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 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-6(Nat)g,uT/F2 ooleThe Departmenppl

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

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 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

	ORAL PRESENTATION
Conter	
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.
Knowl	edge of Material
5	Člear 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.
Deliver	[^] y
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.
	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 in appropriate or with too much small, hard to read data, colors and
	background inappropriate.

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

Table 1. Breakdown of percent correct answers for each question on the pre- and post-

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 emphasize application of concepts to life situations. Our students write a paper on a project they design and carry out as freshmen in our ecology and evolution class. Then, all of our students take genetics in the second or third year. In both, there is considerable emphasis on application of concepts. Our efforts to evaluate this goal began in the Spring 2006 semester. For their Senior Seminar course (BI 481 or 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. Our department first decided that a cutoff of around 10 points earned from the rubric to evaluate papers could be used as an indicator of teaching success for data evaluation and curriculum improvement decisions. However, a score of 12 is a more rigorous green light.

This year, we compared that senior seminar paper with the one done as a first year student in ecology and evolution using the same departmental rubric, for seven students (Figure 1). The total score on the papers increased 25%, from 10.07 to 12.64, and all seven students improved by 20% or more. Paired t-tests showed that the total rubric score on the paper increased significantly (p = 0.0002), as did scores on format (p = 0.004) and conclusions (p = 0.0002). The score for research design did not change (p = 0.44). Both the fact that seniors are scoring higher than 10 [now 12] and that there is at least a 20% improvement in scores fit within the criteria for a green light for meeting this departmental goal.

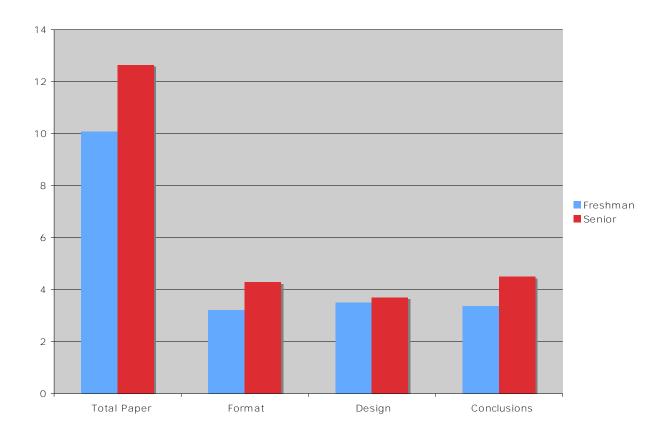


Figure 1. Comparison of Freshman (entering fall 2005) papers from Ecology and Evolution class with Senior Seminar papers from the same students, in spring 2009. Total possible point value is 15, with each of the three portions of the rubric worth a possible five points.

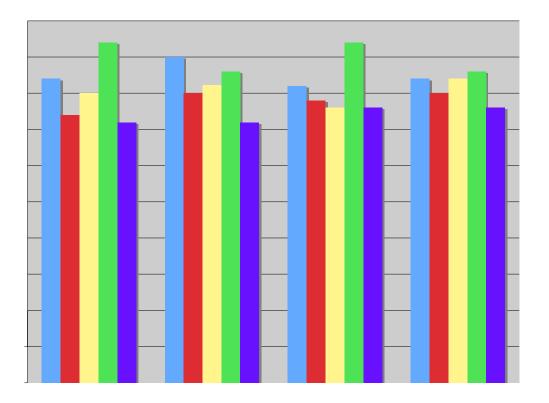


Figure 2. Mean scores for posters presented by students in Senior Seminar for five different semesters. Total possible was 20 points, with five points for each category of the rubric.

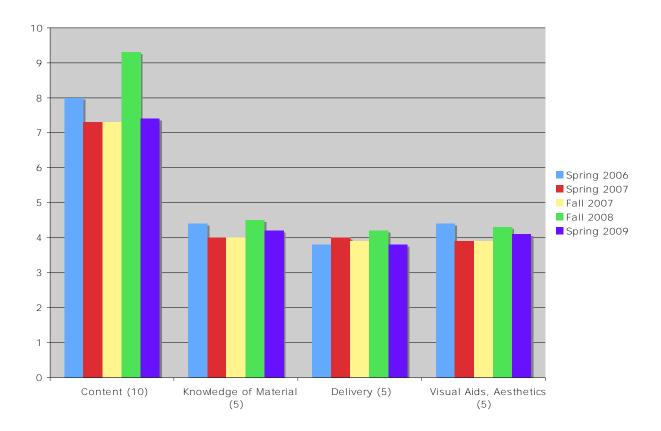


Figure 3. Mean scores on departmental rubrics for oral presentations in Senior Seminar for five different semesters. Total possible points was 25 for the presentation.

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 only achieved in two of the evaluated semesters (Fig. 3). Averaging fall 2008 and spring 2009 data, the mean total score was 20.5 for this year, just within the green light criteria. However, 11/34 of the 2008/2009 students did not score at least 20 points on the presentation.

Secondary Education Program

All secondary education students must complete 10 Candidate Assessments, as well as some 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.

Table 5. Number of students receiving each rating in assessment rubrics for biology secondary education.

Rubric	Not	Marginal	Proficient	Commendable
	Proficient			
Analysis of student learning (CA 10)				
Teacher Work Sample, phase I				
Context of Learning	0	0	0	1
Learning Goals	0	0	1	0
Assessment Plan	0	0		

Another issue, which we have not adequately addressed, is the issue of consequences for

Although the rubrics have not been used consistently 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 all biology faculty in the scoring process for assessment, we should have more consistent data that can be used for program planning and improvement.

APPENDIX A

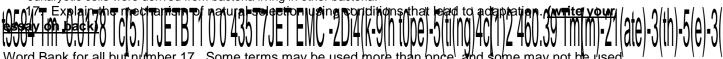
Evolution and Natural Selection Survey Biology Department, Spring 2009 Name

- 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. material for evolution
- 5. A structure with similar function but different ancestral origins is a(n)____
- 6. A structure that no longer has a function in an organism, that has a function in related organisms, is _____structure. (Example: pelvic bones in whales) a(n)
- 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.

_____ Theory suggests that chloroplasts and mitochondria of 16. The

eukaryotic cells were derived from bacteria living in other bacteria.



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. Commensaliscomm 7(s)6(m)- 0 0 1Comm 7(s)6(m26(i)8BT TJETBT.A7 0 54M

- 13. Genetic Drift
- 14. Genetic Variation
- Homologous
 Migration, Movement between populations
- 17. Mutation
- 18. Mutualism
- 19. Natural selection 20. Non-random mating
- 21. Parasitism

- Phylogeny
 Species
 Stabilizing
 Vestigial

Ecological Journey	Neurobiology	Immunology	Endocrinology
BI 404	BI 326*	BI 322	
Evolution	Plant Biology	Neurobiology	
		BI 325*	
		Vertebrate Biology	
		BI 328	
		Ornithology	
		BI 413	
		Advanced Cell Biology	

*Courses with student/designed research projects students must take at least one of these courses Appendix C. Examples of posters.