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Neuroscience M.S./Ph.D. Program Proposal

A Collaborative Proposal

**Between the Department of Cell Biology and Neuroscience, MSU-Bozeman
and the Department of Biomedical and Pharmaceutical Sciences, UM**

PROGRAM DESCRIPTION

Overview

The proposed new program is a Master's and Doctoral (M.S./Ph.D.) degree program in Neuroscience. This program will be a collaborative graduate program between the Department of Cell Biology and Neuroscience at Montana State University - Bozeman and the Department of Pharmaceutical Sciences at The University of Montana. Neuroscience encompasses a wide variety of scientific disciplines concerned with all aspects of the structure and function of the nervous system both in the normal state and during disease and/or injury. The proposed new graduate program is a natural result of the rapid growth in neuroscience that has occurred simultaneously on both campuses. At MSU, the recently created Department of Cell Biology and Neuroscience (CBN, created in July of 2000) now includes 14 faculty members. CBN currently offers the M.S. and Ph.D. degrees in Biological Sciences, a shared graduate program with the Dept. of Ecology that originated many years ago under the old Biology Dept. This "umbrella" degree program no longer serves the needs of the faculty and graduate students in CBN. At the University of Montana, the newly established COBRE Center in Structural and Functional Neuroscience (CSFN) has helped to bring 6 new neuroscientists to the UM campus (for a total of 14 neuroscience faculty). Establishment of a collaborative Neuroscience graduate program between MSU and UM will enable the two campuses to use their resources in synergy, creating a nationally competitive graduate program in neuroscience at minimal cost. The objectives of the new program are: (1) to attract the best possible graduate students in neuroscience to Montana; (2) to provide comprehensive multidisciplinary training and research opportunities to the students enrolled in the program; (3) to enrich undergraduate education in CBN by providing well trained and highly motivated graduate teaching assistants; (4) to provide highly trained and versatile scientists to meet the needs of the growing biotechnology sector in Montana; and (5) to gain national recognition for the Montana University System through the future accomplishments of our graduates in the field of neuroscience.

The new program is highly innovative in that it will utilize the Access Grid Node (AGN) to teach shared classes. The AGN is an internet-based video conferencing technology that will allow selected classes to be held simultaneously on both the MSU and UM campuses. CBN faculty and staff have been instrumental in establishing AGN technology at MSU, where the AGN classroom is housed in the Center for Computational Biology affiliated with CBN. The University of Montana has a new AGN classroom in the Honors College. This technology will allow faculty and students at both Universities to simultaneously participate in lectures and seminars, in essence creating

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a single classroom between the two sites. The advantage for students is that all 28 neuroscience faculty at MSU and UM will have the opportunity to participate in providing graduate education to the students.

Needs Assessment

The Association of Neuroscience Departments and Programs (ANDP), a North American organization created in 1981 to promote training and research in neuroscience, published a summary report of the third annual ANDP national survey in May 2000. The survey indicates that as neuroscience has matured into a distinct discipline, there has been growth in the number of students applying and accepted into neuroscience programs. In 1986 there were an average of 24 applicants per program, whereas by 1998 there were an average of 61 applicants per program. Graduates of neuroscience programs continue to find jobs at universities, research institutes, and pharmaceutical and biotechnology laboratories. The survey also suggested that the number of available jobs for neuroscientists is likely to increase due to the expansion of the biotechnology and pharmaceutical industries and the emergence of bioinformatics.

The Society for Neuroscience (SFN), the main professional society for neuroscientists, has determined that current and future research needs within the areas of neuroscience encompass the integration of research among all neuroscience-related disciplines, including fields beyond biology and medicine such as the physical and social sciences, as well as the translation of neuroscience fundamental knowledge into strategies for the treatment of nervous system disorders, such as neurological, neurosensory, neurodevelopmental, psychiatric, addictive and other related illnesses. These needs have been incorporated into the SFN strategic plan (www.sfn.org/strategicplan) and reinforce the necessity for broad-based graduate training in the neurosciences.

