

## **ITEM 122-1004-R0104 Proposal**

- 1. Briefly describe the proposed new program. Please indicate if it is an expansion of an existing program; a new program; a cooperative effort with another institution, business, or industry; or an on-campus or off-campus program. Attach any formal agreements established for cooperative efforts.**

The proposed graduate program in Biomolecular Structure and Dynamics (BSD) will be an on-campus Ph.D. program with a provision to grant an M.S. degree in the rare instance when a student cannot complete the full program. The program is designed to be interdisciplinary; the academic units of the Division of Biological Sciences, the Department of Chemistry, and the Department of Pharmaceutical Sciences will participate. The College of Arts and Sciences is proposed as the academic home of the BSD program.

Biomolecular Structure and Dynamics focuses on structural and mechanistic biology at the molecular level, an area that is an intellectual meeting ground for students and faculty in the disciplines of chemistry, biology, and biomedical science, and is an area of priority for federal research funding. At The University of Montana, we have an enthusiastic cadre of faculty and students who share a passion for studying life processes at the molecular level. However, the interested parties are distributed among separate academic units, a factor that dilutes the presence and potential impact of the group. A program that brings faculty members together based on shared academic interests, rather than by departmental affiliation alone, would create the environment to better train graduate and undergraduate students, would enhance our ability to recruit top-tier graduate students, and would boost the intellectual "critical mass" of molecular-level research in biological systems.

- 2. Summarize a needs assessment conducted to justify the proposal. Please include how the assessment plan was developed or executed and the data derived from this effort.**

A formal needs assessment has not been conducted for the proposed program. However, the need for the program derives from the academic and economic goals of the University. The search for truth, knowledge and excellence in research, teaching, and service requires a sound basis in fundamental science. An understanding of the structure, function, and dynamics of macromolecules (proteins and nucleic acids) and membranes (lipids and associated proteins) underpins all life sciences, which in turn supports applied disciplines such as agriculture, medicine, ecology, and wildlife management.

The U.S. Congress, in bipartisan accord, has recognized the importance of biomedical research to the health and wealth of our nation by doubling the budget of The National Institute of Health (NIH) from 1999 to 2003. This presents a great opportunity for growth of the biotechnology industry in Montana. The health benefits of basic biomedical research include eradication of diseases such as smallpox and polio. The economic benefits derive from a healthier populace, and from the expansion of pharmaceutical and biotechnology industries. Dr. Elias Zerhouni, current Director of the NIH, has a keen interest in promoting basic research that translates into medical therapy. In an address to the American Society for Cell Biology in December, 2002, Dr. Zerhouni emphasized

that a fundamental understanding of macromolecules and their interactions remains a major challenge and goal for biomedical research. This understanding is essential for all diseases, pathogenic, genetic, or toxicological origin, and is especially important now that genome sequence data is available for a number of species including our own. About 80% of the genes in the human genome encode proteins of unknown function. Therefore, we must rely on the tools of biochemistry, molecular biology, and cell biology to determine the function and potential applications of these novel genes.

Faculty in the Division of Biological Sciences, the Department of Chemistry and the Department of Pharmaceutical Sciences concur that training in biochemistry and structural biology is essential for undergraduate and graduate students in each of their departments. The proposed graduate program links faculty who share common research goals and methodologies, which enhances the potential to recruit research-oriented undergraduate and graduate students, and new, research-competitive faculty. A rigorous, fundamental curriculum and a dedicated seminar series will bring faculty together in new ways that will create scientific interactions and stimulate new funding initiatives.

In times of economic slowdown, it is especially important to seek federal and private sources of funding that will provide employment for Montanans and will contribute to University resources. Members of BSD will be increasingly competitive for research-project funding from NIH and the National Science Foundation (NSF) and for private funding from pharmaceutical and biotechnology companies. The new, interdisciplinary doctoral program will be a viable competitor for NIH Graduate Training Grants, NSF's Interdisciplinary Graduate Education Research Training Grant (IGERT), and the Department of Education's Graduate Assistance in Areas of National Need (GAANN) award. The proposed doctoral program will thus be an integral part of ongoing efforts to attract grant funding for research and education to The University of Montana.

