

## ITEM 116-2011-R0702: Graduate Certificate Program in Complex Biological Systems

### PROGRAM DESCRIPTION

**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; an on-campus or off-campus program. Attach any formal agreements established for cooperative efforts.**

The Graduate Certification in Complex Biological Systems (CBS), a new on-campus program, is designed to provide multidisciplinary, cutting-edge scientific training to students pursuing their PhD in biological research. The CBS curriculum integrates with the student's chosen departmentally-based PhD program to transform it into a cross-cutting, multidisciplinary educational experience. Over 30 faculty from eight departments across campus (Chemistry and Biochemistry, Cell Biology and Neuroscience, Microbiology, Plant Sciences, Veterinary Molecular Biology, Computer Science, Electrical/Computer Engineering and Mathematical Sciences) will participate to provide innovative graduate training opportunities that cut across departmental boundaries.

We believe that the increasing relevance of such a multidisciplinary graduate program necessitates the creation of a new administrative structure to appropriately deal with the non-departmental nature of this mode of study. We therefore propose that in the proposed program, graduate students be admitted to CBS upon entry to MSU, and participate in three research rotations (10 weeks each) with CBS faculty members in any of the eight departments in their first year. Students will become affiliated with one of the participating departments after year one, where they will complete departmental PhD requirements within the compatible CBS program structure. Upon graduating and completion of CBS requirements, the student will receive a PhD through his/her home department, as well as a "CBS program certificate."

Currently, 15 graduate students enrolled in PhD programs in Biological Sciences (neuroscience option), Chemistry and Biochemistry, Mathematics, and Veterinary Molecular Biology are receiving NSF-IGERT (CBS fellowship) funding. These students have taken the CBS courses, participate in weekly CBS seminars, have performed research rotations and are engaged in multidisciplinary research projects. Currently, these students have no formal recognition by the MSU administration of the multidisciplinary nature of their graduate study program. Implementation of a CBS graduate certification program would allow such formal recognition, as well as allow a stronger and more rigorous program to be established.

Current CBS fellowship requirements (proposed CBS program requirements):

- Coursework. CBS 610, 611, 612, 613 (offered through 7 participating CBS departments); VTMB 424 (Ethical Practice of Science); and Bioinformatics or a similar multidisciplinary course.
- Completion of three laboratory rotations.
- Active participation in the weekly CBS seminar series, summer research technique workshops, and completion of off-site research/training (the "Out-of-Montana Experience").
- Two semesters of teaching assistant experience, one semester undergraduate mentoring.
- Satisfactory completion of a multidisciplinary research project supervised by two CBS faculty in different research areas, culminating in the publication of at least one peer-reviewed manuscript.
- Completion of the PhD degree through the student's home department.

Key reasons why program status is necessary and appropriate:

- Program status will allow CBS to admit graduate students, avoiding departmental "labels" that are so problematic for multidisciplinary studies.
- Program status is appropriate for CBS, which offers a coherent course of study incorporating multidisciplinary elements throughout the graduate student's course of study.
- Effective recruitment of students necessitates a formal program structure.
- Program status affords better visibility on MSU web pages, bulletin, etc.

We feel strongly that the CBS program will continue to be granted extramural funding in support of its graduate training efforts, and will become a permanent, visible and successful fixture of cutting-edge graduate training at MSU.

**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.**

In a 1995 National Academy of Sciences (NAS) report on "Reshaping the Graduate Education of Scientists and Engineers," the NAS Committee on Science, Engineering and Public Policy noted that although graduate education of scientists and engineers has long set the international standard, adjustments need to be made in graduate education to prepare doctoral students for the changing nature of our nation's workforce. Increased national demand for doctoral level scientists and engineers in professional service, applied research, development and consulting, necessitates a reshaping of attitudes toward post-baccalaureate education to develop more broadly educated, versatile graduates. Indeed, the committee noted "broad criticism from many [nontraditional] employers concerning graduates' immediate suitability for entry jobs – criticism that is often based on a belief that students are too specialized, in view of the variety of tasks that they will confront, and that it is hard for them to adapt to the demands of nonacademic work" (75). Additionally, the committee found that "the disadvantages of overspecialization in graduate school...are real for both the student and the nation, whether or not the student becomes a researcher. Excessive concentration in a particular subfield can limit a person's later research contributions and affect later career choices" (77).

