May 2007 Assessment Report for the Biotechnology Program

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 only has full ownership of one course, Biot 480, the senior seminar course. This poses some challenges in assessing the program.

II. Assessment Review

The Biotechnology Program only offers one major, so we do not need to account for several options with our learning outcomes. Our plan does have learning outcomes, and their generality is under consideration as we develop assessment tools. 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.

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 9, 2007, to go through the results of the seminar evaluations from Spring 2006 and Spring 2007 and to discuss outcomes 1, 3, and 4. These learning outcomes are:

1. Biotechnology students will demonstrate knowledge and comprehension of core concepts, which includes but is not limited to knowledge of cellular biology, biochemistry, genetics, molecular biology, and microbiology.

3. Biotechnology students will demonstrate knowledge of ethical principles regarding the use of biotechnology.

4. Biotechnology students will demonstrate the ability to understand, analyze and evaluate original research literature and to communicate this understanding using appropriate technology.

We also developed a graduating student survey this semester (see the attached revised plan) as an indirect measure of all outcomes.

Our program is currently revising our curriculum and we are using the assessment process to inform our curriculum revisions (see attached current and proposed curricula).
III. Assessment Results and Action Plan

Seminar Evaluations
The seminar evaluation data was tabulated and discussed at the May 9th meeting and the following observations were made.

Observations: For Spring 2007, faculty rated “depth of research in the area” the lowest and “stimulation and interest provoked in audience” the highest. Spring 2007 faculty member ratings were lower than the Spring 2006 ratings, but the sample size for faculty ratings was particularly low for Spring 2006. Faculty members that were present at the Spring 2007 seminars, expressed some disappointment with the depth of research and personal understanding displayed by the students during this semester, particularly compared to some previous semesters. Reasons for the poor performance in this area were discussed and one possible reason put forth was the lack of mentorship during the seminar preparation process by a faculty member other than the seminar class instructor. Many of the students were presenting on literature topics and had just performed their research the same semester. Students also face the challenge of addressing the level of their audience, which is primarily students at a lower level. They should be encouraged to begin at a basic level, explain the methods in sufficient detail, but bring the audience along to a higher level. The two outside speakers did a very good job illustrating this. Through appropriate mentoring, students should be able to accomplish this. Students also did not research beyond what was presented, so were unable to address questions as well as they should have.

Actions: All students registered for the senior seminar class will be paired with a faculty mentor other than the faculty member in charge of the class. Lisa Kroutil is teaching the class Fall 2007, and will develop a suggested guideline to distribute to faculty mentors, indicating what we hope to achieve in the mentorship process and expectations. As part of the curricular changes, we have also decided to include a junior seminar component and students will be expected to select their seminar topic and be paired with a faculty mentor at this time, so they can begin research sooner.

Observation: Student ratings are generally more favorable than faculty ratings. This may indicate a problem with critical analysis, a different interpretation of expectations than faculty have, or a desire to “go easy” on fellow students.

Action: We may want to consider creating a rubric to distribute to the students to help them critically evaluate each other better. This will not be implemented immediately, due to relative importance and time constraints.

Discussion of Outcome 1 – content knowledge
Observations: While the biotechnology students are often more adept at using some lab equipment than some of the chemistry students, they often have difficulty applying the content knowledge in the lab or lack fundamental content knowledge such as the ability to figure out how to prepare solutions (mathematical calculations) even though they have been exposed to it in lecture courses. Some students can figure out what sets of experiments to run and why, but do not possess the core technical knowledge about what is going on with the techniques, so they have difficulty interpreting what is happening. Faculty noted that student inability to figure out how to prepare solutions is present among animal science and biology students as well. It was noted that this skill requires repeated exposures to obtain proficiency.

Why is there a difference in the students? When they take analytical. The types of students who go into chemistry versus biotechnology. Whether they see the relevance when they take general chemistry. Level of mathematical skills.
**Actions:** Continue monitoring student performance in these areas and see if the proposed bioorganic first chemistry curriculum has any impact. It will also be necessary to see if eliminating analytical chemistry makes the situation worse. Discuss with the biology department the possibility of doing more solution preparation in earlier courses such as Biology 150 and microbiology, so that students get more exposure to it.

