periods. For simplicity of purification, 6 His-tagged versions of these proteins are used. Proteins are reconstituted into either planar or spherical membranes (liposomes) and characterized under voltage-clamp conditions. Kinetics measurements are made on single and multi-channel membranes. Changes in kinetics and energetics due to the application of an electric field, membrane tension, or chemical agents are examined. Theoretical treatments of gating thermodynamics are integrated into the experimental work. A Fluorescence Recovery After Photobleaching imaging apparatus will be used to measure lipid/protein lateral diffusion.
CHEM684, Thermodynamics and Statistical Mechanics, 3 Credits, J. D. Weeks

The course provides the thorough grounding in statistical mechanics and thermodynamics that is needed for students to understand current developments in biophysics and to prepare them for research. Solving problems in biophysics requires the ability to use concepts from physics, chemistry, and engineering as well as biology. Statistical thermodynamics provides the common language through which these ideas can be integrated. An understanding of thermodynamics helps the student realize the importance of thinking about phenomena on different length scales and how a reduced description involving a few relevant variables can emerge on larger length scales. Statistical mechanics provides the explicit machinery by which the averaging over microscopic degrees of freedom can, in principle, be carried out and highlights the important role of simple models in developing a general perspective. These subjects provide a conceptual framework students can use for systematic investigation of complex biophysical systems. Students will take an integrated two semester graduate level course in thermodynamics and statistical mechanics. About 2/3 of the first semester will be devoted to a deeper understanding of thermodynamics, using the postulate approach as developed in the classic text of Callen, (Herbert Callen, “Thermodynamics and an Introduction to Thermostatistics,” John Wiley, 1985). A virtue of the postulate approach is that abstract concepts can be introduced quickly and can be illustrated through modern applications to relevant biophysical problems. Recent texts by Nelson (Philip Nelson, “Biological Physics,” W.H. Freeman, New York, 2004) and by Dill and Bromberg (Ken Dill and Sarina Bromberg, “Molecular Driving Forces,” Garland Science, 2003) give many biophysically relevant examples.

The last third of the first semester and all of the second semester will focus on statistical mechanics, with relevant biophysical applications. Properties of liquids and solvents, especially water, and the statistical properties of biopolymers will be covered in depth. Computer simulations will be integrated into the course in such a way that students can develop a more realistic appreciation of its use in biophysical systems. This course will provide an essential common background that will permit students to take more advanced special topics courses on computer simulations and biopolymers (Courses 3, 4, 6, and 7) that will be offered in the Biophysics Program.

Versions of this three-credit course with emphasis on applications to traditional physics problems has been taught for over five years to students from the Department of Chemistry and the Chemical Physics Program. In conjunction with the proposed programs the course will be further developed to illustrate application of fundamental concepts to problems of biological interest.

CHEM687, Statistical Mechanics, 3 Credits, D. Kosov

The following topics are covered in the course: non-interacting systems including ideal Bose gas, Bose-Einstein condensation, thermal properties of crystals and macromolecules, ideal Fermi gases, atomic gases, molecular gases, classical fluids and the reduced configuration distribution function, the reversible work theorem, thermodynamic properties from g(r), solvation and chemical equilibrium in liquids, and molecular liquids, theory of phase transitions using the Ising model and lattice gas, broken symmetries and range of correlations, mean field theory, and renormalization group theory, non-equilibrium statistical mechanics including Brownian motion
and Langevin equations, the Fokker-Plank equation, and master equations

**PHYS789N, Basic Biophysics for Motion in Cells, 3 Credits, M. E. Fisher**

The aim of the course is to give graduate students in the physical and chemical sciences an introduction to some aspects of modern molecular biophysics, which draws on concepts and ideas from physics, chemistry, engineering and, of course, biology. The recent book by Jonathon Howard (see below) will be used as the required course text although not all the topics treated in the book will be covered. Some appreciation for modern research on molecular motors or motor proteins, which is being pursued at the single-molecule level, is an overall goal. The course will be taught at an introductory graduate level, developing needed concepts and presupposing only some acquaintance with undergraduate mechanics, thermodynamics, statistical mechanics and calculus. No prior knowledge of biology will be presupposed. A number of text books are used and/or recommended for this advanced special topics course.


