

WSU Five-Year Program Review  
Self-Study

Cover Page

Department/Program: Department of Microbiology

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## A. Brief Introductory Statement

### DEPARTMENT OF MICROBIOLOGY

The Microbiology Department at Weber State University fills a unique role in Utah's higher education system because it is the only state institution that grants a bachelors degree in microbiology. Microbiology is a growing field with a large demand for educated employees with advanced technical and laboratory skills. The Microbiology Department has a strong, comprehensive curriculum that balances teaching basic microbiological concepts with training in the most rapidly expanding areas of the discipline. The department's curriculum, including courses in medical microbiology, cell culture, microbial ecology, environmental microbiology, immunology, and industry microbiology, are assessed thoroughly to ensure courses prepare graduates for employment, graduate school, and professional programs.

The greatest strength of our department is the well-qualified faculty with expertise in a wide variety of microbiology sub-disciplines. This allows the department to offer courses that provide a strong background in general microbiology and specialized upper-division courses, rarely found in undergraduate curriculum. Faculty spend considerable time staying current in their specialties and are active in improving their courses and enhancing their teaching abilities. The Department offers diverse upper-division course work that covers the breadth of microbiology. The courses offer advanced laboratory exercises and experiments that train students in practical techniques as well as the nature of science. The department has articulated core concepts and learning outcomes for the major courses that are covered through the content and laboratory exercises. Assessment of these outcomes is done within each course. We are currently developing tools to comprehensively assess these outcomes at the departmental level.

Placement of microbiology graduates in jobs has been a strength of the department. Our students are recruited by local and regional industries. The need for qualified microbiologists in a wide variety of industries has been increasing and most graduates find employment immediately upon graduation. Graduates have also been very successful in obtaining acceptance to professional and graduate school programs. More students are choosing this career path and several courses have been tailored to assist them in preparing for professional or graduate studies. In addition, mentored student research has played a significant role in increasing the acceptance rates for our graduates. The high numbers of students majoring in microbiology over the past ten years illustrates the popularity of our program.

Several general education and service courses are also offered through the department. The general education courses were renewed in 2009, and meet the Natural Science and Life Science Learning Objectives. Enrollment in these courses remains high despite competition from LS courses outside of the college. Online, evening, and distance-learning sections of these courses allows them to be highly accessible to non-traditional students. The department is working with the Life Science General Education Assessment Committee on developing assessment tools for these learning objectives that can be used for all of the life science general education courses. We also offer upper-division service courses for students in health professions, non-microbiology science majors, and off-campus professionals. The department is involved with teacher education, providing courses to help prepare elementary and secondary teachers to teach science. In addition, faculty have been active in working with local science teachers by teaching in-service courses, in laboratory development, providing science demonstrations, and science fair mentoring.

Basic and applied research done by the faculty has provided the department and students with additional vitality. Refereed publications, laboratory manuals, research grant monies, and presentations at regional, national, and international meetings have enhanced the reputation of the department and drawn state and national attention to the program. Involvement of students in mentored research projects has increased significantly over the past five years with students presenting at state regional and national meetings, publishing papers, and even winning graduate student competitions. Research experience is now expected for admission to many medical and dental schools. Participation in research has increased the rate of graduate and professional school acceptance among our graduates.

The Microbiology Department has developed a number of relationships with local industries. These relationships have led to student internships, the donation of supplies to the department, use of faculty expertise for problem solving in industry, and the employment of graduates. The department needs to continue efforts to develop partnerships with industry. Traditionally this has been a weakness and has only started to improve in the last five years, particularly with the assignment of a specific development person to the College of Science. The use of incentives for faculty to continue development of research programs that attract national attention must be explored. More national recognition would allow the department to attract better-qualified students from broader backgrounds. The department would also like to develop programs that attract and assist minority students in obtaining degrees in microbiology.

The needs in the department are primarily related to continued growth of upper-division courses and increased mentored student research projects. Increases in personnel, space, and budget are needed for continued growth. Between 2008 and 2012, the department functioned and enrollments grew with only six faculty members. This put a tremendous strain on the department; as faculty taught larger and larger courses. We had little flexibility for scheduling, sabbatical leave, reassigned time, or developing new courses. In July 2012, we were able to fill a frozen position, however, as the major continues to grow, the department will continue to experience this stress. Adding another faculty member (bringing our total to eight) will allow more flexibility for scheduling, and allow the department to offer more courses in cutting edge microbiology.

Laboratory space is in short supply with none available for increasing laboratory enrollments or faculty research. The only solution to increasing laboratory sections in upper-division courses was to convert research space into laboratory teaching space. It is also becoming increasingly difficult to find classrooms to teach upper-division courses that will accommodate the higher enrollments. Infrastructural deficiencies, such as the availability of laboratory space, continue to cause trouble for the Department, and these issues will likely only be completely resolved upon the completion of a new science lab building.

Current expense budgets have barely kept pace with enrollment increases, particularly in upper-division, laboratory intensive, courses. Inadequate funding limits the number and types of experiments that can be done in these courses. Sophisticated disposable test kits, pre-mixed reagents, and single use laboratory materials have become increasingly common in microbiology and these are the types of materials utilized by industry so the students must be trained in their use. With the current budget situation, students work in larger laboratory groups and faculty can only provide demonstrations of some procedures and test kits. Continued support of our laboratory manager and hourly student lab aids is also vital for our upper-division labs. Some of the department's equipment is outdated and needs to be replaced while critical pieces are in need of significant repairs. Even when we can afford to purchase new equipment, there is no place to house

it or current expense money to maintain it. Inadequate funding also means very little support can be provided to faculty, for travel, research, curriculum development, and teaching improvement.

Student research is expensive and labor intensive for faculty, but is now necessary for students to be competitive for graduate and professional school positions. Funding, primarily through Office of Undergraduate Research, for student research in the summer has brought some relief. Unfortunately, there have been no funds available for faculty overload salaries as they mentor research students during summer semester.

The department has the opportunity for further growth through increasing the number of majors, increasing course offerings, collaborative and interdisciplinary research and teaching, and adding new faculty to expand the expertise within the department. As the field of microbiology continues to advance, the demand for well-trained microbiologists will increase. The Microbiology Department at Weber State has a strong record of teaching excellence, placement of graduates, research, and service that will continue through the next decade.

## B. Mission Statement

The department of Microbiology seeks to provide a quality undergraduate education to students of Weber State University in both general education and discipline-specific courses. We strive to provide our graduates with a solid academic foundation for further educational opportunities, and the knowledge and skills for career opportunities upon graduation. We seek to integrate into student's program of study the development of skills including critical thinking, problem solving, written and oral communication, and laboratory research techniques. The department provides opportunities for research and other scholarly activities for both faculty and students, and serves as a resource for the campus and the state of Utah in the area of microbiology. We attempt to inspire life-long learning and teach students the broad range of disciplines in microbiology. We also believe that a more knowledgeable public will be able to make more informed decisions with regard to scientific issues that impact their lives.

Revised, November 1999

### C. Curriculum Overview

#### Degrees Offered

1. Microbiology Major (BS)
2. Microbiology Minor

#### General Education Courses:

1. LS 1113      Introductory Microbiology
2. LS 1153      Elementary Public Health
3. LS/SI 2054    Principles of Microbiology

#### Service Courses

1. LS 1113      Nursing, Dental Hygiene, Respiratory Therapy, Medical laboratory Sciences
2. LS 2054      Medical Lab Sciences, pre-medicine, pre-dentistry, pre-physical therapy, pre-veterinary, pre-physician's assistant, Botany, Zoology, Biology Composite Teaching, Biotechnician Training (AS, certificate)
3. MICR 2600    Biology Composite Teaching, Biotechnician Training (AS, certificate),
4. MICR 3053    Biotechnician Training (AS, certificate)
5. MICR 3203    Medical Laboratory Sciences, pre-medicine, pre-dentistry, pre-physical therapy, pre-veterinary, pre-physician's assistant, Zoology
6. MICR 3484    Botany, Biology Composite Teaching, pre-agriculture, pre-horticulture, Applied Environmental Geoscience emphasis
7. MICR3603    Medical Laboratory Sciences
8. MICR 4154    Biotechnician Certificate
9. MICR 4252    Pre-medicine, Biotechnician Certificate
10. MICR 4354    Biotechnician Certificate
11. MICR 4554    Pre-medicine, Biotechnician Certificate

#### **Major/General Education Comparison**

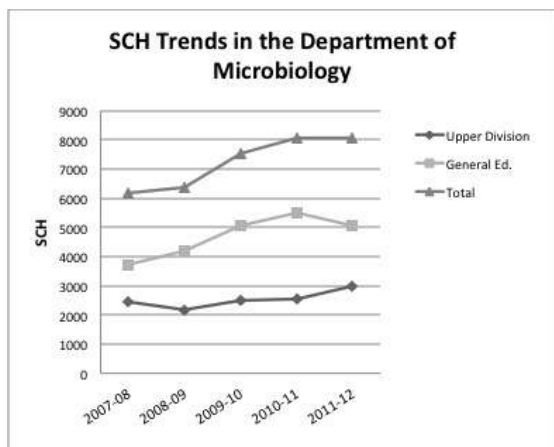
Faculty generally teach an equal number of upper-division and general education courses. The number of SCHs from upper-division courses compared to lower division SCHs has continued to rise (Table 1, Figure 1). This rise is due to an increase in the number of majors in the department, and the use of upper-division courses as service courses by other programs. There has been a significant increase in the number of online SCHs offered by the department. Department productivity and faculty productivity, which includes uncompensated overload teaching, has increased dramatically (Table 3). While this implies higher productivity, it also points to a critical shortage of funds for upper-division laboratory courses.

