Millikin University
Student Learning in Biology

Department of Biology
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Division of Natural Science and Mathematics
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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. Have exposure to the following general areas of biology: ecology, taxonomy, morphology, function, molecules/cells and genetics/reproduction.
3. Be able to use and apply critical thinking to life situations.
4. Be able to present in oral and written form a completed research project, using testable hypotheses, logical arguments and appropriate methodologies and equipment.

These goals have been reviewed in terms of the connectivity with the university goals in the following ways.

- Goal 1. Millikin University students will be prepared for **professional success.**
  Our goals (1-4) give biology students a strong biological background to prepare them for success in many professional areas: a strong pre-professional curriculum for medicine, dentistry, veterinary medicine etc; a thorough exposure to research skills needed for graduate, industrial and environmental programs; a rigorous secondary education program for teaching high school science.
- Goal 2 Millikin students will actively engage in the responsibilities of **citizenship in their community.**
  The goal of developing good reasoning and logical skills (3) as well as the knowledge students obtain (goals 1, 2, 4) will be of immeasurable value in dealing with the biological issues facing society such as pollution, health, medical treatment, stem cell research, reproductive issues, etc.
- Goal 3 Millikin students will discover and develop a **personal life of meaning and value.**
  Goal 4, and to some extent 3, help to develop in biology students self confidence that they can do well in the world. It gives them a feeling of self worth by completing the difficult task of taking on an investigation and coming up with a meaningful interpretation and conclusion. This skill is essential to their education.

SNAPSHOT

The Department of Biology is located in the Leighty Tabor Science Center on the second and part of the third floor, with an animal facility in the basement and a greenhouse on the fifth floor. The faculty has been selected to provide specialized focus in the areas emphasized in biology goals #1 and 2. We have a geneticist, a molecular/cell biologist, a microbiologist, an ecophysiologist, a mammalogist, an animal ecologist, two physiologists (one is teaching half-time), a plant biologist, an environmental biologist (teaching half time and preparing labs the other half), and an animal 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
- Allied Health Preparation
    - Pre-PT/OT
    - Pre-Med Tech
- Cellular/Molecular Biology

These tracks prepare students for careers in almost any area of biological research, including organismal or molecular/cellular research, medicine, dentistry, veterinary medicine, environmental biology, high school teaching, physical therapy, occupational therapy, and medical technology. The department advises and provides biological training of 115 (average) majors and annually graduates an average of 22 students. The largest areas of specialization for students are the Pre-Professional and Allied Health tracks. In addition to providing training for our majors, the department services about 50 pre-nursing majors and 35 exercise science majors by providing courses in anatomy and physiology and approximately seven elementary education majors seeking concentrations in science. We also teach an average of 12-13 sections of MPSL laboratory science classes and honors seminars per year, 2-3 PACE MPSL courses, 2 courses for the graduate nursing program, and 5-7 interdepartmental courses each year (Table 1).

*Table 1. Biology Student Credit Hours generated by Biology Faculty in the 2013/2014 academic year.

	Biology Majors	IN courses	MPSL lab (BI 102)	Service Courses
Fall 2013	935	232	476	432
Winter immersions, PACE	0	12	184	0
Spring 2014	674	261	484	380
Summer 2014	28	0	24	0

Our faculty loads are often high, with 4-5 faculty members on overload each semester. We try to even out loads, with an average of 10 credit hours or 12 contact hours over the academic year, and at least one upper level course per full time faculty member per year (Table 2). With 9.67 FTE in our department, we averaged 214.8 student credit hours per faculty member in Fall 2013, and 187.7 SCH per FTE in the Spring 2014. Our faculty also mentored 31 registered students in research projects, 4 in internships, taught 75 student credit hours in the graduate nursing program, 172 student credit hours in PACE, and 64 student credit hours in winter and summer immersions.

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]
Ros O'Conner (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 stipend
Dr. Marianne Robertson	BI 303 Entomology 9 [15]	BI 323 Animal Behavior 10 [12]
Dr. Jen Schroeder	BI 306 Comparative Animal Physiology 7 [9] Gravett	Gravett 7 Graduate Physiology for Nurse Anesthetists (3)
Dr. Sangeetha Srinivasan	BI 481 Senior seminar 8 [11]	BI 330 General Microbiology 9 [13]
Dr. Travis Wilcoxen	13 [18]	Physiological Ecology 7 [11]

STORY

Student learning in biology requires an extensive exposure to methods and examples of life situations. This is accomplished to a great extent through the hands-on-experience in the field and laboratory. Our science building was designed to provide ample laboratory space for the various biological areas listed in departmental goal #2. At maximum, teaching labs can accommodate 16-20 students; these small numbers enable us to give each student personal attention. This personal attention motivates 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 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.

<u>Curriculum Map</u>

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

<u>ASSESSMENT METHODS for BIOLOGY DEPARTMENT GOALS</u>

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 freshmen the strong background needed to understand evolution and natural selection and the reasons for the diversity of living organisms and their physiologies. Assessment is done using a pre-test and post-test format (Appendix A). Testing is conducted at four times using a test consisting of evolution related questions from the freshman courses, Ecology and Evolution (BI