### **3. Explain how the program relates to the Role and Scope of the Institution as established by the Board of Regents.**

In addition to abiding by the general principles set forth in the mission statements for The University of Montana and the Montana University System with respect to providing high-quality, pertinent education to its students, the proposed program also directly addresses three of the five goals put forth by the Board of Regents for the University system in the 2002 Briefing Book. Specifically, the proposed program will help to "provide a stimulating, responsive, and effective environment for student learning, student living, and academic achievement" (Goal A), to "deliver higher education services in a manner that is efficient, coordinated, and highly accessible" (Goal C), and to "be responsive to market, employment, and economic development needs of the State and the nation" (Goal D).

The BSD program addresses Goals C and D above with particular strength because (1) it will promote resource sharing within the university system and (2) it will offer a program that responds to the needs of the state and the nation. The BSD program is also consistent with the Role and Scope of The University of Montana through its potential contributions to education, technical training, and economic development in the state. The proposed program will foster externally funded scientific research and will

provide academic and economic opportunities for undergraduates, graduate students, postdoctoral students, and technical professionals.

**4. Please state what effect, if any, the proposed program will have on the administrative structure of the institution. Also indicate the potential involvement of other departments, divisions, colleges, or schools.**

The proposed BSD graduate program will have no immediate effect on the administrative structure of UM. We will administer BSD with approaches similar to those of the very successful interdisciplinary graduate program in Fish and Wildlife Biology, in which DBS participates, and with which we have extensive experience. The BSD program will be lead by two faculty co-directors, one in Chemistry and one in DBS. The co-directors will receive a modest summer stipend, and their teaching loads will not be reduced. The role of the co-directorship will be to administer the program, lead faculty discussion and decision-making about curriculum, faculty membership, graduate admissions, and other pertinent matters. The program co-directors will report to the Associate Dean of DBS and the Chair of the Chemistry Department, who along with the Dean of the College of Arts and Sciences (CAS) have budgetary authority and the responsibility for assigning and evaluating faculty who will participate in the program. Thus, the administrative structure of BSD will reside within CAS and its academic units.

Initially, approximately 18 DBS, Chemistry, and Pharmaceutical Sciences faculty will serve as the core that will develop and lead the BSD program. Drs. Lodmell, DBS, and Ross, Chemistry, will serve as co-directors. Faculty from these three academic units will jointly share responsibility for maintenance of quality and delivery of the BSD program.

If student demand grows, and if external funding is available to initiate such an effort, we will consider instituting a "center" within the College of Arts and Sciences. This new structure would increase program visibility and facilitate external funding that would enhance research and graduate training opportunities. However, our current preference is to manage the program in its early years within the existing departmental and collegiate structure.

**5. Describe the extent to which similar programs are offered in Montana, the Pacific Northwest, and states bordering Montana. How similar are these programs to the one herein proposed?**

The following list of universities in the Northwest describes and compares their programs in the field of Biomolecular Structure and Dynamics. Most universities have at least several faculty members in the traditional departments of Biochemistry, Chemistry, or Biology who investigate the structures and dynamics of biological systems at the molecular level. In some of the institutions listed below, expertise in structures and dynamics of biological systems at the molecular level is not a research focus. In others, there are sufficient numbers of faculty conducting research in this area that training can be obtained, although no degree in Biomolecular Structure and Dynamics is offered. A few universities offer interdepartmental programs such as the one we envision at UM. These programs are aimed at encouraging innovative, cross-disciplinary research among resident faculty by fostering collaboration, communication, as well as recruitment of graduate students with diverse scientific backgrounds.

**Colorado, Idaho, North Dakota, South Dakota, Wyoming** - no Masters or Ph.D. training programs are available for students outside traditional departments.

### **Montana**

*Montana State University.* The Department of Chemistry and Biochemistry has strengths in this area, but does not offer any formal degree program in BSD.

### **Oregon**

*University of Oregon.* The Department of Chemistry has strengths in this area, but does not offer any formal degree program in BSD.

