

**Millikin University
Student Learning in Biology**

**Department of Biology
Chair, Travis Wilcoxen
Division of Natural Science and Mathematics
August 1, 2019**

GOALS

The Department of Biology at Millikin University, in an attempt to educate students in the knowledge and practice of biology, agrees that the following goals are of sufficient rigor and coverage to produce highly competitive graduates of the program. The following goals have been developed and approved by the members of the department.

Graduates with a Biology Degree should:

1. Understand and be able to apply the concepts of evolution and natural selection.
- 2.

SNAPSHOT

The Department of Biology is located in the Leighty

departmental goal #2. At maximum, teaching labs can accommodate 20 students; these small numbers enable us to give each student personal attention. This personal attention should motivate students to perform at a high level, as they are under the personal view of the instructor. This motivation leads to increased understanding of the concepts associated with our 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 Department of Biology facilitates and integrates reasoned choices that promote the student's growth 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 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	BI 206 and 207 or BI 300	BI 300 lab
Junior	Expanded in all other courses taken	See Appendix B	*Course with research project OR BI 391 or 392	*Course with research project OR BI 391 or 392
Senior	Expanded in all other courses taken	See Appendix B	BI 481 or 482	BI 481 or 482

ASSESSMENT METHODS for BIOLOGY DEPARTMENT GOALS

Goal #1, understanding the concepts of evolution and natural selection, is met in two ways.

First, students learn about evolution and natural selection by successfully completing the freshman courses, Ecology and Evolution (BI 105/155), and Diversity of Life (BI 108/158). These courses give freshm

	Excellent (5)	Adequate (3-4)	Nominal (1-2)
Format	•		

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	Emphasis on student testable, novel hypothesis that would extend research in the field.

ORAL PRESENTATION	
Content	
7-10	Emphasis on student testable, novel hypothesis that would extend research in the field.
	All required components included (Abstract, Introduction, Methods and Materials, Results, Discussion, Acknowledgements, Literature Cited) with correct and necessary information included in each section.

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- for objective 2. The ETS field test is also used in assessment of this goal.
- Two papers, one from the freshman year, and the senior seminar capstone research paper, are collected and evaluated using the rubric for goal #3 (see above rubric). Transfer and other students without the first paper to evaluate are excluded from the analysis.
- Presentations of student research at international, national, state/regional, and on-campus scientific meetings.
- Evaluation scores for objective 4 for paper, poster, and presentation as well as documentation of student presentations at scientific meetings, grant writing, and publication of manuscripts.
- We also have assessments of biology secondary education majors available through LiveText on performance of students on the Candidate Assessments and Program Assessments necessary for completion of an NCATE-accredited teacher education program in biology. Results from rubrics for assessing Student Learning (CA10), Social Context of Science (SCI PA8) in two sections, and a science lab safety manual (SCI PA6) are reported.

ANALYSIS OF ASSESSMENT RESULTS

- **GREEN LIGHT –**

At the introductory level, testing indicates that we are approaching a high level of success. Goal #1 is judged successful if we are able to demonstrate a 25% improvement between the pre-test and the post-test scores during the freshman year and maintain this through the senior year. Over 90% of syllabi show direct relationship of evolutionary concepts.

Goal #2 – All students complete a course in each content area, all grades for the six courses elected by all graduating students are C- or better, and less than 10% must repeat courses to achieve this goal.

Goal #3 – Two papers are placed in the student's portfolio, there is an average of 20% improvement from freshman to senior, and the average review score for seniors is 12 or better.

Goal #4 – At the completion of Senior Seminar capstones, the oral presentation scores average 20 or better and poster evaluation scores average 15 or better.

- **YELLOW LIGHT –**

Goal #4 – Average evaluation score for the oral presentation is between 18 and 20, and the poster score between 13 and 15.

- **RED LIGHT –**

Goal #1 - Little or no improvement between pre and post-tests (10% or less), or little retention of concepts. Less than 75% of syllabi for majors courses show direct relationship of evolutionary concepts.

Goal #2 – More than 10% of students do not complete one or more of content areas, or more than 15% must repeat courses to achieve C- or better.

Goal #3 - Fewer than two papers in the student's portfolio, with an average evaluation score for the senior paper of less than 11.

Goal #4 - Average oral presentation score for seniors is below 18 and average poster score is less than 13.

Goal #1 Understand and be able to apply the concepts of evolution and natural selection.