Relation to the Role and Scope of Montana State University and the Dept. of Cell Biology and Neuroscience

The Mission of Montana State University is:

To provide a challenging and richly diverse learning environment in which the entire university community is fully engaged in supporting student success. To provide an environment that promotes the exploration, discovery, and dissemination of new knowledge. To provide a collegial environment for faculty and students in which discovery and learning are closely integrated and highly valued. To serve the people and communities of Montana by sharing our expertise and collaborating with others to improve the lives and prosperity of Montanans.

The creation of the department of Cell Biology and Neuroscience (CBN) within the College of Letters and Science in July of 2000 has opened new opportunities for our faculty to fulfill the MSU Mission at both the undergraduate and graduate levels. With over 400 undergraduate majors and \$4,700,000 in research grant expenditures in FY=02, CBN is already promoting both learning and discovery within a substantial community of students and scholars. Our goal in graduate education is to train a new

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generation of biological scientists equipped to exploit advanced experimental and computational approaches to develop a comprehensive understanding of nervous system function. Creation of a collaborative M.S./Ph.D. program in Neuroscience will enhance the ability of both MSU and UM to compete nationally in attracting the very best graduate students, students who will enrich the university community. These graduate students will play essential roles both in providing high quality undergraduate instruction as Teaching Assistants and in discovering new knowledge while pursuing their research projects in our funded laboratories.

Relation to the Administrative Structure of MSU

The proposed program will not affect the present administrative structure of Montana State University-Bozeman. The graduate program will be part of the College of Graduate Studies and will be housed within in the Department of Cell Biology and Neuroscience in the College of Letters and Science. A Graduate Coordinator for the Program in Neurosciences will be appointed by the departmental chair. Dr. Charles Paden is currently the acting Graduate Coordinator for the department. The Coordinator will serve as principle liaison with the Dean of the Graduate School on all matters relevant to graduate applications and student progress through the program.

Involvement of Other Departments and Campuses

New courses offered through the Program will be available to enrich the educational opportunities for interested graduate students from other departments and colleges at MSU-Bozeman. Similarly, courses currently offered by the departments of Chemistry & Biochemistry, Veterinary Molecular Biology, Math, Computer Science, and Microbiology are available as electives to broaden the opportunities available to doctoral students in Neuroscience.

The rapid growth in the neuroscience faculty and their funded research programs at both Montana State University-Bozeman and The University of Montana has driven the development of this graduate program. The expertise and research interests of the faculty on the two campuses complement each other, and taken together provide an opportunity to create a comprehensive graduate training program in Neuroscience. Research foci in CBN include the cellular and molecular basis of neural development, neurophysiology and computational biology of sensory systems, and response of the central nervous system to injury. Faculty interests at the University of Montana are focused in neurochemistry, neuropharmacology, neurotoxicology, and disease processes. Clearly the research strengths at each institution complement each other. The fact that many neuroscience faculty at MSU and UM are already engaged in collaborative efforts emphasizes the cohesiveness of this group of faculty researchers. Neuroscience doctoral students participating in the collaborative program will greatly enhance this cooperative effort and will provide an essential link between research at the two institutions. In addition, a strong doctoral program is essential for attracting outstanding faculty who can enhance undergraduate education, graduate education,

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and research in the neurosciences at both campuses.

Relation to Other Neuroscience Graduate Programs in the Region

At present, neither Montana, North Dakota, South Dakota, or Idaho provide a comprehensive Ph.D. program in neuroscience. The University of North Dakota and the University of Idaho are in the process of trying to implement doctoral programs in neuroscience but are limited by the very broad spectrum of faculty expertise required to provide a comprehensive Ph.D. program. Formal training programs for graduate students to pursue a Ph.D. in Neuroscience are currently available in Washington State, Wyoming, Oregon, Utah, and Colorado.

A collaborative M.S./Ph.D. program between Montana State University-Bozeman and the University of Montana would combine faculty expertise and resources in education, research, and technology to generate a comprehensive graduate training program in neuroscience. The strength of the University of Montana in neuropharmacology and neurochemistry complements the strength of Montana State University in developmental, systems and computational neuroscience to create a truly outstanding interdisciplinary neuroscience master's and doctoral program that would provide a unique and exceptional training opportunity for students that meets national and regional needs.