*Oregon Health and Science University, Oregon Graduate Institute.* The Department of Biochemistry and Molecular Biology has strengths in this area, but does not offer any formal degree program in BSD.

### **Utah**

*University of Utah.* Interdepartmental graduate program with faculty from the Departments of Biochemistry, Biology, Chemistry, Medicinal Chemistry, Oncological Sciences, and Pharmaceutics and Pharmaceutical Chemistry. The focus of this program is Biological Chemistry. Research interests include structure and function of proteins and nucleic acids, enzyme reaction mechanisms, drug delivery, protein folding and biosynthesis, DNA replication, neurochemistry, theory of small molecule/large molecule interactions and biological separation.

*Utah State University.* The Department of Chemistry and Biochemistry have strengths in this area, but does not offer any formal degree program in BSD.

### **Washington**

*University of Washington (UW).* The BioMolecular Structure and Design Program is an interdepartmental graduate program with faculty from the Departments of Biochemistry, Bioengineering, Biological Structure, Chemistry, and Medicinal Chemistry at UW and participating scientists at the Fred Hutchinson Cancer Research Center. The focus of the UW program is Biomolecular Structure and Design. Research interests are the study of the atomic-level structures of biologically important molecules and aims that include understanding the relationship between structure and function, predicting three-dimensional structures of biomolecules, and designing new molecules.

*Washington State University.* The School of Molecular Biosciences is an interdepartmental program with faculty from Biochemistry, Microbiology, Biophysics, Genetics and Cell Biology, Animal Science, and Zoology. It offers B.S., M.S., and Ph.D. degrees in Biochemistry, Genetics and Cell Biology, and Microbiology. Research interests include basic biochemistry and molecular biology to biomembranes, signal transduction, physical biochemistry, proteins and enzymes, immunology, virology, cell biology.

**6. Please name any accrediting agency(ies) or learned society(ies) that would be concerned with the particular program herein proposed. How has this program been developed in accordance with the criteria developed by said accrediting body(ies) or learned society(ies)?**

The Biophysical Society is a professional scientific organization with nearly 7,000 members in the United States and more than 45 countries. The Society encourages development and dissemination of knowledge in biophysics, a function that is germane to the goals of BSD. The Biophysical Society publishes a peer-reviewed journal, *Biophysical Journal* and a newsletter; it conducts an annual meeting, workshops, subgroup meetings, and outreach programs. The Education Committee, chaired by Dr. Suzanne Scarlata, is responsible for providing materials to be used by students in biology, chemistry, and physics. The Committee organizes a program for students and teachers from local high schools and colleges at each Annual Meeting. In addition, the Education Committee is concerned with continued development and updating of the Biophysics Textbook Online, an Internet tool that serves as an up-to-date educational resource for undergraduate and graduate students. The current BSD Program proposal has been reviewed and commented upon by Dr. Scarlata (see attached letter in appendix).

**7. Prepare an outline of the proposed curriculum showing course titles and credits. Please include any plans for expansion of the program during its first three years.**

The BSD curriculum will combine existing departmental offerings with new BSD courses. Courses in the BSD curriculum may be cross-listed with the participating departments. Because there will be significant overlap with curriculum in the graduate programs of the participating departments, we propose that degrees granted by the BSD program be co-credited to the academic unit of the student's advisor as well as to BSD.

The core courses of the BSD curriculum will consist of three of the five BIOC 580-series courses, and a total of nine additional credits from graduate-level elective courses chosen from existing CHEM/ BIOC/ PHAR courses and new BSD offerings.

The BSD program will introduce a new, semester-long course involving most or all BSD faculty members who will lecture for one or two weeks in an area commensurate with their field of specialty. This course, "Advanced Topics in Biomolecular Structure and Dynamics", will be offered in the first semester and will give students an opportunity to meet BSD professors in a classroom setting.

In addition to traditional classroom training, the BSD program will require that first- and second-year students participate in a weekly journal club. The journal club will foster interaction and discussion among students and will give them an opportunity to present scientific material in a collegial environment.