The National Science Foundation responded to these national trends by implementing the IGERT program. As described by the NSF:

“The Integrative Graduate Education and Research Traineeship (IGERT) program was developed to meet the challenges of educating Ph.D. scientists and engineers with the multidisciplinary backgrounds and the technical, professional, and personal skills needed for the career demands of the future. The program is intended to catalyze a cultural change in graduate education, for students, faculty and universities, by establishing new, innovative models for graduate education in a fertile environment for collaborative research that transcends traditional disciplinary boundaries.”

These national mandates certainly speak to the needs of Montana. With employers looking more and more for versatile, broadly educated science and engineering graduates, it becomes the responsibility of the university that serves this state to provide the kind of education employers demand. As such, CBS is a powerful recruiting and retention tool for Montana State University. Many students currently funded by the NSF-IGERT grant and engaging in multidisciplinary studies under the CBS banner looked into other graduate programs in other states, but chose to participate in the CBS curriculum because of the opportunities for interdisciplinary study. In the words of one current graduate student:

“I did a thorough search before I chose CBS at MSU. Most interdisciplinary programs either narrow their training in the “edges” of some fields, or bring the dependence on certain faculty members. No one provided such a broad exposure to different scientific topics, various lab techniques and multidisciplinary insights as CBS.”

The CBS curriculum is also an effective retention tool for graduate students who are finding that traditional MSU graduate programs are not fitting their needs. Of the 15 PhD students who are currently funded through the NSF-IGERT grant, four were initially pursuing PhDs through traditional departmental curricula at MSU. The multidisciplinary research offered by CBS has resulted in the retention of three of these graduate students who otherwise would have gone elsewhere for their graduate education. One student stated “there is no question in my mind that without CBS, I would have left MSU. I was going to apply out of state [for graduate programs] when [a CBS faculty member] suggested I apply for CBS.”

Each year that CBS fellowships have been awarded has seen an increase in the quantity and quality of applicants. For the 1999 academic year, there were 4 applicants for CBS fellowships (1 was awarded). For 2000 fellowships, 9 applications were submitted from incoming graduate students (3 were awarded), with one current MSU graduate student also receiving a fellowship that Fall. In Spring 2001, 3 current MSU graduate students received CBS fellowships. For Fall 2001, there were 15 applicants (6 fellowships were awarded), and for Fall 2002, there were 24 applicants (as of June 2002, 6 awards made, with more under consideration).

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

As the University’s April 2002 mission statement declares, MSU is dedicated to “provide a challenging and richly diverse learning environment...in which discovery and learning are closely integrated and highly valued.” Furthermore, the University strategic priorities (for FY03) are recruitment (including expanding the graduate student population), retention (including fulfilling student interest/preferences for specific academic programs) and quality enhancements (including enhancing the quality of our academic offerings). The CBS program, with its emphasis on much-needed and highly desired multidisciplinary approaches to graduate education, clearly meshes well with all these directives. MSU Bozeman is a campus which emphasizes research and encourages collaboration among faculty on campus, and therefore is uniquely positioned to implement IGERT programs and carry out this mission. NSF-IGERT programs are designed to foster the growth and development of interdisciplinary research, and to strengthen the environment for collaboration and cooperation between faculty. Such an environment enhances the recruitment and retention of quality graduate students, and strong faculty researchers and teachers. It also builds an environment that has already, and will continue to make, an increase in successful grant writing possible.

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

The program will have no effect on the administrative structure of the institution. One faculty member will serve as project director. The CBS curriculum is currently well supported by the participating departments (see Addendum A: Internal Letters of Support).