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 (5 points)	Adequate (3-4 pts)	Nominal (1-2 pts)
Format	• Paper in proper scientific form, with all standard categories • Tables and figures correctly constructed with good legends • Standard use of grammar and spelling. Fewer than one error per two pages • Logical organization • Literature appropriately used and cited	• Section(s) missing, or some material in wrong section • Same data presented more than once, or inappropriate figures used • Some grammar errors and spelling errors (Fewer than one per page) • Some literature used, but inadequate or improperly cited	• Non-scientific form • Data not presented, or raw data presented • One or more grammatical and spelling errors per page. • Poorly organized • Little or no literature used
Design	• Key variables considered • Appropriate Experimental Design with testable hypothesis • Alternate hypotheses considered • Design adequate to test hypotheses • Appropriate use of data analysis • Includes Control, Experimental groups testing one variable	• Design only partially addresses foreseeable variables • Alternative hypotheses not eliminated • Design insufficient to test hypotheses • Incorrect use of data analysis	• Poor design, does not separate variables • Hypothesis not testable, or design does not test primary hypothesis • No use of data analysis

Conclusions	• Accurately reflect data presented • Correct use of logic • Fit study into broader context • Adequate summary of paper. • Considers where the work should go from here	• Some conclusions not based on results • Contains faulty logic • Study weakly related to broader context	• Many conclusions not related to data • Poor use of logic • No attempt to fit study into broader context

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	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.
	Rigorous experimental data and appropriate statistics presented with emphasis on student interpretation of data.
3	Reasonable hypothesis but difficult to test, not completely novel and would not really extend knowledge in the field.
	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.
1	Hypothesis not testable, novel or adequate. No extension of knowledge beyond that already known would result.
	Some components missing and information incomplete.
	Experimental data weak, statistics inappropriate or absent, no novel data interpretation by student.
Tables/Figures	
5	Used effectively and appropriately (proper use of table versus figure, proper type of figure used), high quality with title positioned properly and axes properly labeled.
3	Need for better use of visuals, not all tables/figures of the appropriate type, average quality with mistakes in title positioning or some axes either not labeled or labeled incorrectly.
1	Visuals not used effectively, inappropriate type of table/figure used, minimal quality with title incorrectly positioned or missing and most axes not labeled or labeled incorrectly.
Use of Literature	
5	Thorough search of the literature with fundamental papers used, minimum of 6 relevant, recent (last decade) primary papers used, all in-text citations formatted correctly, Literature Cited formatted correctly.
3	Most literature used was appropriate, but at least one fundamental paper was not found or used, incomplete search of literature but at least 6 relevant, recent primary papers used, most in-text citations formatted correctly, minimal mistakes in Literature Cited section.
1	Student's search of the literature incomplete with crucial papers not found or used, fewer than 6 relevant, recent primary papers used, many mistakes on in-text citations and Literature Cited section.
Aesthetics	
5	Correct spelling, grammar, and punctuation, only main points presented with text minimized and emphasis on tables and figures, tables and figures large and easy to read, text readable from a distance, professional colors used, all margins cut straight, no glue showing, layout correct.
3	Occasional but limited errors in spelling, grammar, or punctuation, too much text with some tables and figures difficult to read, text readably from a distance but should be a bit larger, colors distracting, some margins cut unevenly, minimal glue showing, layout acceptable but some pieces out of place.
1	Heavily flawed with frequent errors in spelling, grammar, and punctuation, too much text, tables and figures minimal, text too small to read from a distance, colors friggin' ugly, many margins uneven and much glue showing, layout with many pieces out of place.

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.
	Rigorous experimental data and appropriate statistics presented with emphasis on student interpretation of data.
3-6	Reasonable hypothesis but difficult to test, not completely novel and would not really extend knowledge in the field.
	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.
1-2	Hypothesis not testable, novel or adequate. No extension of knowledge beyond that already known would result.
	Some components missing and information incomplete.
	Experimental data weak, statistics inappropriate or absent, no novel data interpretation by student.
Knowledge of Material	
5	Clear confident presentation with audience questions answered in a way to illustrate a complete knowledge of the topic.
3	A good presentation but lacking clarity or confidence with inability to answer some audience questions.
1	An awkward, weak presentation with inability to handle audience questions.
Delivery	
5	No reading from notes or screen, eye contact with audience, appropriate voice inflection, no annoying mannerisms, no usage of um/uh or stumbling over words, proper time allowed for each slide, professional clothing.
3	Some reading from notes or screen, some eye contact with audience, minimal voice inflection, few annoying mannerisms, some usage of um/uh and some stumbling over words, some slides rushed through, clothing acceptable.
1	Over-reliance on notes or screen, minimal or no eye contact with audience, no voice inflection (monotone or robotic), many annoying mannerisms, excessive usage of um/uh and much stumbling over words, slides rushed, clothing not professional.
Visual Aids and Aesthetics	
5	Correct spelling, grammar, and punctuation, only main points presented on slides without being text-laden, tables and figures appropriate, axes labeled, large and easy to read, professional colors and background used.
3	Occasional but limited errors in spelling, grammar, or punctuation, some slides too busy with too much text, some tables and figures difficult to read, some mistakes in title positioning, colors or background distracting.
1	Heavily flawed with frequent errors in spelling, grammar, and punctuation, slides with too much text, tables and figures inappropriate or with too much small, hard to read data, colors and background inappropriate.

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.
- Evaluation scores for objective 4 for paper, poster, and presentation
- 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 a maintenance of 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 #1 – Definite improvement between pre and post-tests but less than 25%. Seventy five percent of syllabi for majors courses show direct relationship to evolutionary concepts.
  - Goal #2 – Some students are not completing one or more of the content areas, or more than 10% must repeat courses to achieve a C- or better in each.
  - Goal #3 - Two papers have been placed in the student's portfolio, with less than 20% improvement. Average evaluation score for the senior paper is 11.
  - 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, 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.