Summary of programs in the region

Montana: No formal Ph.D. training programs in Neuroscience are available for students

North Dakota: No formal Ph.D. training in Neuroscience is available.

South Dakota: No formal Ph.D. training in Neuroscience is in place.

Idaho: No formal Ph.D. training in Neuroscience is available at the University of Idaho or at Idaho State University.

Washington: The University of Washington houses the graduate Program in Neurobiology and Behavior.

This interdisciplinary program encompasses over 80 faculty from 15 different departments within the College of Arts and Sciences and the School of Medicine. Education and research provide a broad background ranging from molecular, to developmental, cellular, systems, and behavioral neuroscience. Washington State University offers a Ph.D. degree in Neuroscience that is an interdisciplinary program. The program is administered through the Department of Veterinary and Comparative Anatomy, Pharmacology and Physiology (VCAPP) in the College of Veterinary Medicine.

Oregon: The University of Oregon houses an interdisciplinary Institute of Neuroscience. Oregon Health Sciences University provides the multidisciplinary Neuroscience Graduate Program to prepare students for research areas ranging from molecular to behavioral neurobiology.

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Utah: The University of Utah offers an interdepartmental graduate program in neuroscience. Training and research foci include electrophysiology, molecular biology, genetics, and behavior and cognitive neuroscience.

Colorado: An interdisciplinary graduate program is offered at Colorado State University. The program emphasizes cellular, molecular and integrative aspects of nervous system function and systems neuroscience. The University of Colorado Health Science Center (UCHSC) provides a multidisciplinary Training Program in Neuroscience. The University of Colorado Boulder houses a Center of Neuroscience and offers an interdisciplinary graduate training program in neuroscience.

Wyoming: The Departments of Psychology, Zoology and Physiology, and Molecular Biology together with the College of Pharmacy provide an interdisciplinary graduate program in neuroscience.

Proposed Curriculum for Master's and Doctoral Students Enrolled at MSU-Bozeman.

Minimum credit requirements for Doctoral students:

Required core courses (4)	12 credits
Elective courses (5)	15 (or more) credits
Dissertation credits (Biol 690).	18 credits
Minimum Total	45 credits

Minimum credit requirements for Master's students:

Required core courses (4)	12 credits
Elective courses (3)	8 (or more) credits
Dissertation credits (Biol 590).	10 credits
Minimum Total	30 credits

I. Required core courses

Biol 6xx	Neurosciences I*	3 cr.
Biol 6xx	Neurosciences II*	3 cr.
VTMB 424	Ethical Practice of Science	3 cr.
Stat 524	Biostatistics	3 cr

*Neurosciences I and II will be team-taught by faculty from MSU-Bozeman and the University of Montana and will be offered simultaneously on both campuses using Access Grid-Node technology. This two semester sequence will be taken during the first year of graduate school and will provide a comprehensive introduction to all areas of neuroscience.

II. Elective courses.

Students will take a minimum of 3 to 5 additional elective courses in order to tailor their graduate program to their specific areas of research interest.

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Individual students may be required to take additional courses beyond the minimum program requirements as determined by their department or Graduate Committee. Students will be able to choose electives from a wide variety of courses offered by faculty from CBN, other MSU departments, and UM.

Courses taught by CBN faculty

Biol 510	Topics in Neurobiology*	3 cr
Biol 5xx	Systems Neuroscience	3 cr
Biol 5xx	Molecular Neuroscience	3 cr
Biol 5xx	Advanced Neurophysiology	3 cr
Meds 512	Mechanisms in Cellular Physiology	4 cr
Meds 532	Nervous System	6 cr

* This course rotates between different faculty who choose the specific topic to be covered. Examples of recent topics are Injury and Repair of the Mammalian Brain, Axonal Sprouting, Neuroethology, and Neurophysiology of Vision.

