Biotechnology Major Assessment Plan

The field of biotechnology was born out of rapid advances in biochemistry and biotechnology during the second half of the last century. Biotechnology is based on genetic engineering and related techniques to modify living organisms to produce and improve products.

Biotechnology is a very diverse field with applications in many areas that affect everyday life. Some of the areas include:

- Animal biotechnology includes advances in reproductive technology such as embryo transfer, preservation of semen and sexing embryos. This field also includes genetic engineering and cloning of organisms.
- Environmental biotechnology includes genetically engineered plants and microorganisms for the removal of toxins from the environment in a process known as bioremediation. This field also includes these types of organisms to improve processes by reducing both energy use and the production of polluting byproducts.
- Industrial biotechnology includes using genetically engineered plants and microorganisms, or natural catalysts derived from them, to produce products in an industrial setting.

Biotechnology at the University of Wisconsin-River Falls infuses diverse sciences into one major and is a perfect fit for students with versatile science skills. This interdisciplinary program combines coursework through biology, chemistry, animal and food science, and plant and earth science. It also happens to be one of the highest demand biological fields.

Students looking for flexibility in a major can find it in biotechnology. As part of an interdisciplinary program, students will take part in an array of courses. Critical-thinking, problem-solving and laboratory skills are emphasized. Students can design their own specialization area, building on core curriculum offered in the program. Medical, production animal, business, forensic, and pharmaceutical biotechnology are just some of the areas students have selected to specialize in. Internships are encouraged in this program and UWRF students have gained valuable experience at such companies as BioDiagnostics, Diasorin, and Ohly Americas.

Mission Statement: The mission of the Biotechnology Program at the University of Wisconsin-River Falls is to provide students with an education that establishes a strong foundation and appreciation for understanding developments in the rapidly advancing field of biotechnology, to develop the technical and critical thinking skills necessary for success in the field, to foster ethical behavior, and to promote outreach.

**Program Goals:**

1. UWRF Biotechnology degree recipients shall meet or exceed the standards in content knowledge necessary for a career or post-graduate education in the field.
2. UWRF Biotechnology degree recipients shall meet or exceed the standards in student skills necessary for a career or post-graduate education in the field.
3. The UWRF Biotechnology Program shall maintain faculty, staff, and budget which meet national standards.
4. The UWRF Biotechnology Program shall maintain infrastructure which meets national standards.
5. The UWRF Biotechnology Program shall work to implement institutional goals, including the University’s Mission, Vision, Strategic Plan, and General Education.

Program goals 1 & 2 deal directly with student learning outcomes and are evaluated as part of this Assessment Plan. Goals 3 and 4 are indirect measures of programmatic quality. Goal 5 reflects the Department’s responsibility to the College of Arts and Sciences and to the broader University community.

**Coursework**

Biotechnology is an interdisciplinary degree and, as such, is a broad field major. The coursework of the Biotechnology program is organized to include introductory coursework in biology, chemistry, and animal science. Foundational coursework is then taken in order to provide a breadth of knowledge, especially in biology and chemistry. In-depth coursework in these fields then builds upon that foundation. The departmental Content Learning Outcomes are developed during these courses.

The Biochemistry Degree is designed to offer flexibility to students to tailor their coursework in order to fit their own personal post graduate goals. This flexibility is offered primarily as elective in-depth coursework.

