I. Profile

Mission Statement
The mission of the Biotechnology Program at the University of Wisconsin-River Falls is to provide its 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.

Factors that affect assessment and learning
Biotechnology holds a lot of promise as an area that can move the economy of Wisconsin forward, and is an area of potential growth. Biotechnology is a rapidly expanding and changing field. Biotechnology is also highly technical. Our students need core skills and knowledge and they need to learn how to adapt, critically analyze information, and extend what they have learned into other areas. Since biotechnology manipulates the genetic material of living organisms, the field encounters numerous ethical questions and challenges that must be addressed. These factors must be considered when assessing the program.

The biotechnology program is also an interdisciplinary program with course offerings from the constituent departments and the program has only had full ownership of one course, Biot 480, the senior seminar course up to this point. This has posed some challenges in assessing the program. We have revised our curriculum and it was just approved and includes additional biotechnology specific courses, which can be used for assessing the major.

II. Assessment Review

The following is a description of what was identified as being needed in the last report and how those needs were addressed. Several action items were recommended. The program successfully implemented many of the items, but some were not implemented yet.

Our last report indicated a lack of indirect measures. Last spring we developed a senior survey and it was administered in the seminar class for the Fall 2007 and Spring 2008 semesters.

We found that “depth of research in the area” was rated low in senior seminars. We recommended assignment of faculty mentors besides the seminar instructor. This was implemented, but mentors were not provided with a list of guidelines and expectations for mentoring the student seminars. It was also recommended that we include a junior seminar course to help prepare our students. Our curriculum has been revised to include both sophomore and junior seminar components, but students have not yet participated in these courses.

Last year, we had no tool in place to measure the ethics learning objective. Starting fall semester 2007, we began asking students to include a discussion of ethics components of the seminars in their seminar summaries.

We found that students lack the ability to analyze the literature in depth. We planned on reestablishing the journal club component of the seminar class. We also indicated that we would reserve the first four weeks for class expectations and what makes a good seminar and do two journal club analyses and that we would advocate for better access to the literature so students can access articles for papers in courses and in preparation of seminars easier (quicker). In the fall we had one journal club discussion, but it was not well publicized and faculty other than the instructor did not attend.
journal club was not well organized, and not as effective as it should have been. We did use several class periods for class expectations and what makes a good seminar. The class was scheduled for a two hour time slot and the hour not occupied by the seminar was used for practices. The journal club was not implemented in the Spring semester. We need to make sure to implement this course component on a regular basis.

We noticed that faculty attendance at seminars was low. The recommended action was to change the seminar day from Mondays to Thursdays for the 2007-2008 academic year to reduce conflicts. Steering committee members were asked to encourage more attendance and participation in evaluations from faculty members in their departments. This did not seem to improve attendance consistently. We moved some seminars to 4:00 and attendance was improved.

Our learning outcomes were in place for our last report. The feedback from the University Assessment Committee questioned the generality of our outcomes, but we asked Barbara Walvoord to review our learning outcomes at the Assessment Workshop help April 13, 2007, and she indicated that they look appropriate for program level learning outcomes. Since we had several other action items to focus on, we did not look at revising our learning outcomes, and based on the feedback from Barbara, we do not feel it is necessary at this time.

We currently have the evaluation of the senior seminar in place as a direct measure of the outcomes with the exception of 2. We met May 16, 2008, to discuss and review the assessment data collected Fall 2007 and Spring 2008 focusing on outcomes 2 and 5. These learning outcomes are:

2. proficiency in laboratory techniques essential to biotechnology.

5. the ability to clearly define questions or problems and develop comprehensive solutions individually and/or collaboratively.

As mentioned above, we developed a graduating student survey Spring of 2007 as an indirect measure of all outcomes. The results of this survey were discussed at the May 16, 2008 meeting.

Our curriculum has just been revised using the assessment process to inform our curriculum revisions. We still need to develop a couple of new courses, particularly a Biotechnology Ethics course, and we need to revise the Fermentation course to include a laboratory component.

