



behaviorist/entomologist. Almost all (82%) have Ph.D.s in their special areas and have training to be able to provide backup for at least one other area as well as the skills to teach in more general freshman level courses. The curriculum has been divided into the following study tracks:

General Biology

Traditional Track

Pre-Professional Preparation

Secondary Education

Environmental Biology

Table 2. Biology Faculty loads for academic year 2013/2014. Credit hours are listed, then contact hours in brackets. Our departmental goal is 10 credit hours or 12 contact hours averaged over the year. Upper level courses are listed. In Fall 2013, average number of credits taught per biology faculty FTE was 10.24 and 14.48 contact hours. In Spring 2014, we averaged 9.51 credit hours taught per biology FTE and 12.1 contact hours per FTE.

Faculty Member	Fall 2013	Spring 2014
Dr. Sam Galewsky	BI 407 Molecular Genetics 12 [14]	BI 305 Cell/Molecular Biology 10 [16]
Dr. Cynthia Handler (1/2)	BI 203 Histology 8 [9]	+Graduate Anatomy for Nurse Anesthetists (1/2 of 3) 4 [+1.5]
Dr. David Horn	BI 314 Ecology 9[11]	11
Dr. Jeff Hughes	BI 300 Genetics, 8 [13]	8[12]
Gregg Marcello ABD final submission	8 [15]	+Graduate Anatomy for Nurse Anesthetists (1/2 of 3) [1.5] BI 325 Vertebrate Biology 8 [11]
(1/2 time)	7 [7]	7 [7]
Dr. Judy Parrish	BI 326 Plant Biology BI280/380 Ecological Journey, South Africa 10 [18]	11 [13] Chair Reduction sti

learning areas and this learning becomes self propagating as the student begins to enjoy the connectivity of what he/she is doing in the classroom with what he/she anticipates doing upon graduation.

Just as the curriculum helps the department achieve goals for student learning outcomes and helps students actualize their plans of study, so too does the advising process. Advising in the

as a person and as a major. In order to realize this mission, we work with students to: (1) Develop plans of study for successfully achieving their degree and career goals, (2) Select courses each semester to progress toward fulfilling their plans of study, (3) Use the resources and services on campus to assist in fulfilling their plans of study, and (4) Graduate in a timely manner. Students meet in person with their academic advisors throughout the semester to discuss fulfillment of the plan of study. Those in the pre-professional programs have both an academic advisor and a pre-professional advisor whose job it is to ensure that students are aware of requirements and prepared for application to professional schools.

### Curriculum Map

Courses listed below each goal provide information and experiences necessary for students to complete the departmental goals in a timely manner during their four years at Millikin (Table 3)

Table 3. Biology department goals and courses that focus on them in each academic year.

Academic Year	Goal #1	Goal #2	Goal #3	Goal #4
Freshman	BI 105, BI 108	Only courses level 200 and above can be used for this goal	BI 105, BI 155, BI 108, BI 158	BI 155
Sophomore	Expanded in all other courses taken	See Appendix B		

105) and Diversity of Life (BI 108). The first test is given at the beginning of BI 105 and the second one at the end of BI 105. A third exam is given at the end of Diversity of Life, BI 108, and a final one when students complete the senior seminar course (BI 481 or 482). Second, the theme of evolution is intentionally included in all appropriate courses taught in the department. How it is incorporated is described in each course syllabus.

Goal #2, the exposure to the various areas of biological study, involves emphasis on the approaches taken to study six major areas of biology: ecology, taxonomy, morphology, function, molecules/cells and reproduction/genetics (Appendix B). Because students are required to take courses in each of these areas, they not only gain additional understanding of the essential nature of these concepts to biology but also explore the continued theme of adaptation and diversity that living organisms exhibit. Students are expected to take six courses, one in each area, and complete each course with a grade of C- or better. Students must retake or take another course in this content area if their grade is D+ or lower. This applies to every student in every concentration. We also require that seniors take the ETS field test in biology during their senior seminar. Students are charged a lab fee of \$50 for this course (BI 471 or 472) to cover most of the expenses for this national exam.

Goal #3, the use of critical thinking, is essential to the sciences. Many of our courses include laboratory research and reports that assess critical thinking skills. We use a portfolio system and collect two papers, one written the first year at Millikin, and then one from senior seminar research. These papers must be of an investigative nature that draw conclusions from data personally collected or analyzed by the student. The following rubric is used to evaluate how well students use logic and critical thinking in their work.