Because biotechnology is an experimental science, it is also necessary that substantial laboratory work be a part of the student’s education. The departmental Professional Skills Learning Outcomes are developed through this laboratory experience and the departmental capstone experiences (student research and seminar).
Learning Outcomes

Biotechnology students will demonstrate:

1. Knowledge and comprehension of core concepts, which includes but is not limited to knowledge of cellular biology, biochemistry, genetics, molecular biology, and microbiology.
2. Proficiency in laboratory techniques essential to biotechnology.
3. Knowledge of ethical principles regarding the use of biotechnology (bioethics).
4. The ability to understand, analyze and evaluate original research literature and to communicate this understanding using appropriate technology.
5. The ability to clearly define questions or problems and develop comprehensive solutions individually and/or collaboratively.
6. The ability to recognize chemical hazards, assess the risk of these hazards, design or modify laboratory procedures to minimize risk, and prepare for possible emergency situations. (Laboratory Safety Skills)
7. The ability to present information in a clear, organized, and technically appropriate manner. (Communication Skills)

These learning outcomes will be measured through three venues – the first through questions on national standardized exams (same as content knowledge outcomes), the second through performance in Chemistry 261, Laboratory Safety, and the third through the student’s senior seminar (Chemistry 480).

Outcomes and their link to UWRF strategic goals and initiatives.

The University’s three strategic goals are 1) Distinctive Academic Excellence, 2) Global Education and Engagement, and 3) Innovation and Partnerships.

The Biotechnology Program’s learning outcomes are most closely linked to

- Initiative 2012-6: Undergraduate Research, Scholarship, and Creative Activity. Students are encouraged to do RSCA during their time at UWRF (either on-campus or at another institution).
- Initiative 2012-10: Active Learning Classrooms. Several members of the Department are engaged in an effort to modify courses to utilize the new Hagestad ALC and to assess the resulting changes in student learning.

Finally, the Biotechnology Program’s Goals (page 1) explicitly include

5. The UWRF Biotechnology Program shall work to implement institutional goals, including the University’s Mission, Vision, Strategic Planning, and General Education.
Much of the Department’s effort to meet this goal is not directly reflected in our student learning outcomes.

**Learning Profile**

**Specific courses identified for each learning outcome.**

Our curriculum is divided into Introductory, Foundational, In-depth, and Capstone experiences. Laboratory courses, where students get hands-on experience, are required in the first three divisions and is encouraged as part of the Capstone. Student content knowledge is introduced in the Introductory and Foundational courses and then expanded in the In-depth courses. Student professional skills are developed through the Foundational, In-depth, and Capstone experiences, especially through the laboratories.

The Biotechnology curriculum typically consists of

- Introductory courses in Chemistry, Biology, and Animal Sciences (Introduction to Biotechnology) are required in order to introduce concepts required for foundational coursework;
- Foundational courses including, but not limited to, Organic Chemistry, Cell Biology, Genetics, Microbiology, and Biochemistry I.
- In-depth courses are of two types; those that are required and those that are electives
  - Required in-depth courses include Laboratory Safety, Molecular Biology Biochemistry II, Biochemistry Lab, and Separations Science.
  - Elective in-depth courses allow students to go in directions of particular interest and may include courses such as Immunology, Bioinformatics, and Organic Synthesis.
- Cognate courses in Physics, Mathematics (Statistics), and Philosophy (Bioethics);
- An opportunity for a capstone experience of some sort, usually undergraduate research along with a seminar presentation.

**Course map indicating different levels of learning and skill development.**

Our curricular map is shown over the next two pages.
### Biotechnology Program Course Map

#### Required Coursework

<table>
<thead>
<tr>
<th>Introductory</th>
<th>Foundational Courses</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chem 120* or 121*, 122*</td>
<td>Chem 231, 232, 236†, 237† or 233*</td>
</tr>
<tr>
<td>General Chemistry I &amp; II</td>
<td>Organic Chemistry for those students who take the General Chemistry introductory sequence</td>
</tr>
<tr>
<td>Biol 150 or Biol 160</td>
<td>Chem 233</td>
</tr>
<tr>
<td>ANSC 222</td>
<td>Foundations in Organic Chemistry for those students who take the <em>Organic First</em> curriculum</td>
</tr>
<tr>
<td></td>
<td>Biol 240</td>
</tr>
<tr>
<td></td>
<td>Biol 324*</td>
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<tr>
<td></td>
<td>Biol 350</td>
</tr>
<tr>
<td></td>
<td>Chem 361</td>
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</tbody>
</table>

