Millikin University
Student Learning in Biology
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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 feels 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**.**

Goals for Millikin Biology Majors
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 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, 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 personal well being. They come away knowing that if they can complete this tough goal, then they are well on their way to dealing with life's difficult challenges.

SNAPSHOT

The department of Biology is located in the Leighty Tabor Science Center on the second and part of the first and third floors. The faculty has been selected to provide specialized focus in the areas emphasized in goal #2. We have one geneticist, one molecular/cell biologist, one microbiologist, one ecologist, one anatomist, two physiologists, a botanist and an animal behaviorist. Almost all (89%) 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:

- Traditional Biology
    - 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, 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 151 (avg) majors and annually graduates 28 students. The largest group of graduates fall into the Pre-Professional and Allied Health tracks. In addition to providing training for our majors, the department services about 50 pre-nursing majors and 40 exercise science majors by providing courses in anatomy and physiology.

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 laboratory. Our new building has been designed to provide ample laboratory space for the various biological areas listed in departmental goal #2. At a 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 higher 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 hopefully 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 try to help students: (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. One or more times per semester, students meet in person with their academic advisor to discuss fulfillment of the plan of study.

Curriculum Map

Courses listed below each goal provide information necessary for students to complete the departmental goals in a timely manner during their four years at Millikin.

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 125,	
Sophomore	Expanded in all other courses taken	See Appendix A	BI 205, BI 206, BI 207 BI 230	Research Methods BI 293
Junior	Expanded in all other courses taken	See Appendix A	BI 326, BI 323 or BI 391	
Senior	Expanded in all other courses taken	See Appendix A		BI 481, 482

METHODS

Goal #1, understanding the concepts of evolution and natural selection, will be met in two ways. First. students will learn about evolution and natural selection by successfully completing the freshman courses, Evolution and Ecology (BI 105), and Attributes of Life (BI 108). These courses give freshmen a strong background needed to understand evolution and natural selection and the reasons for the diversity of living organisms. Assessment is done using a pre-test and post-test format. Testing will be conducted four times using a test consisting of evolution related questions from the freshman courses, Evolution and Ecology (BI 105) and Attributes of Life (BI 108). The first test will be given at the beginning of BI 105 and the second one at the end of BI 105. A third exam will be given at the end of Attributes BI 108 and a final one when students complete the senior seminar course (BI 481 or 482). Second, the theme of evolution will be included in every course taught in the department. How it will be covered will be described in each course syllabus.

Goal #2, the exposure to the various areas of biological study, involves emphasis on the approaches taken to study biology: ecology, taxonomy, morphology, function, molecules/cells and reproduction/genetics (See Appendix A). By requiring students to take courses in each of these areas, we feel that they will not only gain additional understanding of the essential nature of these concepts to biology but will also see the continued theme of adaptation and diversity that living organisms exhibit. Students will be expected to take 6 courses, one in each area, and pass each course with a grade of C or better. Students must retake or take another course if their grade is C- or lower. This will apply to both lecture and lab. If a student makes a grade lower than a C in a lab, the

student must retake the lab or take a different lab that covers most of the same material. This applies to every student in every concentration.

Goal #3, the use of critical thinking, is essential to the sciences. Our plan is to use a portfolio system to collect two papers, one written the first year at Millikin and the other from their senior seminar research during their senior year. These papers must be of an investigative nature that draw conclusions from data personally collected or analyzed by the student. The following table will be used to evaluate how well the student used 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, will be the culminating experience of graduating biology students. It will consist 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 will be 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 will most 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 have not required wet bench 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 analysis and conclusions in a formal setting. Evaluation of the poster and oral presentation will be based on guidelines presented in the following tables. The scientific paper will be 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 10 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	
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.
Visual Aids	
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.
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.
Aesthetics	
5	Correct spelling, grammar, and punctuation, only main points presented on slides without being text-laden, tables and figures 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, colors or background distracting.
1	Heavily flawed with frequent errors in spelling, grammar, and punctuation, slides with too much text, tables and figures with too much small, hard to read data, colors and background inappropriate.

