Final Report
Assessment Grant Program
Undergraduate major in Ecology and Evolutionary Biology
Fall 2009

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A. Description of project

The undergraduate major in Ecology and Evolutionary Biology (EEB) is one of eight majors in the biological sciences. At the present time, students majoring in EEB have a set of courses that all students must take, in addition to a very large number of alternative courses (e.g. take 1 from a list of 11, take 1 from a list of 5, take 3 from a list of 34). While this variety of alternatives helps a student to tailor class choices more closely to his/her interests, it also makes it more challenging to describe the curriculum, or make plans for assessment. Therefore, I worked with the Office of Research and Evaluation to collect data on which course sequences have actually been taken by the majors. In addition, a draft of proposed learning outcomes was shared with all department faculty members, and their feedback on the learning outcomes and assessment procedures was solicited.

B. Accomplishments and findings

B.1. Development of student learning outcomes

A draft of student learning outcomes for the major in Ecology and Evolutionary Biology was developed and shared with the chair of the Departmental Curriculum Committee, the chair of the Department of Ecology and Evolutionary Biology, and the chair of the Undergraduate Cabinet in the School of Biological Sciences (Dr. Steve Weller, Dr. Brandon Gaut, and Dr. Michael Leon, respectively). This list of student learning outcomes was discussed by the faculty in the EEB department at a faculty meeting in May 2009.

The current student learning outcomes (approved May 2009 by EEB department) are:

(1) Students will demonstrate an understanding of ecological relationships between organisms and their environment.
(2) Students will demonstrate an understanding of key concepts in evolutionary biology, the history of life on Earth, and phylogenetic relationships between organisms.
(3) Students will demonstrate an understanding of physiological properties of organisms.
(4) Students will demonstrate scientific quantitative skills, such as the ability to evaluate experimental design, read graphs, and understand and use information from scientific papers.
(5) Students will demonstrate skill in communication of scientific data in standard format.

These student learning outcomes are being posted on the EEB website.

B.2. Identification of rate-limiting course in curriculum – Bio E106

An unexpected problem with the curriculum was identified during this time: a course which is the "gateway" (a prerequisite) to upper-level courses in ecology and evolutionary biology (Bio E106, Processes in Ecology and Evolution; called Bio 96 until 2005) was apparently not being offered to a large enough number of students starting in 2005, and so was primarily populated by seniors, rather than freshman/sophomores. This meant that there was only a very small number of students who had satisfied the prerequisite for upper-level courses in ecology and evolution. The department started offering the course more frequently after 2006, but still few freshman or sophomores have the opportunity to enroll in the class. Although things are getting better in 2009 (the percentage of students who are seniors has declined), further increases in enrollment in Bio E106 would appear to be advisable and would provide students who would then be eligible to take upper-level courses (some of which are plagued by insufficient enrollment). (Information in table from John Selegean and Carolyn Willman)

Year	Enrolled	% seniors	Class
2003	213	15	96
2004	1,355	7	96
2005	193	36	96/E106
2006	98	41	E106
2007	183	82	E106
2008	196	86	E106
2009	260	65	E106

B.3. Analysis of classes taken by EEB majors over the last few years

Analysis of the classes taken by EEB majors over the last few years revealed that these classes are primarily populated by other biology majors (EEB majors are in the minority). It also was clear that there is a wide range in classes taken by EEB majors (see table below). Therefore, assessment of student learning outcomes that will be linked to a class is confined to a small number of possible classes (e.g. E115L and E166, both typically taken in the senior year). The numbers in the table below are for the total of 17 students who graduated during the three academic years of 2004-2005, 2005-2006, and 2006-2007 (information on enrollment from John Selegean).

Biology Course	Number enrolled
BIO CORE	
2B Freshmen Seminar	10
93 From DNA to Organisms	n/a
94 From Organisms to Ecosystems	13
97 Genetics	17
98 Biochemistry	17
99 Molecular Biology	17
100LW Experimental Biology Laboratory	13

194S Safety and Ethics for Research	17
EEB REQUIREMENTS	
96/E106 Processes in Ecology and Evolution	17
E107 Seminar in EEB	13
UPPER DIVISION LABS	
E115L Evolution Laboratory	17
E166 Field Methods in Ecology	16
ONE OF THE FOLLOWING 12 UD LABS	
D111L Developmental and Cell Biology Laboratory	5
E112L Physiology Laboratory	4
E161L Ornithology Laboratory	0
E172L Plant Systematics Laboratory	-
E179L Field Freshwater Ecology	4
M114L Biochemistry Laboratory	0
M116L Molecular Biology Laboratory	4
M118L Experimental Microbiology Laboratory	0
M121L Advanced Immunology Laboratory	0
M122L General Microbiology Laboratory	0
M124L Virus Engineering Laboratory	0
N113L Neurobiology Laboratory	0
ONE OF THE FOLLOWING 5 ELECTIVES	
D103 Cell Biology	5
D104 Developmental Biology	5
D105 Cell, Developmental, and Molecular Biology of Plants	4
E109 Human Physiology	9
N110 Neurobiology and Behavior	1
3 OF THE FOLLOWING 34 ELECTIVES	
E118 Terrestrial Ecosystems	0
E124 Infectious Disease Dynamics	1
E127 Physiological Plant Ecology	7
E135 Molecular Evolution	0
E136 The Physiology of Human Nutrition	1
E137 Genetics of Complex Traits	1
E138 Comparative Animal Physiology	0
E141 Cell Signaling in Development	0
E142 Writing/Philosophy of Biology	0
E150 Conservation Biology	4
E151 Population Dynamics in Ecology, Epidemiology, and Medicine	0
E153 Functional and Structural Evolutionary Genomics	0
E155 Physiology in Extreme Environments	0
E157 Comparative Vertebrate Anatomy	0
E160 Ornithology	0
E168 Advanced Evolutionary Biology	2
E170 Mechanical Physiology	0
E172 Systematics and Evolution of Flowering Plants	1
E174 Behavioral Ecology	4
E175 Restoration Ecology	6