***Results from 2013/2014, compared to results from 2005/2006 to 2012/2013.**

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

Summary of the Evolution assessments for 2013/2014

When we gave the test to Ecology and Evolution students early in the semester, 71 students took the exam, averaging 6.54 out of 25 (Table 4). At the end of the semester, 60 students took it, and averaged 16.8/25, improving by 40.8 percentage points.

In Diversity of Life, 38 students took the exam, and averaged 15.2 of 25 points, a slight decline from mid semester (immediately after concentrated teaching of evolution).

The 18 seniors who took the assessment in 2013/2014 senior seminars averaged 19 of 25. Two seniors earned 23-25/25, 5 earned 20-22/25, 4 earned 18-19, five 15-17, and one under 15/25, for a 5% failure rate. In 2006/2007, 35% of seniors did not earn at least a 60% on the assessment. In 2007/2008, 43% of the seniors did not pass, 29% failed in 2008/2009, in 2009/2010 and 2010/2011 only 14% of the seniors did not pass, and in 2011/2012, only 8% failed the evaluation. In 2012/2013, only 4% of the seniors did not pass. In 2011/2012, we starting making the test count as 10% of the senior seminar grade, and we are clearly making progress in ensuring that our seniors understand and retain concepts of evolution.

The data from all years of assessment have similar trends, showing that the students do not have much understanding of evolution when they start the program, and that their performance improves much more than our 25% target, with about three times as many correct answers on the test at the end of the first semester. The retention of the basic understanding of evolution was similar, with scores from the test in Diversity of Life at the end of the first year and from senior seminar being very similar to scores on the ecology and evolution post-test in most years, just after concentrated teaching of the concepts. This part of the assessment strongly falls into the "green light" category.

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)	% Correct Midyear Freshmen (60)	% Correct End of First Year (38)	% Correct Senior Seminar (18)
1 Species	49	73	85	93
2 Evolution	32	55	51	86
3Adaptation	20	62	62	71
4 Mutation	73	83	84	93
5Analogous	22.5	63	57	57
6 Vestigial	39	77	84	86
7 Nat. Sel	18	70	81	71
8 Converg.	21.1	62	54	50
12 Mech. (5)	36.4	65	63	52
13aNatSel	13	20	16	28
13bMutatio	20	40	27	43
14 Direc.Sel	15	65	59	86
15 Disr. Sel	11	70	46	86
16 Phylog.	45	83	86	93
17 Fitness	4	60	62	78
18. Variatio	48	77	81	86
19 Endosym	42	78	97	93
20 Nat Sel (4 pts)	8	42	44	57
Average 2013/2014	26.16%	67%	60.9%	76
Average 2012/2013	8.34	67.28	53.2 (68)	81.8%
Average 2011/2012	26.5%	71.1%	62.4%	74.4%
Average 2010/2011	23.2%	79.32	63.5	69.4%
Average 2009/2010	32.4%	69.2%	70.16%	72.56%
Average 2008/2009	26.93%	68.97%	56.8%	60.9%
Average 2007/2008	8.82%	61.2%	Not Done	61.2%
Average 2006/2007	23.11%	63%	61.2%	60%
2005/2006	28.4	78.8	Not Done	75.6%

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 evolution is addressed in each course. In spring 2006, only 6 of 14 majors' syllabi included departmental goals (42.86%), and only 3 of the 14 showed directly how evolution is addressed in the course (28.57%). In both 2006/2007 and 2007/2008, all biology majors' course syllabi included 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% and in spring 2008, 91% of the majors' courses directly demonstrate how evolution is incorporated 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 Wilcoxen	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	Wilcoxen	Yes
BI 380 Ecological Journey: Florida	Wilcoxen	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.

The Biology Department determined which courses best cover the six general content areas of biology, with one course fitting into 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. 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. All students in all programs are exposed to a broad background in biology.

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
Molecules and Cells	BI 305	45	0
Comparative An. Phys	BI 306	13	1
Ecology	BI 314	11	0
Animal Behavior	BI 323	6	0
Vertebrate Biology	BI 325	13	1
Plant Biology	BI 326	14	1
General Microbiology	BI 330	17	2
Physiological Ecology	BI 360	15	0
Ecological Journey – South Africa	BI 380	7	0
Molecular Genetics	BI 407	10	0
		238	16
			6.7%

*Only biology majors considered – most of the students are in nursing and athletic training programs.

Since Spring 2010, we have required that our seniors take the Educational Testing Service field exam for biology. Scores have been consistently near the national averages (Fig. 1)