DATA

The following data will be collected and averaged:

- The average improvement scores for objective 1,
- List of classes taken and grades for objective 2.
- Two papers, one from the freshman year and the second from the senior seminar capstone, will be collected and evaluated using the rubric for objective 3.
- Evaluation scores for objective 4

We have not fully settled on the plan of action regarding how we will proceed at this point. A number of ideas have been suggested regarding data sampling and collection. Since we have so many students to deal with on an annual basis, the issue of adequate time to be able to assess our goals becomes relevant. As a result, we are considering the following possibilities:

- Evaluate only a limited number of students each year? These could be selected randomly from the entire group or selected from the different tracks we offer.
- Run a qualitative evaluation of all students by checking to make sure they did the work in a rigorous fashion. We would check items in the portfolio (goal #3), and spot check averaged data for the other three goals on a two or three year basis.
- Follow a selected number of students through the entire four-year process and develop improvement strategies based on their results.

Another issue, which we have not adequately addressed, is the issue of consequences for individual failure 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 would be remediated in order to bring them up to the level expected by our objectives. There is a need for early feedback to allow time for remediation.

ANALYSIS

- GREEN LIGHT –
    - At the introductory level, testing indicates that we are approaching a high level of success. Goal #1 will be 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 .
    - Goal #2 - If the average grade for the six courses elected by the student is C or better.
    - Goal #3 – Two papers have been placed in the student's portfolio, and the average review score is 10 or better.
    - Goal #4 – At the completion of their Senior Seminar capstone, the oral presentation scores average 20 or better and poster evaluation scores average 16 or better.

- YELLOW LIGHT –
    - Goal #1 – Definite improvement between pre and posttests but less than 25 %.
    - Goal #2 – The average grade for the six courses is between C and D.
    - Goal #3 - Two papers have been placed in the students portfolio. Average evaluation score is 9
    - Goal #4 – Average evaluation score for the oral presentation is between 18 and 20, and the poster score between 14 and 16.

- RED LIGHT –
    - Goal #1 - Little or no improvement between pre and post-tests.
    - Goal #2 - Average grade for the six courses is D- or less.
    - Goal #3 - Fewer than 2 papers in the folio with an average evaluation score of less than 9.
    - Goal #4 - Average oral presentation score is below 18 and average poster score is less than 14.

PLANS

How we might meet the goals of the department:

Goal #1 – Our plan is to develop the pre-post test at the beginning of the year and use it from that point on. We will collect and analyze data before students take the introductory course Ecology and Evolution BI 105, post-test data after teaching BI 105, at the end of the second semester in BI 108 and at the beginning of their senior seminar course BI 481 or 482. Faculty efforts to incorporate evolution into their courses will be judged by the course syllabus. All syllabi should contain specific examples of how evolution will be used.

Goal #2 – The first step in completing this goal is to develop a list of courses that provide meaningful exposure to the six areas of emphasis in Biology. Once we have done this, we will develop a check sheet to be included in the advising folder of each student. It will be the annual responsibility of the advising professor to check the progress of their advisees to be certain they are in compliance both for exposure and grades. There will be a place on the tally sheet for averaging the grades. The average grade will be reported and the number falling in the C- or below category will be used to assess our effectiveness in giving the students the exposure they need.

Goal #3—During the spring semester of 2006, we will collect and evaluate the writing of seniors in the Senior Seminar course Bi 482. We will use the results to determine the appropriate standard that students should meet in order to deem our teaching efforts acceptable. During the fall of 2006, efforts will be made to collect papers from all sophomores that they wrote in either of the two introductory classes as freshmen. These papers will be evaluated using the writing rubric for Goal #3 and placed in their student folder.

Goal #4 – It was decided that we would evaluate the performance of seniors in the seminar course Bi 482 during the spring of 2006. The evaluation rubrics would be distributed to all faculty and evaluations of both the seminar and poster would be made and tabulated.