<table>
<thead>
<tr>
<th>In-depth courses</th>
<th>Capstone and other out-of-class experiences</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chem 261</td>
<td>Biot 380</td>
</tr>
<tr>
<td>Chem 355†</td>
<td>Biot 480</td>
</tr>
<tr>
<td>Chem 362, 366†</td>
<td>Biot 495</td>
</tr>
<tr>
<td>Biol 451*</td>
<td>Internships</td>
</tr>
<tr>
<td>Biol 463*, Biol 464* OR Hort 369*</td>
<td>Chem Demons (Chemical demonstration student group)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Cognate courses</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Phys 121/122 or 131/132</td>
<td>Introductory Physics. Other Physics courses that can be taken for Chemistry credit include Phys 465 (Quantum Mechanics)</td>
</tr>
<tr>
<td>Math 231 OR</td>
<td>Biostatistics OR</td>
</tr>
<tr>
<td>Ansc 341</td>
<td>Biometrics</td>
</tr>
<tr>
<td>Phil 220</td>
<td>Bioethics</td>
</tr>
</tbody>
</table>

Courses with laboratory are designated with an asterisk (*); those that are lab-only are designated with (†).
# Biotechnology Program Course Map

## Elective In-depth Coursework

### Animal Science electives
- Ansc 260: Animal Physiology
- Ansc 433: Advanced Nutrition
- Ansc 447: Endocrinology
- Ansc 448: Physiology of Reproduction
- Ansc 449: Artificial Insemination of Farm Animals

### Biology electives
- Biol 314: Plant Pathology
- Biol 320: Plant Physiology
- Biol 325: Medical Microbiology
- Biol 345: Immunology
- Bop; 351: Epigenetics
- Biol 352: Applied Genomics
- Biol 353: Histology
- Biol 356: Neurobiology
- Biol 364: Developmental Biology
- Biol 453: Virology

### Chemistry electives
- Chem 250: Foundations of Analytical Chemistry
- Chem 356: Chemical Instrumentation Lab
- Chem 461: Pharmacology

### Crop Sciences electives
- Crop 345: Weed Control
- Crop 410: Plant Breeding and Crop Improvement
- Crop 435: Crop Physiology
- Crop 451: Integrated Pest Management

### Environmental Sciences electives
- Esm 412: Fate and Transport
- Esm 413: Environmental Analysis

### Horticulture electives
- Hort 200: Plant Propagation
- Hort 420: Floriculture

### Communication and writing electives
- Coms 318: Communication and Leadership
- Engl 266: Business Writing
- Engl 367: Technical Writing
- Engl 371: Proposal Writing: Change Through Rhetoric

### Mathematics elective
- Math 166: Calculus I
**Introductory courses.** The introductory or general chemistry experience plays an important role for all students. It provides a common background for students with a wide range of high school experiences.

We have two introductory sequences for chemistry, the traditional (General Chemistry I and II, Chemistry 120/121 and 122) sequence and the *Organic First* sequence (which starts with Introduction to Organic Chemistry, Chemistry 130).

Similarly, there are two options for the introductory biology course; General Biology (Biol 150) or General Biology – Freshman Research (Biol 160)

The remaining introductory course is Animal Science 222 (Introduction to Biotechnology)

**Foundational courses.** The foundation course work provides breadth to the curriculum. These foundation courses come from both the chemistry and biology departments. The foundation chemistry courses are Organic Chemistry and Biochemistry I, while the foundation biology courses are Cell Biology, Genetics, and Microbiology. At the conclusion of a foundation course, a student will have mastered the vocabulary, concepts, and skills to pursue in-depth study in that area.

**In-depth courses.** The curriculum for a Biotechnology major must include at least thirty-two credits of in-depth work beyond the foundational courses. The in-depth courses build on the prerequisites of the foundational courses. The goals of in-depth courses are to integrate topics introduced in the foundational courses and to investigate these topics more thoroughly. Exams and other assignments are designed to encourage critical thinking and problem-solving skills.