Courses taught by other departments at MSU (all are 3 credits)

BChm 544	Molecular Biology
BChm 541	Lipids and Membranes
BChm 543	Proteins
BChm 550	X-Ray Crystallography
CS 432	Computational Biology
Math 455	Intro to Dynamical Systems
Math 551	Complex Analysis
MB 525	Advanced Immunology
MB 528	Advanced Genetics
MB 538	Cell and Molecular Biology
VTMB 505	Eukaryotic Gene Regulation

Courses taught by UM faculty*

Phar 610	Neuropharmacology	3 cr
Phar 646	Neurotoxicology	2 cr
Phar 66y	Neurobiology of Disease	3 cr
Phar 66z	Structural Neurobiology	3 cr
Phar 615	Molecular Pharmacology	3 cr
Phar 621	Advanced Medicinal Chemistry	3 cr
Phar 626	Research Meth Bioc Pharmacol	3 cr
Phar 630	Pharmacogenetics	3 cr
Phar 641	Toxicology I	4 cr
Phar 642	Toxicology II	4 cr
Phar 643	Cellular and Molecular Toxicology	4 cr
Phar 644	Immunotoxicology	3 cr

* These courses would be made available to MSU students via the Access Grid-Node

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on an “on demand” basis. Alternatively, an MSU student whose research required advanced training in neuropharmacology or neurotoxicology could arrange to spend a semester or more in residence at UM. Similarly, UM students who wish to pursue more extensive training in computational neuroscience, for example, would have the opportunity to spend one or more semesters in residence at MSU.

III. Additional requirements

- A. All doctoral students will complete 3 research lab rotations of approximately 8 weeks each during their first year in the program. Students will be strongly encouraged to rotate through laboratories at both campuses.
- B. All students will be required to serve as a Teaching Assistant for a minimum of 2 semesters.
- C. All students will be required to participate in a Current Research Literature seminar at least one semester each year.

FACULTY AND STAFF REQUIREMENTS

Faculty

There are currently 14 MSU faculty in the Dept. of Cell Biology and Neuroscience who will be involved in the graduate program in Neuroscience (below).

Roger Bradley, Ph.D., Assistant Professor
Alex Dimitrov, Ph.D., Assistant Professor
Steven Eiger, Ph.D., Associate Professor
Susan Gibson, M.S., Lecturer
Charles Gray, Ph.D., Professor
Thomas Hughes, Ph.D., Associate Professor
Gwen Jacobs, Ph.D., Associate Professor and Head
Frances Lefcort, Ph.D., Associate Professor
Jim McMillan, Ph.D., Professor
Christa Merzdorf, Ph.D., Assistant Professor
John Miller, Ph.D., Professor
Charles Paden, Ph.D., Professor
Dwight Phillips, Ph.D., Professor
Anne Rusoff, Ph.D., Associate Professor

In addition, the following 14 faculty at UM will participate in the collaborative program.

Steven Black, Associate Professor
Richard J. Bridges, Professor
Fernando Cardoza-Peleaz, Assistant Professor
C. Sean Esslinger, Research Assistant Professor
Charles L. Eyer, Professor
John M. Gerdes, Associate Professor
Mark L. Grimes, Associate Professor

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Craig A. Johnston, Associate Professor
Michael P. Kavanaugh, Associate Professor
Thomas B. Kuhn, Assistant Professor
Diana I. Lurie, Associate Professor
Keith K. Parker, Associate Professor
David J. Poulsen, Research Assistant Professor
Charles M. Thompson, Professor

No additional faculty hires are needed to implement the proposed program. Team teaching and rotation of assignments among the total of 28 faculty involved at the two institutions will make it possible to offer the new courses required for the program with no net reduction in faculty contributions to other undergraduate and graduate programs. The 15-20 students anticipated to be enrolled in the graduate program at MSU will be mentored by 10 faculty with funded research programs. The substantial number of faculty who will participate in both mentoring and teaching provide a breadth of expertise that will allow the MSU-UM collaborative M.S./Ph.D. program to immediately establish itself as one of the premier neuroscience programs in the Northwest.

Staff

Staff who currently support the graduate program in Biological Sciences within CBN will be reassigned to the new Neuroscience program. These include approximately 0.2 secretarial FTE and 0.2 technical network support FTE. No additional staff are required to implement the Neuroscience graduate program.