**Discussion of Outcome 3 – ethics**

**Observations:** We have not yet implemented our tools to measure this outcome or implemented the bioethics course yet.

**Actions:** Implement the student critiques of each others’ seminars including an analysis of any ethical questions the seminars may raise. Develop and offer the bioethics course.

**Discussion of Outcome 4 – literature analysis, evaluation and communication**

**Observations:** Students display an amazing degree of knowledge of current research in the field of biotechnology. This may be due in part to the fact that the biotechnology club discusses an article each week.

Students lack ability to analyze literature in depth (also revealed in seminar evaluations above).

**Action:** Reinstitute the journal club component of the seminar class. Reserve the first four weeks for class expectations and what makes a good seminar and do two journal club analyses. Advocate for better access to the literature so students can access articles for papers in courses and in preparation of seminars easier (quicker).

**Discussion of Outcome 2 – laboratory skills – not scheduled**

**Observations:** In biochemistry laboratory students are surprisingly adept at using equipment, and the biotechnology majors are more adept at using micropipetters than the chemistry students. Cell culture students are very good at the microbiology subset of skills, but initially lack general lab skills and adaptability, but the course moves them beyond this. Some of the students are stuck in the recipe approach. They are good once they figure out what they need to do, but not as good at figuring out what to do.

**Actions:** None at this time.

**Preparation of the Assessment Plan**

In the process of developing the assessment plan a few items were noted that led to actions as well. The observations and actions as a result of this process are noted below.

**Observations:** The construction of the table identifying where objectives/outcomes are being achieved revealed that Biology 210/230 and Chemistry 251/256 are not contributing much to achieving our objectives.

**Actions:** We decided to eliminate them from our curriculum requirements to provide students more flexibility in the program.

**Observations:** We found that we are not adequately addressing outcome 3, knowledge of ethical principles.

**Actions:** We are adding student analysis of the ethical components of the seminars in Biotechnology 480, senior seminar, and we are developing a required bioethics course as a required ethical citizenship course.
Results Availability
This report is available on the biotechnology web page 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: The number of faculty members filling out seminar evaluation forms is low. This was particularly true for Spring 2006. We need to work on increasing faculty member attendance and completion of the evaluations.
Action: The seminar day was changed 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.

Observation: The learning outcomes are not exactly paralleled by the items on the evaluation form. Do the outcomes need to match exactly? Outcomes 1 and 4 do dovetail nicely with the seminar evaluation.
Action: No action at this time, but we may want to revisit this question and make changes to the assessment tool in the future.

Observation: Preparation of the assessment plan revealed a lack of an indirect measure for the outcomes.
Action: The student survey was developed.

Observation: Preparation of the assessment plan revealed a lack of evaluation of the ethics outcome.
Action: We are adding student analysis of the ethical components of the seminars in Biotechnology 480.

Observation: Student evaluations of seminars are higher than faculty evaluations.
Action: We may want to consider creating a rubric to distribute to the students to provide to students to help them critically evaluate each other better. This will not be implemented immediately, due to relative importance and time constraints.

Observation: We found that the seminar evaluations and discussion provided some insight into core knowledge, but did not adequately assess outcome 1. This is in part due to lack of response or input from faculty teaching some of the courses such as microbiology. One of the faculty members requested more direction regarding input.
Action: We will develop tools to address this in the upcoming year and will implement them in the following year.

Observation: As we make curricular changes, it is important to consider the expectations for our students as they enter the work force or graduate programs.
Action: We are considering forming an advisory committee to provide us with input.

Observations: The committee considered the feedback provided by the university assessment committee for our assessment plan in consultation with Barbara Walvoord at the Assessment Workshop on Friday, April 13, 2007, and some additions and revisions were made.
**Actions:** Program level learning objectives were not changed since Barbara indicated that they are appropriate for program level outcomes, but we will consider their generality as we continue to develop assessment tools. We tried to clarify some of the points that reviewers had questions about. In particular, we attached the rubric that goes along with the seminar evaluation form and will be looking to revise this in the future so that it will match our learning outcomes better, and we attached our newly developed senior survey to help clarify what our assessment tools are for section III. We believe the timetable is fairly straightforward so we did not revise it but welcome any additional feedback that might help resolve any questions. We added an opening paragraph more fully explaining the process in section V. We believe the last two sections are adequate for the plan, since the results to be disseminated and revisions to be made are to be included in the report not the plan. Please see the attached revised plan.

**V. Data from Institutional Research**

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