There are a total of 14 credits of required in-depth courses. One course, from either Biology or Horticulture must be a tissue culture experience. Beyond that, the required in-depth courses are Molecular Biology, Biochemistry II, Biochemistry Lab, and Separation Science Laboratory.

A student must also take at least 18 credits of elective in-depth courses. There is a lengthy list of optional courses from a variety of departments including Biology, Animal Science, Crop Sciences, and English that a student may choose from to tailor their degree to best serve their interests and needs.

**Cognate courses.** The Biotechnology major is a broad-field major, with requirements in Mathematics, Physics, and Philosophy. All Biotechnology majors require two semesters of Physics with laboratory, one semester of statistics (Math 231 or Ansc 341), and Bioethics (Phil 220).

**Capstone.** The Biotechnology major capstone experience consists of Biot 380 (Junior Seminar), Biot 480 (Biotechnology Seminar) and Biot 495 (Undergraduate Research). Biot 495 is optional but encouraged.
Biot 480 is the student’s senior seminar. Students give a seminar to the department, based either on work they did for Biot 495 or on a literature topic. These seminars are evaluated by department faculty and other Biotechnology and Chemistry students.

Since it is a required course and comes at the end of the curriculum, Biot 480 provides an assessment venue for student professional skills as well as for an exit survey.

**Impact of out-of-classroom experiences on learning outcomes**

Biotechnology, like chemistry and other sciences, is by its nature a hands-on process. Students learn best by doing. Therefore, the Biotechnology curriculum has multiple opportunities for out-of-classroom learning, including laboratories, research, internships, international experiences, and Chem Demons.

**Laboratory.** Because of the hands-on nature of laboratory work and its value in achieving required student learning outcomes, the laboratory experience is an essential part of the skills building process in biotechnology. Therefore a number of the required and elective courses of the curriculum include a laboratory experience.

Students have some latitude in which laboratory courses they take, depending upon their program and their interests. All students are required to take laboratories in organic chemistry, biochemistry, microbiology, molecular biology and tissue culture.

**Research.** Students are encouraged (but not required) to engage in undergraduate research. Some students do their research here at UWRF, others do it over the summer at larger universities. In either case, this experience is an invaluable part of the student’s capstone experience.

**Internships.** Internships are uncommon in Biotechnology but not unheard of. We have had several students who have recently accepted summer internships.

**International experiences.** In the past several years, UWRF Biotechnology students have gone to other countries for undergraduate research experiences.

**Chem Demons.** UWRF Biotechnology students are able to work with the Chem Demons. This student group puts on chemical shows for local audiences including local schools. In the process of learning their demonstrations, the students have to learn about Chemistry content knowledge as well as presentation skills.

**Assessment venues**

Program level assessment of learning objectives for university purposes are carried out at the two curricular levels – foundational and in-depth. Foundational level assessment is conducted after
the core course of Organic Chemistry. In-depth assessment is conducted near the end of the student’s career in Biochemistry II, in the departmental safety course (Chemistry 261 – Laboratory Safety) and during the student seminar (Biot 480 – Biotechnology Seminar).

**Venues and artifacts for measuring learning outcomes.**

**Foundational level assessment.**
Students finishing Chem 232 : Organic Chemistry 2 or Chem 233: Foundations of Organic Chemistry are given standardized final exam which have been developed by the American Chemical Society’s Division of Chemical Education Examinations Institute. These exams are nationally normed.

For new exams, the Examinations Institute has been working to reference individual exam items to the ACS Curricular Concept Map. In the meantime we have mapped exam items to our content and skills learning objectives. Student exams are saved and then we will perform item analysis to see how our students perform on the different learning objectives.