We have established an alumni and industry advisory board, which met for the first time on May 8, 2008.

III. Assessment Results and Action Plan

Seminar Evaluations
The seminar evaluation data was tabulated and discussed at the May 16th meeting and the following observations were made.

Observations: The data looks consistent with the data from the previous year, particularly considering the small sample size.

Actions: Continue to make improvements to the mentoring process and the Journal Club component of the course. Implement sophomore and junior seminar components and continue to collect and track data. A graphical analysis may be helpful in identifying trends.
Discussion of Outcome 2
proficiency in laboratory techniques essential to biotechnology.

The discussion of this learning objective centered on faculty perceptions and the responses to question 2 of the student survey.

**Observations:** The scores for question 2 of the survey are summarized below. A 1-5 scale was used where 1= unable to recall the technique or never exposed to it, 3= capable of performing the technique with a detailed protocol and time to repeat as necessary, 5= able to perform the technique with minimal instruction and able to obtain the desired result on the first or second trial. Five students completed the survey each semester.

<table>
<thead>
<tr>
<th>Question 2 - Proficiency with laboratory skills</th>
<th>Dec 2007</th>
<th>May 2008</th>
<th>total</th>
</tr>
</thead>
<tbody>
<tr>
<td>gel electrophoresis of protein or DNA</td>
<td>4.8</td>
<td>4.6</td>
<td>4.7</td>
</tr>
<tr>
<td>protein purification</td>
<td>4.4</td>
<td>4.0</td>
<td>4.2</td>
</tr>
<tr>
<td>sterile technique</td>
<td>5.0</td>
<td>5.0</td>
<td>5.0</td>
</tr>
<tr>
<td>use of micropipettes</td>
<td>5.0</td>
<td>5.0</td>
<td>5.0</td>
</tr>
<tr>
<td>manipulation of DNA</td>
<td>4.4</td>
<td>3.8</td>
<td>4.1</td>
</tr>
<tr>
<td>ability to collect, analyze and interpret data</td>
<td>4.8</td>
<td>4.6</td>
<td>4.7</td>
</tr>
<tr>
<td>design an experiment to amplify a DNA segment</td>
<td>4.4</td>
<td>4.2</td>
<td>4.3</td>
</tr>
<tr>
<td>calculate and prepare solutions</td>
<td>4.8</td>
<td>4.8</td>
<td>4.8</td>
</tr>
<tr>
<td>computer analysis of sequences</td>
<td>4.0</td>
<td>5.0</td>
<td>4.5</td>
</tr>
</tbody>
</table>

It was noted that the bioinformatics course was offered for the first time the spring semester and that several of the students enrolled in seminar in the spring were also enrolled in the bioinformatics course. This could account for the increased rating for the computer analysis of DNA and protein sequences.

The faculty indicated that the student rating of the ability to manipulate DNA seemed about right.

Faculty believe that students were a little overconfident in some of the areas such as use of micropipettes and faculty would assess students as weaker in their ability to collect, analyze, and interpret data than in protein purification, not stronger. This may stem from the amount of feedback provided to the students in these areas.

**Actions:**
It would be interesting to see how faculty perceptions compare to student perceptions by having the faculty members take the survey to reflect our perceptions of our graduating seniors abilities. We can modify the survey and set up a D2L course for biotechnology faculty to complete the survey at.
Discussion of Outcome 5
the ability to clearly define questions or problems and develop comprehensive solutions individually and/or collaboratively.

The scores for question 4 of the survey are summarized below. A 1-5 scale was used where 1 = weak, 3 = adequate, 5 = proficient. Five students completed the survey each semester.