The lectures will cover the following topics:


**Status of Development:** This three-credit graduate course has been taught twice formally in the Physics Department and the Chemical Physics Program. Forty students attended the first time and about twenty were enrolled the second time.

**CHEM669D, Protein Structure, Folding, and Dynamics, 3 Credits, D. Fushman**

An understanding of how proteins fold and function is essential in the training of all biophysicists. The purpose of this course is to introduce students to the basic principles
governing protein structure and stability, and expose them to the most recent experimental, theoretical, and computational approaches.

The course will serve two complementary purposes in the curriculum of the program in biophysics. The first goal is to introduce the concepts in structural biology and physical chemistry in order to bring to a common level students with different academic backgrounds. The course will start with a series of lectures on the basic principles of the chemical and three-dimensional structure of proteins, the basic interactions stabilizing protein structure and the general ideas governing protein stability and folding. The course will continue with a series of lectures on modern chemical kinetics and dynamics with an emphasis on statistical mechanical approaches (See Course 2). This will be followed by an introduction to protein dynamics and folding in the context of a modern physicochemical framework. The students will be introduced to state of the art experimental methods and analytical tools, using a broad view of protein folding as the common theme. This part of the course will consist of a synergetic combination of lectures and computer-based exercises. Students will learn the theoretical basis of several spectroscopic techniques (including nuclear magnetic resonance, laser and single molecule spectroscopy) and their application to the study of proteins. Experimental results will be simulated with custom-built computer programs, such as Virtual NMR Spectrometer (www.vsnmr.org). Simulated data for particular problems will be analyzed with models developed in-situ by students using general data-analysis software (e.g. Matlab). Molecular simulations will complement the theoretical descriptions and experimental applications.

At the end of the course the students will be familiar with the following topics: 1) Principles of Protein Structure, Energetics and Stability; 2) Modern Chemical Kinetics and Dynamics; 3) Protein Folding and Conformational Dynamics; 4) Description of Methods and Experimental Approaches; 5) Computationally-based Analysis of Experimental Data; 6) Merging Experiment and Molecular Simulations.

Some aspects of this proposed three-credit course are currently taught to graduate students in biochemistry. Further development of the course, with emphasis on interdisplinary aspects, will be pursued under the proposed Biophysics Program.

CHEM689, Introduction to Biological Physics, 3 Credits, D. Thirumalai

It is important for life science students to appreciate that biological macromolecules (DNA, proteins, and RNA) are special forms of polymers. Many of the physical properties of biomolecules can be understood from the principles of polymer physics principles. It is equally important for physical science and engineering students to understand the unique features of biomolecules in terms of their chemical structures. The purpose of this course is to integrate concepts in colloid and polymer science and structural biology.

The course will cover the following topics: (1) An introduction to polymer physics including modern experimental methods (scattering techniques and single molecule techniques) for the determination of the shapes and elastic properties of biomolecules. The methods will be illustrated with examples from experiments on DNA, single molecule studies, scattering studies on RNA, and direct analysis of protein structures in the Protein Data Bank. (2) A description of the building blocks of nucleic acids and proteins leading to the emergence of diverse biological structures. The notion of “phase transition” is illustrated with the example of the helix-coil
transition. This establishes a link between the concepts in thermodynamics and order-disorder transitions in biology. (3) With the knowledge of polymer physics, Ising model, and structural biology, the important concept of allostery is introduced using the binding of oxygen to hemoglobin. Using this system several new ideas including ligand binding, cooperativity, and binding-induced conformational fluctuations are introduced. (4) Biological macromolecular recognition, which is important in cellular functions ranging from signaling to regulation, is introduced using the interaction of lac repressor with DNA as an example. This well studied problem illustrates the interactions between biological molecules by integrating concepts in polyelectrolyte theory, ionic hydration, and stochastic diffusion.

A condensed version of the course was offered three years ago to a group of graduate students and postdoctoral associates with backgrounds in physics, chemistry, biology, and biochemistry.