The program is designed to complement and fill out existing departmental PhD programs. It is not an “in addition to” program but rather an integrated multidisciplinary program that transforms the existing program into a fuller-multidisciplinary approach to learning.

### **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.**

There are no similar multidisciplinary programs that formalize cooperation between so many science and engineering departments in the state or the Pacific Northwest. CBS fulfills a unique academic niche which will help MSU become a preeminent research institution in the region. Of 79 IGERT grants awarded since 1998, this is the only one in Montana (neighboring states with IGERT programs include Washington (4), Oregon (3), Colorado (2), Idaho (1), Utah (1), and Alaska (1)). However, these IGERT programs in neighboring states have different research foci. The closest similar program is the IGERT-funded Program in Computational Neuroscience at the University of Minnesota. However, the MSU IGERT, although having neuroscience as a component, is more encompassing of other research areas. CBS has five research clusters; neural basis of information processing, neuronal growth and differentiation, intracellular transport mechanisms, cell signaling systems and molecular recognition in cell adhesion, engaging researchers from the eight participating departments in three different colleges at MSU.

**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)?**

There are no accrediting agencies or societies that have established criteria for multidisciplinary graduate training certifications. However, because it is an IGERT program, the success of CBS is closely monitored by the National Science Foundation. The NSF performs exhaustive annual reviews of the program and sponsors IGERT program directors meetings and site visits to ensure program goals are met.

**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.**

I. Requirements for the proposed CBS graduate certification program:

1. Satisfactory performance in the CBS core graduate courses: Structural and Functional Organization of Complex Biological Systems (with Complex Biological Systems Laboratory I); and Structure and Mechanisms of Complex Biological Systems (with Complex Biological Systems Laboratory II).
2. Completion of scientific ethics course (VTMB 424 "Ethical Practice of Science").
3. Completion of Bioinformatics graduate course, or other suitable multidisciplinary course integrating elements of mathematics, computer science or engineering with biological research.
4. Three 10-week laboratory rotations (normally completed in the student's first year).
5. CBS comprehensive examination, coordinated through the student's home department.
6. Two semesters of teaching assistant experience (normally in the second and third years).
7. Mentoring of undergraduate students (at least one student for one semester/summer).
8. Attendance at advanced summer workshops led by visiting experts in areas relevant to CBS research.
9. "Out of Montana" experience: individualized instruction or research, lasting several weeks to several months, at another institution to complement the research strengths available at MSU.
10. Publication of at least one peer-reviewed manuscript.
11. Successful completion of research in CBS, acceptance of PhD dissertation in a CBS theme, successful public defense of dissertation according to graduate school guidelines.
12. Students admitted to CBS must also fulfill the requirements of the doctoral program in their home department.

II. Description of Required Courses:

**610. Structural and Functional Organization of Complex Biological Systems** (3 units). First semester of a two-semester sequence (with course 611). Course goal is to integrate understanding of the components of biological systems into quantitative models of the integrated, intact systems. Topics covered include signal transduction, cellular organization, molecular motors, and the neural basis of learning and memory. (Offered as BCHM 610, BIOL 610, CS 610, MATH 610, MB 610, PS 610, and VTMB 610).

**611. Structure and Mechanisms of Complex Biological Systems** (3 units). Second semester of a two-semester sequence (with course 610). This course continues to examine complex biological systems. Topics covered include genomic analysis, prediction of protein folding, allosteric regulation and nitric oxide signaling, and modeling of biological systems. (Offered as BCHM 611, BIOL 611, CS 611, MATH 611, MB 611, PS 611, and VTMB 611).

**612. Complex Biological Systems Laboratory I** (2 units). To be taken concurrently with course 610. Provides hands-on experience in computer simulations of complex biological systems, and trains students to have a broad command of the experimental techniques used in the observation of complex biological systems. (Offered as BCHM 612, BIOL 612, CS 612, MATH 612, MB 612, PS 612, and VTMB 612).

