

**ITEM 110-1006-R0301**  
**March 22-23, 2001**

**FULL PROPOSAL AND BUDGET**  
**New graduate degree (M.S. and Ph.D.) option in Microbial Ecology**

**PROGRAM DESCRIPTION**

**1. Brief description of proposed new program.**

We are proposing a **new option for the Ph.D. and M.S. degree in Biochemistry/Microbiology**. The Biochemistry/Microbiology Program currently offers M.S. degrees in Biochemistry and in Microbiology. The doctoral degree is in Biochemistry/Microbiology with options in Biochemistry, Microbiology, and Molecular Biology available. This proposed change would offer a Microbial Ecology option for the existing M.S. in Microbiology and a Microbial Ecology option for the existing Ph.D. in Biochemistry/Microbiology. These are not new degrees, but rather new options for existing degrees in the Biochemistry/Microbiology Program. The new options will serve students interested in ecological, applied, and environmental aspects of microbiology. The current program structure does not accommodate students with these educational goals very well. This is not a cooperative effort with another institution, business, or industry. It is, like all other existing options in these degrees, an on-campus program. This program combines faculty and existing or restructured curricula from the existing ecology and microbiology programs. No additional courses or faculty are proposed or needed.

**2. Summary of a needs assessment conducted to justify the proposal.**

Microbiology programs throughout the United States traditionally emphasize themes of medical microbiology and general microbiology (centered on structure and function). These areas are sometimes complemented with applied aspects such as Food Microbiology or Environmental Microbiology. An evident emerging microbiology theme across the U.S. and other countries (e.g. Sweden and Denmark) is the field of Microbial Ecology. As the eminent scientist and "Father" of conservation biology, E. O. Wilson, said three years ago when he delivered a Presidential Address at the University of Montana "If I had to do it all over again I would be a Microbial Ecologist". The world of microbes is essentially undiscovered (only 5,000 of the predicted 100,000 species are currently known). The microbial ecology field is emerging and gaining importance and prominence, we propose to carve a niche at the forefront. In doing so, we expand the repertoire of the Biochemistry/Microbiology Program and complement an already strong and internationally recognized Ecology Program housed in the Division of Biological Sciences and the School of Forestry.

Evidence of need in Microbial Ecology can be found in the form of the increasing number of jobs advertised in the Microbial Ecology area, increased funding at the national level, and an increase in student inquiries and interests. In the last year, 20-40% of the Microbiology related jobs advertised in the American Society for Microbiology Trade Journal were in the field of Microbial Ecology. Of the last 7 hires in the Microbiology/Biochemistry program (UM), three were in the field of Microbial Ecology. In addition, for the last two years, almost half of the incoming graduate students in the Microbiology/Biochemistry Program have opted for research programs in or related to Microbial Ecology. The new options would provide coherent, supporting and relevant coursework to complement their research. This will make University of Montana students more competitive for numerous Microbial Ecology-related positions.

Although several institutions offer courses or minors in microbial ecology, only one major university in the U.S. (Univ. Pennsylvania) offers a degree option in microbial ecology. The option at UP is in "Ecology with a Microbiology side". The program option proposed here is in "Microbiology with an Ecology side".

For the above reasons we believe that this program will attract new students. These students will graduate with timely skills necessary to address key regional and national environmental issues in coming years. In an effort to notify potential students of the program, we will: a) Develop a web page specific to the program, b) Author and distribute a brochure to 2 and 4 year schools in the region and elsewhere describing the strengths of program, and c) Promote the program at key regional and national meetings and events related to the discipline of microbiology.