**Table 1. Department of Microbiology SCH Summary**

<b>Year</b>	<b>Upper-division</b>	<b>General Ed.</b>	<b>Total</b>	<b>% Upper Div.</b>
<b>2007-08</b>	2,443	3,726	6,169	39.6
<b>2008-09</b>	2,179	4,185	6,364	34.2
<b>2009-10</b>	2,476	5,052	7,528	32.8
<b>2010-11</b>	2,569	5,487	8,056	31.9
<b>2011-12</b>	2,995	5,058	8,053	37.0

**Table 2. General Education SCH Summary**

Year	LS1113	LS1153	LS2054	3203	3603
2007-2008	2670	1026	612		225
2008-2009	3045	1113	572		363
2009-2010	3588	1434	624	240	339
2010-2011	3972	1485	800	369	360
2011-2012	3789	1236	688	525	462



**Figure 1.** SCH Trends in the Department of Microbiology 2007-2012

**Table 3. SCHs have continued to rise, and cost per SCH decreases**

Year	SCH	Total Budget	Cost/SCH
2007-08	6,169	\$766,929	\$124.31
2008-09	6,364	\$696,273	\$109.40
2009-10	7,528	\$686,021	\$91.13
2010-11	8,056	\$827,724	\$102.75
2011-12	8,053	\$671,033	\$83.33

### General Education

General education numbers have generally increased (Table 2, Figure 1), even with competition from courses not previously designated with general education credit. Further, several programs in the College of Health Professions have begun offering their own prerequisite courses instead of using MICR 1113, 1153, and 2054. Enrollment in these general education courses has increased over the past five years (Figure 1), primarily because of more robust online offerings and improved scheduling procedures. SCHs in service courses and upper-division courses have also risen in the past five years in spite of the loss of a key faculty position (replaced in 2012). Reasons for this increase include:

1. More off-campus offerings and alternative formats, Davis Campus, Honors sections, remote campus locations
2. More general education courses (1113, 1153) offered online and summer semesters

**Table 4. Curriculum Map**

	Core Concepts					Fundamental Skills							
	Model systems for Basic Biology	Integral role in Disease and Human Health	Ubiquitous in nature	Vital Role - Integration of Science and Society	Indispensable role in Environment and Ecology	Nature of Science	Laboratory Skills	Critical thinking	Data Analysis	Problem Solving	Communication	Cooperation	Values
<b>Required Courses</b>													
2054, Principles of Microbiology	1, A	2	2, A	1	2, A	1	3, A	1	1	1	1	2	1
3053, Microbiological Procedures	2, A					3, A	3, A	3	3	3	3	3	
3154, Microbial Ecology	2, A	2	3, A	2	3, A	3, A	3, A	3, A			2, A	2, A	2
4054, Microbial Physiology	3, A	2	3, A	2	3, A		3, A		3, A			3, A	3
4154, Microbial Genetics	3, A		1	2	3, A	2	3, A	2, A	2, A	2	3, A	3, A	2
<b>Elective Courses</b>													
3254, Immunology		3, A		3, A			3, A				3, A		3, A
3305, Medical Microbiology		3, A		3, A		3, A	3, A	3, A	3, A	3, A	3, A	3, A	2
3403, Tropical Diseases		3, A		3, A		3, A	3, A	3, A		3, A	3, A	3, A	3, A
3484, Environmental Microbiology	3, A	3, A		3, A	3, A	3, A	3, A	3, A		3, A	3, A	3, A	
3502, Environmental Health		2	3		3			2		2			3
3753, Geomicrobiology	2		3, A		3, A	2	3, A	3, A		2, A	2	2	
3853, Food Microbiology	1, A	2, A	1	3, A	1			3, A	3, A	3, A			
4252, Cell Culture	3, A	2	2	2	2	2	3, A	2	3, A	3	2	3, A	
4354, Industrial Microbiology				3, A		3, A	3, A	3, A	3, A				
4554, Virology	3, A	3, A	3, A	3, A	3, A	3	3, A	3	3, A	3	3	3, A	
<b>High Impact Courses</b>													
4800, Directed Research	3	3	3			3	3				3, A		
4830, Directed Readings	3	3	3								3, A		
4991, Microbiology Seminar											3, A		

*Note<sup>a</sup>*: Define words, letters or symbols used and their interpretation; i.e. 1= introduced, 2 = emphasized, 3 = mastered, A = Assessed Comprehensively;

*Note<sup>b</sup>*: Rows and columns may be transposed as required to meet the needs of each individual department

#### D. Microbiology Learning Outcomes

1. Upon graduation, Microbiology majors should have a thorough knowledge and understanding of the core concepts in the discipline of Microbiology. Microbiology students will be able to:
  - i. Describe how microorganisms are used as **model systems** to study basic biology, genetics, metabolism and ecology.
  - ii. Identify ways microorganisms play an **integral role** in disease, and microbial and immunological methodologies are used in disease treatment and prevention.
  - iii. Explain why microorganisms are **ubiquitous in nature**; inhabiting a multitude of habitats and occupying a wide range of ecological habitats.
  - iv. Cite examples of the **vital role** of microorganisms in biotechnology, fermentation, medicine, and other industries important to human well being.
  - v. Demonstrate that microorganisms have an **indispensable role** in the environment, including elemental cycles, biodegradation, etc.
  
2. Upon graduation, Microbiology majors should have mastered a set of fundamental skills which would be useful to function effectively as professionals and to their continued development and learning within the field of Microbiology. These skills include the following:
  - i. **Nature of Science and Scientific Inquiry:** Microbiology majors should be able to discuss science and scientific methodology as a way of knowing. Microbiology majors should make observations, develop hypotheses, and design and execute experiments using appropriate methods. They should be able to explain how the nature of science is applied to every day problems.
  - ii. **Laboratory Skills:** Microbiology students should master the following laboratory skills: aseptic and pure culture techniques, preparation of and viewing samples for microscopy, use appropriate methods to identify microorganisms, estimate the number of microorganisms in a sample, and use common lab equipment. They should practice safe microbiology, using appropriate protective and emergency procedures.
  - iii. **Data analysis skills:** Microbiology majors should be able to systematically collect, record, and analyze data, identify sources of error, interpret the results, and reach logical conclusions. They should be able to appropriately format data into tables, graphs, and charts for presentation and publication.
  - iv. **Critical Thinking Skills:** Microbiology majors should be able to (1) differentiate between fact and opinion, (2) recognize and evaluate author bias and rhetoric, (3) develop inferential skills, (4) recognize logical fallacies and faulty reasoning, and (5) make decisions and judgments by drawing logical conclusions using sound quantitative and statistically-based reasoning.
  - v. **Problem-Solving Skills:** Microbiology majors should be competent problem-solvers. They should be able to assess the elements of a problem and develop and test a solution based on logic and the best possible information. Microbiology students should be able to analyze and interpret results from a variety of microbiological methods, and apply these methods to analogous situations. They should use mathematical and graphing skills and reasoning to solve problems in microbiology.
  - vi. **Communication Skills:** Microbiology majors will demonstrate competence in written and oral communication.
  - vii. **Cooperation/Social Responsibility:** Microbiology majors should understand and appreciate the value of cooperating and working effectively with peers and be able to demonstrate a commitment to the process of developing such skills.
  - viii. **Values:** Microbiology majors should identify and discuss the ethical issues and responsibilities of doing science.



## Evidence of Learning: Courses within the Major by Course

The Microbiology Department is currently working to develop a comprehensive assessment plan for each of the learning outcomes. The learning outcomes will be specifically assessed in the courses highlighted in the Curriculum Map. Assessment plans for each of the major courses is described briefly here and in more detail in the supplemental file for each course. Faculty members provided information about their assessment procedures in their courses and provided artifacts that have been collected in the supplemental file.

### 2054

Core Concepts: Direct assessment is administered through six ChiTester exams with multiple choice, fill in the blank, and short essay questions. There is also a final exam. We will include questions that specifically address the identified learning outcomes on the exams. This course is also assessed as a general education course.

Fundamental Skills: Students' proficiency at **physical laboratory manipulations** is assessed with three lab exams. The third exam is used to demonstrate student mastery of the laboratory skills (80% or better on the exam). In 2010 and 2011, 70% of the class met this objective, we would like this to be 80% or higher to meet the lab skills objective. Students may need more time for practicing fundamental laboratory skills during the regular laboratory sessions.

Indirect measures: To improve and increase student involvement with the course content, we use homework assignments, in-class activities, and case studies that require students to synthesize the material in each unit. Although these activities slow the progression through the course, the students enjoy these activities and demonstrate improved retention of important terms and concepts.