**613. Complex Biological Systems Laboratory II** (2 units). To be taken concurrently with course 611. Continuation of course 612. Provides hands-on experience in computer simulations of complex biological systems, and trains students to have a broad command of the experimental techniques used in the observation of complex biological systems. (Offered as BCHM 613, BIOL 613, CS 613, MATH 613, MB 613, PS 613, and VTMB 613).

**VTMB 424. Ethical Practice of Science** (3 units). Examines the evolution of the scientific process with special focus on the ethical responsibilities of scientists; examines policies and procedures developed within the scientific community to ensure integrity in the research process.

**Bioinformatics: Genomic Analysis Laboratory** (3 units). (Initially offered in Fall 2001 as MB 580). Course allows students to gain hands-on experience in computer-based genetic research. Topics covered include gene and protein sequence alignment strategies, genetic database searching, 2-D and 3-D molecular structure prediction, and phylogenetic analysis.

## FISCAL IMPACT AND BUDGET INFORMATION

Indicate the planned FTE enrollment, estimated expenditures and projected revenues for the first three years of the program. Include both the reallocation of existing resources and anticipated or requested new resources. Second and third year estimates should be in constant dollars

	FY 2003-2004 (1 <sup>st</sup> Year)	FY 2004-2005 (2 <sup>nd</sup> year)	FY 2005-2006 (3 <sup>rd</sup> year)
--	--	--	--

### I. Planned- Student Enrollment

	Headcount	Headcount	Headcount
New enrollments <sup>a</sup>	29	7	7
<b>Total planned student Enrollments</b>	<b>29</b>	<b>36</b>	<b>35</b>

<sup>a</sup> The first year of the program, students already receiving CBS fellowships (since 1999) will all enter the program, including 7 new students for Fall 2003. Thereafter, we anticipate 7 entering students each fall, with students graduating after 5 years, for a total of about 35 CBS students in the program.

### II. Budget

	AY 2003-2004	AY 2004-2005	AY 2005-2006
Graduate student stipends	238,000	252,000	252,000
Tuition & fees	70,000	73,500	78,000
Student computer/supplies	21,000	21,000	21,000
CBS weekly seminar	10,000	10,000	10,000
Summer workshop	10,000	10,000	10,000
Out of Montana	14,000	14,000	14,000
Faculty teaching	20,000	20,000	20,000
Program coordinator	30,000	30,000	30,000
Fringe	10,000	10,000	10,000
Summer undergraduate research program	24,000	26,000	28,000
Recruitment/advertising	5,000	5,000	5,000
<b>Total operating exp.</b>	<b>452,000</b>	<b>471,500</b>	<b>477,000</b>

<b>NSF-IGERT award</b>	<b>499,860 (year 5)</b>	<b>500,000 (carryover)</b>	
------------------------	-------------------------	----------------------------	--

Total NSF-IGERT award: \$ 2,699,300 awarded over a 5 year period (1999-2004). Budget was \$699,860 for 1999-2000, and 499,860 per year for the following 4 years. Due to low expenditures in Year (1) of the grant, initial IGERT grant will support the program through AY 2004-2005.