Observations:

<table>
<thead>
<tr>
<th>Question 4 - literature and research skills</th>
<th>Dec 07</th>
<th>May 08</th>
<th>total</th>
</tr>
</thead>
<tbody>
<tr>
<td>find articles in scientific literature</td>
<td>4.4</td>
<td>5.0</td>
<td>4.7</td>
</tr>
<tr>
<td>understand purpose and importance</td>
<td>4.2</td>
<td>4.8</td>
<td>4.5</td>
</tr>
<tr>
<td>understand results and conclusions</td>
<td>4.0</td>
<td>4.6</td>
<td>4.3</td>
</tr>
<tr>
<td>interpret graphs, tables and figures</td>
<td>4.4</td>
<td>4.8</td>
<td>4.6</td>
</tr>
<tr>
<td>prepare and present a technical poster</td>
<td>3.8</td>
<td>4.6</td>
<td>4.2</td>
</tr>
<tr>
<td>write a scientific paper</td>
<td>3.8</td>
<td>4.6</td>
<td>4.2</td>
</tr>
<tr>
<td>technical presentation</td>
<td>4.2</td>
<td>4.6</td>
<td>4.4</td>
</tr>
<tr>
<td>general audience presentation</td>
<td>4.4</td>
<td>4.6</td>
<td>4.5</td>
</tr>
<tr>
<td>plan experiments based on previous studies</td>
<td>4.0</td>
<td>4.2</td>
<td>4.1</td>
</tr>
<tr>
<td>identify problems relevant to biotechnology</td>
<td>4.2</td>
<td>4.6</td>
<td>4.4</td>
</tr>
<tr>
<td>work in a lab team</td>
<td>5.0</td>
<td>4.8</td>
<td>4.9</td>
</tr>
<tr>
<td>work in a team on paper or presentation</td>
<td>4.6</td>
<td>4.8</td>
<td>4.7</td>
</tr>
<tr>
<td>apply core knowledge to real world problems</td>
<td>4.6</td>
<td>4.8</td>
<td>4.7</td>
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</tbody>
</table>

Students were generally not as confident with their literature skills as they were their lab skills.

Actions:
In Biochemistry lab this spring, we had students present posters on their kinetics projects during finals week. We could use the poster session as an assessment tool and to provide students with additional feedback on their data analysis and interpretation skills. We should invite additional faculty to this session and give the students more time to prepare their posters.

Critically go through papers with the seminar class in a journal club. Possibly pick a faculty member other than the instructor to lead the journal club. With repeated exposure in sophomore, junior, and senior seminars, students should become more confident. We might be able to have senior students lead the journal club in a few years.

Advisory Board Meeting
The Biotechnology Steering Committee organized an Advisory Board and had the first meeting with the board on May 8, 2008. The primary purpose of this meeting was to get to know the members of the board and to provide them with information about our program. These goals were accomplished and we had a brief meeting where we discussed what they want from our graduates, but we did not have much time for this discussion. Some of the main points of the discussion are summarized below.

Observations:
Independent research projects are very valuable to students.

Internships are very valuable to the students and sometimes a benefit to industry, but usually they are of little benefit to the industry because it takes so much time to train the student.
Have students emphasize their research projects on their resumes.

Some of the advisory board members work in highly regulated industries (which is common for the biotechnology related fields). They noted that students do not realize the difference between the regular (such as academic) laboratory and a highly regulated laboratory. It would be good to add a component to the curriculum to prepare students bound for industry for this environment. The importance of documentation, running the assay the same way each time, rigid deadlines, and other such issues should be included in such an experience.

Cooperative education experiences were described.

Communication skills were also emphasized.

**Actions:**
- Look into developing a course for industry bound students to help prepare them for work in a highly regulated field.
- Plan a follow up Advisory Board Meeting where we can spend more time discussing desired knowledge and skills and how to prepare our students.

**Results Availability**
This report is available on the biotechnology web page [http://ww.uwrf.edu/biotechnology](http://ww.uwrf.edu/biotechnology). The biotechnology program director made the students aware of the results availability by sending an email to their UWRF email account asking them to review the results and send feedback to the director.

**IV. Recommendations for Improving Assessment Process**

The following are observations that prompted revisions to the plan and the actions being taken to improve the assessment process.

**Observation:** Our curriculum has changed, but this is not reflected in the curriculum map.
**Action:** Update the curriculum map.