Excellent

Conclusions	<p>Accurately reflect data presented</p> <p>Correct use of logic</p> <p>Fit study into broader context</p> <p>Adequate summary of paper.</p> <p>Considers where the work should go from here</p>	<p>Some conclusions not based on results</p> <p>Contains faulty logic</p> <p>Study weakly related to broader context</p>	<p>Many conclusions not related to data</p> <p>Poor use of logic</p> <p>No attempt to fit study into broader context</p>
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Goal #4, research report and evaluation, is the culminating experience of graduating biology students. It consists of the following components:

Selection of an appropriate research topic.

A thorough search of relevant research using primary literature.

Collaborative wet-bench research with a member of the faculty or critical analysis of existing literature on the topic. The culmination of this is the development of a well-supported position (hypothesis) on the topic.

Presentation of this position consists of an oral presentation before faculty and peers, a poster display similar to those presented at scientific meetings, and a scientific paper patterned after current research literature.

As the curriculum map indicates, this goal is likely be fulfilled in Senior Seminar, BI 481 or 482. Because of the large number of majors, the limited resources of faculty and space, and the limited need for allied students to do research, we do not require hands on research of all students to satisfy this goal. We have included the option of researching the primary literature in biology in order to meet this goal. Senior Seminar gives our students the opportunity to present their analyses and conclusions in a formal setting. Evaluation of the poster and oral presentation are based on guidelines presented in the following rubrics. The scientific paper is evaluated using the rubric for goal #3.

POSTER PRESENTATION

Content

5	<p>Emphasis on student testable, novel hypothesis that would extend research in the field.</p> <p>All required components included (Abstract, Introduction, Methods and Materials, Results, Discussion, Acknowledgements, Literature Cited) with correct and necessary information included in each section.</p> <p>Rigorous experimental data and appropriate statistics presented with emphasis on student interpretation of data.</p>
3	<p>Reasonable hypothesis but difficult to test, not completely novel and would not really extend knowledge in the field.</p> <p>All required components included but some with information in wrong section or not included. Experimental data and statistics presented data not overly rigorous, statistics unclear or incomplete, student interpretation of data not emphasized.</p>

ORAL PRESENTATION

Content

7-10 Emphasis on student testable, nove



## ASSESSMENT DATA

The following data are collected and averaged:

The average improvement between pre- and post- scores on the evolution assessment in Ecology and Evolution, the average score on the evolution assessment given in Diversity of Life, and the average score for evolution assessments for both semesters of senior seminar.  
The percentage compliance of syllabi for direct ties to evolutionary concepts  
List of classes taken and grades below C-



Table 4. Breakdown of percent correct answers for each question on the pre and post test for knowledge of evolution

Question	% Correct New Freshmen (71)	% Corre
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In addition to the above effort to assess our teaching of evolution as a central theme of biology, the faculty developed syllabi for courses including departmental goals and a demonstration of how departmental goals (42.86%), and only 3 of the 14 showed directly how evolution is addressed in departmental goals (100%). Seventy-five percent of Fall 2006 syllabi, and eighty percent of Spring 2007 syllabi, directly demonstrated how courses covered evolutionary themes. In fall 2007, 81.8% into them. Similar results hold for the syllabi in 2010, and 2011 (83% in fall and 80% in spring). The Anatomy/Physiology courses are not strongly centered on the concept of evolution, because they are human, not comparative, and mainly aimed at nursing students. We decided as a department that it is reasonable for the A&P courses NOT to have a core theme of evolution, since only the human species is discussed, and we have decided to remove them from this portion of the assessment. Our goal is to have evolution as a core theme in all other classes, and we are meeting that goal (Table 5).

Table 5. Direct coverage of evolution on syllabi for Fall 2013 and Spring 2014 Classes for Biology Majors

Class	Instructor	Evolution directly addressed
BI 105 Ecology and Evolution	Parrish, Robertson, and Wilcoxon	Yes, Yes, Yes
BI 108 Diversity of Life	Parrish, and Srinivasan	Yes, Yes
BI 300 Genetics	Hughes	Yes
BI 303 Entomology	Robertson	Yes
BI 305 Cell and Molecular Biology	Galewsky	Yes
BI 306 Comparative Animal Physiology	Schroeder	Yes
BI 314 Ecology	Horn	Yes
BI 323 Animal Behavior	Robertson	Yes
BI 325 Vertebrate Biology	Marcello	Yes
BI 326 Plant Biology	Parrish	Yes
BI 330 Microbiology	Srinivasan	Yes
BI 360 Physiological Ecology	Wilcoxon	Yes
BI 380 Ecological Journey: Florida	Wilcoxon	Yes
BI 380 Ecological Journey: South Africa	Parrish	Yes
BI 407 Molecular Genetics	Galewsky	Yes