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

Dr. Roger Bradley	Asst. Professor	Dept. Cell Biology and Neuroscience
Dr. Patrik R. Callis	Professor	Dept. Chemistry and Biochemistry
Dr. Mary Cloninger	Asst. Professor	Dept. Chemistry and Biochemistry
Dr. Valerie Copie	Asst. Professor	Dept. Chemistry and Biochemistry
Dr. David M. Dooley	Provost	Dept. Chemistry and Biochemistry
Dr. Trevor Douglas	Assoc. Professor	Dept. Chemistry and Biochemistry
Dr. Edward A. Dratz	Professor	Dept. Chemistry and Biochemistry
Dr. Michael Franklin	Asst. Professor	Dept. Microbiology
Dr. Tomas Gedeon	Asst. Professor	Dept. Mathematical Sciences
Dr. Charles M Gray	Professor	Dept. Cell Biology and Neuroscience/Center for Computational Biology
Dr. Paul A. Grieco	Professor & Head	Dept. Chemistry and Biochemistry
Dr. Gwen Jacobs	Assoc. Prof & Head	Dept. Cell Biology and Neuroscience
Dr. Al Jesaitis	Professor	Dept. Microbiology
Dr. Mark Jutila	Professor	Dept. Veterinary Molecular Biology
Dr. Martin Lawrence	Asst. Professor	Dept. Chemistry and Biochemistry
Dr. Frances Lefcort	Assoc. Professor	Dept. Cell Biology and Neuroscience
Dr. Jeff Leid	Asst. Res. Prof	Dept. Cell Biology and Neuroscience Immunol. Proj. Dir. Center for Biofilm Engineering
Dr. Marcie McClure	Assoc. Professor	Dept. Microbiology
Dr. Christa Merzdorf	Asst. Professor	Dept. Cell Biology and Neuroscience
Dr. John Miller	Professor	Dept. Cell Biology and Neuroscience Director Center for Computational Biology
Dr. Brendan Mumey	Asst. Professor	Dept. Computer Science
Dr. Charles M. Paden	Professor	Dept. Cell Biology and Neuroscience

Dr. Mark Pernarowski	Assoc. Professor	Dept. of Mathematical Sciences
Dr. Mark T. Quinn	Professor	Dept. Veterinary Molecular Biology
Dr. Edward Schmidt	Asst. Professor	Dept. Veterinary Molecular Biology
Dr. David J. Singel	Assoc. Professor	Dept. Chemistry and Biochemistry
Dr. Jean R. Starkey	Research Professor	Dept. of Microbiology
Dr. Jan Sunner	Assoc. Professor	Dept. Chemistry and Biochemistry
Dr. Martin Teintze	Assoc. Professor	Dept. Chemistry and Biochemistry
Dr. Curt Vogel	Professor	Dept. Mathematical Sciences
Dr. Mark Young	Professor	Dept. Plant Sciences
	Director	Montana EPSCoR
Sara Young	Director	American Indian Research Opportunities

**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.**

No new faculty will be needed. CBS members are recruited from present MSU faculty in the participating departments. CBS has assembled a broad group of faculty focused on the goal of understanding biological systems of emergent complexity. CBS faculty have demonstrated ability to mentor graduate students, procure extramural funding, engage in multidisciplinary research and collaborate with other researchers, both within the university and in the greater research community. CBS faculty member's research programs benefit from their participation in this NSF IGERT program; CBS faculty invite eminent scholars to present research seminars for the CBS seminar series, organize summer technique workshops taught by experts in the field, and have attractive interdisciplinary research projects that recruit graduate students.

The CBS lecture and lab courses (BIOL/BCHM/VTMB/MB/MATH/CS/PS 610, 611, 612 & 613) are team-taught by CBS faculty members. This does not require participating faculty to be relieved from regular departmental teaching obligations. The course coordinator, a CBS faculty member who organizes the lectures and labs, teaches computing components, and oversees testing and grading of the students, is provided teaching relief from his/her regular departmental teaching load by a 0.25 FTE "buyout."

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

The CBS faculty is comprised of participating faculty members from departments across campus. With the exception of the CBS course coordinator, participating faculty are not directly compensated by CBS (however, faculty benefit by being part of the CBS group by their ability to recruit better graduate students due to the sought-after interdisciplinary nature of the program and lucrative graduate student funding package; through participation in a collaborative and stimulating research environment; via opportunities to invite respected researchers from other institutions for campus seminars; and by hosting/participating in intensive summer research technique workshops).

Administrative support is provided through the Cell Biology and Neuroscience department office and one full-time program coordinator housed in the CBN dept offices. The program requires a full-time program coordinator to aid the project director in managing the program, including graduate student tracking; organization of recruitment and admissions; coordination of seminars, summer workshops, Native American outreach and faculty travel; budget management, etc.