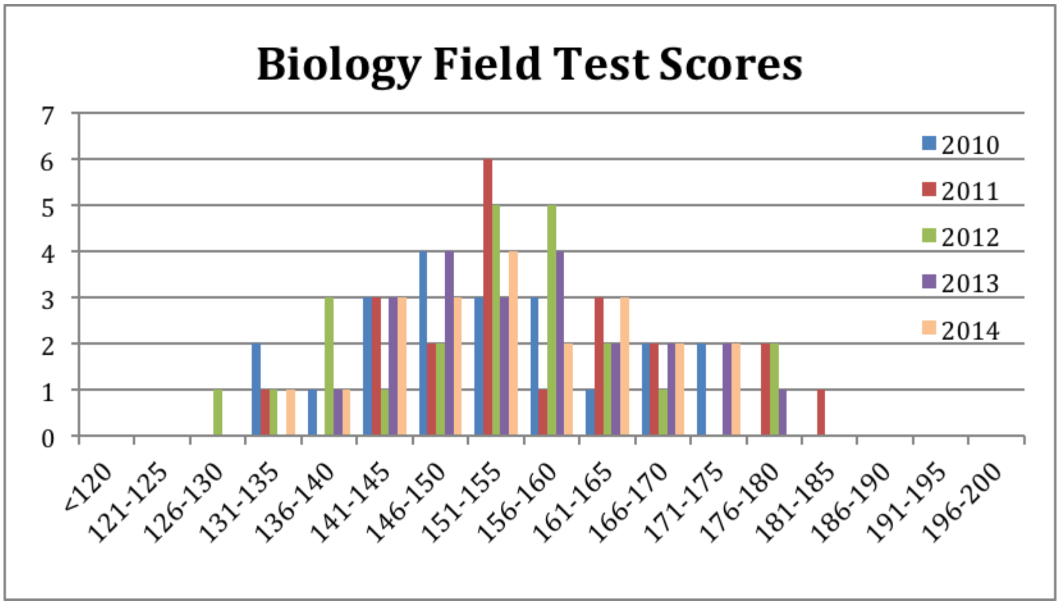

Figure 1. Educational Testing Services Biology Field Test Scores for Millikin seniors 2010 - 2014.

In 2013/2014, 13 of the 21 seniors taking the exam scored 150 or above, at the 40th 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 for this year's seniors. In 2012/2013, 14 of 22 Millikin seniors taking the exam scored 150 or above, at the 40th percentile, and 15 of 23 in 2011/2012, 15 of the 21 in 2010/2011. Millikin's mean total was 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 75th 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
Millikin 2011	52.76	57.90	56.24	55.57
Millikin 2012	48.78	49.42	49.63	55.0
Millikin 2013	51.15	51.1	52.35	60.55
Millikin 2014	52.49	52.52	51.52	56.24
National Average 2013	53	53	53.5	52.6

Although students from Millikin biology programs have scored close to national averages for the field test, there are some areas in which they are generally weaker than others (Fig. 2). The only one of the nine subtypes of questions on the exam in which our students score lower than 40% is in organismal plant biology for the fifth year in a row (Fig. 2). Three quarters of our students never take a plant course, so their only exposure to plants is in a small section of our Diversity of Life class in the first year. To prepare our students better for work in biology, we need to more strongly encourage most of our students to take a course in plant biology, especially those in the organismal disciplines. However, we are apparently preparing students well in most of the areas, 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.

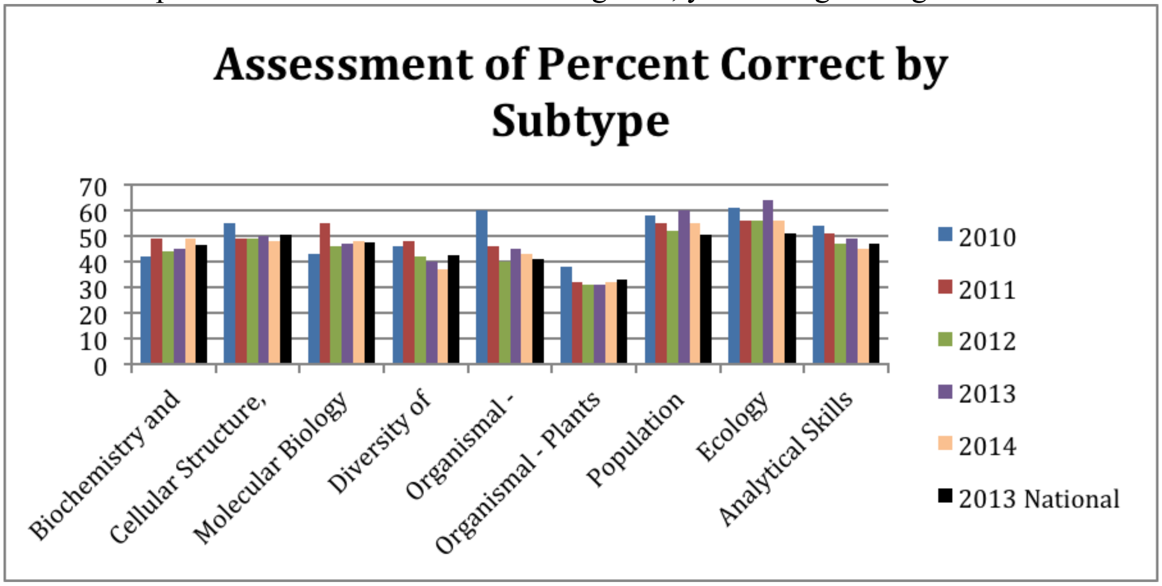

Figure 2. Average score of Millikin students for each of the subtypes of questions asked.

Goal #3 *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, one faculty member compares papers from the freshman year to papers from the senior year to evaluate 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 assessment under Goal 3). Our department decided an average improvement of 20% from freshman to senior years, in addition to an average overall 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 2013/2014 school year, we compared the Senior Seminar papers and freshmen Ecology/Evolution papers of eleven students (Fig. 3). The average total score on the papers increased 25%, from 10.73 to 13.45. Paired t-tests showed that the total rubric score on the paper increased significantly ($p = 0.00089$), as did scores on format ($p = 0.027$), design ($p = 0.0039$) and conclusions ($p = 0.0045$). 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.