**Observation:** Faculty and student perceptions may differ.
**Action:** Administer the survey to faculty.

**V. Data from Institutional Research**

Institutional Research never provided the requested data for the last couple of years, so this section does not reflect anything new. As stated in the last report, the number of biotechnology majors has decreased in recent years as illustrated by the numbers in the table below. Even so, when the program was approved in 1987, it was estimated that the number of students would stabilize at 30 by 1991-1992, and our current numbers exceed these estimates. While numbers of students exceed estimates, funding for the program has not kept pace with the projections much less the current needs of a rapidly developing highly technical field, in order to maintain or expand the number of students and maintain the quality and reputation of the program, additional funding will be required. This has been pointed out in each of the biotechnology program reviews. Other unidentified factors including the amount of publicity surrounding the field in the general press may have influenced enrollments as well. We need to obtain statistics from institutional research to determine whether recruitment or retention of majors is the primary factor related to declining enrollments.
### Student Head Counts

<table>
<thead>
<tr>
<th>Budget Year</th>
<th>Number of Biotechnology Students</th>
</tr>
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<tbody>
<tr>
<td>1997</td>
<td>70</td>
</tr>
<tr>
<td>1998</td>
<td>68</td>
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<tr>
<td>1999</td>
<td>67</td>
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<tr>
<td>2000</td>
<td>54</td>
</tr>
<tr>
<td>2001</td>
<td>32 CAS + 20 CAFES = 52</td>
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<tr>
<td>2002</td>
<td>42 CAS + 16 CAFES = 58</td>
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<tr>
<td>2003</td>
<td>42 CAS + 11 CAFES = 53</td>
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<tr>
<td>2004</td>
<td>34 CAS + 12 CAFES = 46</td>
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<tr>
<td>2005</td>
<td>33 CAS + 14 CAFES = 47</td>
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<tr>
<td>2006</td>
<td>30 CAS + 15 CAFES = 45</td>
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<tr>
<td>Current (4/13/07)</td>
<td>26 CAS + 18 CAFES (+ 1 other) = 45</td>
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</table>

The biotechnology steering committee consists of 6 faculty members, 2 each from the departments of Chemistry and Biology, 1 from Animal and Food Sciences, and 1 from Plant and Earth Sciences. Two faculty were hired specifically for their ability to contribute to the Biotechnology Program as part of a Decision Item Narrative in 2001-2002, but the funding sought as part of this initiative never materialized and the faculty are housed in the departments of Chemistry and Biology. The Plant and Earth Science faculty member that teaches the plant cell culture course has not been retained, so it will be important to hire a faculty member with Biotechnology and Plant Cell Culturing expertise to support the program.

The majority of biotechnology courses are housed in the contributing departments and several other faculty contribute to the teaching of these courses. With the development of new biotechnology courses, it will be important to work closely with the contributing departments to ensure that we are able to offer the new courses and adequately cover the existing required courses.
Biotechnology Assessment Plan

I. Student Learning Objectives/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.

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.

II. Identification of where Objectives/Outcomes are Being Achieved

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</table>

I = students are introduced to the objective – prior exposure is not required or expected
E = course emphasizes the learning objective
R = an objective is reinforced, but not the key focus of the course – prior exposure is required or expected
III. Assessment Tools used to Measure Objectives/Outcomes

<table>
<thead>
<tr>
<th>outcome</th>
<th>seminar (direct)</th>
<th>yearly meeting (direct)</th>
<th>graduating student survey (indirect)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>yearly</td>
<td>even academic years</td>
<td>yearly</td>
</tr>
<tr>
<td>2</td>
<td></td>
<td>odd academic years</td>
<td>yearly</td>
</tr>
<tr>
<td>3</td>
<td>yearly</td>
<td>even academic years</td>
<td>yearly</td>
</tr>
<tr>
<td>4</td>
<td>yearly</td>
<td>even academic years</td>
<td>yearly</td>
</tr>
<tr>
<td>5</td>
<td>yearly</td>
<td>odd academic years</td>
<td>yearly</td>
</tr>
</tbody>
</table>

See attached rubric used to assess learning outcome 4 as part of the seminar class.
See attached graduating student survey, to be used as our indirect measure.