### 3053

Fundamental Skills: Students work in laboratory groups to **design and complete an independent experiment**. This requires appropriate use of **experimental design, data analysis, and statistical evaluation**. Students complete a laboratory report that is used for assessment. Accomplishment of this objective is successful if 80% of students earn 80% or better on the lab report. In 2012, this objective was obtained.

Students demonstrate **problem solving** (calculations) abilities and **laboratory skills** on multiple choice quizzes and practical examinations. At least 80% of students should earn 70% or better to meet this objective. This level was exceeded in 2012.

### 3154

Core Concepts: Students explain the core concepts and content on four multiple choice and essay exams during the semester. The core concepts are considered accomplished if 80% of students earn 70% or better on each exam. In 2011 and 2012 the average score on each exam was 80% or better, indicating the core concepts were met.

Fundamental skills: Students use **critical thinking and problem solving** to evaluate recent journal or review articles on microbial ecology, they then **analyze and critique the methods and results**. These skills are assessed with written quizzes given in class. **Laboratory skills** are evaluated by assessment of student laboratory notebooks. Notebooks are collected twice during the semester for evaluation and a **rubric** is used for assessment. At the end of the semester, 100%

of students should have an 80% or better on the laboratory notebook evaluation. This has occurred each semester, indicating student improvement in lab note-taking during the semester.

Beginning Spring 2013, students will be given a pre-test on the core concepts. Post-test questions will be embedded in the unit exams and the scores will be compared to the pre-tests after the completion of the semester.

Indirect Measures: Several in-class assignments, quizzes, and discussions occur throughout the semester that allow the instructor to determine the level of students' understanding of the concepts and to adjust the course delivery as needed.

4054

Core concepts: Students answer questions on short answer, essay, and multiple choice questions that assess content relating to the core concepts. Homework questions, **requiring critical thinking and problem solving** are also used. Evaluation thresholds will be established prior to the course offering in Fall 2013.

Fundamental Skills: Students demonstrate **laboratory skills**, including spectroscopy, plate counts, microscopy, centrifugation and aseptic technique during labs. The laboratory instructor observes and assesses the students' lab skills. Students interpret **results and analyze their own data** from experiments and combined data sets from the entire class. They are required to present the data graphically. Students **cooperate** on experiments, data analysis and written reports.

4154

Core concepts: Multiple choice and essay exams are used to assess content and core concepts.

Fundamental skills: Students work in groups and each student takes a turn being the group leader and assigning responsibilities for that experiment. Students write up each laboratory in journal manuscript form with emphasis on **data presentation and interpretation** and abstract writing. Lab reports are assessed with a **rubric**. Critical thinking is assessed with homework assignments that require students **evaluate primary literature** and answer a series of essay questions relating to the data presented in the article.

3254

Core concepts: Competency is assessed with at least five exams, which include hundreds of multiple choice questions, essay, and short answer questions. These exams have students solve problems and explain how the **immune response** of mammals to microbial infection is **integral to the development or avoidance of disease**. A selection of these questions will be used in future semesters as evidence of meeting these learning outcomes.

Fundamental skills: Students are evaluated with written laboratory reports to demonstrate **laboratory skills**. They also complete a written assignment and participate in a class debate on the **ethics** of animal use in research. These assignments also assess **written and verbal communication** skills.

3305

Core concepts: Competency is assessed with at least five exams, which include hundreds of multiple choice questions, essay, and short answer questions. These exams have students solve problems and explain how **microorganisms cause disease** and how they can be **treated and prevented**. A

selection of these questions will be used in future semesters as evidence of meeting these learning outcomes.

Fundamental skills: Several of the fundamental skills are assessed with a research project that is designed, proposed, conducted, and presented by student groups. This project includes an evaluation of students' **ability to safely handle potential pathogens**. They are required to **design the experiment, prepare media, sterilize equipment, collect data, interpret data, identify sources of error, and make conclusions as to their data**.

3403

Core concepts: Direct measure of competency will be measured with administration of a pre-test. Tests will include short response and essay questions on all major topics covered in the course. These include types and virulence factors of disease-causing agents, disease pathogenesis, diagnosis, treatment, prevention and control. Pre-test results will be compared to responses on subjective lecture exams used to evaluate student progress and understanding. Exams consisting of fill-in-the-blank, short response, and essays will evaluate a student's ability to integrate a causative agent and its type/properties, its virulence, and pathogenicity in relation to pathogenesis, diagnosis, treatment, and methods for prevention and control based on epidemiology and immunology. Students will be able to **explain how an organism causes disease, and how the immune response of mammals to microbial infection is integral to the development and/or avoidance of a particular disease**. The core concepts will be considered obtained if 80% of students answer questions correctly on exams that were answered incorrectly on the pre-test and if at least 80% of students obtain a grade of 80% or better on each of the four exams. This assessment will begin in Spring 2013.

Fundamental skills: Students will present case studies or primary literature reviews to the class. All discussions and presentations will focus on the integral role microorganisms play in disease as well as how **the nature of science** is applied to every day problems. Students will be evaluated using the rubric entitled "Articulate Scientific Information in Oral Form." **Laboratory skills** will be evaluated through student design and presentation of a group project. At least 80% of students should obtain an average of  $\geq 3.5$  according to the "Evaluation of Experimental Design" rubric.

3484

Fundamental skills: Critical thinking and problem solving skills will be assessed with a graded research project. The assignment is specifically constructed to promote and assess **experimental design, implementation, and methodology**. All projects are evaluated based on an oral presentation and class critique.

3853

Core concepts: Assessment is done with multiple choice and short answer exams that require students to explain the **vital** role of microorganisms in **food production** and **fermentation**.

Fundamental skills: Laboratory experiments emphasize and assess **data analysis, critical thinking, and problem solving**. Students demonstrate these skills with formal laboratory reports.

4252

Core concepts: **Model systems for basic biology** is mastered as a core concept in this course. All living things are made of cells. Students study the requirements for life at the cellular level. Students learn that **cells can be manipulated and new technology presents both promises and**

**challenges for society.** Students are assessed using homework and multiple choice, short answer, and essay exams throughout the course. Thresholds for these assessments will be established for Fall 2013.

Fundamental skills: Students master several **laboratory skills** including spectroscopy, cell culturing techniques, revival of frozen cells, microscopy, centrifugation, cell signaling assays, RT-PCR, and aseptic technique. Students **interpret results, analyze their own data** from experiments and combined data sets from the entire class, **and they present the data graphically.** All laboratory exercises are done **cooperatively.** Students are evaluated on their laboratory skills with practical exams and written laboratory reports.

4354

Core concepts: Assessment is done with two take-home examinations that require students to develop and support a specific decision. Evaluation of responses is based on thoroughness, strength of support, and clarity, although creativity may also be considered. Threshold: At least 80% of students will receive overall grades of 70% or better. This threshold was met in 2012. Students are also required to prepare and present a term paper. Oral presentations are made to the class at the end of the semester. Threshold: At least 80% of students will receive overall grades of 70% or better. This threshold was met in 2012.

Fundamental Skills: **Laboratory skills** are assessed with multi-week research projects that require evaluation of **industrial principles**, leading to **experimental design**, construction of equipment, and to develop a successful industrial process.

4554

Core concepts: Viruses infect all living organisms. Bacteriophages are frequently **used as a model system to study the characteristic of viruses** and are used extensively in the laboratory exercises. Viruses are studied for their **role in nature and as the cause of pandemics** Viruses are **ubiquitous in nature**; they infect all living things and play an integral role in genetic change. Students are assessed, throughout the course, using homework and multiple choice, short answer, and essay exams.

Fundamental skills: The instructor evaluates each student on their **laboratory skills** through observation of their laboratory techniques. We are developing rubrics to assess these skills. Laboratory skills used in this course include spectroscopy, plate counts, microscopy, centrifugation, and aseptic technique. Students use **data analysis to interpret their results** and they **present their results graphically.** All laboratory work is done in **cooperative groups.**

### Evidence of Learning: High Impact or Service Learning

4800, 4830

Faculty in the department mentor undergraduate research in MICR 4800 (research) or 4830 (readings) courses. Some faculty conduct research in the summer and usually involve students in this work. Each year students mentored by microbiology faculty have presented at local, regional, national or international conferences. Students have presented or published their work at the following meetings or in the following journals:

#### Meetings:

- American Society for Microbiology General Meetings
- American Society for Microbiology Regional Meeting
- Utah Academy of Science Arts Letters
- Utah Conference of Undergraduate Research
- National Conference of Undergraduate Research
- International Society for Salt Lake Research
- WSU Undergraduate Research Symposium

#### Journals

- Proceedings of the National Conference of Undergraduate Research
- Proceedings of the International Society for Salt Lake Research
- Journal of the Utah Academy of Science Arts and Letters
- Journal of Virology
- *WSU Ergo*

Undergraduate research presentations and publications by year and faculty member are listed in Appendix G.

