

# PLAN FOR ASSESSMENT OF STUDENT LEARNING AND IMPLEMENTATION RESULTS

## DEPARTMENT OF BACTERIOLOGY

Approved by the faculty on February 17, 2004

### **Undergraduate major**

The department recognizes that it serves a diverse undergraduate population, with a variety of career aspirations and therefore with appropriately diverse requirements for their undergraduate education and training. While all Bacteriology majors should have a strong knowledge base, skills in critical thinking and the ability to adapt as society and technology changes, the importance of these different areas to a given student depends on their specific career goals. A substantial portion of the Bacteriology majors will end their education with the B.S. degree and it is therefore of extreme importance that these students be given “real world” job skills. The other major career path for undergraduate Bacteriology majors requires continued education in a graduate program or professional school. For these students, there is a particular need for a strong development of knowledge base and intellectual skills. The department has developed and implemented a set of assessment tools and strategies that are providing us with an understanding of how we are serving these student groups.

### **Learning Goals and Objectives (B.S.)**

An undergraduate major in Bacteriology should possess the following attributes upon graduation:

- A broad background of knowledge in the areas of microbiology (including microbial diversity and physiology), biochemistry, and genetics, with appropriate knowledge of the basic principles of biology, chemistry, mathematics and physics.
- The ability to perform modern experimental procedures.
- An understanding of the nature of experimental design and the use of controls.
- An ability to think critically and analyze scientific data.
- The confidence and knowledge base to read the primary literature and be able to apply that information.
- The ability to communicate the results of one’s own experiments both through laboratory notebooks and more formal written and oral presentations.

- The skills to interact productively with a multi-disciplinary research team, both in experimental performance and data analysis.

### **Mechanisms of Analysis (B.S.)**

The Department assesses student learning by the following mechanisms:

1. Capstone courses and analysis. The capstone course (Bacteriology 551) is a laboratory course and is closely coordinated with Bacteriology 550 (Physiological diversity of prokaryotes). Together, these have been designed to bring together all of the knowledge areas appropriate for the major and use that information to synthesize new insights. These courses therefore serve as indicators of the success of all previous Bacteriology courses to serve their roles in the overall curriculum. The department also uses surveys near the end of Bacteriology 551 to provide feedback on larger issues of the Bacteriology curriculum and student support.

2. The Department will continue to survey graduating seniors with a focus on improvements that should be made to our curriculum and advising, as well as on particularly valuable experiences that they have had as undergraduates.

3. Through its numerous industrial contacts, the Departmental faculty and staff continue to identify areas of strength or weakness in our recent graduates. The student services coordinator provides a point of contact for both students (primarily undergraduates, but also M.S. and Ph.D.) and employers, to help with career advising and job placement.

4. The Department monitors job placement of its recent undergraduates to determine the fraction of students with different career needs, as well as the ability of students to obtain jobs or to enter strong graduate and professional programs.

5. In the past three years, the Departmental Curriculum Committee carefully reviewed the content of all undergraduate courses through examination of syllabi and interviews with various instructors. While there was general satisfaction with the current state of the courses (because they are continuously modernized by the instructors themselves), there were some minor changes of course coordination that were effected.

### **The Graduate Major: The M.S. degree**

The primary goal of the M.S. degree in bacteriology is to provide skills and credentials that are necessary for students to develop a career in microbiology or a related field that requires knowledge beyond that normally acquired by completing a B.S. degree. For most students, the degree is based primarily on a research project that the student documents and defends before a faculty committee. These students will be prepared for employment as research technicians or will continue in a Ph.D. program.

Students also have the option of doing a coursework M.S. program that will update and expand their knowledge of microbiology. For these, the M.S. is likely to be their terminal degree in science.

### **Learning Goals and Objectives (M.S.)**

Upon graduation, a student in the Bacteriology M.S. program is expected to have:

- A very strong knowledge base in the area of microbial biology.
- The ability to critically analyze and interpret scientific literature.
- A demonstrated ability to design, perform, interpret and describe scientific experiments. This includes the ability to explain and defend the experiments and their interpretation both verbally and in writing.
- A general understanding of how a large scientific project, addressing a substantial biological question, is assembled from several individual experimental results.
- The ability to describe the results of one's research in an appropriate form for submission to peer-reviewed scientific journals.
- A degree of self-confidence as an experimental scientist.
- The skills and understanding necessary to function as a member of a research team.