IV. Timetable Indicating the Cycle of Assessment and Continuous Improvement

The table above indicates the timeline for assessment of learning objectives and the tools used. Curricular improvements and revisions will be implemented the following year.

The assessment plan will be evaluated and improvements implemented yearly based on the discussions at the Spring meetings.

V. Data Presentation and Discussion Process

Each spring a 2 hour meeting will be scheduled to discuss how well our students are meeting the learning outcomes as outlined in the timeline above. The program director will compile as much quantitative data as is available prior to the meeting and provide the committee members with this and the original copies of surveys and seminar critiques with comments at least one week prior to the meeting. The program director will also solicit input from faculty that teach the core courses, compile this feedback and distribute it to the committee members prior to the annual meeting. The faculty will review these materials and come to the meeting prepared to discuss the results and actions to be taken.

Outcome 1 (tool to be developed this spring and administered in the seminar class) will be discussed at the annual meeting of biotechnology program faculty. Faculty will also be invited to discuss the assessment tools used in courses related to the outcome and students’ performance.

Outcome 2 will be discussed at the annual meeting of biotechnology faculty. Faculty will report student strengths and weaknesses in relation to this outcome.

Outcome 3 the biotechnology program faculty, in consultation with an ethicist, will review students’ reports addressing the ethical components of the seminars presented in BIOT 480.

Outcome 4 the results from the seminar rubric will be compiled prior to the yearly meeting and the results will be discussed at the meeting.

Outcome 5 (tool to be identified from those currently used in upper division biotechnology courses) will be discussed at the annual meeting.

VI. Implementation of Revisions Based on Assessment Results

The assessment plan will be evaluated and improvements implemented yearly based on the discussions at the Spring meetings, with input from faculty involved in teaching the relevant courses.
Follow up discussions of the plan will occur at the start of each Fall semester at the Biotechnology Steering Committee meetings.

Recommended changes in the assessment plan will be forwarded to faculty involved in teaching the courses for feedback and implementation by the biotechnology representative(s) from their department, or the program director if the course is taught by faculty outside of the represented departments.

VII. Results Availability

Assessment results will be compiled as minutes of the yearly assessment meetings, which will be posted on the department server.

The minutes of the yearly assessment meetings will also be made available upon request to UWRF, students, faculty, and other relevant constituents. Requests should be directed to the Biotechnology Program Director, and a notice stating their availability will be posted on the Biotechnology Program web page.

The results of the assessment process and changes to the assessment plan will be made available at University Assessment Fairs.
Biotechnology Seminar Evaluation

Evaluator: Name: ____________________ please also circle the appropriate category below:

Student in class      Other student      Faculty member      Other

Speaker: Name: ____________________    Date: ____________________

Additional comments may be provided on the back of this sheet if you need more space.

1. Major strong points:

2. Suggestions for improvement:

3. Specifics: Please check the appropriate box. You may indicate letter grade you would assign to each attribute in the box and brief comments in the box if you desire.

<table>
<thead>
<tr>
<th></th>
<th>Excellent</th>
<th>Satisfactory</th>
<th>Weak</th>
</tr>
</thead>
<tbody>
<tr>
<td>Clarity of speaking style</td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>Organization and use of visual aids</td>
<td></td>
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<td></td>
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<tr>
<td>Sophistication and content of material</td>
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<tr>
<td>Depth of research in area</td>
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<tr>
<td>Depth of personal understanding of the material</td>
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<tr>
<td>Stimulation and interest provoked in audience</td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>Attitude and skill in handling questions</td>
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</tr>
</tbody>
</table>

Overall grade assignment: A+    A    A−    B+    B    B−    C+    C    C−
Clarity of speaking style

Excellent – Speaker presented the seminar at an appropriate volume and pace. The speaker made consistent eye contact with the audience and did not simply read notes and/or slides. The number of verbal pauses or distracting mannerisms was minimal.