## Evidence of Learning: General Education Courses

### **Overview**

The Department of Microbiology offers three Life Science General Education courses. These courses were approved by the Curriculum Committee and Faculty Senate in 2009. Assessment is primarily through traditional multiple choice and short essay exams and quizzes. However, some instructors use homework, papers, discussion boards, and other tools depending on their teaching style or section format (e.g. online).

Assessments are designed to evaluate the course content. The content is designed to meet the learning objectives. We do not, at this time, have department-wide standardized questions that assess each of the natural science and life science learning objectives. However, we are working with the Office of Institutional Effectiveness and the General Education Life Science Assessment committee to design assessments in ChiTester or otherwise that can be easily evaluated department-wide.

### **Natural Science Learning Objectives:**

After completing the natural sciences general education requirements, students will demonstrate their understanding of general principles of science:

1. **Nature of science.** Scientific knowledge is based on evidence that is repeatedly examined, and can change with new information. Scientific explanations differ fundamentally from those that are not scientific.
2. **Integration of science.** All natural phenomena are interrelated and share basic organizational principles. Scientific explanations obtained from different disciplines should be cohesive and integrated.
3. **Science and society.** The study of science provides explanations that have significant impact on society, including technological advancements, improvement of human life, and better understanding of human and other influences on the earth's environment.
4. **Problem solving and data analysis.** Science relies on empirical data, and such data must be analyzed, interpreted, and generalized in a rigorous manner.

### **The Life Sciences Learning Outcomes:**

Students will demonstrate their understanding of the following characteristics of life:

5. **Levels of organization:** All life shares an organization that is based on molecules and cells and extends to organisms and ecosystems.
6. **Metabolism and homeostasis:** Living things obtain and use energy, and maintain homeostasis via organized chemical reactions known as metabolism.
7. **Genetics and evolution:** Shared genetic processes and evolution by natural selection are universal features of all life.
8. **Ecological interactions:** All organisms, including humans, interact with their environment and other living organisms

**Table 5. 2054 Principles of Microbiology**

**Course Description:**

Study of the morphology, reproduction, cultivation, metabolism, genetics, and ecology of microorganisms, along with many applications. This introductory microbiology course is designed for science majors and consists of three one-hour lectures and one two-hour lab per week

Outcome	Content	Assessment	Measure	Results
Nature of Science	Current research in microbiology, Historical Microbiology, Classical Experiments in Microbiology, Laboratory Exercises.	Concepts will be linked to questions asked in ChiTester or to a rubric tied to a writing assignment. Lab Exams	TBD	
Integration of Science	Role of other disciplines in microbiology, physics, chemistry, biochemistry, and the impact of microbiology on other sciences, ecology, zoology, botany, agriculture, etc.	TBD: Concepts will be linked to questions asked in ChiTester or to a rubric tied to a writing assignment	TBD	
Science and Society	The impact of microorganisms on the health and well-being of humans, especially their ability to cause disease. Vaccines, antibiotics.	50 exam questions on the impact that microorganisms have on human health and well-being. Including pathogenic organisms, vaccines, and antibiotics.	80% of Students will answer 70% of the questions correctly. Measured with ChiTester	This threshold was met in 2010
Problem Solving	Microbiological laboratory techniques that require data collection and analysis, e.g. determining the number of cells per milliliter in a food or water sample.	Lab Exam 3, student use data to calculate the outcomes of microbiological dilutions. They must plan and execute a dilution scheme to quantify bacteria in a sample culture.  Dilution Quiz: 10 questions, take home quiz. Students solve dilution problems	70% of students will earn 70% or better on Lab exam 3.  90% of students will earn 80% or better. Canvas Quiz	In 2010-2011, 70% of class met this threshold.  In 2012, >90% of students met this threshold
Levels of Organization	Cell structure and function. Three domains of life. Basics of evolution.	50 multiple choice and short answer questions on macromolecules, and cell structure and functions.	80% of Students will answer 70% of the questions correctly Measured with ChiTester	This threshold was met in 2010
Metabolism and homeostasis	Central metabolic pathways, including anabolism and catabolism, aerobic and anaerobic respiration, and fermentations.	50 multiple choice and short answer questions on Glycolysis, Citric Acid Cycle, Electron Transport and related topics	80% of Students will answer 70% of the questions correctly. Measured with ChiTester	This threshold was met in 2010
Genetics and Evolution	Central Dogma of biology, DNA replication, transcription, translation, mutations, genetic exchange, and the relationship between genetic change and microbial diversity and evolution. Antibiotic resistance.	50 multiple choice and short answer questions on DNA replication and protein synthesis, mutations, and genetic exchange	80% of Students will answer 70% of the questions correctly. Measured with ChiTester	This threshold was met in 2010
Ecological Interactions	Impact of microbial activity on their environment. Including human-microbe interactions, Metabolic diversity, nitrogen fixation, waste water treatment.	50 multiple choice and short answer questions on the interactions between microorganisms and between microorganisms and the human immune system	80% of Students will answer 70% of the questions correctly. Measured with ChiTester	This threshold was met in 2010

Indirect Evidence

- Homework and assignments
- Case studies/ in-class assignments
- Quizzes
- Discussions
- Course grades

**Table 6. 1113 Introduction to Microbiology**

**Course Description:**

An introduction to microorganisms, their biology, and their relationships to health, technology, and the environment, with practical applications. Three lecture/demonstrations per week.

Outcome	Content	Assessment	Measure	Results
Nature of Science	Current research in microbiology, Historical Microbiology, Classical Experiments in Microbiology,	<b>Direct Measures:</b> <ol style="list-style-type: none"> <li>1. Students are assessed using traditional multiple choice questions on four to seven, unit exams (depending on instructor). Each exam addresses one or more of the natural science or life sciences learning objectives for the life sciences.</li> <li>2. We have begun working with the Office of Institutional Effectiveness and the Life Science General Education Assessment Committee to embed assessment questions for each objective on the unit exams. Exams are given and the outcomes will be assessed in Chitester. This will allow for easier reporting on each objective, and will help ensure that all sections, including online sections, are meeting the objectives successfully. Since most of the sections have been assessed in Chitester adding the learning objectives to questions should allow us to develop a retrospective evaluation of this course.</li> <li>3. We use a variety of other assessment tools that measure student understanding of the learning objectives. These include, homework assignments, quizzes, essay questions, presentations, discussion questions, and case studies. We are working to develop rubrics that can assess the learning objectives for written or presented assignments.</li> </ol>		
Integration of Science	Role of other disciplines in microbiology, physics, chemistry, biochemistry, and the impact of microbiology on other sciences, ecology, zoology, botany, agriculture, etc.			
Science and Society	The impact of microorganisms on the health and well-being of humans, especially their ability to cause disease. Vaccines, antibiotics			
Problem Solving	DNA transcription and translation			
Levels of Organization	Cell structure and function. Three domains of life. Basics of evolution			
Metabolism and homeostasis	Central metabolic pathways, including anabolism and catabolism, aerobic and anaerobic respiration, and fermentations.			
Genetics and Evolution	Central Dogma of biology, DNA replication, transcription, translation, mutations, genetic exchange, and the relationship between genetic change and microbial diversity and evolution. Antibiotic resistance			
Ecological Interactions	Impact of microbial activity on their environment. Including human-microbe interactions, Metabolic diversity, nitrogen fixation, waste water treatment, other examples			



**Table7. Microbiology 1153: Elementary Public Health Course Description:**

Principles and practices of public health, emphasizing prevention and control of communicable and degenerative diseases, and environmental health problems. Three lectures/ demonstrations/ week.

Outcome	Content	Assessment	Measure	Results
Nature of Science	Historical Microbiology, Classical Experiments in Microbiology,	<p><b>Direct Measures:</b></p> <ol style="list-style-type: none"> <li>Students are assessed using traditional multiple choice questions on four to seven, unit exams (depending on instructor). Each exam addresses one or more of the natural science or life sciences learning objectives for the life sciences.</li> <li>We have begun working with the Office of Institutional Effectiveness and the Life Science General Education Assessment Committee to embed assessment questions for each objective on the unit exams. Exams are given and the outcomes will be assessed in Chitester. This will allow for easier reporting on each objective, and will help ensure that all sections, including online sections, are meeting the objectives successfully. Since most of the sections have been assessed in Chitester adding the learning objectives to questions should allow us to develop a retrospective evaluation of this course.</li> <li>We use a variety of other assessment tools that measure student understanding of the learning objectives. These include, homework assignments, quizzes, essay questions, presentations, discussion questions, and case studies. We are working to develop rubrics that can assess the learning objectives for written or presented assignments.</li> </ol>		
Integration of Science	Sciences of Public Health: Biomedical Science, Social and Behavioral Science, Health Policy, Epidemiology, Statistics, Environmental Health			
Science and Society	The impact of microorganisms on the health and well-being of humans, especially their ability to cause disease. Vaccines, antibiotics. Socioeconomic impact of health and disease.			
Problem Solving	Epidemiology, identifying types of epidemiologic studies, calculating incidence rates and relative risks, Interpreting and evaluating health claims (e.g. vaccine side effects)			
Levels of Organization	Cell structure and function, microbial diversity, three domains of life			
Metabolism and homeostasis	Metabolic diversity in prokaryotic organisms. Organisms used in food production.			
Genetics and Evolution	Central Dogma of Biology, DNA replication, transcription, translation, mutations, genetic exchange, and the relationship between genetic change and microbial diversity and evolution. Antibiotic resistance, sickle cell anemia			
Ecological Interactions	Impact of environmental quality on health and disease. Examples: role of climate change in changing disease patterns, impact of drought on plant pathogens, relationships between UV exposure and skin cancer, air pollution, importance of water and sewage treatment.			