Preliminary Results

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

During the 2005-2006 academic year, the pre- and post-test developed as an assessment for this goal was used. The initial test was developed with questions the Ecology and Evolution class (BI 105) addresses. The test consists of the following questions and question bank.

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. _____ came up with a theory of evolution by natural selection independently of Darwin, and caused Darwin to hurry to publish.
10. Divergent evolution in which two species evolve away from one another, acquiring greater differences, as a result of competition or the risk of lowered survival and fertility caused by hybridization_____ _____
11. _____ wrote *Principles of Geology,* a book that Darwin took with him on his voyage and convinced him that the earth is old enough for evolution to have occurred.
12. The five major mechanisms of evolution are:
    _____
    _____
    _____
    _____
    _____
13. A type of natural selection that acts to eliminate one extreme from an array of phenoptypes is called_____ selection.
14. A type of natural selection that eliminates intermediate phenotypes while favoring both extremes is called _____ selection.
15. The evolutionary history of an organism, represented in the form of an evolutionary tree, is called _____.
16. 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 _____.
17. A type of symbiosis in which both partners are benefited is _____.
18. A type of symbiosis in which one partner is benefited and the host is harmed is _____.

19. Explain the mechanism of natural selection using conditions that lead to adaptation. (essay)

Word Bank for all but number 19. Some terms may be used more than once, and some may not be used

Adaptation	Adaptive Radiation	Analogous
Character displacement	Charles Darwin	Commensalism
Convergent evolution	Directional	Disruptive
Divergent evolution	Evolution	Fitness
Genetic Drift	Homologous	Lamarck
Lyell	Mendel	Movement between populations
Mutation	Mutualism	Natural selection
Non-random mating	Parasitism	Phylogeny
Species	Stabilizing	Vestigial
Wallace		

The test was given at the beginning and end of the introductory course BI 105. Our effort to develop additional questions from the content of BI 108 and include it at the end of Bi105 did not happen. As a result, these latter questions and their use will be implemented beginning in the fall of 2006. The above test was also given to the graduating seniors enrolled in the Senior Seminar course, BI 482, during the spring of 2006. This was done with the idea that it would give us some data with which we could compare our results. Below are the results of the three tests given.

78 freshman students took pre-test exam, averaging 7.1 out of 25. At the end of the semester, 71 students took it, and averaged 19.6.

The 20 seniors who took the test in Senior Seminar averaged 18.9 of 25.

Score of 23-24, n = 4 students
Score of 20-22, n = 6 students
Score of 18-19, n = 5 students
Score of 15-17, n = 2 students
Score below 15, n = 3 students

Question	% Correct New Freshmen	% Correct Mid-year Freshmen	% Correct Senior Seminar
1 Species	59	95	85
2 Evolution	46	95	90
3 Adaptation	22	78	85
4 Mutation	80	98	100
5 Analogous	19	56	40
6 Vestigial	33	98	85
7 Nat. Sel	19	93	85
8 Converg.	11	81	60
9Wallace	50	76	90

10 Char. Dis	11	59	60
11 Lyell	22	81	80
12 Mech Evol	25	39	77
13 Direc. Sel	6	76	65
14 Disr. Sel	17	64	75
15 Phylog.	39	93	100
16 Fitness	0	83	70
17 Mutual	43	88	90
18 Parasit	72	95	100
19 Nat Sel	4	77	65

In addition to the above effort, the faculty developed new syllabi for courses taught during the spring of 2006. These syllabi were to include the following general items, which were intended to standardize the different syllabi and to ensure that the goals of the department were being incorporated into the content of all courses. The following rubric was used to evaluate whether or not the individual syllabi met these expectations.

EVALUATION FORM FOR COMMON ELEMENTS OF THE SYLLABI.