Satisfactory- Speaker met some, but not all of the above criteria, or applied them in an inconsistent manner. For example, the speaker may have made good eye contact, but consistently used too many verbal pauses.

Weak- Speaker consistently failed to meet the above criteria.

Organization

Excellent- Speaker introduced the research importance at the outset of the seminar. Speaker provided appropriate background information and context that showed where the research fits into the broader picture. This should flow into a discussion of the specific techniques used and the results that were seen, always in the context of the specific research question. The conclusions should then also relate the results of the experiments back to the specific research question. At this point, as a summary, the results and conclusions should be reexamined in the context of the broader research picture, especially in terms of what other experiments need to be performed. The seminar should end with acknowledgements and references. Throughout, good transitions should be used to move from one idea to another.

Satisfactory- Generally follows the organization above, but misses some key elements, or puts them at a confusing spot. An example would be a failure to state the take home message and specific research question until the end of the seminar, or perhaps fails to have reasonable transitions and simply jumps from one point to another.

Weak- Consistently fails to meet the above criteria.

Use of Visual Aids

Excellent- Good slides are readable from the back row of the seminar room. This means the use of a large font with a color that contrasts well with the background. Slides should primarily be used to present information visually, and should not contain an abundance of text. When text is used, proper spelling will be used. Any term that is abbreviated should appear in its full form the first time it is used, with the abbreviation in parentheses. Graphs should be used instead of tables to present information when possible. All charts, tables and graphs will be appropriately labeled. Likewise, the graphics used should avoid complexity by using a single idea in each slide. Any visual that is taken from the literature should be appropriately referenced. Avoid the use of graphics that appear pixilated on the screen. Also avoid distracting backgrounds or animations.

Satisfactory- Meets some, but not all of the above criteria, or applies them in an inconsistent manner. As an example, maybe most slides are readable, but several are not, etc.

Weak- Consistently fails to meet the above criteria.

Sophistication and content of material

Excellent- The speaker should aim their presentation to an appropriate level for their audience. This will likely require an explanation or review of some introductory level ideas. This does not mean, however, that ideas should be overly simplified, especially when it comes to presenting results or in forming conclusions. Background information should be complete enough to provide the audience the context needed to appreciate how the work fits into the broader picture, and why the specific research question is important. However, time should not be spent providing background that does not pertain to the experiments or questions presented.

Satisfactory- Meets some, but not all of the above criteria, or applies them in an inconsistent manner. An example would be a seminar that aims appropriately to the audience, but spends too
much time on background information that is not necessary to understanding the specific research question.

**Weak-** Consistently fails to meet the above criteria.

**Depth of research in area**

**Excellent-** The speaker should show a strong understanding of how their specific research question fits into the broader field. This will most clearly be shown in the background section of the seminar where the information presented should be complete, relevant, and stressful of the importance of the research question being pursued.

**Satisfactory -** Meets some, but not all of the above criteria, or applies them in an inconsistent manner. An example would be if the speaker gave a thorough review of the relevant information but did not stress the importance of their own research.

**Weak-** Consistently fails to meet the above criteria.

**Depth of personal understanding of the material**

**Excellent-** This most likely will be demonstrated by the speaker’s ability to understand and answer questions at the end of the seminar. Responses that are insightful and accurate would be indicative of an excellent understanding of the material.

**Satisfactory-** Answers some questions accurately, but not others.

**Weak-** Is unable to accurately answer question related to their research.

**Stimulation and interest provoked in audience**

**Excellent -** The speaker has the attention of the audience and provokes multiple questions at the end of the seminar. This will most easily be accomplished by keeping the seminar focused and relevant, while always keeping in mind the level of the audience.