## Evidence of Program Effectiveness

### **Majors and Graduates**

Over the past five years the Department has seen an increase in the number of majors and graduates. The department continues to rank first or second in the number of majors in the College. On exit interviews, students rank the **overall program effectiveness** as excellent (4.7 out of 5 point scale).

Graduates of our department are highly successful at obtaining employment and acceptance to professional or graduate school (Table 8).

**Table 8. Summary of Majors, Graduates, and Graduate Placements**

Year	Majors	Graduates	% Successful Applicants Professional or Graduate School	Employed in Microbiology
2007-08	169	41	77% (7)*	5
2008-09	165	36	76% (5)*	5
2009-10	185	35	71% (6)*	4
2010-11	183	23	57% (6)*	3
2011-12	217	32	48% (11)*	8
2012-13	238 (8/27/2012)	38 (anticipated)		

\* (# applications pending or unknown)

We expect to see a continued rise in the number of majors and graduates over the next few years. Some of the programs we have initiated to increase and maintain enrollment include:

1. Recruiting in lower division courses
2. Adding variety to the upper-division elective offerings
  - a. Geomicrobiology
  - b. Tropical Diseases
3. Increasing Laboratory sections in upper-division courses (Physiology, Genetics, Ecology, Procedures, Immunology, Medical Microbiology, Virology)
4. Offering upper-division service courses (3203, 3603) online has increased SCHs, but decreased, somewhat, the demand for more laboratory space because non-majors can take the online section without the lab. Online upper-division courses are popular with off-campus/distance students who need credits for continuing education (e.g. MLS programs) or advances in employment.
5. Teaching MICR 2054 in the summer block

#### E. Academic Advising

Advising occurs throughout the department. All faculty work with students, helping them choose courses, discussing careers, graduate and professional schools, and providing general assistance. Official advising activities, including outlining course schedules, approving prerequisites, course exceptions, and graduation clearances are the responsibilities of the department chairperson.

Since the last review, several changes to the advising process have occurred that have decreased confusion. Students usually meet with several different advisors. The University advising office now organizes large new student orientation workshops that include large group general advising sessions where students are introduced to the advisors in the College of Science. In these meetings, students learn about general education requirements, recommended support courses, and general information about the major. They are encouraged to make an appointment with their major advisor.

One of the advising goals identified in the last review was to have students receive advising when they declare Microbiology as their major. This is now the case. Students now usually meet first with the College of Science advisor to address their general education requirements and are then recommended to the chair of the department.

The department chairperson uses the CatTracks student monitoring system to evaluate a student's progress towards their degree. This has been helpful because CatTracks contains all of the student's course history and advising notes. Students can also access this information and create their own course plan. What CatTracks does not do well is help students pick courses, especially elective and support courses. This detailed advising takes place with the department chairperson, the college advisor, and the pre-professional advisors. Having multiple points of advising is helpful; the advising is comprehensive and students gain important information at each step. However, students can also become confused about program requirements when they receive different advice from multiple advisors. Efforts are being made to improve communication between advisors to ensure that students are hearing the most accurate information. Using the CatTracks notes could help with this effort.

The pre-Professional advisors for Physicians Assistants (Dr. Nakaoka) and Dental (Dr. Domek) are within the department of Microbiology. They serve students in our department, college, and across campus. Dr. Culumber advises the Biology Composite Teaching students.

#### Advising Strategy and Process

1. Attend University orientation session, new students
2. Meet with the College Advisor – general education advising and referral to department and pre-professional advisor
3. Meet with the Department Advisor (chairperson) prior to registration
4. Meet with pre-Professional Advisor – if appropriate
5. Students are reminded in their introductory courses, MICR 2054, to make an appointment for advising. In their upper level courses, students are reminded of important deadlines such as graduation evaluations and are encouraged to meet with an advisor well before their graduation date to ensure they will complete their degree as expected.

#### Effectiveness of Advising

On exit surveys, students report that they find the advising provided by the Microbiology Department excellent (average 4.5 out of 5, for the years 2009-2012). This is about one point higher than the rating they give to University advising. On exit surveys, students report an average of five years to degree completion. However, some students report an excessively long time to graduate (6-10 years).

This may be due to several factors, including switching majors and transferring from other institutions. Students may also be including time away from school for work, military service, religious missions, or family obligations.

#### Future Recommendations

The advising process needs to be streamlined. Pre-professional students do need to spend time with both the pre-professional advisor and with the major advisor, but they should be getting the same advice. Advising should start earlier, and materials about the major should be available online. Students interested in Microbiology should meet with an advisor during their first year. This could prevent students from taking unnecessary courses (e.g. MICR 1113). Transfer students, and students seeking associates degrees should meet with the advisor as soon as possible. The department should also consider having more faculty members involved with official advising, especially during registration. Faculty advisors, including the pre-professional advisors, should be trained on CatTracks and should include notes when they advise students.

#### F. Faculty

##### Faculty Demographic Information

The Department of Microbiology has seven tenured or tenure-track faculty members: four full professors, two associate professors, and one assistant professor. Two members of the faculty are women.

The Department currently has four adjunct faculty teaching general education courses. Resumes or curriculum vitae for adjuncts are available in the department chair's office.

##### Programmatic/Departmental Teaching Standards

Departmental teaching standards are those used by the College of Science, specifically in the teaching evaluation section of the Tenure Document and those stated in the Promotion and Tenure evaluation criteria in the PPM section 8-11. Faculty members are made aware of teaching expectations when they are hired and during annual interviews with the department chair.

### **College of Science Tenure Documents**

#### A. Teaching:

The candidate's teaching competency and effectiveness will be systematically evaluated by students, peers, and administrators. A high degree of success in effectively teaching current and accurate information and in assessing the student's mastery of the course materials is required, using methods appropriate to the courses taught. Although the candidate's academic freedom in the choice of teaching methods is specifically recognized, the candidate will be evaluated on the basis of overall effectiveness in the teaching of the subject at the appropriate level for the course. In all cases such instruction should be consistent with the approved course syllabi, lead to fulfilling the department curriculum objectives, and fulfill faculty responsibilities to students (PPM 9-5). Also see PPM 8-11 for more details.

Beginning in 2013, the University approved a formal post-tenure review process (PPM 8-11). All tenured faculty will undergo review of their teaching, scholarship, and service on a five-year rotation. The review process is being developed at the College level.

#### Faculty Qualifications

All tenured and tenure-track faculty have terminal degrees in microbiology or related fields. Faculty CVs are provided in Appendix I.

### Evidence of Effective Instruction

#### i. Regular Faculty

Faculty are evaluated each semester with student course evaluations. Faculty are also evaluated by the department chair during the annual report evaluations, and by peer review at promotion and tenure. Individual faculty evaluations and annual reviews are kept in the department chair's office.

Measures for addressing the specific course objectives are described above.

#### ii. Adjunct Faculty

Adjunct faculty are reviewed annually by the department chair and dean, and through student course evaluations. General education courses taught by adjunct faculty are, and will continue to be, evaluated with the same metrics used for all general education courses as described above. Adjunct faculty vita and evaluations are kept in the chair's office.

### Mentoring Activities

New faculty are mentored by the department chairperson and senior faculty as needed. New faculty are encouraged to attend the New Faculty Retreat and other opportunities provided by the Teaching and Learning Forum, as well as training courses offered by the University. Collaborative research also provides mentoring of early career faculty by senior faculty. Adjuncts are invited to, and encouraged to attend the Adjunct Retreat, offered annually by the Teaching and Learning Forum.

### Ongoing Review and Professional Development

#### **Review**

All faculty undergo annual review that involves a summary of that year's teaching, scholarship, and service activities and student evaluations of every course (excluding seminar, workshops, readings, and research). According to the PPM, tenured faculty are only required to have two courses evaluated each year. Faculty meet with the department chair person each year to review student evaluations and the annual report. In this meeting, professional goals are set and discussed. Goals set in previous years are evaluated and refined. The chairperson generates a departmental review summarizing faculty progress that is forwarded to the Dean.

#### **Professional Development**

All faculty are encouraged to attend, and preferably present at, a professional meeting or workshop each year. Faculty have also been involved with on-campus professional development activities offered by the Teaching and Learning Forum. Some examples of professional development activities of faculty are listed below, specific examples are provided in faculty CV and annual reports.