FIRST PAGE OF THE SYLLABUS	Syllabus is acceptable on item	Syllabus has item included but not in acceptable form	Syllabus does not have item
Identification: Faculty name, office, office hours, e-mail address			
Course Overview: One paragraph similar to the catalog description			
Includes list of department learning Goals applicable to course			
Specifies how evolution will be addressed in the course.			
Has specific Class learning goals.			
SOMEWHERE IN THE SYLLABUS			
Disability Clause			
Course Schedule			
Grading Policy/scale			

Statement on academic honesty with penalties			
Final Exam policy			
Make-up policy			
Writing Rubric			
Presentation Rubric			
OPTIONAL ITEMS			
Course Conduct			
Course pre-requisites			

Results of the evaluation of syllabi are as follows.

School Term Spring 2006	
Current number of full-time faculty	8.00
Number of courses taught in the major	14.00
Number of Faculty syllabi containing applicable department learning goals	6.00
Percent in compliance	42.86%
Number of Faculty specifying evolution content of course	3.00
Percent in compliance	28.57%

Increased effort to comply with the departmental goal needs to be made in the coming year.

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

During the 2005-2006 academic year, the department had 150 majors, 42 of whom were freshmen. This left 108 students to evaluate for completion of Goal #2. At this time, we have not adequately developed a procedure for collecting the data to analyze this goal. The table below indicates that about 17% of our students in upper division courses do not meet the minimum expectation. As we proceed into next semester, we will begin with our sophomores through seniors to map their courses and grades. If a student receives a grade of C- or below he/she will be required to retake the course or lab or take another course/lab in that category in order to have fulfilled the 6 course requirement.

Fall 2005 Course offerings			
Course Title	Course Number	Number enrolled	Number with C- or lower
Genetics	Bi300	32	9
Histology	Bi302	8	1
Entomology	Bi303	12	5
Animal Phys	Bi306	18	4
Ecology	Bi313	19	2
Plant Biology	BI326	14	2
Genetics Lab	Bi35001	12	0
Genetics Lab	Bi35002	14	0
Genetics Lab	Bi35003	5	0
Animal Phys. Lab	Bi35601	10	2
Animal Phys. Lab	Bi35602	8	2
Senior Seminar	Bi481	10	1
		162	28
Percent below Cutoff Grade of C			17.28%

Spring 2006 Course offerings			
Ecol. Journey	Bi280	1	0
Comp. Vert. Anat	Bi301	18	3
Molec. Cell Biol	Bi305	27	4
Parasitology	Bi307	8	5
Plant Physl.	Bi308	6	1
Neurobiology	Bi322	17	5
Animal Behavior	Bi323	11	1
Vert, Biology	Bi325	8	2
General Microbiol	Bi330	14	2
Molec. Cell Lab	Bi35501	14	2
Molec. Cell Lab	Bi35502	13	0
Ecol. Journey	Bi380	8	0

Evolution	Bi404	14	3
Humanistic Med.	Bi460	7	0
Senior Seminar	Bi482	21	2
		187	30
Percent Below Cutoff Grade of C			16.04%

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)*

Our efforts to evaluate this goal began in the Spring 2006 semester. For their Senior Seminar course (BI 482), all seniors are required to write a critical paper on a research topic they are actively involved in via independent research or as a strong interest. The previously developed rubric was used to evaluate the papers of 20 students. Most papers were evaluated by two different faculty. Figure 3 shows the distribution of points awarded to students. The figure shows the variations in both the students ability and the faculties assessment of these abilities. No attempt was made to show the paired evaluation of any single student.