BSCI426 and BIOL622 Membrane Transport Phenomena, 3 Credits, M. Colombini and S. Sukharev

Biology students know the phenomenology and have an intuitive feel for how biological processes behave. On the other hand, students with physical science or engineering background have mathematical skills but often are ill-prepared to apply these skills to complex biological systems. It is only by merging these skills that one can achieve a sound biophysical approach to study biological processes. This course uses such an approach to the study of membrane transport phenomena. The course will start with the fundamental properties of membranes and end with complex multi-component processes.

The course begins with membrane dynamics including the energetics of self-assembly, the Boltzmann distribution, elasticity of membranes, membrane fluidity and molecular dynamic simulations. This is followed by permeation including the solubility diffusion model, the Born equation and permeation of ions, dipole potentials and their influence on ion flux, the general flux equation, the origin of the transmembrane potential, the Donnan equilibrium, and energy transduction in symports, antiports, ion pumps and photosystems. This is followed by the biophysics of channels including the molecular basis for gating and selectivity. The course examines experimental approaches to probe the structure and dynamics of channels and the influence of access resistance, surface potential, 3D pressure, tension, curvature, water activity, and transmembrane voltage. The course ends with examination of selected complex systems; namely chemiosmotic coupling and the efficiency of energy transduction, non-equilibrium thermodynamics, and the Hodgkin/Huxley model of excitability.

This three-credit course is currently taught in the Biology Department (www.life.umd.edu/classroom/bsci426/biol622). Typically 15 students with different backgrounds enroll.

BIOL708O Cell Biology from a Biophysical Perspective, 3 Credits, S. Sukharev and M. Colombini

Biomedical research benefits when representatives of other disciplines such as physics, chemistry, computer science or engineering turn their talents and efforts toward biological
problems. Biology needs to be introduced to appropriate scientists with backgrounds in physical science and engineering. On the other hand, the advantages of modeling and quantitative approaches need to be demonstrated to young biologists who are inclined to think physically. The course will combine two complementary approaches to the study of living matter, the Biological (descriptive) and the Physical (quantitative).

This course will be an in-depth review of cell biology/physiology addressed to both parts of the student audience with primary backgrounds either in physics or in biology. The description of cellular processes and mechanisms will be combined with quantitative models. Each section will emphasize the opportunities for biophysical investigation. The main text for the proposed course will be *Molecular Cell Biology* by Lodish *et al.* Additional biophysical and quantitative aspects will be provided by the instructors. The course will begin with an overview of development, signal transduction, adaptation, reproduction and evolution. It will then delve into the molecular components of cells and cell organization. This will include packing, crowding, folding and molecular recognition. The course will then turn to an overview of membranes and transport including how lipids form organized structures, diffusion and ionic equilibria. Cell polarity and its maintenance will be examined by focusing on membrane trafficking and vectorial transport. Topics in cellular energetics will include mitochondrial reactions, principles of energy conversion, and the generation of tension and torque. The course will explore basics of molecular genetics including the structure of chromosomes, transcriptional control, and RNA editing. This will be followed by cell signaling, perception of mechanical force and temperature, molecular recognition and binding, signaling pathways, information transduction, signal amplification, and control systems. Finally the course will examine the cell cycle, growth control, cell lineages, and apoptosis. We will examine the control of cell numbers, the shape of organ systems, and the elimination of defective or infected cells, and cancer.

The course will be developed and taught over two semesters.

**B. Description of course to be developed**

**Graduate Laboratory Course in Biophysics, 4 Credits**

This course will be developed and put into place during the first three to five years of the Biophysics Program. It is intended that the course serve as a meeting point for graduate students from various disciplines and a good deal of thought has already been put into its organization. Course structure will be modeled after the Interdisciplinary Laboratory for Biological Physics at the University of Arizona, Tucson and will consist of four experimental units. Each unit will draw on the research interests and experience of two faculty members who will be responsible for the organization of the unit and the academic content. The course will meet for four hours twice each week and will be offered in both the fall and spring semesters. The estimated enrollment is six to twelve students per semester. The students will work in groups of two to three. A Ph.D. level Laboratory Supervisor will maintain the experiments in cooperation with the faculty, help with biochemical protocols and sample preparations, and maintain laboratory infrastructure. Appointment of the Supervisor will be made only after we obtain external funding. The Supervisor will then be supported by funds obtained from National Funding Agencies. In the interim the students will work in the laboratories of the current faculty as
outlined on page 9. External grant funding will be sought to purchase the instruments for this laboratory. Contingent on grant funding, it is expected that a Teaching Laboratory Assistant will be supported by the university as listed in the accompanying Resources and Expenditures document.