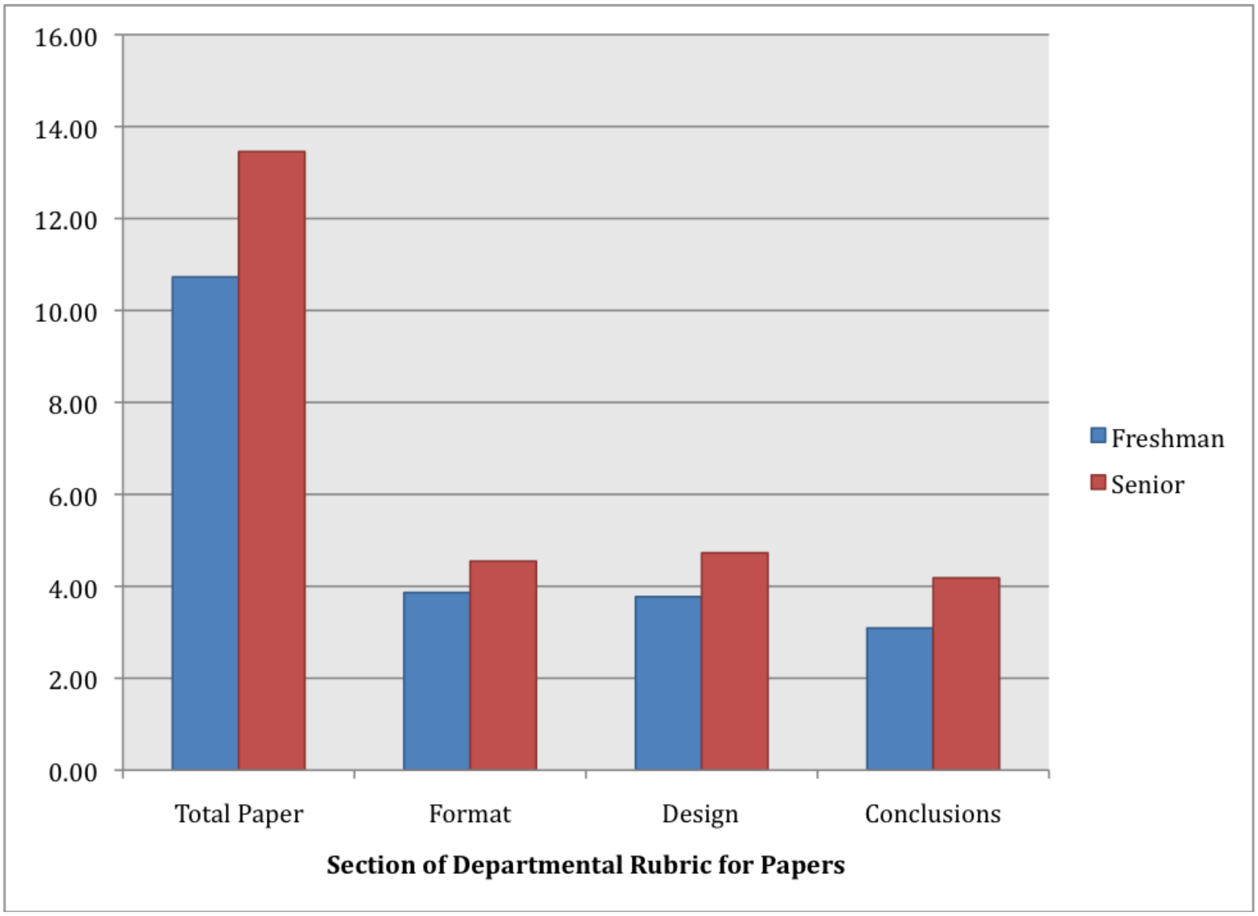

Figure 3. Comparison of Freshmen (entering fall 2010) papers from Ecology and Evolution class with Senior Seminar papers from the same students (fall 2013/spring 2014). Total possible point value is 15, with each of the three portions (Format, Design, Conclusions) of the rubric worth a possible five 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 Course. Students are required, using either personally conducted wet bench research or using published literature, to develop a testable hypothesis and then proceed to develop a logical argument supporting or falsifying that hypothesis. This is often most successful with research actually performed by the student. Prior to their oral presentations, students construct and display a poster using guidelines appropriate for a national meeting. A minimum average score for the poster presentation of 15 was set by the department after three semesters of assessment, and has been met in most semesters (Table 8). Five of 21 students did not score above 15/20 on the poster in this academic year. Average for all posters were above the 15/20 set by the department, earning a green light. Scores in each of the categories used to evaluate poster content and form show that on average students are generally meeting our expectations (Fig. 4). However, with almost ¼ of our students not individually meeting our threshold criteria, we will enhance our mentoring efforts.

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
Spring 2007 (20)	12.2	15.3	19.2
*Fall 2007 (10)	12.5 (11 – 15)	15.9 (12 – 19)	19.1 (16 – 24)
*Fall 2008 (16)	13.3 (9-15)	18.31 (12 – 20)	21.75 (10 – 25)
Spring 2009 (18)	12.6 (9 – 14.5)	14.8 (8.5 – 17.8)	19.4 (10.4 – 23.7)
Fall 2009 (6)	Combined	12.8 (7.3 – 17.6)	17.1 (12 – 23.2)
Spring 2010 (21)	For 9, 12.4	15.2 (7.75 – 19.5)	19.8 (12 – 23.2)
Fall 2010 (6)	Combined	17.4 (14.75 – 19)	21.0 (17.07 – 23.57)
Spring 2011 (15)	For 9, 13.6	16.5 (10.7 - 19)	21.71 (16.8 - 24)
Fall 2011 (5)	Combined	16.8 (13.33 – 19.33)	21.00 (16.8 – 22.85)
Spring 2012 (19)	For 10, 13.7	15.77 (8.34 – 19.34)	20.09 (12.12 – 23.4)
Fall 2012 (10)	Combined	16.83 (8.5 – 20)	21.26 (19 – 23.97)
Spring 2013 (12)	For 17, 14.18	16.39 (10.33 – 20)	21.15 (16.66 – 24.79)
Spring 2014 (13)	12.5	16.51 (12 – 19)	19.94 (15.1 – 23.5)

*Scores from only one faculty member, the senior seminar instructor. Scores from Spring 2006 and Spring 2009 were averages of four or more faculty member evaluations. From Fall 2010 on, posters are the average evaluations from three faculty members, and oral presentations the average from all faculty present, usually 6 or more.