CBS has funded students engaged in interdisciplinary research at MSU since 1999 (1 student starting in 1999, 8 students starting in 2000, 6 students starting in 2001). Projected expenditure assumes 7 new students funded each year, with each student receiving 2 years of funding from the NSF-IGERT grant. Per year expenditure per student is \$17,000 stipend, plus tuition & non-miscellaneous fees, for two years. Projected expenses assume stipend will be raised to \$18,000 for AY2004-5 and 2005-2006. Tuition and fees depends on number of credits taken, number of resident and non-resident students, and tuition and fee increases. A rough estimate of \$5000 / year / student was used for AY 2003-4, with 10% increases each year thereafter.

The initial NSF-IGERT grant of \$2,699,300 was awarded for the five-year period of August, 1999 to July, 2004. However, low expenditures during the first year of the grant period will allow this IGERT grant to fund CBS through academic year 2004-2005. Continuation of the program beyond that date will require additional grant monies. We will apply for a NSF-IGERT renewal, and also explore other funding options. With the continued national focus on multidisciplinary graduate education, we expect continued availability of training grant funds from government funding agencies such as the NSF and NIH, as well as from private foundations. Each of these options will be vigorously pursued. The project PIs and CBS faculty have a strong record of obtaining extramural funding and anticipate continued success in this area.

**CAPITAL OUTLAY, OPERATING EXPENDITURES, & PHYSICAL FACILITIES**

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

Student computer is 7 laptops/year X \$3000 (cost includes computer, software and books/supplies).

"Out of Montana" experience, approximately 7 students per year at \$2000 each towards travel, course registration, lodging, etc. (Students will be asked to find additional funds as needed from scholarships, grants, etc.)

Recruitment/advertising includes costs for print advertising, posters, flyers, and mailing, dues to internet listing agencies, recruiting travel by faculty/program coordinator, etc.).

Summer undergraduate research program supports 5 students at \$4000/summer (\$3000 stipend, plus housing costs). Additional costs are a stipend for the coordinator (\$3000) and \$1000 for expenses (clerical, student picnic, etc.).

**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?**

Library resources are adequate for this certificate program. The Renne Library at Montana State University at Bozeman currently supports PhD programs in the CBS participating departments (Cell Biology and Neuroscience, Chemistry and Biochemistry, Microbiology, Veterinary Molecular Biology, Plant Sciences, Electrical/Computer Engineering and Mathematical Sciences; MS program in Computer Sciences). The library contains over 76,000 books in these research areas, as well as over 3,200 science and engineering journals, in paper or electronic form. In support of MSU's graduate programs, the library is continuing to expand its holdings in science, mathematics, and engineering subject areas as space and budget allow. The library also has access to numerous electronic databases, such as Medline, Biological Abstracts, MathSciNet, etc. that enable graduate students to effectively search the scientific and engineering literature.

**3. Please indicate special clinical, laboratory and/or computer equipment that will be needed. List those pieces of equipment or computer hardware presently available in the department.**

As graduate students in eight different science departments on campus, CBS graduate students have access to superb research facilities and equipment. The Center for Computational Biology (CCB) facility serves as the centerpiece computing facility for CBS, housing a computer cluster including a Silicon Graphics supercomputer and several SGI Octane and O2 workstations. Dr. John Miller, member of the CBS faculty group, is the director of the center. The NSF-IGERT grant has already made possible the purchase of over \$200,000 of computer hardware and software for the CCB. A matching grant through the MSU office of the Vice President for Research will be used to purchase additional specialized research or computer equipment as needed.