**Satisfactory-** Meets some, but not all of the above criteria, or reaches them in an inconsistent manner.

**Weak-** Consistently fails to meet the above criteria.

**Attitude and skill in handling questions**

**Excellent-** The speaker may need to repeat the question for the entire audience. The speaker will answer the question directly as asked rather than attempt to answer of different question. If the speaker does not know the answer they should say so, though it is permissible to speculate as long as any speculation is declared as such. The speaker will avoid any signs of defensiveness in their answers.

**Satisfactory-** Meets some, but not all of the above criteria, or reaches them in an inconsistent manner.

**Weak-** Consistently fails to meet the above criteria.
Biotechnology Program            Graduating Senior Survey

Core Knowledge
How would you rate your knowledge and understanding of key concepts in the following areas?

Poor = unable to recall key information or underlying concepts.
Adequate = able to recall much key information and many of the key concepts, but unable to apply them to new situations.
Extensive = thorough understanding of the key information and underlying concepts and able to apply understanding to new situations or questions.

<table>
<thead>
<tr>
<th></th>
<th>poor</th>
<th>adequate</th>
<th>extensive</th>
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</thead>
<tbody>
<tr>
<td>Knowledge and comprehension of cellular biology:</td>
<td></td>
<td></td>
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<tr>
<td>Knowledge and comprehension of biochemistry:</td>
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<tr>
<td>Knowledge and comprehension of genetics:</td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>Knowledge and comprehension of molecular biology:</td>
<td></td>
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<tr>
<td>Knowledge and comprehension of microbiology:</td>
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</table>

Laboratory Proficiency
How proficient would you say you are with each of the following laboratory skills?

Poor = unable to recall the technique or never exposed to it.
Adequate = capable of performing the technique with a detailed protocol and time to repeat as necessary.
Proficient = able to perform the technique with minimal instruction and able to obtain desired results on the first or second trial.

<table>
<thead>
<tr>
<th></th>
<th>poor</th>
<th>adequate</th>
<th>proficient</th>
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</thead>
<tbody>
<tr>
<td>Gel electrophoresis of protein or DNA.</td>
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<tr>
<td>Protein purification.</td>
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<tr>
<td>Sterile technique.</td>
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<tr>
<td>Use of micropipettes.</td>
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<tr>
<td>Manipulation of DNA such as restriction digestion, ligation, and synthesis.</td>
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<tr>
<td>Ability to collect, analyze and interpret data.</td>
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<tr>
<td>Design an experiment to amplify a segment of DNA.</td>
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<tr>
<td>Calculate and prepare solutions.</td>
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<tr>
<td>To computers to compare and analyze protein and nucleic acid sequences.</td>
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</table>
**Ethical Principals**
Which of the following statements most accurately reflects your beliefs and understanding regarding ethics and biotechnology?

- I plan on strictly working in a laboratory, so a consideration of ethics is irrelevant.
- I know that there are ethical issues related to biotechnology, but I have not seriously considered what they are or how they should be dealt with.
- I am aware of ethical issues related to biotechnology, and have explored them from an ethical, but not a scientific perspective.
- I am aware of ethical issues related to biotechnology, and have explored them from a scientific, but not an ethical perspective.
- I am aware of ethical issues related to biotechnology and I have considered how both ethical and scientific principles inform my understanding of the issues and my behavior.

**Communication, analysis, teamwork and other skills**
How proficient would you say you are with each of the following skills?

<table>
<thead>
<tr>
<th>Skill</th>
<th>weak</th>
<th>adequate</th>
<th>proficient</th>
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<tbody>
<tr>
<td>Ability to find articles in the scientific literature using databases such as Medline.</td>
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<tr>
<td>Ability to read the scientific literature and understand the purpose and importance of the study.</td>
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<tr>
<td>Ability to 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>Ability to interpret, graphs, tables and figures found in the scientific literature.</td>
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<td>Ability to prepare a technical poster to present research findings at a meeting.</td>
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<td>Ability to write a scientific paper.</td>
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<tr>
<td>Ability to prepare and deliver an oral presentation focused on the technical/scientific aspects.</td>
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<tr>
<td>Ability to prepare and deliver an oral presentation on biotechnology to a general audience.</td>
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<tr>
<td>Ability to plan experiments based on previous research studies.</td>
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<tr>
<td>Ability to identify problems that need to be addressed that are relevant to biotechnology.</td>
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<tr>
<td>Ability to work in a team in a laboratory setting.</td>
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<tr>
<td>Ability to work in a team to produce a team product such as a paper or presentation.</td>
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<tr>
<td>Ability to apply core knowledge and skills to real world problems.</td>
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</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?
Bachelor of Science in Biotechnology