FISCAL IMPACT

Enrollment and Student Support

CBN currently has 3 M.S. and 9 Ph.D. students enrolled in the Biological Sciences graduate degree program. All of these students would be offered the opportunity to switch to the new Neuroscience degree program (except for any students that may graduate before its inception). Enrollment of an additional 2 or 3 Ph.D. students per year for the first 4 years of the new program is a realistic goal, and it is anticipated that between 15 and 20 Ph.D. students would be enrolled in the program at MSU from then on. Our intention is to offer an annual stipend of \$18,000 to all doctoral students enrolled in the program. Once the new program is established, CBN will offer the M.S. and Ph.D. degrees in Biological Sciences only in special cases. Teaching assistantships currently assigned to CBN students enrolled in the Biological Sciences doctoral program will be made available to students in the new Neuroscience program. Financial support is also available to CBN students from faculty research grants, departmental indirect cost returns, and on a competitive basis through the NSF funded graduate program in Complex Biological Systems and the EPSCoR Program. The ability to offer a true multidisciplinary graduate program in Neuroscience will enable MSU (and UM) to compete more effectively for additional graduate training grants in the future.

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Costs and Revenues

	2004 -2005	2005 -2006	2006 -2007
<i>Anticipated enrollment</i>			
From Biological Sciences	10		
New	2	3	3
TOTAL	12	15	18

Total enrollment is anticipated to vary between 15 and 20 students from 2007 on.

Expenditures

Student support (@18,000/FTE)			
GTA=s (10@9000/0.5FTE)	90,000	90,000	90,000
GRA=s	126,000	180,000	234,000
Staff (0.40 FTE), salary + benefits	9,920	10,317	10,729
Library support	2,500	2,600	2,700
GRAND TOTAL	228,420	282,917	337,429

Revenues

Shifted GTA's	90,000	90,000	90,000
Faculty Research grants, training grants, and departmental IDC's	138,420	192,917	247,429
GRAND TOTAL	228,420	282,917	337,429

RESOURCES AND PHYSICAL FACILITIES

Library Resources

Neuroscience is an interdisciplinary science and as such, the library needs for this discipline are extremely diverse. The libraries at both MSU-Bozeman and UM are committed to providing electronic access to the majority of journals relevant to the field of neuroscience, and the advent of e-journal access provided by scientific publishing houses ensures that a wide-range of journals are available on both campuses. At MSU and UM these packages include Science Direct, The American Chemical Society, Annual Reviews, OVID, Blackwell-Synergy, Wiley Interscience, and Science. In addition, the MSU library has substantially expanded the availability of electronic publications in recent years, and now offers e-journal suites from Academic Press, Elsevier, Kluwer, JSTOR, and Nature. MSU also subscribes to the powerful Web of Science database offered by Science Citation Index, enabling full citation searching for virtually any neuroscience article. While neuroscience faculty will continue to work with the library staff in identifying areas where expanded access would be beneficial, no

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specific additions are required with respect to this proposal.

Laboratory, Equipment and Computer Resources

The scientific instrumentation available on both the MSU-Bozeman and UM campuses is extensive and comparable to most medical school departments. Laboratories and offices of CBN faculty are located on the 5th floor of Leon Johnson Hall and in the Center for Computational Biology in the basement of Lewis Hall. Shared research facilities include cell culture, confocal and electron microscopy, image analysis, and computational capabilities. These include a Leitz confocal microscope equipped for two-photon excitation, an optical recording workstation, an Origin 2000 minisupercomputer, a 32 processor/16 GB Beowulf cluster, and a high bandwidth Access Grid Node connected directly to the high speed MSU Internet 2 backbone. Much additional advanced instrumentation in the life sciences including mass spectroscopy and gene chip facilities are available on the MSU campus. These facilities provide outstanding support for graduate students at both the M.S. and Ph.D. levels, and no additional facilities or space are required at either campus to establish a graduate program in Neuroscience. A number of state-of-the art core facilities are also available to both faculty and students in the UM campus and include tissue culture, molecular modeling, histology, confocal microscopy and imaging, and both molecular genetics and proteomics core facilities located in the Skaggs building.