Other existing facilities on the MSU campus to be utilized by CBS participants include:

- Mass Spectrometry Facility (8 instruments providing comprehensive mass spectrometry methods).
- NMR facility (3 state-of-the-art instruments for nuclear magnetic resonance imaging).
- Electron magnetic resonance facilities a wide variety of modern spectroscopy instrumentation available through participating faculty.
- Microscopy facilities (including EM, confocal, and fluorescence microscopes).
- Modern molecular biology and biochemistry instrumentation and equipment in faculty laboratories of participating departments.
- Cell biology facilities, including FACS (cell sorting) instrumentation, tissue culture facility, automated DNA sequencers, molecular imagers and scintillation and gamma counters.
- Fully AAALAC accredited Animal Resource Center, supervised by Dr. Warren Frost, DVM.

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

No new facilities are required for the CBS program. The CCB facility serves as a physical focal point for the program, which has participants in diverse spaces on campus. The facility provides instructional, research and social meeting space for faculty and students.



Department of Microbiology  
College of Letters and Science  
109 Lewis Hall  
P.O. Box 173520  
Bozeman, MT 59717-3520  
Telephone (406) 994-2903  
Fax (406) 994-4926

24<sup>th</sup> May, 2002

Gwen A. Jacobs, PhD  
Head, Department of Cell Biology and Neuroscience  
513 Leon Johnson Hall  
Montana State University  
Bozeman, MT 59717

Dear Dr. Jacobs,

This letter is to express my strong support for your initiative to establish a certificate program in Complex Biological Systems. I believe this it is an extremely timely initiative that recognizes the cross-disciplinary nature of biological systems. Our department of microbiology will be delighted to participate in the certificate program and we look forward to the inter-departmental interactions that will follow.

Sincerely,

A handwritten signature in black ink, appearing to read "Tim Ford", is located below the "Sincerely," text. The signature is fluid and cursive.

Tim Ford  
Professor and Head





March 29, 2002

Dear Board Members,

I would like to express my support for establishing a Certificate in Complex Biological Systems at Montana State University-Bozeman. I have been fortunate to participate in the CBS program since its onset in the fall of 1999. I have given a series of lectures in a several offerings of the graduate level theory course (CBS 610,612) and prepared associated exercises for the laboratory course (CBS 611,613). In the 2001 fall semester, I was the course organizer for CBS 611. The CBS program is a valuable resource for MSU-Bozeman. It draws students from across the country as well as excellent international students. Graduates will be well-trained for a broad range of academic and industrial positions. The program is one of a handful of truly interdisciplinary programs around the nation, none of which offer exactly what the CBS program does. It is important that students who complete a PhD under the CBS program obtain specific documentation and recognition of this achievement. Awarding a separate Certificate in Complex Biological Systems will accomplish this goal.

Sincerely,

Dr. Brendan Mumey

Assistant Professor of Computer Science  
Montana State University - Bozeman

---



**Veterinary Molecular  
Biology Laboratory**

Marsh Laboratory  
P.O. Box 173610  
MSU Bozeman  
Bozeman, MT 59717-3610

Telephone (406) 994-4705  
Fax (406) 994-4303

Gwen A. Jacobs, Ph.D., Program Director,  
Complex Biological Systems  
Montana State University  
Bozeman, MT 59717

Bozeman, 1 April 2002

Dear Gwen,

I am writing to support a Certificate for students completing the Complex Biological Systems Program. CBS provides a unique inter-disciplinary program for Ph.D. students. Many subjects within the life sciences just don't fall within the "pigeon-holed" boundaries of classical academic departments. The CBS program embraces this fact and provides graduate students with a far broader exposure and expertise than could otherwise be achieved in any of the individual departments on campus. CBS Ph.D. students necessarily take courses spanning a broader diversity of subjects than do non-CBS students. This includes both the formal CBS courses, which exist only as a result of this program, and the electives available to students as a result of the cross-departmental nature of the program. For example, in the CBS courses, segments are taught in subjects including biochemistry, microbiology, mathematics, molecular biology, genetics, computer science, plant physiology, pathobiology, biofilm engineering, biophysics, immunology, developmental biology, neurobiology, and others. Importantly, this is in addition to the normal departmental requirements, meaning that CBS students

accomplish all that other Ph.D. students in their major department do, as well as these additional courses and experiences. As a result, CBS students tend to not just exhibit a more wide-ranging understanding of Biology, but also, their thesis research generally involves more cross-disciplinary projects.