### Professional Meetings or Workshops

- American Society for Microbiology General Meeting
- American Society for Microbiology Conference for Undergraduate Education
- American Society for Microbiology Intermountain Branch Meeting
- Utah Academy of Science, Arts, and Letters Annual Meeting
- ASM Bioinformatics Workshop
- ASM/JGI Undergraduate Research in Microbial Genome Annotation
- International Society for Salt Lake Research Meeting
- NIH Recombinant DNA Workshop

- Next Generation STEM Learning Workshop
- Academic Chairpersons Conference
- Western Regional Epidemiology Intelligence Service Conference
- Science at the Crossroads

#### On Campus Professional Development and Training

- Online course training (WebCT and Canvas)
- Teaching and Learning
  - Faculty Forum
  - Book Groups
  - Workshops
  - Learning communities
  - Technology symposium
  - New faculty retreat
  - Adjunct retreat

#### **Faculty Service**

Faculty provide service to the Department, College, University and community through participation on committees and through outreach activities. Some of the service activities of faculty in the department include:

#### **Michele Culumber**

1. *Department* Chairperson, 2012-
2. *Department* Library Liaison
3. *Department* Website, Facebook, Outreach
4. *College of Science* Public Relations
5. *College of Science* Biology Composite Teaching Major Advisor
6. *College of Science* Undergraduate Research
7. *University* Animal Care and Use
8. *University* Teaching, Learning, and Assessment
9. *University* Hiring committee for new TLF coordinator
10. *University* faculty senate for 2009-2010
11. Team Captain, Ritchey Science Fair, Microbiology. 23 March 2009
12. Science Fair Mentor. For Cassandra Wilson. Antibiotic Resistance in Thermophiles. Cassandra's project was chosen for the International Science Fair.
13. Invited Lecture: Microbiology of the Great Salt Lake. For Honors 3900 the Great Salt Lake Today. Instructor: Daniel Bedford, Geography. Fall 2008, 2010
14. Invited Lecture: Microbiology of the Great Salt Lake on Antelope Island. For secondary and elementary education teachers, through the Miller Education Project. Invited by Adam Johnston and Stacy Palen, Physics. August 2008

#### **Matt Domek**

1. Pre-dental advisor
2. Faculty advisor, Pre-dental Club
3. Secretary, Intermountain Branch of the American Society for Microbiology
4. Scientific Review Committee for the Harold E. and Helen M. Ritchey State Science and Engineering Fair of Utah, Judge for the Ritchey Junior high school Science Fair
5. Science Olympiad hosted by Weber State University.
6. *University* Curriculum Committee

7. *College of Science* Museum Committee
8. *Department* Departmental subcommittee to review our Safety Policies and Procedures.

**Jason Fritzler (began July 2012)**

1. *University* Animal Care and Use Committee

**William Lorowitz**

1. Microbiology Student Club Advisor
2. *Reviewer: Microbiology: A Human Perspective, 6<sup>th</sup> ed.*, E. W. Nester, D. G. Anderson, C. E. Roberts, Jr., and M. T. Nester, McGraw-Hill. Once again, I was asked to review and edit test bank questions for a new edition of this text. According to McGraw-Hill, I was the only person they had doing this.
3. *Reviewer: Antibiotic Resistance of Escherichia coli O157:H7 Isolated from a Watershed in Indiana for Journal of Environmental Quality*
4. *Reviewer: Analysis of Diazepam Residue from Water Samples by Triple Phase - Suspended Droplet Microextraction Coupled to High Performance Liquid Chromatography and Diode Array Detection for Water Environment Research*
5. Asst. Director, Center for Applied and Environmental Microbiology
6. *University* Curriculum Committee
7. *University* Assessment Committee
8. *University* Computer Committee
9. *University* Promotion and Tenure Committee
10. *University* Peer Review Committee
11. *College of Science* Academic Resources and Computing Committee
12. Scholarship Committee
13. *University* Salary, Benefits, Budget and Fiscal Planning Committee
14. *College of Science* Goldwater Scholarship Committee

**Karen Nakaoka**

1. Pre-professional Advisor for Pre-Physician Assistant Students
2. Pre-PA Club Advisor
3. *College of Science* Curriculum Committee.
4. *Department* Chair, Departmental Tenure and Promotion Committee
5. *Department* Chair, Departmental Peer Review Committee
6. *Department* Secondary member of the Transfer Articulation for the Department of Microbiology
7. *Department* Microbiology Curriculum Committee

**Craig Oberg**

1. Graduate Committee member, USU Dept. Nutrition and Food Sciences Dept.
2. Reviewer, Journal of Dairy Science
3. *Department* Chairperson
4. *Department* Promotion and Tenure Committee
5. *Department* Assessment Committee, Chair
6. *College of Science* Spencer Seager Teaching Award Selection Committee
7. *College of Health Professions* Promotion and Tenure Committee
8. *University* Chair, Faculty Board of Review
9. *University* Medical Benefits Steering Committee
10. *University* Online Steering Committee
11. *University* Athletic Board
12. *University* Athletic Equity Committee

### 13. *University Athletic Compliance Committee*

#### **Mohammad Sondossi**

1. Editorial Board of the *International Biodeterioration and Biodegradation*,
2. The Official Journal of the Biodeterioration and Biodegradation Society and the Pan-American Biodeterioration and Biodegradation Society. 1995-present
3. *Department Curriculum Committee*
4. *Department Director of Applied and Environmental Microbiology Laboratory*
5. *Department Promotion and Tenure Committee*
6. *Department Peer Review Committee*
7. *College of Science Hearing Committee, Hearing Officer*
8. *College of Science Safety Committee*
9. *College of Science Environmental Science Program, Chair*
10. *University Sigma Xi*
11. *University Constitutional review Committee*

#### G. Support Staff, Administration, Facilities, Equipment, and Library

##### Adequacy of Staff

##### **Laboratory Manager**

The Microbiology Department has one part time laboratory manager. Lynn Moyes has done an exemplary job supporting our entry level and upper-division courses, through media preparation, laboratory set up and clean up, maintaining laboratory equipment, purchasing supplies, and serving as the point person for the College for the autoclave and dishwasher maintenance and repair. He also has a role supporting the teaching laboratory and undergraduate research students when they need reagents, supplies, or training. Mr. Moyes also trains, manages, and mentors between one and three undergraduate student employees in the preparatory laboratory each semester. In addition to his responsibilities to the department, Mr. Moyes often works with junior high and high school teachers and students to support their use of microbiology in courses and science fair projects.

##### Staff Development

Because of his involvement in undergraduate research Mr. Moyes attended the American Society for Microbiology General Meeting in 2008, co-presenting posters with Dr. Oberg in the general session and in the education sessions.

##### Challenges of the laboratory manager position

There are two main concerns with the laboratory position. First, in 2010, Lynn Moyes accepted a retirement package that allowed him to continue as lab manager on a part-time, hourly, basis. While this saved the Department and College a significant amount of money, it weakened the position by equating it with a hourly position. The position of **laboratory manager** needs to be a significant career, not part time support. One of the strengths that Mr. Moyes brings to this position is many years of experience. In the future, we will need to hire someone for this position. At that time, we need to ensure the position is respected in the College through appropriate salary, support, and recognition. We anticipate that this should be a position for a person with at least a Masters degree in Microbiology *and* laboratory management experience.

Second, because Lynn is currently part time, the lab is sometimes left staffed only by student hourly employees. While faculty are usually present in offices or labs, they may not be available to make decisions or answer questions for the student workers. Although our student workers are capable and



well-trained, they are students and cannot be expected to take on the responsibilities of a full time employee. Our lab manager should be a full-time position.

### **Administrative Support**

The department is fortunate to have had Carrie Minnoch as our department's administrative assistant for many years. Ms. Minnoch is generally the first departmental contact for new Microbiology majors and she serves as a valuable resource for students. Her many years of experience at WSU have proved invaluable, especially during the transition between department chairpersons. Some of Ms. Minnoch's regular responsibilities include:

- General office support:
  - Photocopies, mail, reception, ordering office supplies
- Faculty support:
  - bookstore orders, class rolls, assisting with light grading, proofreading and editing
- Chairperson support:
  - Budget reports and budget transfers, P-card reconciling, PAR's, payroll for hourly employees, preparation for department audits
  - Calculates yearly course statistics and tracks faculty loads for year end reports, course scheduling assistance, coordinates with continuing education, tracking progress of upcoming graduates, clears majors in CatTracks for graduation
- Student support:
  - Answer's student inquiries when appropriate, processes registration overrides, helps students with course transfer issues, changes program of study when requested

Ms. Minnoch continues to receive training as appropriate, including Lynx, CatTracks, and Banner training. Like Lynn Moyes, Ms. Minnoch accepted a retirement package and returned on a part-time basis. Because of her organization and efficiency, she meets her basic responsibilities and more. However, because she is part-time, the office is sometimes left unstaffed. This causes a strain on both faculty and students.

### Adequacy of Facilities and Equipment

#### **Laboratory and Research Space**

Increased enrollments in our upper-division courses have added a significant strain to our teaching and research spaces. Principles of Microbiology (MICR 2054) has approximately 100 students per semester and our upper-division lab courses have between 24 and 50 students per semester. Each teaching laboratory holds, comfortably and safely, 24 students. This often requires students to "spill-over" into adjacent laboratory rooms. Because only four teaching labs are available, scheduling overlapping laboratory courses is sometimes necessary, but not always possible. This significantly reduces the number of courses that can be taught in a semester and makes scheduling difficult.