Other proposed activities will include regular, scheduled research presentations by faculty members and students in BSD, and a seminar series that will overlap with existing seminar series in the Chemistry, DBS, and Pharmacy units. A brief description of courses, advisory committees, comprehensive examinations, and timelines is provided in the appendix.

Required prerequisite courses:

BIOC 481/482 Biochemistry

CHEM 370 Applied Physical Chemistry or CHEM 371 & 372 Physical Chemistry

Courses which will be available to use for graduate credit:

BIOC 581 Physical Biochemistry (3cr)  
BIOC 582 Proteins and Enzymes (4cr)  
BIOC 583 Lipids and Membranes (3cr)  
BIOC 584 Nucleic Acids Biochemistry (3cr)  
BIOC 586 Advanced Molecular Biology (3cr)  
BIOC 595/695 Cellular Biochemistry (3cr)  
CHEM 581 Chemical Biology (3cr)  
CHEM 561 Biosynthesis (3cr)  
MICB 404 Molecular Genetics (3cr)  
PHAR 615 Molecular Pharmacology (3cr)  
PHAR 621 Medicinal Chemistry (3cr)

New BSD offerings:

BIOC 581 has been completely revised to emphasize modern, quantitative physical biochemistry  
Advanced topics in Biomolecular Structure and Dynamics (will be continually updated)  
Practical Approaches in Biomolecular Structure and Function (including research rotations)  
BSD seminar series (in collaboration with DBS, Chemistry, and PharmSci seminar series)  
Graduate student journal club

Research, thesis credits:

BIOC 597/599 (up to 10 credits for MS degree)  
BIOC 697/699 (up to 30 credits for the Ph.D. degree)

Total credits required: 30 for MS, 60 for Ph.D.

### **Faculty and Staff requirements**

**1. Please indicate by name and rank, current faculty who will be involved with the program proposed herein.**

Lodmell, Stephen	DBS	Assistant Professor
Ross, J.B. Alexander	Chemistry	Professor
Priestley, Nigel	Chemistry	Associate Professor
Samuels, Scott	DBS	Associate Professor
Sugden, Kent	Chemistry	Assistant Professor
Bridges, Richard	Pharm. Sci.	Professor
Thompson, Charles	Pharm. Sci.	Professor
McGuirl, Michele	DBS	Assistant Professor
Grimes, Mark	DBS	Associate Professor
Gerdes, John	Chemistry	Associate Professor
Poss, Mary	DBS	Associate Professor
Hill, Walter	DBS	Professor Emeritus
Martin, Brooke	Chemistry	Research Assistant Professor
Laws, William	Chemistry	Research Assistant Professor
Adams, Earle	Chemistry	Research Assistant Professor

Kuhn, Thomas	Pharm. Sci.	Assistant Professor
Kavanaugh, Michael	Pharm. Sci	Associate Professor
Nunberg, Jack	MT Biotechnology Center	Professor

**2. Please project the need for new faculty over the first five-year program. Include special qualifications or training. If present faculty are to conduct the new program, please explain how they will be relieved from present duties.**

We anticipate that several new faculty members who will be hired in the next five years as replacements for retiring faculty or as new faculty lines in each academic unit will work closely with the BSD program. New hires will be sought to complement the research interests of the existing faculty in the fields of structural biology, biochemistry, and biophysics. Our goal is to attract NIH-funded researchers, or new researchers who have potential to attract NIH funding. In the interim, the faculty listed above will cover the required teaching because most of the courses for BSD are currently offered as part of traditional departmental programs.

**3. Please explain the need and cost for support personnel or other required personnel expenditures.**

In the next two years, there will be no additional support personnel required for this program because of the generous offer of support from DBS and from Chemistry. As the program expands, we anticipate hiring one administrative assistant to help with recruitment, admissions, and record keeping.