A second benefit for graduate students within the CBS Program is the policy of dual-mentoring and multi-departmental advisory/thesis committees. Whereas other Ph.D. students are required to have only one committee member from outside their major department, in the CBS Program, each student has two mentors (i.e., Major Professors) from different departments and a more cross-department representation for the remainder of the committee. This system increases the range of the student's expertise and it fosters increased collaboration between individual research groups across campus. The net effect is a more interactive and diverse research community and education experience at MSU.

As a member of the CBS Executive Committee and the current advisor of one CBS Ph.D. student, I am a strong believer in the value of this interdisciplinary program. I find the unique experiences provided by CBS to be enormously valuable for the students, and very much worth the efforts that I put into contributing to the Program. I strongly recommend that the students who complete the CBS program be given a Certificate to recognize their exposure and accomplishments above and beyond that achieved by students outside of CBS.

Sincerely Yours,  
Edward E. Schmidt, Ph.D.

---

April 1, 2002

Prof. Gwen Jacobs  
IGERT Program Director  
Center for Computational Biology  
MSU, Bozeman, MT, 59715

Tomas Gedeon  
Associate Professor  
Department of Mathematical Sciences,  
MSU  
gedeon@math.montana.edu

{signature}

Dear Gwen,  
I want to write this letter of support for the proposal about the IGERT program to the Board of Regents.

As you know my graduate student Albert Parker will be (probably) the first graduate of this program at MSU next year. The program benefited him (and me) by forcing us to engage in interdisciplinary collaboration. I think he will be one of the best prepared mathematicians for work in neuroscience in the country.

It will be very beneficial for him, when he starts looking for employment, to have a certificate that he is an IGERT graduate. There is quite a few mathematicians out there, but very few with interdisciplinary training in neuroscience.

Sincerely,

Tomas Gedeon

\end{letter}  
\end{document}



**Gwen A. Jacobs, Ph.D.**  
Head, Department of Cell Biology and Neuroscience  
College of Letters and Science  
**513 Leon Johnson Hall**  
P.O. Box 173148  
Montana State University  
Bozeman, MT 59717-3148  
Telephone 406-994-7334  
Fax: 406-994-7438  
e-mail: [gwen@cns.montana.edu](mailto:gwen@cns.montana.edu)  
URL: [cns.montana.edu](http://cns.montana.edu)

June 7, 2002

To: Bruce McLeod, Dean  
College of Graduate Studies

From: Gwen Jacobs, Head, Cell Biology and Neuroscience  
Director, Complex Biological Systems Graduate Training Program

Re: Certificate Program for Complex Biological Systems Graduate Training Program.

I would like to add my strong support to the proposal to the Board of Regents for a Certificate Program in Complex Biological Systems. I have directed the Graduate Program in Complex Biological Systems since its inception in August 1999. I believe that the addition of a formal Certificate in Complex Biological Systems will bring recognition and distinction to the PhD students in the program and will help to institutionalize this important multi-disciplinary program on campus.

The need for a new multi-disciplinary model for graduate training has been recognized by both the scientific and industrial community nation wide. The NSF sponsored Integrative Graduate Education and Research Training program was established to address this need. Our participation in this important effort is highly significant and places MSU among the best institutions in the country engaged in innovative approaches to graduate training.

The educational experience provided by the CBS program is very different from more traditional graduate training programs on campus. Students are expected to bridge across disciplines, work in teams and incorporate both quantitative and theoretical approaches into their research. We expect that students graduating from this program will have many more career options as compared to their peers in other graduate programs on campus.

I endorse this proposal without reservation. It is an important step towards supporting a unique and important educational opportunity for our students at MSU.