78-81 credits total for major and supporting courses
New Curriculum Approved Spring 2008 – new courses in Bold Face

Required Supporting Courses (23-25 cr)
- MATH 166 Calculus I (4) OR
- ANSC 341 Biometrics (3) OR
- MATH 226 Fundamentals of Statistics (3)
- CHEM 120 or 121 General Chemistry I (5 or 6)
- CHEM 122 General Chemistry II (5)
- PHYS 151, 152, 156 and 157 (10) OR
- PHYS 161, 162, 166, and 167 (10)

Biotechnology Core (40-41 cr)
- ANSC 222 Introduction to Biotechnology (2)
- BIOL 150 General Biology (3)
- BIOL 240 Cell & Molecular Biology (3)
- BIOL 324 Microbiology (4)
- BIOL 350 Genetics and Evolution (3) OR
- ANSC 257 Genetics (3)
- BIOL 451 Molecular Biology (4)
- BIOT 280 Sophomore Seminar (0.5)
- BIOT 380 Junior Seminar (0.5)
- BIOT 480 Biotech Seminar (1)
- CHEM 231 Organic Chemistry I (3)
- CHEM 232 Organic Chemistry II (3)
- CHEM 236/246 Organic Chemistry Lab I (1-2)
- CHEM 237/247 Organic Chemistry Lab II (1)
- CHEM 355 Separations Lab (1)
- CHEM 361 Biochemistry I (3)
- CHEM 362 Biochemistry II (3)
- CHEM 366 Biochemistry Lab (1)
- FDSC 460 Fermentation Technology (3) OR
- HORT 369 Plant Tissue Culture (3) OR
- BIOL 463 Animal Cell Culture (3)

Biotechnology Elective (6)
Choose at least six credits from the following additional courses on the right to obtain additional training in methods and content particularly relevant to biotechnology. Fermentation Technology, Animal Cell Culture or Plant Tissue Culture may be chosen as electives after one of the courses is completed as a core course (no double counting as core and elective).

Specialization Area (9)
In consultation with a biotechnology faculty advisor, the student will develop a plan that includes at least 9 additional credits of specialization. Up to four credits may include an internship in the specialization area. The total number of internship credits distributed between the Biotechnology Electives and Specialization Area may not exceed 4 credits. The plan will be submitted to the Biotechnology Program Director by the end of the first semester of the junior year for recording and approval. The senior seminar should focus on a research project the student worked on or a topic intimately related to the area of specialization.

Some possible specialization areas/emphases might include:
- Production Animal Biotechnology
- Production Crop Biotechnology
- Business/Management
- Computational Biotechnology/Bioinformatics
- Criminal Justice/Forensic Biotechnology
- Environmental Biotechnology
- Food Science Biotechnology
- Industrial Biotechnology
- Materials Science Biotechnology
- Medical Biotechnology
- Pharmaceutical Biotechnology
- Veterinary Medical Biotechnology
- BIOL 345 Immunology (3)
- BIOL 453 Virology (3)
- BIOT/CSIS 373 Bioinformatics (3)
- BIOT 295 Biotechnology Lab Research (1)
- BIOT 495 Biotechnology Thesis (1-3)
- BIOT 379 Biotechnology Internship (1-4)
- FDSC 335 Food Microbiology (4)
- FDSC 460 Fermentation Technology (3)
- HORT 369 Plant Tissue Culture (3)
- BIOL 463 Animal Cell Culture (3)