The basic layout will be a wet laboratory and a computational facility. The wet laboratory will be equipped with experimental benches that will be supplied with purified water, compressed gases, and vacuum lines. The laboratory will have its own computers for data acquisition. Sensitive optical equipment will be located in either a separate room or in a separate curtained-off area. The computational facility will have computers and high-speed ethernet connections. This arrangement has significant advantages over the more traditional laboratory rotations for the training of students. Within the laboratory, students will have full access to the instruments in an interdisciplinary setting where different techniques are available simultaneously. Students in the course of sharing the instruments will also interact and collaborate on different aspects of the assignments. Graduate students completing the course will be able to use of the facilities on an "as available" basis.
### TABLE I: RESOURCES

<table>
<thead>
<tr>
<th>Year</th>
<th>Reallocated Funds</th>
<th>Administrative Supplement</th>
<th>Program Support</th>
<th>Tuition Revenue</th>
<th>Grants and Contracts</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>$93,000</td>
<td>$5,000</td>
<td>$10,000</td>
<td>$68,320</td>
<td>$20,000</td>
</tr>
<tr>
<td>2.</td>
<td>$186,000</td>
<td>$5,000</td>
<td>$10,000</td>
<td>$102,480</td>
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</tr>
<tr>
<td>3.</td>
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<td>$5,000</td>
<td>$10,000</td>
<td>$122,976</td>
<td>$5,000</td>
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<tr>
<td>4.</td>
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<td>$5,000</td>
<td>$10,000</td>
<td>$143,472</td>
<td>$5,000</td>
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<tr>
<td>5.</td>
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<td>$5,000</td>
<td>$10,000</td>
<td>$163,968</td>
<td>$5,000</td>
</tr>
<tr>
<td>6.</td>
<td>$186,000</td>
<td>$5,000</td>
<td>$10,000</td>
<td>$163,968</td>
<td>$5,000</td>
</tr>
</tbody>
</table>

6 TA for 1st and 2nd year students @ $15,500, 12 TA steady state $5,000 IPST, $5,000 Chemistry/Biochemistry

#### 4. Tuition Revenue
- **Number of Students**: 8, 16, 24, 32, 40
- **Credit Hour Rate**: $427, $427, $427, $427, $427
- **Annual Average Credit Hours**: 20.0, 15.0, 12.0, 10.5, 9.6 Average over all enrolled students

#### 5. Grants and Contracts
- Proposals to be submitted to Federal agencies

#### 6. Other External Sources
- Foundations to be solicited

#### Total
- $176,320, $303,480, $323,976, $344,472, $364,968

### TABLE II: EXPENDITURES

<table>
<thead>
<tr>
<th>Year</th>
<th>Faculty Expenses</th>
<th>Staff Expenses</th>
<th>Support Staff Expenses</th>
<th>Teaching Lab Equipment/Supplies</th>
<th>Library</th>
<th>Space</th>
<th>Administrative Supplement</th>
<th>Program Support</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>FTE 0.5</td>
<td>FTE 0.3</td>
<td>FTE 0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>$5,000</td>
<td>$10,000</td>
<td>$118,750</td>
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<tr>
<td>2.</td>
<td>Salary $60,000</td>
<td>Salary $15,000</td>
<td>Salary $3,750</td>
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<td>0</td>
<td>0</td>
<td>$25,000</td>
<td>$10,000</td>
<td>$183,750</td>
</tr>
<tr>
<td>3.</td>
<td>Benefits $15,000</td>
<td>Benefits $15,000</td>
<td>Benefits $3,750</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>$25,000</td>
<td>$10,000</td>
<td>$183,750</td>
</tr>
<tr>
<td>4.</td>
<td>Total Faculty Expenses $75,000</td>
<td>Total Staff Expenses $18,750</td>
<td>Total Support Staff Expenses $0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>University funds to match external proposals in preparation</td>
<td></td>
<td></td>
</tr>
<tr>
<td>5.</td>
<td>Total $108,750</td>
<td>Total $183,750</td>
<td>Total $183,750</td>
<td>$183,750</td>
<td>$183,750</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
November 7, 2007