**Starting in 2010, only papers with first-year BI 155 comparisons were evaluated using the rubric. Papers from both semesters of the academic year were used, so data are reported only in spring when comparisons were made. All papers were graded by the senior seminar instructor and faculty mentor, but not included here.

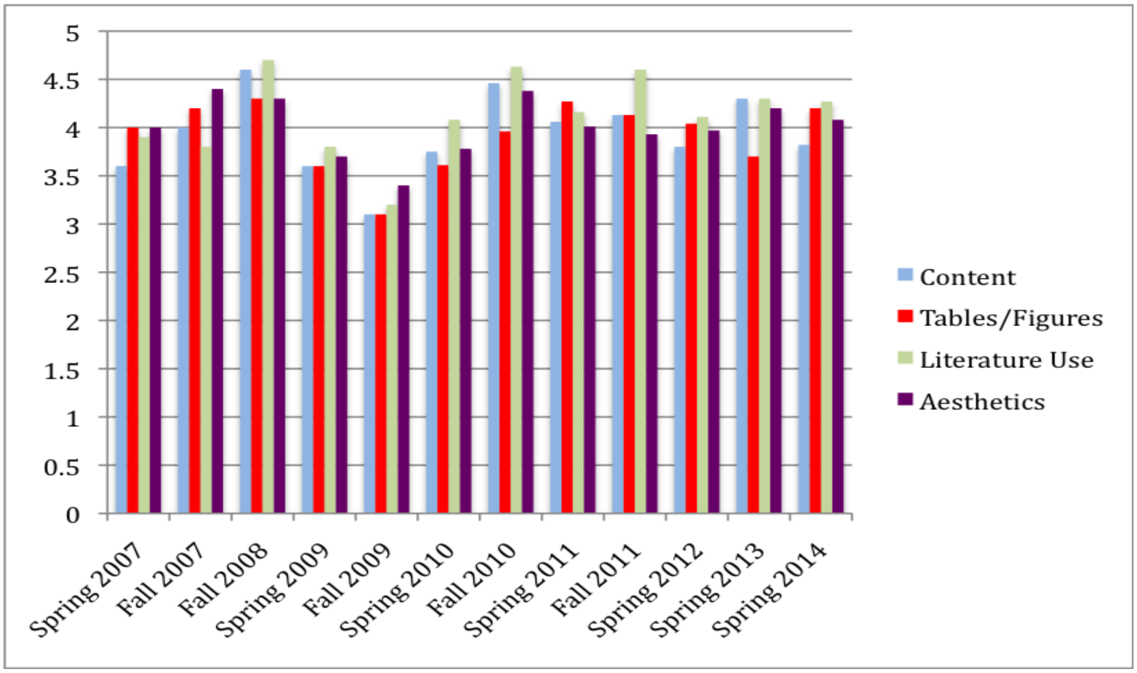

Figure 4. Mean scores for posters presented by students in Senior Seminar for 13 different semesters. Total possible for the poster was 20 points, with five points for each category of the rubric.