Summary of the Evolution assessments for 2018/2019

When we gave the test to Ecology and Evolution students early in the semester, 73 students took the exam, averaging 7.5 out of 25 (Table 4). We have results from 57 students who took it at

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

Question	% Correct New Freshmen	% Correct Midyear Freshmen	% Correct End of First Year	% Correct Senior Seminar
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Goal #2 Have exposure to the following general areas of biology: ecology, taxonomy, morphology, function, molecules/cells and genetics/ reproduction.

The Biology Department determined which courses best cover the six general content areas of biology, with one course fulfilling no more than two categories. Each student must choose which of the two categories that course will satisfy. After a review of transcripts of 20 graduates in the three general tracks, we found that our Allied Health students were often not taking courses that cover ecological concepts. Because their programs are often very tight, we decided to allow the summer immersion, field ecology (BI 220), to count for the ecology area for Allied Health students. Our proposal to require all biology majors to successfully complete at least one course from each of the six content areas (Appendix B) was approved by division and school and became effective for students entering the program during the 2007/2008 academic year. We have since required that students take both BI206 and BI207 in order to count those courses as a content area course. All students in all programs are exposed to a broad background in biology.

This year, 3.03% did not achieve a C- or above in a biology content class (Table 6). This is consistent with the average since we began using this criterion (Table 7). This year's data fulfill the criteria for a GREEN light for the number of students required 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
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Since Spring 2010, we have required that our seniors take the Educational Testing Service

Goal #3 Be able to use and apply critical thinking to life situations. This success is inferred by their ability to write critically in biology.

Most of our courses, from the freshmen course, Ecology/Evolution, to the senior course, Senior Seminar, emphasize application of concepts to life situations. In order to assess this critical thinking goal, papers from the freshman year are compared to papers from the senior year to look for improvement. The two papers have to be from the same student to be included. A common rubric of three sections, worth five points each, is used to score the papers. The rubric sections are Format, Design and Conclusions (see above rubric). Our department decided an average evaluation score improvement of 20% from freshman to senior years, in addition to an average evaluation score of 12/15 for the senior papers, would be used as a “green light” and therefore an indicator of teaching success for data evaluation and curriculum improvement decisions.

For the 2018/2019 school year, we compared the Senior Seminar papers and freshmen Ecology/Evolution papers of eleven students (Fig. 1). The average evaluation score on the papers increased 16%, from 12.43 to 14.36. Paired t-tests showed that the total evaluation scores on the papers increased significantly ($p = 0.028$), as did format ($p = 0.001$). Scores did not significantly improve for design ($p = 0.36$) and conclusions ($p = 0.11$), but this was driven by an overall low sample size and a number of high scores for the freshmen. Both the fact that seniors are scoring, on average, higher than 12 and that there is at least a 20% improvement in scores fit within the criteria for a green light for meeting this departmental goal.