To Whom It May Concern:

I am writing in strong support of the proposal to establish a M.S. and Ph.D. degree granting program in Biophysics at the University of Maryland, College Park. After carefully reviewing the supporting documents, I believe that the proposed program will be an important addition to the academic and research activities of the campus and is fully compatible with the educational and research mission of the University.

The proposed program builds on strengths that the University has developed in engineering and the physical sciences over several decades. It will also contribute in important ways to two of the University’s major goals—building excellence in the life sciences, and developing exciting new interdisciplinary areas at the interface of the life sciences, physical sciences, and engineering.

There is strength in biophysics across the College of Chemical and Life Sciences. The Department of Chemistry and Biochemistry has been committed to developing a center of excellence in molecular biophysics for some time. This effort began in the 1980s and is ongoing. The Center for Biomolecular Structure and Organization, directed by George Lorimer, a member of the National Academy of Sciences and Distinguished University Professor, was established to drive these efforts. Currently approximately thirteen tenure/tenure track faculty members, located in either the Biochemistry Building or the Biomolecular Sciences Building, have research programs with a molecular biophysics component. Several, including myself, have won awards or held offices in the Biophysical Society. Most are engaged in studying the relationship between the structure, energetics, dynamics, and functions of biological macromolecules. Major instrumentation includes a macromolecular X-ray diffraction unit, high resolution mass spectrometers, and 600MHz nuclear magnetic resonance spectrometers. In addition to the faculty in Chemistry and Biochemistry, two faculty members in the Department of Biology study the molecular mechanisms of membrane channels using biophysical and computational approaches. And one faculty member in the Department of Cell Biology and Molecular Genetics studies the mechanism of bacterial chemotaxis. Together with colleagues from across the University, particularly in the College of Computer, Mathematics, and Physical Sciences, they form a strong group.

The faculty from several Colleges who have worked together to propose the new Biophysics program under the leadership of Professor D. Thirumalai will fulfill a major intellectual need at the University. This program has the required resources and support from the Departments of Physics, Chemistry and Biochemistry, and the Institute for Physical Science and Technology. I fully endorse the proposed program in Biophysics and look forward to participating in it in the future.

Sincerely,

Norma M. Allcock
Professor and Dean
To Whom It May Concern:

This is a letter of strong endorsement for the establishment of an M.S. and Ph.D. degree granting program in Biophysics at the University of Maryland, College Park. After carefully reviewing the supporting documents, I believe that the proposed program will be an important addition to the academic and research activities of the campus and is fully compatible with the educational and research mission of the University. It is a graduate program based on a partnership that will enhance interdisciplinary research and educational activities in three colleges; Chemical and Life Sciences, Computer Mathematical and Physical Sciences, and Engineering.

Over the past decades the University has achieved a well deserved reputation as one of the nation's leading research universities in basic and applied science and technology. Within the University the College of Computer, Mathematical and Physical Sciences has a special interest and responsibility to be actively engaged in research and the training of graduate students in disciplines at the frontiers of knowledge. Furthermore, the rapid pace of scientific discovery and the need to transform discoveries into practical technologies require graduate programs that bring together students and faculty from a wide variety of disciplines to make the scientific breakthroughs that will advance and enhance the leadership role of the University of Maryland and contribute to society. The proposed Biophysics Program fulfills, in a substantial way, this need and complements the newly established Bioengineering graduate program.