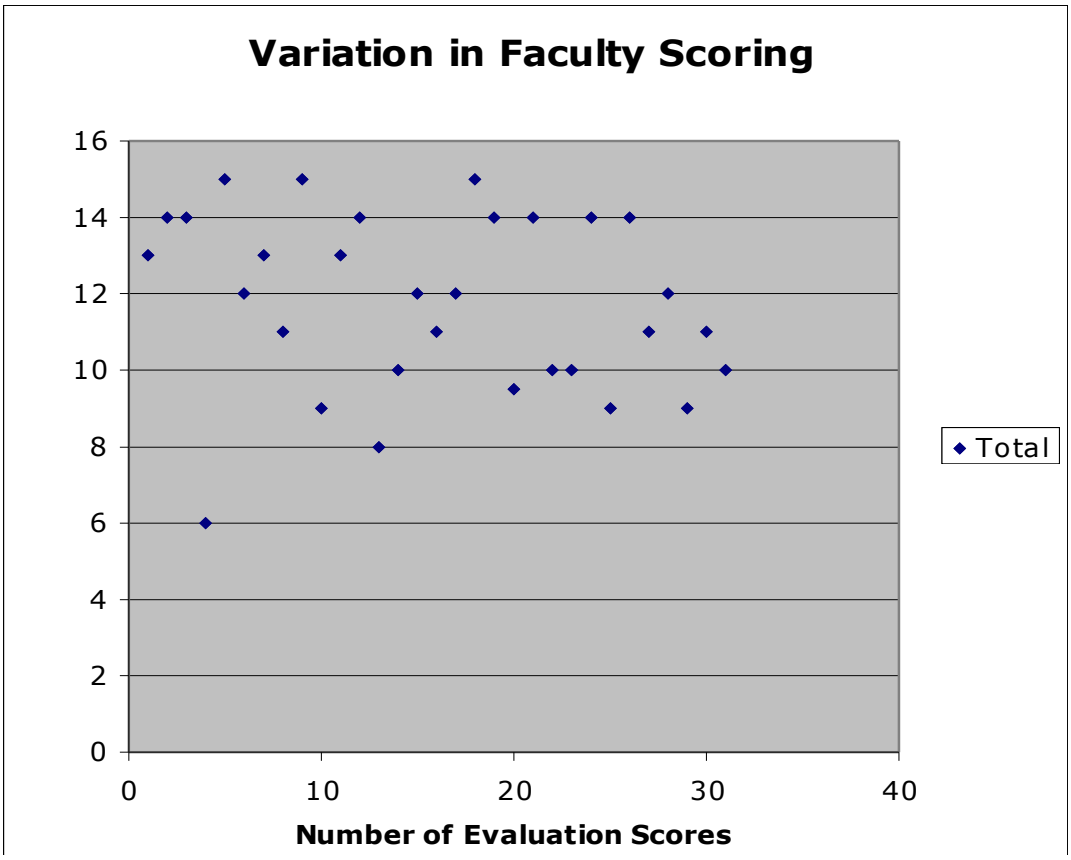

Figure 3. Paper evaluation scores for 20 student papers graded by nine faculty during the Spring Semester 2006. Points were awarded for efforts in Paper Formatting, Design and Conclusions.

The results in Figure 3 along with the individual scores for the format, design and conclusion categories are tabulated in Table 3 below. Results suggest the students are a

bit weaker in their ability to develop conclusions than in the other two categories. The overall point average was 11.83 out of 15. Data suggest that a cutoff of around 10 points could be used as an indicator of teaching success to be used for data evaluation and curriculum improvement decisions.

Table 3 – The mean +/- Standard Deviation received after Biology Department Faculty evaluated the papers of 20 students during the Spring Semester 2006. Most papers were evaluated by 2 different faculty.

Student Paper Evaluation Spring 2006				
	Format	Design	Conclusions	Total
Number (n)	31	31	31	31
Average	3.88	4.09	3.86	11.83
S.D.	0.94	0.90	1.06	2.32
AVG-SD				9.51

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 easier to do with experiments actually performed by the student. During the spring semester 2006, twenty students were evaluated. Fifteen defended a hypothesis constructed around a set of experiments they performed while 5 defended a hypothesis developed from comparing literature findings on the subject. The results of their oral presentation are shown in figures 4a and 4b.