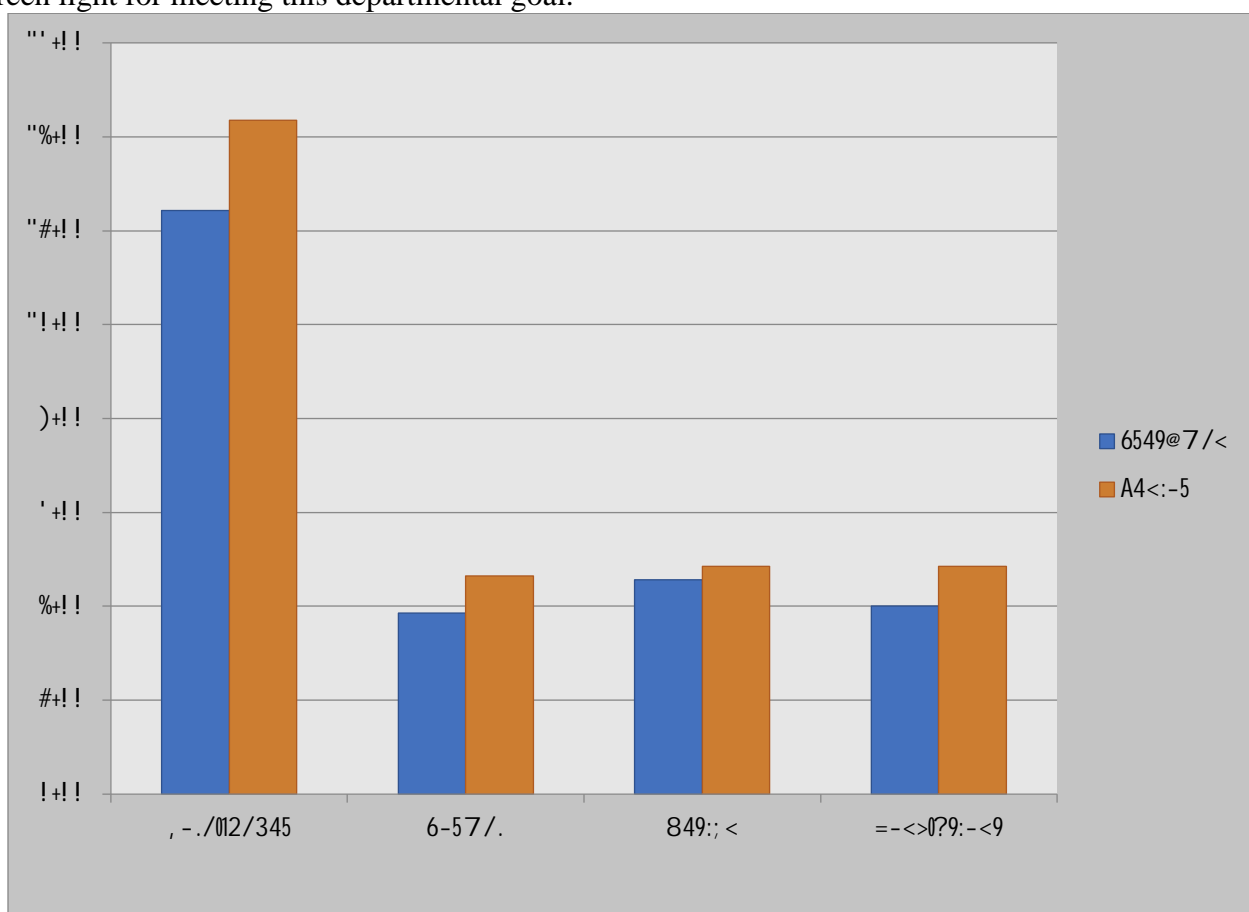


Figure 1. Comparison of Freshmen (entering fall 2015) papers from Ecology and Evolution class with Senior Seminar papers from the same students (fall 2018/spring 2019). Total possible point value is 15, with each of the three portions (Format, Design, Conclusions) of the rubric worth a possible five points.

Goal #4. Be able to present in oral or written form a completed research project, using testable hypotheses, logical arguments and appropriate methodologies and equipment.

This goal is assessed by means of a poster and an oral presentation in the Senior Seminar

Secondary Education Program

All secondary education students must complete 11 Candidate Assessments, as well as 8 program assessments specific to biology. These assessments are a part of the education courses in the curriculum as well as Biology 110 and Student Teaching. During the 2008/2009 academic year, Christie Magoulias developed a LiveText system for documenting performance of our students in meeting the specific requirements for accreditation within NCATE for the National Science Teachers Association. Rubrics were developed to track performance meeting the requirements, with proficient performance required and commendable performance exceeding requirements. We did not have any Biology Education students complete the requirements this year.

IMPROVEMENT PLANS

Goal #1 – We developed four different versions of the pre-post test and have used each, improving it each time. The first version had no material from BI 108, and two of the questions used did not directly relate to evolution. The second version, which included concepts from BI 108, was too long, requiring a whole class period to complete, and also had quite a few questions that were only tangentially related to evolution. In the fall of 2008, the department decided that the questions on names of scientists addressed memory, not concepts, so we removed them. The final version (Appendix A) is what we have used from Fall 2008 to the present

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, using the above rubric.

Due to previous assessment report recommendations, our efforts to increase the collection and storage of the freshmen papers is making some improvement. 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, in 2012/2013 the number was 17, in 2013/2014 the number was 11 in 2014/2015 we also had 11 students, in 2015/2016 we had both papers for 23 seniors, in 2016/17 we had 16 papers, and this year we had papers for 11 students.

Goal #4 – The senior seminar instructor calculates

Report Summary

Overall we have set realistic goals and progress is being made toward achieving these goals.

- **Goal 1.** Freshmen students demonstrated a more than

APPENDIX A Biology Content Category Courses Fall 2018

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