Over the past two years, the University has made significant additions to faculty in the area of biophysics in the Department of Physics, and the Institute of Physical Science and Technology. These new faculty supplement established biophysics faculty and together form a highly creative and imaginative group in this area of research. The University has also made significant commitments in laboratory renovation and start-up funds to construct and refurbish modern laboratories with the necessary vibration and thermal stability and environmental control required for experimental work with biomolecules and cells. The design of the new Physical Sciences Complex is now underway. It is intended to be an advanced state-of-the-art facility that will bring together scientists from different disciplines and create a new environment for the kind of collaborative research that is very much in the spirit of the proposed Biophysics Program.
Another major advantage of the proposed program in Biophysics is the proximity to the National Institutes of Health and the National Institute of Standards and Technology. These major national labs offer unique and special opportunities for both students and faculty in terms of education, research and funding. Finally, no graduate program can succeed without well trained, motivated, and academically gifted students. In this regard, the Biophysics Program will be able to take advantage of a strong surge of interest in biophysics on the part of undergraduates now applying to existing programs in Physics, Chemical Physics, Biology and Chemistry and Biochemistry. The program in Biophysics will provide a pathway for our students to gain the best research experience and to work with the most creative scientists from around the world.

The faculty from several Colleges who have worked together to propose the new Biophysics program under the leadership of Professor D. Thirumalai will fulfill a major intellectual need at the University. This program has the required resources and support from the Departments of Physics, Chemistry and Biochemistry, and the Institute for Physical Science and Technology. It is worthwhile to note that the Institute has, over the past fifty years, partnered in the establishment of many of the strongest graduate programs at the University, and attracted exceptional faculty and students. I fully endorse the proposed program in Biophysics and look forward to its achievements in the future.

Yours sincerely,

Steve Halpern
Professor and Dean
To Whom It May Concern:

I am writing this letter to express my strong support for the establishment of an M.S. and Ph.D. degree granting program in Biophysics at the University of Maryland, College Park. I have reviewed the supporting documents and believe that such a program represents an important step forward for the University. The field of Biophysics is a very vibrant research area in which UMD should be an active player. I also believe that this program will be compatible with our existing research and educational programs.

Within the Clark School, I expect that a number of faculty members will become involved in the new program. Much of the work in the field of Bioengineering builds upon the fundamental advances in Biophysics research. Our Bioengineering Program emphasizes the use of engineering principles in molecular and cell biology with a focus on biotechnical applications. As such, there will be a powerful synergistic relationship between Bioengineering and the new Biophysics Program that may include research in a number of areas including signal processing, imaging and metabolic engineering. The emphasis of Biophysics on fundamental science will complement the more applied mission of the Bioengineering Department. I also anticipate active participation by some of the faculty from the Department of Materials Science and Engineering and the Maryland NanoCenter.

In conclusion, I fully endorse the proposed program and eagerly anticipate its implementation.

Sincerely,

Herbert Rabin
Professor and Interim Dean
To Whom It May Concern:

This letter is in support of the establishment of an M.S. and Ph.D. degree granting program in Biophysics. Over the last few years there has been a rapidly growing number of very talented and motivated graduate students applying to graduate programs in Physics, Chemistry, Biology, Chemical Physics and Applied Mathematics and Scientific Computation, who are interested in applying for and receiving a degree in the area that has emerged as "Biophysics."

Biophysics currently describes an academic discipline concerned with using the knowledge and methods of the mathematical and physical sciences to investigate problems that are important and significant in biology. The discipline is evolving, and an increasing number of students have become interested in acquiring the academic knowledge research experience necessary to make contributions in this interdisciplinary area.

At the University of Maryland, Biophysics has a very special role. It brings together faculty and students from the Colleges of Computer, Mathematical and Physical Sciences, Chemical and Life Sciences, Engineering and potentially, Behavioral and Social Sciences. One cannot overestimate the importance of providing students interested in Biophysics in these colleges with the opportunity to study and do research in an adaptive and encouraging academic environment that maintains the highest standards. By addressing the fundamental science that underlies both engineering and medical applications a Biophysics program will complement the newly established Bioengineering graduate program at the University.

The already well-established and highly regarded Chemical Physics graduate program at the University offers a model for initiating the graduate program in Biophysics. Recent joint appointments of faculty in the area of Biophysics in the Institute of Physical Science and Technology and Physics and Chemistry have established a new level of cooperative research and education. The weekly seminars in Biophysics, now ongoing for four years, are most interactive and draw a wide attendance from many departments and Colleges. We expect these efforts and initiatives to expand, and faculty to acquire new resources from national funding agencies, including the National Institutes of Health and private foundations.