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

The proposed graduate degree option is fully consistent with and strongly supports institutional mission and purpose at the levels of the university system, The University of Montana, and The University of Montana-Missoula. The proposed program offers a more refined and focused option for graduate study in microbial ecology (compared to current degree options), with emphasis on application and relationship of microbiology to ecology and the environment. As such, the program enhances university values and goals of providing strong, modern graduate (including doctoral) programs and opportunities. The proposed program will support UM-Missoula aspirations of national and international recognition as a research-oriented, doctoral-granting institution. Coupling this new graduate specialty with a parallel undergraduate degree option is aligned with university aspirations of sustaining a healthy balance between research/graduate education and undergraduate education. The program will contribute to growing research focus and emphasis in microbial ecology, including molecular-level approaches and problems, that relates closely to issues and problems of significance to Montana and the nation. Thus, the program supports university goals of addressing and reflecting state and regional issues and problems. The program will enhance and diversify opportunities for graduate student research, enhancing university values for close professional interactions among students and faculty, and providing students with key skills, perspectives, and abilities to address complex problems in this expanding discipline.

**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.**

This program, along with other degree options within the Biochemistry/Microbiology graduate program, will be administered within the Division of Biological Sciences in the College of Arts and Sciences. This program will not alter the administrative structure of the institution at any level.

**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?**

To our knowledge, there are no established graduate programs offering degrees with an option in the area of microbial ecology in Montana, the Pacific Northwest, or states bordering Montana. Indeed, the only such established program in this area that we have identified is in Pennsylvania. This is in spite of the fact that there is increasing interest in this area from businesses, government agencies and universities and the number of microbial ecology positions available in all of these sectors continues to rise.

As mentioned above, the microbial ecology option at the University of Pennsylvania is in "Ecology with a microbiology side". The program that we propose for The University of Montana is in "Microbiology with an Ecology side". Thus, we will be uniquely situated as one of the few providers of an formally acknowledged advanced degree option in the area of microbial ecology.

**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 is no official national accreditation for Microbiology Degree Programs. The American Society for Microbiology, however, sets National Standards for degrees in Microbiology. These standards were used in the development of the curriculum proposed below.

**7. Outline of the proposed curriculum showing course titles and credits.**

Applicants for a graduate degree with an option in microbial ecology must have completed as an undergraduate or complete as a graduate student the following courses:

**General Microbiology  
General Ecology  
Introductory Statistics (or Experimental Design)**

Four credits of professional seminar shall be required as will one credit in introduction to research, one credit in training seminar and two credits in grant writing. Additional professional seminar credits will not count toward degree requirements. In addition, all students are required to participate in the seminar "Microbial Ecology" (1 credit, offered every semester) for at least two semesters (no more than 4 credits may be counted toward degree requirements), and to take the core class "Advanced Microbial Ecology" (2 credits) in their first semester, or as early as possible.

All students are required to take at least two of the following microbiology graduate courses: MICB/ BIOL 595 Soil/ Fungal Ecology, MICB 595 Molecular Microbial Ecology, MICB 595 Aquatic Microbial Ecology and Physiology (all 3 credits). Students must take at least one class from the blocks "Microbial Processes/ Biogeochemistry", "Environmental/ Quantitative Microbial Ecology", and "Microbial Diversity and Interactions", detailed as follows.

**Microbial Processes/Biogeochemistry**

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MICB 595 AQUATIC MIC. ECOL./ PHYSIOLOGY (3)  
CHEM 541 ENVIRONMENTAL CHEMISTRY (3)  
FOR 511 SOIL CHEMISTRY/ BIOCHEMISTRY (3)  
GEOL 515 BIOGEOCHEMISTRY (3)  
GEOL 531 ENVIRONMENTAL GEOCHEMISTRY (3)  
GEOL 571 ADVANCED GEOCHEMISTRY (3)

**Environmental/Quantitative Microbial Ecology**

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MICB 595 SOIL/ FUNGAL ECOLOGY (3)  
BIOL 512 POPULATION ECOLOGY (3)  
BIOL 513 COMMUNITY ECOLOGY (3)  
BIOL 517 PLANT ECOLOGY (3)  
EVST 560 ENVIRONM. IMPACT ANALYSIS (3)  
FOR 532 FOREST ECOSYST. ANALYSIS (3)  
WBIO 580 POPULATION DYNAMICS (3)  
WBIO 540 EXPERIMENTAL DESIGN (3)