**Capital outlay, operating expenditures, and physical facilities**

**1. Please summarize operating expenditure needs.**

To most effectively start this program, we request five new teaching assistantships devoted to the BSD program. In addition, DBS and Chemistry have each agreed to provide one TA dedicated to the BSD program, totaling seven teaching assistantships for the program. To recruit competitively, we must offer competitive stipends, currently in the range of \$20,000-\$25,000 per year. In addition, there will be modest outlays for student recruitment and stipends for the co-directors of the BSD program.

	Year 1	Year 2	Year 3
<b>Enrollment</b>	5	10	15
<b>Expenditures</b>			
<b>Category</b>			
Graduate student stipends	\$100,000	\$200,000	\$300,000
Tuition waivers	40,000	80,000	120,000
Recruitment	4,000	4,000	4,000
Supplies and Seminars	4,000	4,000	4,000
Co-directors' stipend	3,000	3,000	3,000
<b>Annual Totals</b>	<b>151,000</b>	<b>291,000</b>	<b>431,000</b>

<b>Revenue</b>			
State reallocation	24,000	24,000	24,000
Federal grants	127,000	267,000	407,000
Total revenue	151,000	291,000	431,000

Future teaching assistantships should be augmented in number by external grant support, as described above.

**Sources of funding:** Provost Lois Muir has agreed to commit resources for one graduate stipend annually, and Prof. Chuck Thompson, UM director of the Montana NSF-EPSCoR program has endorsed the BSD program as one of the principal emphases of the 2004-2007 EPSCoR proposal (see attached). As such, the BSD program will be fully funded by EPSCoR for the first three years, pending success of the EPSCoR application. As the program becomes established, the BSD program will apply for NIH Graduate Training Grants, NSF Interdisciplinary Graduate Education Research Training (IGERT) grants, and/or Department of Education Graduate Assistance in Areas of National Need (GAANN) grants to help support the program.

**2. Please evaluate library resources. Are they adequate for operation of the proposed program? If not, how will the library need to be strengthened during the next three years?**

With the continued implementation of electronically available journals at The University of Montana, the library facilities will be adequate to support this program. Because the interdisciplinary program draws from Biology, Chemistry, and Pharmaceutical Sciences and because the basic library needs for these programs are met with the current resources at the Mansfield Library, we do not anticipate additional library requirements for the program. The recent efforts toward improving our electronic access to journals has greatly expanded and improved our library resources.

**4. Please describe facilities and space required for the proposed program. Are current facilities adequate for the program? If not, how does the institution propose to provide new facilities?**

All investigators who will be involved in the program currently have laboratory and office space. Although space has not been specifically identified for the proposed new faculty members, expansion plans are in place in each academic unit.

Significantly, we have several state-of-the-art shared core instrumentation facilities on campus that provide necessary infrastructure for the proposed program. These include the Murdock Molecular Biology facility in DBS that provides oligonucleotide synthesis and DNA sequencing, the Electron Microscopy facility in DBS, which is equipped with a transmission and a scanning electron microscope, the spectroscopy facility in Chemistry, that is equipped with nuclear magnetic resonance (NMR), electron paramagnetic resonance (EPR), fluorescence and total internal reflectance (TIR) spectroscopy, and the Mass Spectrometry laboratory in Pharmaceutical Sciences that is equipped with three mass spectrometers. Each of these core facilities is staffed with a full time technician or scientist who provides service and/ or technical assistance with the experimental design and implementation.



**Evaluation of proposed program**

**1. Please name faculty committees or councils that have (or will) reviewed and approved the program herein proposed.**

Faculty of Biochemistry/Microbiology program, Division of Biological Sciences  
Faculty of Chemistry Department  
Faculty of Pharmaceutical Sciences  
Graduate Council, The University of Montana  
Faculty Senate, The University of Montana

**2. If outside consultants have been employed, please list the names of these consultants, their current positions, and titles. Append copies of their written reports (this is required of new doctoral programs).**

1. Suzanne Scarlata, Associate Professor, Department of Physiology and Biophysics, Stony Brook.
2. Richard Ludescher, Associate Professor, Department of Food Science, Rutgers University
3. Katherine Borden, Associate Professor, Department of Physiology and Biophysics, Mount Sinai School of Medicine, NY