Specific foundational level content that will be assessed in this exam includes;

- Nomenclature
- Reaction mechanism
- Spectroscopy
- Acids and bases
- Physical properties and intermolecular forces
- Structure and bonding (conformations and aromaticity)
- Stereochemistry

Exam security and copyright prohibits us from publishing the mapping (as it would give students clues how to study). Exam mapping protocols are approved by the department Assessment Committee and kept by department faculty.

**In-depth level assessment.**
In-depth level assessment occurs in three venues – Biochemistry II (Chemistry 362), the Chemistry Laboratory Safety course (Chemistry 261), and Seminar (Biotechnology 480).

Biochemistry II – Chemistry 362. As with the Organic II assessment, students finishing Biochemistry II are given standardized final exams which have been developed by the American Chemical Society’s Division of Chemical Education Examinations Institute, in which we have mapped exam items to our content and skills learning objectives.

Specific foundational and in-depth level content that will be assessed includes;

- Evaluation of the structure and function relationship between the biological macromolecules including proteins, carbohydrates, lipids, and nucleic acids.
- Knowledge of how enzyme activity is quantified through kinetic assays.
• Identification of the various components of biological membranes and the role each plays in membrane function.
• Understanding of the role of thermodynamic and equilibrium in the metabolic pathways of carbohydrates and lipids.
• The ability to describe the process of oxidative phosphorylation in the making of cellular adenosine triphosphate (ATP)

Laboratory Safety – Chemistry 261. This course was developed as the result of our last Program Prioritization. It is specifically designed to teach and to assess Professional Skills Outcome 4, Laboratory safety skills; the course learning objectives are identical to the desired programmatic outcomes. Because of this, the assessment metric is the distribution of student grades.

Student seminar – Biotechnology 480. Biotechnology majors are required to give a seminar to the department (faculty and students) before graduation. Students develop and present a 30-minute seminar based upon laboratory or literature research. The seminar is evaluated by faculty and BIOT 480 students using the Chemistry Seminar Evaluation rubric presented in the appendices. The rubric provides a means of assigning a grade to the seminar and delivering feedback to the presenter. The rubric is used to assess Professional Skills Outcome 3, Communication skills.

Student Survey Feedback
Graduating seniors enrolled in Biotechnology 480 complete a survey measuring 1) their perception of how the program’s learning experiences help them to meet their needs and 2) their satisfaction with the program. A copy of the survey is included at the end of this document.

Alumni Feedback
Every three years, the program will send an electronic survey to students that have graduated in the past ten years. The survey will ask them about
• the relevance and effectiveness of the program in preparing them for their current position,
• what they see as trends in the Chemistry profession, and
• how the program could enhance its curriculum and learning opportunities.

Process for Assessment

Assessment cycle
Student content knowledge outcomes are measured at two points:
• Twice during the student’s in-depth courses, at the end of organic chemistry (Chem 232 or 233) and at the end of biochemistry (Chem 362), through the administration of standardized exams in these classes.

Student professional skill outcomes are measured at different points depending upon the outcome.
Laboratory knowledge outcome – at the same time as student content knowledge through appropriate questions on the three administered exams.
Laboratory Safety outcome – In Laboratory Safety (Chem 261), typically taken during the student’s junior year.
Communications outcome – During the student’s senior seminar, Biot 480.

Accountability for assessment process
The Biotechnology program director along with the Chemistry Department chairperson arranges for regular meetings of the Biotechnology Committee and oversees the compilation and distribution of documents to the department for review and the submission of plans and reports to appropriate parties (department chair, campus administration, etc.) on time. The program assessment committee prepares assessment plans and reports. The committee seeks input from members of the department during the process and submits all documents to the department as a whole for review and approval.

Assessment process
The department assessment committee is responsible for the assessment process.

• Collection and review.
  o Individual faculty are responsible for administering the required standardized exams for content knowledge objectives.
  o The instructor for the Laboratory Safety course is responsible for ensuring that the course learning objectives and grading rubric match the departmental learning objective, and for administering the exam.
  o The instructor for Chemistry 480 is responsible for administering and collecting faculty and student evaluations of student seminars and for administering the student exit survey.