**Microbial Diversity and Interactions**

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MICB 595 MOLECULAR MICROBIAL ECOLOGY (3)  
MICB 520 MEDICAL PARASITOLOGY (3)  
MICB 540 MICROBIAL PATHOGENESIS (3)  
MICB 510 MICROBIAL STR. AND FUNCT. (3)  
MICB 509 VIRUS ECOLOGY AND EVOLUTION (3)  
BIOC 584 NUCLEIC ACIDS (3)

## BIOC 595 ADVANCED MOLECULAR BIOLOGY (3)

For the M.S. degree in addition to the courses listed above other undergraduate courses listed in the catalog as "UG" may be taken for graduate credit. Of the twenty credits of course work which are required for the degree no more than 10 credits may come from 300 (only 6 can be at the 300 level) and 400 level courses. Ten credits, or a minimum of 50% of the course work required, must be at the 500 level and above.

For the Ph.D. degree the requirements are described in The University of Montana Graduate catalog. These include a total of 60 semester credits, of which a minimum of 40 must be course work (as opposed to research and dissertation) credits. The course work program for the Ph.D. degree will be prepared by the student and permanent advisor in consultation with the student's advisory committee and must be approved by the advisory committee. The 60-credit requirement is only a minimum and may be exceeded when the advisory committee considers it appropriate in developing the programs of individual students.

### Ph.D. COMPREHENSIVE EXAMINATION

#### Comprehensive Exam for Microbial Ecology Option:

The examination committee will consist of at least 5 faculty members. For the written exam, each member of the committee will submit questions designed to probe both depth and breadth of knowledge in microbial ecology and cognate areas. The written exam will take place over a two-day period. Each day the student will be given 7 questions and asked to choose 5 to answer. (Before giving the student the written exam, the Examination Committee Chair will consult with the other members of the exam committee to insure the exam is relevant and fair to the student.) A total score of 80% will be needed to pass the exam. If the student fails, they can take the exam one more time. After passing the written exam, an oral exam, that will last no longer than 3 hours, will be conducted to orally examine the student's depth and breadth of knowledge in microbial ecology (including basic concepts in microbiology, ecology, and statistics). The student can pass with no more than 2 no-pass votes. If the student fails the exam, they can take it one more time.

### FACULTY AND STAFF REQUIREMENTS

#### 1. Name and rank of current faculty who will be mainly involved with the core program:

**Dr. James E. Gannon**, Professor  
**Dr. William E. Holben**, Associate Professor  
**Dr. Matthias C. Rillig**, Assistant 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.

No new faculty will be needed in support of this new microbial ecology option. This is possible because a significant portion of the required curriculum combines existing courses in various programs into a different configuration that produces the appropriate knowledge base for success in the area of microbial ecology. Where courses are being restructured to meet the needs of the option, the above-named faculty will be responsible for those courses. This is being accomplished as follows: **Rillig's** position was created and filled in support of microbial ecology education and research. As such, his assigned duties are totally in line with the microbial ecology option. **Gannon** retains responsibility for the microbial physiology course which is a key component the general microbiology degree and the new option. His other assignments, environmental microbiology and food and industrial microbiology are being cancelled and the information restructured and combined into the new full-year microbial

ecology course series which will serve both the general microbiology requirements and the microbial ecology option. **Holben** retains responsibility for his lower division undergraduate course, elementary microbiology. His graduate teaching assignment, molecular microbial ecology, is a required course in the new curriculum and he has been reassigned from teaching molecular genetics in to new assignments within the microbial ecology option.

**3. Need and cost for support personnel or other required personnel expenditures:**

None required for the proposed option.