The accompanying proposal from Professor D. Thirumalai puts forth the structure for the Biophysics Graduate Program, and it is evident that there is a group of excellent faculty who teach a wide range of courses that form the core of the course requirements necessary. The Program will have a structure that will provide students with a rigorous academic education and research experience that will equip them for the enormous range of growing opportunities in universities, national laboratories and private industry.
I support most strongly the proposal to establish a Biophysics graduate program, and anticipate that it will grow and attain outstanding success in the near future. It is time for the University of Maryland to establish itself as a national focus for Biophysics research; this program is an important step in this direction.

Sincerely,

Rajarshi Roy
Professor of Physics
Director, Institute for Physical Science and Technology
Phone: 301 405 4878
e-mail: rroy@umd.edu
Dear Dave:

I am writing on behalf of the Department of Chemistry and Biochemistry to lend our support to the creation of the Biophysics Program at the University of Maryland. When the original initiative was established in 2004 there was hope that it would allow the University of Maryland to achieve visibility in this area for which we had recognized expertise. At that time the Department of Chemistry and Biochemistry committed up to three teaching assistant positions to aid in its development.

The Department of Chemistry and Biochemistry received your progress report at its February 2007 meeting, and the overall sense of the department was to congratulate you on the progress that has been achieved and to support efforts to establish the Biophysics Initiative as a Program. A Biophysics Program will enhance the reputation of the university and advance the research of its participants.

Yours truly,

Michael P. Doyle

MPD/cjc
October 23, 2007

Dean Stephen Halperin  
College of Computer, Mathematics, and Physical Science  
3400 A. V. Williams Building

Dear Dean Halperin:

This is a letter of support for the establishment of a graduate program in biophysics, the details of which are contained in the accompanying documents. I view this program as having important academic, educational, research, and funding benefits to the Physics Department, the College and the University. As a measure of support, the Physics Department will allocate two full-time teaching assistants to the program each year, subject, of course, to their qualifications to teach undergraduate physics courses.

Biophysics is an emerging area of research within the Physics Department with three experimental faculty (Losert, Upadhyaya, and LaPorta) and one faculty member in theoretical biophysics (Fisher) with an emerging strong biophysics component in non-linear dynamics (Ott and Girvan). Because of the strong physics component of the program, it is expected that Biophysics graduate students will choose to do Ph.D. research on a regular basis with these distinguished faculty.

Currently there is a great deal of interest in biological problems that can be effectively addressed by physical science and engineering methods. This is demonstrated at the undergraduate level by the exceptionally large number of applicants to the recently established Bioengineering Department as well as in the biophysics preferences of applicants to the Chemical Physics Program. A Biophysics Program will bring to campus talented graduate students interested in interdisciplinary research, who normally would not apply to Maryland. It will also provide the basic science training that very effectively compliments the engineering orientation of the Bioengineering Department. The program will also fit very well with the Physics Department's recent initiatives to develop an undergraduate biophysics option.

The proposed Biophysics program is interdisciplinary with the participation of three colleges, CMPS, Engineering, and CCLS, four departments (Physics, Chemistry/Biochemistry, Biology, and Materials Engineering) and IPST. It will bring together faculty and students with a wide variety of backgrounds and research interests and will increase opportunities for collaborative research that are essential for biophysics education and research.

The establishment of the program will open up possibilities for the financial support of teaching and research facilities from Federal agencies and private foundations that require a formally established academic and research program as a prerequisite for funding.