• Aggregation, analysis, and maintenance.
  o The departmental assessment committee is responsible for aggregation and analysis of the data.
  o The Chemistry Department chair and the Biotechnology Program director, along with the department program assistant, are responsible for maintenance of the data.
• Actions taken in response to the assessment are documented by the assessment committee.

Process for implementation of changes based upon assessment findings.
Results are presented to the department during an annual assessment meeting and during occasional (every several years) department retreats. Depending upon the results, the department may mandate curricular or other changes. Changes made over the past several years based upon assessment include:

• Introduction of an Organic First introductory curriculum,
• Development and implementation of a departmental lab safety course,
• Redesign of the program curriculum to give students more flexibility in course offerings,
• Redesign of the program’s capstone offerings (ongoing),
• Development of active learning strategies to engage students (ongoing), and
• Implementation of Peer-Led Team Learning to improve student performance (ongoing).
Most recent changes have been designed to include extensive evaluation. Changes are re-assessed by the assessment committee and the department during the departmental assessment meeting.

**Location of assessment results and actions**
Currently, assessment results and actions are summarized in the minutes of the annual department assessment meeting, kept in the department office and available by request.

**Other**

*Learning Outcome Rubrics – Seminar:* The seminar rubric each faculty member completes is given below. Chemistry students who attend the seminar are also encouraged to evaluate their peers using the same rubric. Room is also provided on the form for comments:

<table>
<thead>
<tr>
<th>Seminar Evaluation</th>
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</thead>
</table>
| 1. Major strong points: *What were the major strong points in the student’s presentation?*
| 2. Suggestions for improvement: *What could the student do to improve their presentation?*

Specifics: Please circle the appropriate score below, where a 5 indicates excellence in the area and a 1 indicates a weak performance. You may include brief comments in the respective box if you desire.

<table>
<thead>
<tr>
<th><strong>Clarity of speaking style</strong></th>
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<tbody>
<tr>
<td>5</td>
</tr>
<tr>
<td><strong>Organization and use of visual aids</strong></td>
</tr>
<tr>
<td>5</td>
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<tr>
<td><strong>Sophistication and content of material</strong></td>
</tr>
<tr>
<td>5</td>
</tr>
<tr>
<td><strong>Depth of research in area</strong></td>
</tr>
<tr>
<td>5</td>
</tr>
<tr>
<td><strong>Depth of personal understanding of the material</strong></td>
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<td>5</td>
</tr>
<tr>
<td><strong>Stimulation and interest provoked in audience (including relevance)</strong></td>
</tr>
<tr>
<td>5</td>
</tr>
<tr>
<td><strong>Attitude and skill in handling questions</strong></td>
</tr>
<tr>
<td>5</td>
</tr>
<tr>
<td>Overall grade assignment:</td>
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</tbody>
</table>

*Learning Outcome Rubrics – ACS Exams.* Information about ACS exams and national norms can be found at the ACS – Division of Chemical Education – Exams Institute web page at
http://chemexams.chem.iastate.edu/. We have identified individual exam items which map to the learning outcomes. These rubrics are stored in the Chemistry Department – including them here would violate exam confidentiality rules.

**Learning Outcome Rubrics – Safety Course.** Chemistry 261, Laboratory Safety, was designed to meet the Laboratory Safety learning outcome (the course learning objectives correspond to the departmental laboratory safety learning objectives). Student learning is assessed through exams and projects, including a paper and a presentation on a laboratory safety topic.
Biotechnology Program  
Graduating Senior Survey

Please fill in the circle that best reflects the extent to which you agree or disagree with the following statements:

<table>
<thead>
<tr>
<th></th>
<th>Strongly Agree</th>
<th>Agree</th>
<th>Slightly Agree</th>
<th>Slightly Disagree</th>
<th>Disagree</th>
<th>Strongly Disagree</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Core Knowledge</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
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</tr>
<tr>
<td>I have developed knowledge and comprehension of cellular biology.</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
</tr>
<tr>
<td>I have developed knowledge and comprehension of biochemistry.</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
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<tr>
<td>I have developed knowledge and comprehension of genetics.</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
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</tr>
<tr>
<td>I have developed knowledge and comprehension of molecular biology.</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
</tr>
<tr>
<td>I have developed knowledge and comprehension of microbiology.</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
</tr>
<tr>
<td><strong>Laboratory Proficiency</strong></td>
<td>Strongly Agree</td>
<td>Agree</td>
<td>Slightly Agree</td>
<td>Slightly Disagree</td>
<td>Disagree</td>
<td>Strongly Disagree</td>
</tr>
<tr>
<td>I can perform gel electrophoresis of protein or DNA.</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
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<tr>
<td>I can perform protein purification.</td>
<td>○</td>
<td>○</td>
<td>○</td>
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<tr>
<td>I am experienced with sterile technique.</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
</tr>
<tr>
<td>I am able to use micropipettes.</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
</tr>
<tr>
<td>I am able to manipulate DNA such as restriction digestion, ligation, and synthesis.</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
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<tr>
<td>I am able to collect, analyze and interpret data.</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
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<tr>
<td>I can design an experiment to amplify a segment of DNA.</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
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<tr>
<td>I am able to calculate and prepare solutions.</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
</tr>
<tr>
<td>I can use computers to compare and analyze protein and nucleic acid sequences.</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
</tr>
<tr>
<td><strong>Ethics</strong></td>
<td>Strongly Agree</td>
<td>Agree</td>
<td>Slightly Agree</td>
<td>Slightly Disagree</td>
<td>Disagree</td>
<td>Strongly Disagree</td>
</tr>
<tr>
<td>I am aware of ethical issues related to biotechnology.</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
</tr>
<tr>
<td>I have considered how both ethical and scientific principles inform my understanding and my behavior related to ethical issues in biotechnology.</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
</tr>
<tr>
<td>Communication, analysis, team work and other skills</td>
<td>Strongly Agree</td>
<td>Agree</td>
<td>Slightly Agree</td>
<td>Slightly Disagree</td>
<td>Disagree</td>
<td>Strongly Disagree</td>
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<td>----------------------------------------------------</td>
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<tr>
<td>I can find articles in the scientific literature using databases such as Medline.</td>
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<tr>
<td>I can read the scientific literature and understand the purpose and importance of the study.</td>
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<tr>
<td>I can read the scientific literature and understand the results of the study and how the conclusions were arrived at.</td>
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<tr>
<td>I can interpret graphs, tables and figures found in the scientific literature.</td>
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<tr>
<td>I can prepare a technical poster to present research findings at a meeting.</td>
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<tr>
<td>I can write a scientific paper.</td>
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<tr>
<td>I can prepare and deliver an oral presentation focused on the technical/scientific aspects.</td>
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<tr>
<td>I can prepare and deliver an oral presentation on biotechnology to a general audience.</td>
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<tr>
<td>I can plan experiments based on previous research studies.</td>
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<tr>
<td>I can identify problems that need to be addressed that are relevant to biotechnology.</td>
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<tr>
<td>I can work in a team in a laboratory setting.</td>
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<tr>
<td>I can work in a team to produce a team product such as a paper or presentation.</td>
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<tr>
<td>I can apply core knowledge and skills to real world problems.</td>
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</tbody>
</table>

1. What aspect(s) of the biotechnology program do you consider strengths of the program and why?
2. What aspect(s) of the biotechnology program do you consider weaknesses of the program and why?

3. What if anything would you like to see included in the program and why?

4. What if anything would you like to see removed from the program and why?

5. What are your plans after graduation and where are you at in the process?