### **Mechanisms of Analysis (M.S.)**

The Department assesses student learning and progress using the following mechanisms:

1. The Advisor of the M.S. program monitors student progress and maintains contact with students throughout their term. For students doing a thesis M.S., the Advisor's role is to help the students identify a laboratory and research mentor. For students doing the coursework M.S. option, the Advisor role is to help the student select classes appropriate to their goal of advanced training in Microbiology.
2. The Advisor monitors student performance in academic courses to verify that an appropriate background and performance level is achieved.
3. Student performance and achievement in the research component are primarily monitored by the student's thesis advisor, and is documented by a minimum of two meetings with the student's Research Committee. This committee advises the student on progress and provides the final assessment of the student through the analysis of the student's thesis and oral defense.

4. The Advisor and Student Service Coordinator monitor students' progress toward the degree, and maintain data on the time to degree completion and percent of students who finish the program.
5. The Student Services Coordinator provides job placement resources for M.S. students and is therefore monitoring that success as well as identifying any employer concerns about our M.S. degree holders.

## **The Graduate Major: The Ph.D. degree**

The Department merged its Ph.D. program with that of Medical Microbiology and Immunology to form a Microbiology Ph.D. program that is administered by a program director and an executive committee of faculty trainers from a variety of departments. That program has developed its own goals and assessment strategies, but the following goals and general strategies apply.

### **Learning Goals and Objectives (Ph.D.)**

Upon graduation, a student in the Microbiology Ph.D. program is expected to have:

- A broad and deep understanding of the most current state of knowledge and all fundamental topics in microbiology.
- The ability to identify important and tractable research problems of substantial intellectual importance and to design a research program aimed at solving those problems. This includes the skill of producing compelling grant proposals to describe that research program.
- The ability to impart knowledge to others in the role of teacher, mentor, and colleague. This includes the ability to supervise and train other scientists in either an academic or industrial environment.
- The confidence and ability to analyze the scientific literature critically.
- The confidence and motivation to act as an independent researcher, yet one who profits from, and is active in, interactions with other scientists. Increasingly, this requires interactions with scientists and other experts from very different disciplines.
- The ability to describe the results of one's research in appropriate form for submission to peer reviewed scientific journals.
- The ability to present the results of one's research in public, oral presentations at national and international scientific conferences.

### **Mechanisms of Analysis**

1. The knowledge base of students is analyzed in two general ways: Students complete a core course curriculum in which the knowledge and intellectual skills described above are central, and the students interact with their advisors and their research committees throughout their degree program.

2. The ability to perform research is predominantly monitored by the advisor and the student's research committee and this is documented in annual meetings of that committee with the student. The success of this effort is validated by a "thesis prospectus" meeting that takes place 6-12 months before graduation, and then through the final thesis defense. Much of the intellectual content of the research experience is also addressed in the critical analysis of the scientific literature that is central to the majority of the graduate courses required by the major.

3. The development of mentor and teacher skills is addressed in two mechanisms. All students have a degree requirement to teach two semesters of formal course work. The student performance in this is evaluated in part through interactions with the instructor and also through student course evaluations. Mentoring skills are typically developed through one or more opportunities to work with an undergraduate either during the normal school year or through a summer REU program.

4. The development of writing skills, in the form of both scientific manuscripts and research proposals, is addressed in several ways. The primary avenue is through the generation of submissions to the primary literature based on the student's own research, and these are produced in close coordination with the student's advisor. Research proposal skills are engendered through the preliminary exam process, wherein students produce research proposals for their Ph.D. thesis work. These proposals are then critiqued by, and discussed with, their advisors and members of their Research Committees. The students then write and defend revised proposals. The final aspect of the validation of writing skills is through the thesis preparation and defense.

5. The development of verbal skills is predominantly through the requirement for research seminars. These seminars are presented annually at a weekly seminar attended by faculty and students in the program. Meetings with the Research Committee after these seminars provide feedback on the presentation as well as on scientific progress. Students are also strongly encouraged to present seminars at other campus research group meetings, as well as at local and national scientific meetings.