**Stony Brook University**  
**Health Sciences Center**  
*School of Medicine*

Department of Physiology and  
Biophysics

March 20, 2003

Dr. J.A.B. Ross  
Department of Chemistry  
University of Montana  
Missoula, MT 59812-0001

Dear Dr. Ross:

I have read your proposal for an interdisciplinary graduate program in Biomolecular Structure & Dynamics at your institution and strongly support your effort. In recent years, it has become apparent both by government organizations and private research corporations of the need for biophysics and biochemistry in health and agricultural-based research. This view can be seen by the initiation of biophysics based training grants through the NIGMS, GAANN and the IGERT program of NSF. An integrated program such as the one you propose is, in my opinion, the best way to prepare students for careers in health related research.

Front the proposal that you have sent, the organization of your program in terms of curricula looks very comprehensive and the need for such a program justified. We have a similar type of program here at Stony Brook that is supported through GAANN. I will be more than willing to offer any specific advice both from my experiences as Director of Graduate Studies in Physiology & Biophysics and Chair of the Education Committee of the Biophysics Society.

Best of Luck,

Suzanne Scarlata  
Associate Professor of Physiology & Biophysics

THE STATE UNIVERSITY OF NEW JERSEY

# RUTGERS

Richard D. Ludescher, Ph.D.

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March 10, 2003

J.B. Alexander Ross  
Department of Chemistry  
University of Montana

Dear Sandy;

The proposal to initiate a novel graduate program in Biomolecular Structure & Dynamics at The University of Montana is important, sound, and timely. I endorse it unequivocally.

The proposed area is of vital importance for biological and biomedical research. As you well know, the structure and dynamics of biomolecules determine biological function.. Our ability to predict, control, and manipulate biological functions, or to correct the biological dysfunctions of congenital or transmitted diseases, presupposes a detailed molecular understanding of the structure and dynamics of proteins, nucleic acids, carbohydrates, lipid membranes, and the numerous ways in which they interact and assemble into complexes, organelles, cells, tissues, and whole organisms. The new program will certainly enhance the stature of The University of Montana in this important area of biological research.

The proposal for a novel graduate program that builds on the strengths of existing faculty from three departments, and which will motivate future hires with specialization in biomolecular structure and dynamics, is a sound use of resources that will quickly and efficiently position The University of Montana as a regional leader in biophysical research. The existence of a stand-alone interdisciplinary program should significantly improve your chances of attracting outstanding graduate and post-doctoral students and of attracting federal support for your students through training grants. As just one small example of this opportunity, I chair a new sub-committee of the Biophysical Society that will develop an extensive educational website for biophysics; one element of this site will be a complete listing for prospective students of undergraduate and graduate opportunities in biophysics; this new program would certainly be listed on that site (whereas your existing programs would probably not qualify).

The existence of a new program focused around biomolecular structure and dynamics should also catalyze and promote novel research and enhance funding opportunities by bringing faculty and students together with a common purpose. Such synergies, albeit in many ways intangible, are vitally important for scientific progress. In short, the area of specialization is important, the need is great, the opportunities are vast, and the proposal is sound. I sincerely hope that your proposed program quickly becomes a reality.

Sincerely,

Rick Ludescher

**Moupi  
Sinai**

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J.B.A. Ross  
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14 March 2003

Dear Dr Sandy,

Re: A new, expanded, cooperative or off-campus instructional programme leading to MS/Ph.D. Biomolecular Structure and Dynamics in the area of Biomolecular Structure and Dynamics.

I have read your proposal to develop a graduate student training area in Missoula. At Mt Sinai, we have already instituted such a program, which you were key in developing while still here. This program has remained popular with new graduate students, especially given the broad interest in understanding protein and nucleic acid structure and dynamics at the atomic level. This training area will greatly benefit the University in terms of encouraging student interest and training students for future work in such high profile industries as rational drug design. It's implementation at the university, would be a great asset and undoubtedly attract future graduate students.

Your plan for implementing this programme is well thought out and will undoubtedly become extremely popular.

Best wishes,

Kathy