**Laboratory space is one of the main factors that limits the growth of our program.**

Because we must use all four of the larger laboratory spaces for teaching, there is very little room for students or faculty to do research. Research must either be conducted when labs are not in session or in the limited project room spaces that exist. One of the biggest problems that exists is that students and faculty have very limited space to store reagents, supplies, cultures, and experiments in progress, where they will be accessible and secure, and involve more students in research.

One of our project rooms, SL346A, is being renovated to provide more research space and space for an anaerobic growth chamber. Room SL346 has been converted into a molecular biology laboratory.

These two rooms, previously had limited functionality, but have allowed some faculty the ability to move their research out of the teaching laboratories.

### **Laboratory Equipment**

The Department of Microbiology houses several important, heavily used, pieces of equipment (autoclaves, incubators, ultra cold freezers, centrifuge, ultra centrifuge, etc.). While the Microbiology Department is the primary user of this equipment, it is available to anyone in the College. Much of our equipment is old, and although it is still functional, a major breakdown in any of these key pieces would be costly in time, functionality, and finances. **There is currently no plan for repairing or replacing aging equipment.** Other heavily used items, such as vortex mixers, stir plates, incubators, pipettmen, and microcentrifuges might not be replaceable with our current budget.

Since the last review, however, the department has acquired some new equipment, including:

- Phase contrast microscope, with digital camera
- Microcentrifuge
- Thermocycler
- Three sets of pipettmen
- Vortex mixers
- Electronic burners
- Autoclave boilers, to keep autoclave's operational when campus steam is not available (all summer and most of the Fall), purchased through Facilities Management.

Equipment we desperately need:

- -80°C freezer with back-up electrical system (currently funded, but no current back up system is in place). The freezer holds thousands of dollars worth of reagents and cultures and invaluable and irreplaceable cultures from past research.
- Sorvall centrifuge rotor and a new centrifuge. This is a key piece of equipment, used for research and teaching labs, and the centrifuge is past its service life-span.
- Additional incubators. The incubators we have now do not provide enough space to accommodate course experiments and research needs.

### **Teaching Space and Resources**

Most of our lecture classrooms are located in Lind Lecture Hall. A few years ago, the bucket seat desks were removed for rolling seats and long narrow tables. Although the goal was to provide more comfortable learning environment, the new seating arrangement has some serious problems. The classrooms are not amenable to group discussions or classroom activities. Students often have difficulty accessing the seats in the center of the room. Further, the long tables and chairs may limit egress in the event of an emergency.

The University has been very supportive of integrating computers into the curriculum and in supplying hardware and software, however, keeping up with the pace of new technologies has been problematic. Expensive computer and projection equipment purchased for the teaching lecture halls is not being maintained, or in some cases, serviced. These systems are often difficult to integrate with newer technologies like iPads and student response systems (e.g. clickers).

Since our last review we have installed three large screen HDTVs in our teaching laboratories. These are useful for incorporating audio/visual information into the laboratory experiences. Faculty have found creative ways of using this equipment in the laboratory. However, because of laboratory space issues, using the labs as true lecture spaces is awkward and inconvenient.

### Adequacy of Library Resources

The central Stewart Library provides digital databases, online journal subscriptions, and has enhanced interlibrary loan services. Library holdings are generally adequate providing research is along the lines of the journal's emphasis. Certain additional journals would be helpful, but probably are not worth the expense. Our science librarian, JaNae Kinikin, is readily available to help both students and faculty find and access materials.

## H. Relationships with External Communities

### Description of Role in External Communities

Liaison with the community relies primarily on relationships cultivated between individual faculty members and local businesses, regional companies, schools, and government facilities (county health departments, water treatment plants, etc) (see Appendix E). In addition, the microbiology laboratory manager has cultivated relationships with other microbiology laboratories (including hospital and microbiological quality control laboratories). Many of the contacts in these companies and agencies are graduates from the Microbiology Department over the past twenty plus years.

### Benefits of Community Liaison

Community associations have resulted in donated equipment, donated expendables (media, chemicals, etc.), placement of student interns, and employment of graduates. The department has received out-of-date media (still valuable for teaching laboratories), equipment (incubators, balances, pipettmen, etc.), reagents, and cell culture supplies from companies that recognize the department's needs. Local and regional companies now send recruiters to the WSU Job Fair and job openings to the College of Science employment specialist. Often these recruiters are WSU microbiology graduates that have encouraged their company to recruit at WSU. WSU graduates have even come back to the department from county and state government agencies to assist students in preparing for employment with these entities. Companies hire many microbiology graduates because they have previously hired WSU microbiology students. Student internships with local and state agencies have resulted in employment for the students upon graduation. Community contacts have also resulted in the establishment of several scholarships for microbiology majors. These donations have provided opportunities for faculty and students to work on timely projects with potentially significant outcomes.

### Evaluation of Liaison with the External Community

Liaison between the Microbiology Department and the local community is good and expanding every year. Part of this increase is due to interaction of faculty with the community and part is due to the number of microbiology graduates who work in local companies and government agencies. Graduates are loyal to the department and often contact us to see how they can assist the department and its graduates. Lisa Largent from the WSU Development Office has also been of great assistance in contacting potential donors (usually affiliated with the medical community or regional businesses) and helping the department develop relationships with this segment of the community. Faculty members have numerous ties to the local community with many resulting benefits to the department and its students.

### Summary of External Advisory Committee Minutes

The department does not have an advisory committee at this time. We have begun looking for alumni and community members that may be interested in serving on an advisory committee. We would like to assemble the committee membership so they can begin meeting in the 2013-2014 school year.

## I. Results of Previous Program Reviews

### Department Strengths

The 2007-2008 Program Review identified the following as program strengths:

1. The Department of Microbiology is a unique and valuable asset to the State System for Higher Education. There are no other undergraduate microbiology programs in the State system.
2. The Department annually produces a large pool of graduates that are successful in job placement, graduate, dental, medical, and other professional schools.
3. The Department has talented and dedicated faculty
4. The Department faculty participate in a significant amount of undergraduate research, leading to publications and presentations.

The problems and weaknesses identified in the 2007-2008 review were largely external to the department.

### Issue 1. Resources are not adequate to support teaching and scholarly activities.

**“It would be unrealistic to expect the department to perpetuate such a high standard indefinitely in the absence of greater institutional support.”**

- A. Professional development funds are low
- B. Reliance on external support
  - a. Internal grants
  - b. Consulting
  - c. Donations

During the last two years, the department lost the support it was receiving from the Nutraceutical Corporation. Reliance on external, and thus variable, support for basic operating expenses is risky.

- C. Outdated equipment. Sophisticated equipment is required to support the core departmental teaching objectives.

### Actions:

1. Very little has been done to increase ongoing support for the department, especially in terms of budgets for courses and hourly support. This is despite the continued increase in upper-division SCHs being offered in the department.
2. In 2012, a modest cost-of-living increase to base salaries was approved and merit pay increases were distributed. This was proceeded was following several years of no salary increases across campus.
3. Some faculty received equity pay increases in 2011.
4. Funds became available for the department to purchase some important equipment, including:
  - a. Thermocycler
  - b. Microcentrifuge
  - c. Phase-contrast Microscope
5. Facilities Management funded Autoclave boilers due to summer steam shutdown
6. University funds for improving infrastructure and departmental funds are being used to renovate SL346A to make it a more useful research space.
7. A -80°C freezer will be purchased so that a backup freezer is available to house valuable cultures, cell lines, research samples, and reagents. This freezer will be housed in Microbiology, but will be a resource for the entire College.

**Issue 2: Faculty SCH loads are too high**

The department currently has little flexibility to support leave or provide opportunities for professional development, grant writing, course development, service, research, or scheduling.

- A. **The 2007-08 review team recommended that the frozen faculty position be reinstated and a new position be added.**
- B. The low faculty number increases the Department's reliance on adjunct faculty.
- C. Low faculty numbers and a growing number of majors means some lab courses are understaffed (student to faculty of 40:1 or greater), leading difficulty training our students and potential safety issues.
- D. There is currently no latitude or flexibility to develop and teach new courses without sacrificing current offerings.

Actions:

1. In 2012, the department hired Dr. Jason Fritzler, to fill the frozen faculty position. This addition will relieve some of the SCH stress, but the department continues to struggle to staff labs and offer courses, especially when a faculty member takes sabbatical leave.

**Issue 3: Faculty load credit for lab contact hours and undergraduate research is below the national standard.**

- A. Currently faculty earn 0.5:1 credit hours for a 2 hour lab. Credit load should be at least 0.75:1.

Actions: No action has been taken

**Issue 4: Continue growing the major**

- A. The department should continue to look for ways to increase SCH in both Upper-division and General Education Courses

Actions:

1. Improved recruitment in MICR 2054 and MICR 1113 and through participation at events such as Major's Fair and University Orientation sessions.
2. Experimented with teaching courses at satellite campuses, however because of low enrollments these sections were impractical and inefficient.
3. Increased online offerings, resulting in a significant increase in SCHs (Table 2)
  - a. MICR 1113
  - b. MICR 1153
  - c. MICR 3203 Immunology – for health professions students and off campus students
  - d. MICR 3603 Medical Microbiology – for health professions students and off campus students
4. General Education Course Renewal
5. Microbiology Facebook Page for students and alumni
6. Increased access to advisors. Dr. Domek (pre-Dental) and Dr. Nakaoka (pre-Physician's Assistants) are valuable as advisors and are excellent at recruiting students.
7. Updated Microbiology and College webpages, with technical support provided through the Dean's office.