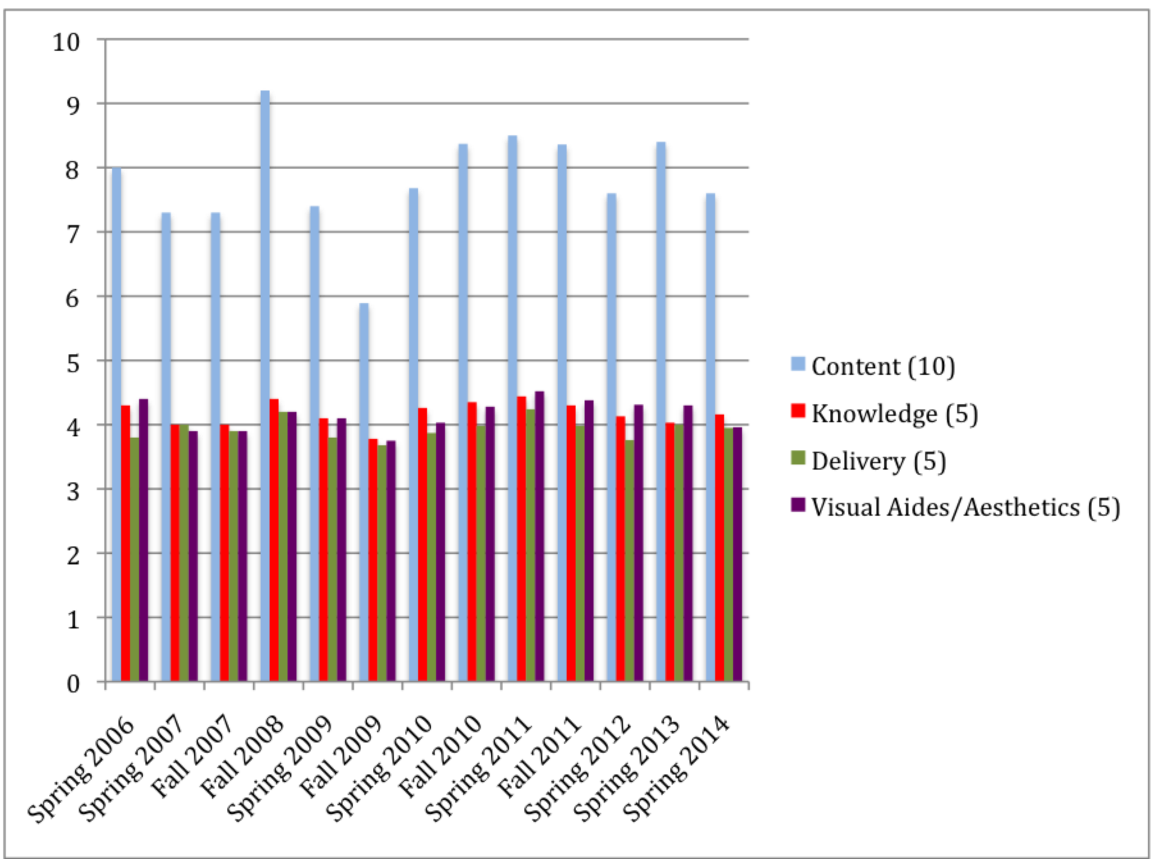

Figure 5. Mean scores on departmental rubrics for oral presentations in Senior Seminar for 13 different semesters. Total possible points was 25 for the oral presentation.

For the oral presentations, the department set a goal for a minimum total average of 20/25 to achieve a "green light". This goal was not quite achieved in Spring 2014 (19.94), but has been reached in each of the previous six evaluated semesters (Table 8). Only 6/13 students achieved the 20/25, however. In 2009/2010, only 11/32 individual presentation scores were 20 or over, and in 2010/2011, 15 of 21 scored over 20. In 2011/2012, averages were above 20/25 in both semesters, with only 7 of 24 students scoring below 20, and in 2012/2013 only 5 of 22 students did not meet our departmental standards. Again, generally students are meeting our expectations in all categories of evaluation of the presentation (Fig. 5). It appears that our efforts to improve student preparation for their professional presentations are working, and we will continue to ensure that students receive early and frequent mentoring.

Secondary Education Program

All secondary education students must complete 11 Candidate Assessments, as well as eight 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 had two biology students who completed student teaching this academic year, both earning commendable ratings (with 100% and 95%) on their Teacher Work Samples which are part of the final evaluation for student teaching.

PROFESSIONAL SUCCESS

In the 2011 – 2012 Success Report from Millikin University Career Center, our department had 39% of respondees professionally employed, 50% in graduate and professional school (for a total of 89% professional success), and 11% underemployed. All 18 respondees were earning between $20,000 and $25,000 per year in the year directly following graduation.

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 used from Fall 2008 to the present at the beginning and end of BI 105, Ecology and Evolution, at the end of the second semester in BI 108 and during senior seminar course BI 481 or 482. Faculty efforts to incorporate evolution into their courses are judged by the course syllabus. All syllabi should contain specific examples of how the concept evolution will be applied, and are assessed by department chair.

Biology Secondary Education students must pass the evolution test as one of their specific program assessments, and are given a second chance after study (although only their first attempts are included in our assessment report). Also, until fall 2007, allied health majors were not required to take genetics and cell and molecular biology, in which concepts of evolution are further examined and applied. Many of these students became overly focused on human systems and did not have a broad background in biology. Our changes in the departmental curriculum should allow students to specialize without overly limiting their exposure to the field.

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.

Goal #4 – The senior seminar instructor evaluates the performance of seniors in the seminar course BI 482 using the evaluation rubrics on oral presentations, posters, and papers.

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 3 faculty members in a manner very similar to how posters are presented at professional poster symposia.

Another issue, which we have not adequately addressed, is the issue of consequences for individual failure of a student to meet the expected objectives. Obviously if the problem is wide-spread, it requires adjustments in the department teaching and curriculum. Individually, however, we need to formulate how students will be remediated in order to bring them up to the level expected by our objectives. We need to be sure that all students, especially transfers, attend senior seminars so that they can understand and plan for their own capstone experience. First year 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, often on "book reports" that do not result in success. Before we began developing firm criteria for 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 sign up for the class until they have written approval from a mentor and an approved topic. Average scores on paper, poster, and presentation have improved and are more consistently reaching the standards adopted by the department. We are working to ensure that all students have the tools needed to succeed in meeting the goals of the biology department. We also plan to start keeping our own data about what our alums are doing, with senior seminar mentors responsible for keeping up with each student (via phone, visits, Facebook, e-mail, etc.).

Report Summary

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

- **Goal 1.** Freshmen students demonstrated a more than 25% improvement, from 8% to 67%, in their knowledge of evolutionary principles. At the end of the next semester, freshman scored 53%. From the test results of graduating seniors, this knowledge appears to be retained fairly well. Seniors performed very similarly to the students who had freshly studied evolutionary principles, 82%. GREEN light.

  Biology faculty are successfully showing how evolution is incorporated into their majors courses, with all demonstrating how courses directly relate to evolutionary concepts. Green light.
- **Goal 2.** In 2012/2013, biology majors took 180 upper division classes that meet the criteria for goal #2, with 96% of students earning a C- or above. The responsibility of keeping track of successful progress for each student needs to be completed by faculty advisors, and we are making some progress along these lines. GREEN light.

  Scores for Millikin students on the ETS biology field tests are very close to national averages (for students completing programs that choose to use the test), demonstrating that our program is effective at preparing students in biology. We have results slightly below the national averages in 3 of the 4 subsets of the discipline on the ETS test. Our students also perform below standards in plant organismal biology, an area not required in our program. Yellow to green light.
- **Goal 3.** Results assessing the critical skills of our students using scientific papers show that our seniors have developed the skills we feel are necessary for them to succeed in their future careers. The average score for evaluating the seniors' paper format, design and conclusions was 13.45 out of 15. This exceeds the minimum cutoff value of 12, which indicates we are providing satisfactory instruction for students to succeed in this area. We were able to compare eleven sets of papers from students as freshmen and seniors, and found that there was a significant mean improvement of 25% in their rubric scores. GREEN light.