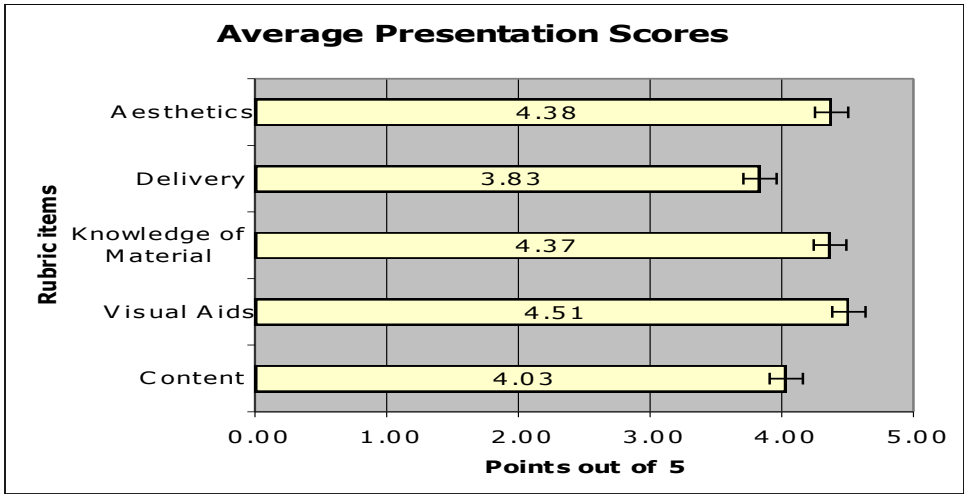

Figure 4a. Average scores of 20 students presenting oral seminars on research they had completed. Five categories were evaluated using the rubric previously shown. Averages are shown along with standard error bars.

In addition to the individual scores for different areas of oral evaluation, a total of the five areas was determined and averaged. The average score was 21.12 +/- 2.38. Figure 4b shows the average that would be of concern if scores fell below it.

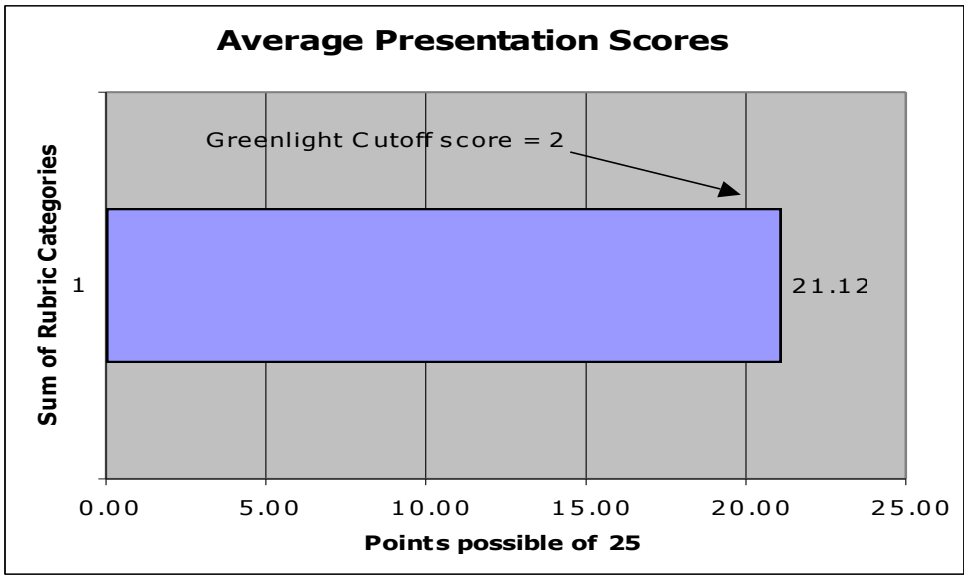

Figure 4b. Average total score of oral evaluations for 20 senior students enrolled in Bi482, Spring 2006.

Prior to their oral presentation, the twenty student constructed and displayed a poster using guidelines appropriate for a national meeting. Fourteen students posters were evaluated by one or more faculty, and the scores obtained are displayed in Figure 4c.