Action Plan for Ongoing Assessment Based on Current Self Study Findings

## I. Action Plan for Evidence of Learning Related Findings

### **Item 1: General Education Assessment**

#### Actions:

1. The department will continue to review general education course offerings and assessment to ensure they meet the Natural Science and Life Sciences Learning Outcomes.
2. The department will work with Office of Institutional Effectiveness and the General Education Life Sciences Assessment committee to develop and implement assessment tools to measure the learning outcomes in our courses.
3. The department will begin using Chi Tester to gather data on course learning objectives, and will keep records of assessment tools (e.g. rubrics) and data used in these courses.

### **Item 2: Assessment in Upper-division Courses**

#### Action:

1. Over the next five years each course will be evaluated on its fulfillment of the identified Microbiology Core Concepts and Fundamental Learning Outcomes. Faculty will provide assessment tools and data related to the outcomes.

### **Item 3: Laboratory Skills Course Map**

1. Laboratory skills required for each upper-division courses will be mapped in their approximate sequence. This will be used to determine if the appropriate lab skills are being developed during the course sequence, or if lab skills need to be emphasized in a different order.
2. We have incorporated of lab skill assessments through practical exams in MICR 2054. This model will be used in other lab courses.

## Action Plan for Staff, Administration, or Budgetary Findings

### **Item 1: The current budget barely covers operating expenses, and does not keep pace with increases in SCHs.**

#### Action:

1. There should be a budgetary incentive to increase SCH especially upper-division SCHs. This increase is needed to cover operating expenses and to pay hourly workers that support our laboratory courses. Many upper-division labs also must use expensive kits and reagents and require the upkeep and repair of sophisticated equipment.

### **Item 2: The laboratory manager position is currently a part-time, hourly, position.**

#### Action:

1. **Short term solution:** Increase funds for hourly wages to cover lab time with trained students.
2. Prepare a job description for a full-time laboratory manager, outlining the responsibilities and required training. Our current lab manager is effective, experienced, and efficient. However, should he choose to retire, the lab manager position will need to be reevaluated.

**Item 3: The department secretary is currently a part-time, hourly, position.**

Action:

1. ***Short term solution: Fund hourly students to cover the office when needed.***
2. Prepare a job description for a departmental secretary. Our current secretary is highly efficient and exceptionally trained in meeting our office needs. However, because she is part-time the office is often unstaffed. Should she decide to retire, the department would suffer if the position remained an hourly position.

Summary of Artifact Collection Procedure

Faculty provided course syllabi and assessment artifacts. The artifacts are kept in the supplemental file.

## K. Department of Microbiology SWOT Analysis

### Strengths:

#### Faculty

- Innovative faculty who take pride in excellent teaching
- Faculty expertise covers the breadth of the microbiology
- Good communication between faculty and faculty/students
- Faculty who are collegial to one another
- Faculty engage in scholarly activities and College and University service

#### Comprehensive Curriculum

- Only state funded microbiology program
- Microbiology major is a very marketable degree
- Students get the training through their coursework needed for preparation for the job market or graduate or professional school
  - High acceptance rates of our graduates to professional schools and graduate schools
  - Excellent student job placement in microbiology related fields
- Popular major with Pre-Dental, Pre-Medical, Pre-Physicians Assistant, Pre-Podiatry and even some Pre-Pharmacy students.
- Popular interdisciplinary major, especially for BIS and Criminal Justice second major

#### Undergraduate Research

- Department provides numerous opportunities for undergraduate research
- Faculty direct several ongoing undergraduate research projects
- High numbers of undergraduate research students present at professional meetings and publish in their respective periodicals. This increases the visibility and reputation of the Department, College, and University.
- Great Salt Lake research projects conducted with collaborations at BYU, USU, UofU, Westminster, and other institutions.
- Faculty collaborate with researchers at the Western Dairy Center, USU Department of Nutritional Sciences, National Center for Pharmaceutical Crops, U.S Forest Service, U.S Fish and Wildlife Service

#### Other

- Knowledgeable and committed support staff/support (Carrie Minnoch, Administrative Assistant/Lynn Moyes, Laboratory Manager)
- **Large number of graduates related to number of faculty and budget**
  - Largest percentage of SCH in upper-division courses in the College
  - Among the lowest cost per SCH in the College
- Good advising is increasing the number and retention of our majors

#### Students

- The department has intelligent and highly motivated students.



- Students are interested in the field, and are motivated to do well to progress to graduate school, professional school, or industry.
- The Student ASM Club is large and active in outreach and service activities
- Students cite faculty, coursework, and advising as reasons for joining the microbiology department

## **Department Weaknesses:**

### Space Considerations

- Laboratories have insufficient room for research needs (especially with the dramatic increase in undergraduate and collaborative research the past 5-8 years)
- Teaching labs and research space overlap, limiting access to research materials when course labs are in session.
- Lecture hall seating arrangement does not help facilitate active or group learning pedagogies

### Safety Issues

- Lab space is not as safe as possible.
  - Emergency shower has no drain, eyewash stations are limited
- Lack of fire suppression system (sprinklers)
- Aging and outdated equipment and infrastructure
  - Contamination issues due to open ceilings and exposed ductwork
  - Leaking faucets, gas turrets, fume hoods
  - Inadequate electrical system
- The building is not earthquake safe

### Equipment

- Vital equipment that is used daily is aging and is at risk of breaking without a comprehensive plan for replacement or repair.
  - Autoclaves
  - Dishwasher
  - Centrifuges

### Recruiting

- Need to use new communication technologies, including the website and social media for recruiting majors.
- Students typically don't begin the microbiology curriculum until their second year. We may be losing potential students during this first year.

### Insufficient faculty positions

- High SCH load affects flexibility for research, recruitment and course development, university service, sabbatical leave, grant writing
  - An outcome of our 2007-2008 program review was the recommendation that we replace the frozen faculty position (which occurred in 2012) and *add* an additional faculty position to the department

- Reliance on adjuncts to teach more and more courses, strains the department's budget and decreases student interaction with full time faculty. This may limit recruiting from the general education courses.
- Large laboratory sections often go understaffed. Class size ranges from often range between 35-50 students. Each lab room can accommodate 24 students, requiring the extra students to work in an adjacent laboratory space. We can sometimes staff the additional room with a faculty member or adjunct, but often the primary instructor must work in both rooms.
  - Limits the ability of the instructor to teach and assess laboratory skills and to assure students are using proper and safe techniques.
  - Creates a laboratory and biosafety concern.

### **Department Opportunities:**

#### Curriculum

- Microbiology lends itself to interdisciplinary courses
  - We have developed two interdisciplinary courses: Geomicrobiology, Tropical Diseases
- Provide service courses to students in health sciences at WSU and elsewhere through online offerings
  - We have two, upper-division, online courses that serve non-Microbiology majors: Microbiology 3603, Advanced Microbiology for the Health Professions and 3203, The Immune System in Health and Diseases
- Develop or design new general education courses
- Develop short courses or workshops on cutting edge topics or skills that may be of interest beyond our department.
- Develop existing collaborations with departments outside of the college (HPPH, Health Sciences, Criminal Justice) and establish new collaborations for teaching and research.

#### Research Collaborations

- Expand ongoing projects with Chemistry, Zoology, and Athletic Training
- Expand outside collaborations – Nutraceutical Inc., EC Services, Western Dairy Center, Nelson Labs, Leprino Inc.

#### Recruitment

- Use website and social networking for recruiting
- Recruit new majors from students graduating from SLCC or other regional institutions. Find ways to help transfer students enter the Microbiology degree program quickly and easily

#### Other

- Development of internships with private industry and government agencies
- Encourage more undergraduate research involving GSL – a unique opportunity that lends to collaboration with other state universities

## **Departmental Challenges/Threats:**

### Resources do not keep pace with growth

- Difficult to obtain additional financial resources to improve teaching and research
- Current funding is not matching increases in SCH growth and research
  - We have a large number of graduates and SCH compared to other Departments
  - We have potential for growth, but there has been no incentive for growth from the University
- Reliance on donations, external funds, student fees to pay for core infrastructure and equipment is risky because these funds can vary from semester to semester and year to year.
  - Student fees pay for supplies used in labs that semester, we attempt to keep student fees as low as possible.
- Reliance on CE to cover overload courses, largely taught by adjuncts, limits our ability to offer additional sections of general education courses.

### Loss of identity

- Consolidation of three Life Science departments into one department would result in a loss of our identity and a loss of the specific niche the department fills at the University and in the State.
- Other colleges now offering pre-professional programs that have the potential to take away our majors

### Other

- Offering Micro 1113 online has increased our number of SCHs. However face-to-face sections of Micro 1113 are important for recruiting majors.

November 15, 2012