- **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 the department, with a different person in charge each semester. With the addition of participation of more biology faculty in the scoring process for assessment, we have more consistent data that can be used for program planning and improvement. Yellow/GREEN light

APPENDIX A

Evolution and Natural Selection Survey – Biology Department

Name________________________

1. Natural populations of organisms that can interbreed and produce fertile young and are reproductively isolated from other such groups are known as ____________________________.
2. A change in frequency of a particular trait in a population over time is___________________________.
3. A particular structure, behavior, or physiological function that allows organisms possessing it to survive and reproduce more than individuals in the population that lack it _________________________________.
4. A permanent change in a cell's DNA, usually caused by errors in copying the DNA, that is the raw material for evolution__________________________
5. A structure with similar function but different ancestral origins is a(n)_________________________ structure. (Example: bee's wings and bird's wings)
6. A structure that no longer has a function in an organism, that has a function in related organisms, is a(n)_______________________________structure. (Example: pelvic bones in whales)
7. What is **the** mechanism of adaptive evolution?_________________________________
8. The apparent similarity between marsupial mammals in Australia and ecologically equivalent mammals in other parts of the world is an example of __________________________ evolution.
9. The five major mechanisms of evolution are:

   __________________________ __________________________

   __________________________ __________________________

   ____

10. What TWO evolutionary mechanisms play a major role in resistance to HIV?________________________ and ____________________________.
11. A type of natural selection that acts to eliminate one extreme from an array of phenoptypes is called__________________________________ selection.
12. A type of natural selection that eliminates intermediate phenotypes while favoring both extremes is called _________________________ selection.
13. The evolutionary history of an organism, represented in the form of an evolutionary tree, is called _______________________________.
14. The genetic contribution of an individual to succeeding generations, a relative term comparing the contribution of one individual to others in a population gene pool ______________________________.
15. The advantage of sexual reproduction over asexual reproduction is that sex generates ____________________________ (which makes evolution by natural selection possible) and asexual does not.
16. The _________________________________ Theory suggests that chloroplasts and mitochondria of eukaryotic cells were derived from bacteria living in other bacteria.
17. Explain the mechanism of natural selection using conditions that lead to adaptation. **(write your essay on back)**

Word Bank for all but number 17. Some terms may be used more than once, and some may not be used

1. Adaptation
2. Adaptive Radiation
3. Analogous
4. Character displacement
5. Commensalism
6. Convergent evolution
7. Directional
8. Disruptive
9. Divergent evolution
10. Endosymbiotic theory
11. Evolution
12. Fitness
13. Genetic Drift
14. Genetic Variation
15. Homologous
16. Migration, Movement between populations
17. Mutation
18. Mutualism
19. Natural selection
20. Non-random mating
21. Parasitism
22. Phylogeny
23. Species
24. Stabilizing
25. Vestigial

APPENDIX B **Biology Content Category Courses Fall 2012** **revised 6-1-2012**

Complete **ONE** from Each Category with "C-" or better. (Does **Not** include First Year Core Courses)

Each Course May Count for Only ONE Category
(e.g., if BI 325 Vert.Bio is taken for Taxonomy, then it cannot also be counted for Morphology or any other category.) Refer to "Biology Projected Course Offering Schedule" for availability of specific course.

Ecology ①	**Taxonomy** ②	**Morphology** ③	**Function** ④	**Molecules/ Cells** ⑤	**Reproduction/ Genetics** ⑥
BI 220-320 Field Ecology **(PT/OT & Allied Health)**	**BI 303** Entomology	**BI 204** Essen. Of A&P **(Sec.Ed only)**	**BI 204** Essen. Of A&P **(Sec.Ed only)**	**BI 300** Genetics	**BI 300** Genetics
BI 314 Ecology	**BI 311** Virology	**BI 206** A & P I **(PT/OT, PA & Allied Health & Sec Ed)**	**BI 206** A & P I **(PT/OT, PA & Allied Health & Sec Ed)**	**BI 302** Histology	**BI 323** Animal Behavior
BI 323 Animal Behavior	**BI 324** Ornithology	**BI 207** A & P II **(PT/OT, PA & Allied Health & Sec Ed)**	**BI 207** A & P II **(PT/OT, PA & Allied Health & Sec Ed)**	**BI 305/355** Molecular and Cell Biology	**BI 404** Evolution **(recommend)**
BI 340 Conservation Biology	**BI 325** Vertebrate Biology	**BI 301** Comparative Anatomy	**BI 301** Comparative Anatomy	**BI 311** Virology	**BI 407** Molecular Genetics
BI 360 Physiological Ecology	**BI 326** Plant Biology	**BI 302** Histology	**BI 304** Developmental Biology	**BI 312** Immunology	
BI 380 Ecological Journey	**BI 330** Microbiology	**BI 303** Entomology	**BI 306** Comparative Animal Phys.	**BI 330** Microbiology	
BI 404 Evolution **(recommend)**	**BI 380** Ecological Journey	**BI 304** Developmental Biology	**BI 308** Plant Physiology	**BI 407** Molecular Genetics	
		BI 322 Neurobiology	**BI 312** Immunology	**BI 413** Advanced Cell Biology	
		BI 325 Vertebrate Biology	**BI 322** Neurobiology		
		BI 326 Plant Biology	**BI 324** Ornithology		
			BI 360 Physiological Ecology		
			BI 413 Advanced Cell Biology		