*For Goal #2 Have exposure to the following general areas of biology: ecology, taxonomy, morphology, function, molecules/cells and genetics/ reproduction.*

In fall 2007, 8.94% and in spring 2008, 6.94% of the grades earned were below C- . In fall 2008, 5.93% and in Spring 2009, 6.89% of students received grades below C- in the content area courses, and in Fall 2009 and Spring 2010, 6.03 % and 4.6%, respectively. For Fall 2010 and Spring 2011, 5.48% and 2.25% of biology majors received grades below C- in content area courses. For Fall 2011/Spring 2012, 6.02% of our students did not successfully complete content area classes, and in 2012/2013, only 3.89% of our biology majors failed to achieve the C- necessary to meet content standards (Table 6). This year 6.7% did not meet the C- requirement in content classes. These data fulfill the criteria for a green light for the number of students needing to repeat upper level courses in the content areas.

\*Table 6. Courses that meet biology content area requirements for majors, number of biology majors enrolled in each course, and number of students failing to meet the required C-.

Course Title	Course Number	Number Enrolled	Number earning D+ or below
*A & P I	BI 206	4	1
*A & P II	BI 207	14	0
Genetics	BI 300	48	9
Histology	BI 302	6	0
Entomology	BI 303	5	1

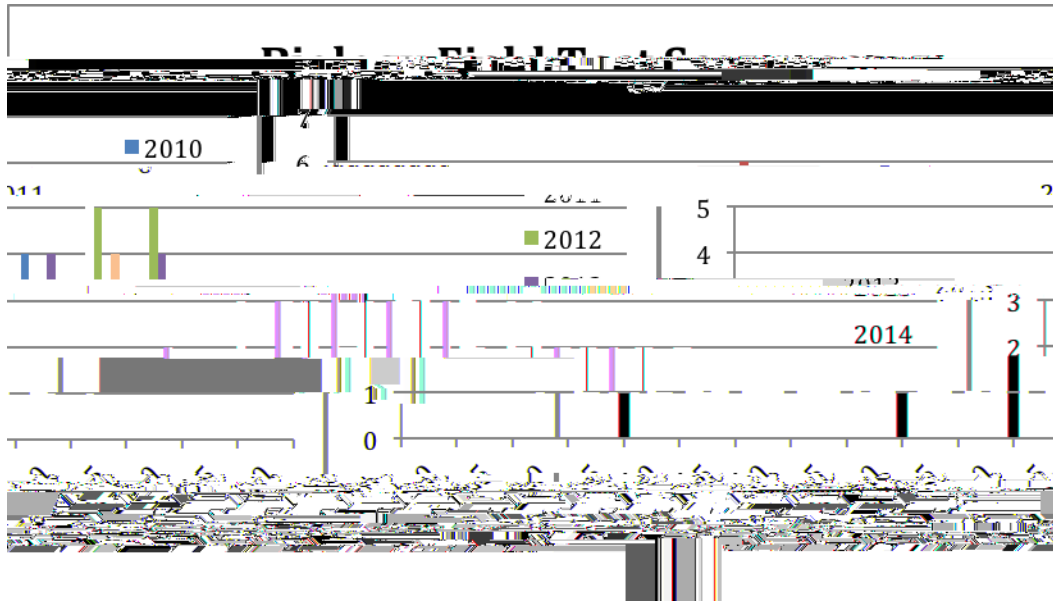


Figure 1. Educational Testing Services Biology Field Test Scores for Millikin seniors 2010 - 2014.

In 2013/2014, 13 of the 21 seniors taking the exam scored 150 or above, at the 40<sup>th</sup> percentile or above for all students taking the exam nationwide (scaled overall test score ranges from 120 - 200). The range of scores was 136 - 170. In 2012/2013, 14 of 22 Millikin seniors taking the exam scored 150 or above, at the 40<sup>th</sup> percentile, and 15 of 23 in 2011/2012, 15 of the 21 in 2010/2011. The mean scores were 153.38, compared to 154.45 for 2012, 150.8 for 2012, 156.24 in 2011 and 152.05 in 2010. Four of the 18 students taking the exam this year scored above the 75<sup>th</sup> percentile nationwide.