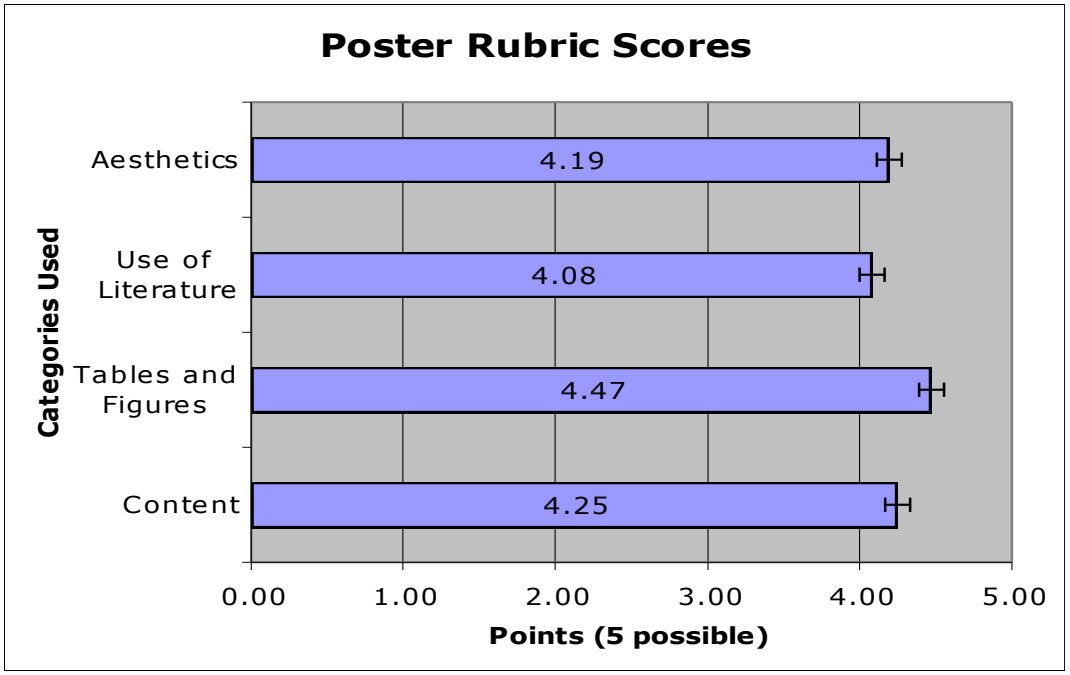

Figure 4c. Average poster scores of 20 students displaying results of research they had completed. Four categories were evaluated using the rubric previously shown. Averages are shown along with standard error bars.

At the time we developed our evaluation plan, we had not considered using scores of the individual categories as evaluation criteria. In examining the results, it might be something to consider. Our original goal was only focused on developing overall standards for presenting results as a poster. Average scores of the five categories and a total are presented in Table 4b. The average score of 17 is above the minimum average score of 16 set by the department at the beginning of the study.

Table 4b. The mean +/- standard deviation received after Biology Department faculty evaluated the posters of Seminar students during the Spring Semester 2006. In compiling the data, 14 students were evaluated using 36 faculty evaluations.

Average Poster Scores					
Student	Content	Tables and Figures	Use of Literature	Aesthetics	Total
Average	4.25	4.47	4.08	4.19	17.00
Stand Dev	0.94	0.74	0.97	0.79	2.52

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 in their knowledge of evolutionary principles and from the test results of graduating seniors, this knowledge appears to be retained. We still need to complete the pre/post test to include additional questions that cover the content of our second semester freshman class, Attributes of Life, BI 108. Our plan is to have this in place for the 2006-2007 academic year.
- Goal 2. In compiling the data, 14 students were evaluated using 36 faculty evaluations. Specific data, i.e. class taken and grade received, for each individual Biology student were not collected this year. However, in the fall 162 and in the spring 187 biology majors took upper division classes that meet the criteria for goal #2. Of these students, roughly 16% did not meet the minimum grade expectation of C. This measure was not originally included in our method of assessment, but it gives us some insight as to the outcome of collecting individual data. Before fall our plan is to develop a tally sheet to be placed in each student folder. Faculty advisors will be responsible for completing the sheet for each student they advise. At the end of the year, results will be evaluated.
- Goal 3. Results assessing the critical skills of our students using scientific reports show that our seniors have developed the skills we feel are necessary for them to succeed in their future career. The average score for evaluating paper format, design and conclusions was 12.25 out of 15. This exceeds the minimum cutoff value of 10 which indicates we are providing satisfactory instruction for students to excel in this area. This fall, our plan is to collect a paper from all 2005-06 freshmen to put in their portfolio folder. Either all or a sample of these papers will be evaluated with the rubric. A second paper will be collected and evaluated in their senior year.