Sincerely,

Andrew Baden  
Professor and Chair
To Whom It May Concern:

This letter is in support of the establishment of an M.S. and Ph.D. degree granting program in Biophysics. The Biology Department has long had a small research program in Biophysics – the current core of which consists of the laboratories of Dr. Sergei Sukharev and Dr. Marco Colombini, both ion channel biophysicists. As a measure of the quality of this group, Dr. Sukharev was recently awarded the Michael and Kate Barany Award for Young Investigators by the Biophysical Society of America. This small core interfaces with a larger group of neuroscientists and cell biologists whose methods often overlap those of the biophysics group. As the technical demands of the discipline of biophysics have increased over the past decade, so the students of my colleagues have required graduate classes in chemistry and physics to provide them with core knowledge. It therefore seems to me to be a natural step to formalize this need for interdisciplinary study by creating a Biophysics Graduate Program. The great benefit that I can see to the Biology Department is that it will draw into our research groups more students with a background in physical sciences, while at the same time creating new courses for Biology students to participate in. This would improve our efforts to foster cross-disciplinary training in mathematical and physical biology. A growing portion of NIH funding directed towards our departmental faculty is now for interdisciplinary projects and we must train students and postdoctoral workers to take advantage of this trend. The Biology Department has substantial experience in hosting the students of interdisciplinary graduate programs. Faculty from our department founded and led the Program in Neuroscience and Cognitive Science for many years. It is the policy of the Department that all student whose advisors are Biology faculty member should have equal access to Departmental resources. This policy has helped us to attract new students within interdisciplinary programs and to grow both those programs and our overall student numbers. The proposal for a Biophysics Graduate program from Professor D. Thirumalai will continue that trend, providing both Biophysics and Biology students with valuable new courses, creating a new cadre of students with broad interests. I support strongly this proposal.

Sincerely,

Richard Payne
Professor and Chair
Department of Biology
Phone: 301 405 6885
e-mail: rpayne@umd.edu
March 30, 2007

Professor Dave Thirumalai  
Director of the Biophysics Program  
Institute for Physical Science and Technology  
Department of Chemistry and Biochemistry  
University of Maryland

Dear Dave:

As Chair of the Materials Science and Engineering Department at Maryland I want to express my strong support for the proposed new program in Biophysics at Maryland. Although I have a personal interest in participating in the program, there are a significant number of faculty throughout engineering that I am sure will also be joining the program. The field of Biophysics is a dynamic and exciting research area and it is quite surprising that the University does not have a graduate program already. Within Engineering and the field of Bioengineering in particular (but also Materials Science and Engineering) much of the work is built upon the fundamental discoveries coming out of biophysics research. Building a vibrant and successful graduate program in Biophysics at Maryland is really not an option but a necessity.

Regards

R.M. Briber  
Professor and Chair  
Materials Science and Engineering Department
April 1, 2008

Professor Devarajan Thirumalai
Institute for Physical Science and Technology
University of Maryland
College Park, MD 20742

Dear Dave:

This is a letter of support for the proposed Biophysics Graduate Program on behalf of the Fischell Department of Bioengineering. As we have discussed many times, Biophysics and Bioengineering represent complementary aspects of an important research area that combines the descriptive approach of biology with the quantitative methods of the physical sciences and engineering. I look forward to our continued collaboration and to the recruitment of an entirely new cadre of students to our campus. I am very much in favor of your program.

Sincerely yours,

William E. Bentley
Robert E. Fischell Distinguished Professor & Chair
The Institute for Physical Science and Technology proposes a new program in Biophysics, comprised of existing courses, leading to MS and PhD degrees.

Library collections in biophysics are generally adequate. However, subscriptions to a number of key journals are missing. In order to support research and teaching in this field more fully at these advanced levels, additional funding for library materials is required.

Books

The Libraries’ current collection of biophysics and related books is sufficient to meet the needs of the program. The ongoing acquisition of scholarly books is expected to be adequately covered through existing acquisition practices and budgeting.

Journals

The Libraries’ current list of subscriptions includes both core and related journals that support research and teaching in biophysics.

Journal Citation Reports is a database that uses citation data to rank and determine the impact factors of journals within given academic fields. Although the Libraries do not currently subscribe to a number of top-ranked journals in JCR’s Biophysics and Biomaterials categories, consultation with the program Director indicates that subscriptions to these journals are not required.

Databases

UM Libraries subscribe to the core databases that would be necessary for graduate research in biophysics. These include BIOSIS Previews, INSPEC, Medline, and Web of Science.
Funding

At the present time, library holdings are at least adequate to support the existing courses. Journal subscriptions, however, remain particularly vulnerable. As a result, the level of future support is dependent on ongoing funding and other circumstances affecting journal subscriptions.