Of the four main subsets of scores, Millikin students performance was above the national averages for population biology, ecology, and evolution, and only slightly below national averages in each of the other subtests (Table 7).

Table 7. Mean ETS Biology Field test subset scores for Millikin students in 2010 - 2014, and national average for each subset for 2013.

	Cell Biology	Molecular Biology & Genetics	Organismal	Population Biology and Ecology and Evol
Millikin 2010	52.47	49.04	50.19	56.28



and our students scored well in analytical skills. Our department has a strong emphasis on critical thinking and application rather than memorizing facts, and we are glad to see that this emphasis is reflected in performance. ETS assessment of goal 2, yellow to green light.

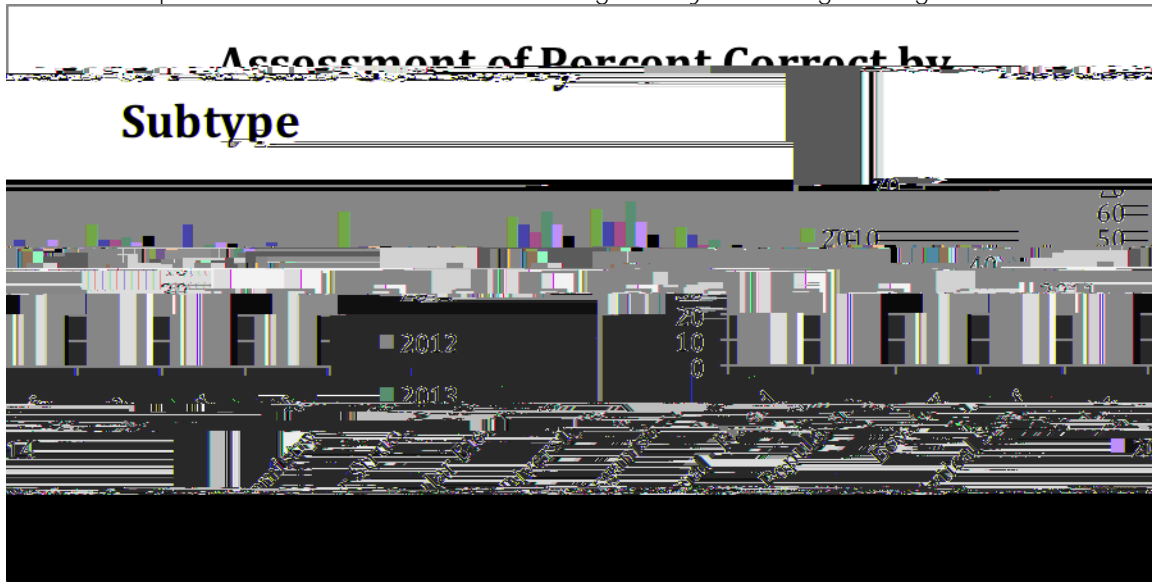


Figure 2. Average score of Millikin students for each of the subtypes of questions asked.

Goal #3





Table 8. Mean scores on departmental rubrics for evaluating senior seminar performance. Actual range of individual scores is listed for recent semesters.

Semester (Number of students)	Mean Total Paper (Range 0-15)**	Poster (Range 0-20)	Oral (Range 0-25)
Spring 2006 (20)	11.8	17.0	20.6