- Goal 4. Average presentation scores and poster scores were both above the cut off value we established at the beginning of the study. All students who were able to complete a wet bench project did very well in demonstrating their ability to support or falsify a hypothesis. There is still some concern for those who elect to defend a position using the literature. There is a tendency for these students to give a book report instead of a critical analysis of an issue. No data were collected to see whether there was any real difference between the two groups. Faculty report that a couple of this latter type of presentation were every bit as good as those who developed a hypothesis from their lab work. Our plan is to decide on how to further evaluate this goal, with all faculty involved or a select few, and then to continue using the assessment tools currently developed.

An issue that needs to be addressed is how to maintain consistency in the use of the evaluation rubric. As can be seen from the data collected, not all faculty members participated in the process. Do we need to require such participation? A second issue is the variation in individual faculty standards not shown in the current data. This may require that all biology faculty participate in the evaluation process.

APPENDIX A

Biology Content Category Courses
Tentative for Fall 2006

revised 2/2/06

Complete One from Each Category with a "C" or better. (Does Not include First Year Core Courses)

Each course may count for only one category e.g. if Vert. Bio. is taken for *Morphology*, then it cannot be counted for *Taxonomy* or any other category.)

Ecology	***Taxonomy***	***Morphology***	***Function***	***Molecules / Cells***	***Reproduction / Genetics***
BI 303 Entomology	**BI 303** Entomology	**BI 204** Essent. of A&P (Sec Ed only)	**BI 204** Ess. of A&P (Sec. Ed only)	**BI 206** A & P I	**BI 207** A & P II
BI 314 Ecology	**BI 307** Parasitology	**BI 206/207** A & P I & II	**BI 206/207** A & P I & II	**BI 300/350** Genetics/Lab	**BI 300/350** Genetics/Lab
BI 323 Animal Behavior	**BI 325** Vertebrate Biology	**BI 301** Comparative Anatomy	**BI 301** Comparative Anatomy	**BI 302** Histology	**BI 304** Developmental Anatomy
BI 326 Plant Biology	**BI 326** Plant Biology	**BI 302** Histology	**BI 302** Histology	**BI 305/355** Molec and Cell Biology/Lab	**BI 307** Parasitology
BI 380 Ecological Journey	**BI 328** Ornithology	**BI 303** Entomology	**BI 304** Develop. Anatomy	**BI 312** Immunology	**BI 323** Animal Behavior
BI 404 Evolution	**BI 330** Microbiology	**BI 304** Develop. Anatomy	**BI 306** Animal Physiology	**BI 330** Microbiology	**BI 404** Evolution **(Recom'd)**
BI 220/320 Field Ecology **(allied health only)**	**BI 380** Ecological Journey	**BI 307** Parasitology	**BI 308** Plant Phys.	**BI 407** Molec. Genetics	**BI 407** Molecular Genetics
	BI 393 Adv Insect Taxonomy	**BI 322** Neurobiology	**BI 312** Immunology	**BI 413** Cell Biology	
	BI 404 Evolution	**BI 325** Vert. Biology	**BI 322** Neurobiology		
		BI 326 Plant Biology	**BI 325** Vertebrate Biology		
		BI 328 Ornithology	**BI 328** Ornithology		
		BI 393 Adv Insect Taxonomy	**BI 407** Molecular Genetics		
			BI 413 Cell Biology		