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

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

The proposed program will rely on existing courses, and new courses that are either 1) modifications of existing courses, 2) replacing others being eliminated (and taught by current faculty), or 3) being developed as part of the regular teaching assignment of a new faculty member hired to support the growth and development of this disciplinary focus within our programs. In addition, the program will build on formalizing student and faculty group meetings, discussions, and seminars that currently are ongoing but not organized into formal courses. We anticipate only modest increase in enrollment in particular courses.

**2. Evaluation of library resources.**

The proposed program combines elements of two graduate programs (microbiology and ecology) that have been in existence for many years. As such, current library resources will be as adequate as they are for the existing programs.

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

None required for the proposed option.

**4. 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?**

Current facilities are adequate for the proposed option; no additional facilities or space is required.

**EVALUATION OF PROPOSED PROGRAM**

**1. Faculty committees or councils that have reviewed and approved the program herein proposed.**

The proposal has been reviewed by the following committees: Microbiology Curriculum committee, DBS curriculum committee, DBS student advising staff, ASCRC Science Subcommittee, ASCRC full committee, The University of Montana Graduate Council science subcommittee, University of Montana Graduate Council (full committee) and the University of Montana Faculty Senate (pending, Nov 29, 2000).

**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).**

Not applicable to this proposal.

## FISCAL IMPACT AND BUDGET INFORMATION

On this form, 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 02 FIRST YEAR		FY 03 SECOND YEAR		FY 04 THIRD YEAR	
	FTE	HEADCOUNT	FTE	HEADCOUNT	FTE	HEADCOUNT
<b>I. PLANNED STUDENT ENROLLMENT</b>						
A. New Enrollment	0		4		7	
B. Shifting Enrollment	8*		7		5	
*currently 8 of about 25 students in the Biochem/Microbiology graduate program work and study in microbial ecology						
<b>GRAND TOTAL PLANNED STUDENT ENROLLMENT</b>	<b>8</b>		<b>11</b>		<b>12</b>	

	FIRST YEAR		SECOND YEAR		THIRD YEAR	
	FTE	COST	FTE	COST	FTE	COST
<b>II. EXPENDITURES</b>						
A. Personnel Cost	program is built on existing counts and faculty/staff resources					
1. Faculty						
2. Administrators						
3. Adjunct Faculty						
4. Graduate/Instruc/Assistants						
5. Research Personnel						
6. Support Personnel						
7. Fringe Benefits						
8. Other (_____)						
<b>Total Personnel FTE</b>	<b>0</b>		<b>0</b>		<b>0</b>	
B. Operating Expenditures	most operating expenses reflect research costs, which will be borne primarily by external grant funding and student-generated resources					
1. Travel						
2. Professional Services						
3. Other Services						
4. Communications						
5. Utilities						
6. Materials & Supplies						
7. Rentals						
8. Repairs & Maintenance						
9. Materials & Goods for Manufacturing						
10. & Resale						
11. Miscellaneous						
<b>Total Operating Expenditures</b>	<b>0</b>		<b>0</b>		<b>0</b>	
C. Capital Outlay						
1. Library Resources						
2. Equipment						
<b>Total Capital Outlay</b>	<b>0</b>		<b>0</b>		<b>0</b>	
D. Physical Facilities						

1. Construction or Major Renovation

E. Indirect Costs (Overhead)

<b>GRAND TOTAL EXPENDITURES</b>	<b>0</b>	<b>0</b>	<b>0</b>
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**II. REVENUES**

A. Source of Funds

2. Appropriated Funds-Reallocation
3. Appropriated Funds-New
4. Federal Funds
5. Other Grants
6. Fees
7. Other (\_\_\_\_\_)

<b>Total Source of Funds</b>	<b>0</b>	<b>0</b>	<b>0</b>
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B. Nature of Funds

1. Recurring
2. Non-Recurring

<b>GRAND TOTAL REVENUES</b>	<b>0</b>	<b>0</b>	<b>0</b>
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