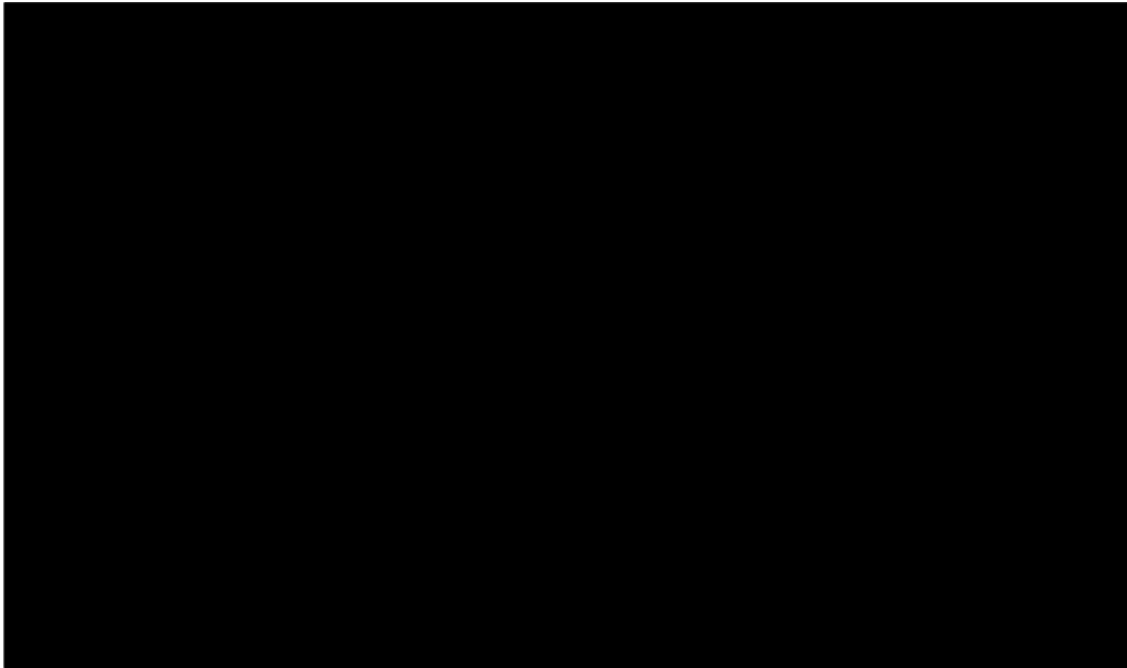


Figure 4. Mean scores for posters presented by students in Senior Seminar for 13 different semesters. Total possible for the poster was 20 points, with five points for each category of the rubric.

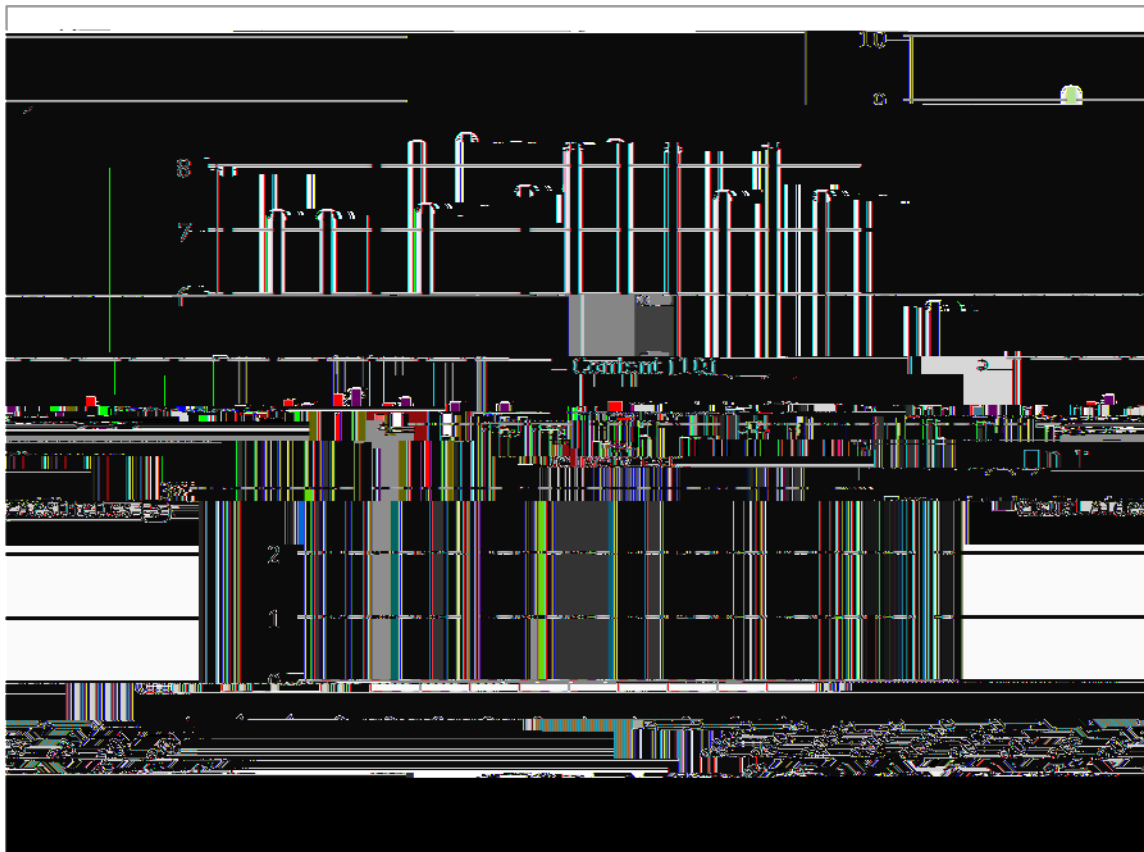


Figure 5. Mean scores on departmental rubrics for oral presentations in Senior Seminar for 13 different semesters. Total possible points was 25 for the oral presentation.



Goal #2 The first step in completing this goal was to develop a list of courses that provide meaningful exposure to the six areas of emphasis in Biology (Appendix B). We submitted our curricular changes to the Division of Natural Sciences and Mathematics and to the College of Arts and Sciences for approval in November 2006, and began to use the new requirements for biology majors entering in the Fall of 2007. We developed a check sheet to be included in the advising folder of each student. It is the annual responsibility of the advising professor to check the progress of advisees to be certain they are in compliance both for exposure and grades. The number of students falling below a C- in the content area courses is used to assess our effectiveness in giving the students the exposure they need. Adding the field test from ETS also improves our assessment of this goal.

The requirement for each student in each program to succeed in at least one course in each of the six content areas went into effect for students graduating in 2011. We expect to see more breadth in the program choices of our students. Because it is difficult for the Allied Health students to work in a course in the ecology content area, we approved our summer immersion course in Field Ecology (BI 220) to count in the ecology area for Allied Health.

Goal #3 During the spring semester of 2006, we collected and evaluated the writing of seniors in the Senior Seminar course. We used the results to determine the appropriate standard that students should meet in order to deem our teaching efforts acceptable. Since that time, research papers from the freshmen Ecology/Evolution course and Senior Seminar course have been collected and assessed, for comparison.

Due to previous assessment report recommendations, the collection and storage of the freshmen papers has improved. In 2009/2010 both freshmen and senior papers were available for only seven students, in 2010/2011 the number was nine, in 2011/2012 the number was ten and in 2012/2013 the number was 17 out of 18 graduating seniors. This year, 2013/2104 the number is eleven out of 20 graduating seniors but, this year we implemented electronic storage of the freshmen and senior papers in the G share file and therefore we anticipate a higher collection and storage rate of papers in the future.

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We had all faculty participate in assessment of the posters and presentations in 2006 to develop our criteria, then returned to having only the senior seminar instructor and faculty mentor score the poster and paper. The process of assessment of senior seminar performance as developed by Drs. Marianne Robertson and Jeffrey Hughes have allowed us to become much more objective and quantitative in the evaluations, and we should be able to compare performance from semester to semester better. At least three faculty members evaluate each poster now, and all faculty present, usually at least six, evaluate the oral presentations. In some previous semesters, assessments were completed by only one faculty member, and those vary widely. With a formalized system for departmental evaluation, semester to semester comparisons, and therefore rigorous assessment allowing for justification of changes in the curriculum, can be made. Another improvement in evaluating posters is that we now have students present for the poster evaluations with are performed by

students are required to attend 5 seminars each semester, but students who transfer into the department as upper classmen sometimes attend only when they are enrolled. Advisors need to strongly encourage our transfer students to attend and to start thinking about what they will choose to work on for their capstones. There is also a need for early feedback to allow time for remediation on projects. Some students do excellent research with a faculty member, worthy of presentation at regional and national meetings, or even publication. Others have worked with little mentoring,

performance, no student had failed senior seminar. Since we began developing the rubrics in the Fall of 2005, we have encouraged four students to drop senior seminar and retake it when they were more prepared, seven students to redo analyses and posters and present later in the semester, three to take an incomplete and prepare an acceptable analysis over the summer or winter break, and five students have failed. Students are now required to work with a mentor throughout the preparation for senior seminar, and that mentoring relationship is becoming more formalized and successful. Students cannot

Goal 4. Average oral presentation scores for the 10 students in fall 2012 were 21.26, and 21.15 for the 12 students in the spring of 2013, both exceeding the 20/25 needed for a green light. Average poster scores were 16.83 in the fall and 16.39 in the spring, again exceeding the 15/20 criterion for a green light. Although the rubrics are not used consistently by all faculty members in grading, we have found that having them, and making them available within the syllabus for senior seminar, has made expectations more clear to our students and evaluation more consistent. The responsibility for instructing senior seminar rotates through



## APPENDIX B