E176 Coevolution of Hosts and Parasites	0
E178 Ocean Ecology	0
E179 Limnology and Freshwater Biology	10
E181 Conservation in the American West	0
E182 Mediterranean Ecosystems: Biodiversity and Conservation	5
E183 The Comparative Physiology of Exercise	0
E184 Entomology	0
E185 Plant-Animal Interactions	0
E186 Population and Community Ecology	4
E188 Introduction to Insect Physiology	0
E189 Environmental Ethics	4
E190 Topics	11
D147 Plant Molecular Biology	0
STRONGLY ENCOURAGED	
199 Independent Research	n/a

B.4. Analysis of Academic Preparation of EEB majors

In order to understand the needs of EEB majors, their academic preparation was compared with other majors by comparing scores from admission files. The numbers (shown in the table below, from John Selegean) show no large or consistent differences between EEB majors and other majors.

Cohort and Major	Number of Entrants	High School GPA	SAT Verbal Score	SAT Math Score	SAT Writing Score
Fall 2005 Entrants					
Eco Evo Majors	9	3.67	570	618	n/a
Other Bio Sci Majors	1,007	3.79	575	618	n/a
Other Majors	3,322	3.69	582	617	n/a
Total Entrants	4,338	3.71	580	617	n/a
Fall 2006 Entrants					
Eco Evo Majors	11	3.63	584	621	n/a
Other Bio Sci Majors	1,111	3.75	574	617	n/a
Other Majors	3,714	3.68	575	613	n/a
Total Entrants	4,836	3.69	575	614	n/a
Fall 2007 Entrants					
Eco Evo Majors	13	3.87	585	615	579
Other Bio Sci Majors	1,285	3.83	568	613	576
Other Majors	3,633	3.78	569	613	574
Total Entrants	4,931	3.79	569	613	574

Sources: Admissions files, F05, F06, F07; SIS files, 3rd week and eot, F05 to F07.
Note: Only students entering directly from high school are included.

C. Recommendations for building meaningful and sustainable assessment

These recommendations primarily reflect my opinion, but any opinions voiced at the May 2009 faculty meeting were supportive.

C.1. Use embedded assessment (course assignment(s) that will also contribute to part of a student's grade in a course)

Advantages over developing a separate "exit exam" or test outside of a regular class

- Less burdensome for faculty
- Avoids problems with student motivation or compliance

Advantages over using a commercial assessment product

- Less expensive
- Uncertain whether such an appropriate product exists
- More relevant for incorporating curriculum strengths here at UCI
- Avoids problems with student motivation or compliance to use such a commercial product

C.2. Need coordination at departmental level

Coordination at the departmental level will be necessary to schedule the assessments (i.e. which student learning outcome is assessed which year), to ensure that the assessment results are shared with relevant faculty, and that the assessment results are used to make any changes in the curriculum when warranted. One possible entity that might be appropriate to take this on is the departmental curriculum committee. The courses that have been identified as the most appropriate for this purpose are Bio E115L and E166 (usually taken by majors in their senior year).

C.3. Need coordination at school level

Given that biology courses are taken by a variety of biology majors, and that there is a fair amount of overlap in the "student learning outcomes" for the different majors, it would make sense to coordinate assessment efforts between the different biology majors (simultaneously assess a single shared learning outcome for all of the biology majors in a particular class). The Undergraduate Cabinet for the School of Biological Sciences might be the appropriate body to coordinate this. Below is the information for the "student learning outcomes" for the other seven biology majors to make it easier to see the similarities with those of the EEB major.

Student learning outcomes for the other seven biology majors at UCI (information from Dr. Michael Leon 2009):

(1) Students will demonstrate an understanding of biology at the level of molecules, cells, systems, organisms and ecosystems. [THIS OUTCOME IS NOT IN EEB LIST]
(2) Students will demonstrate an understanding of key concepts in _____ (different phrases for the 7 different non-EEB majors, see below for details) [THIS IS A MORE GENERAL STATEMENT THAN EEB OUTCOMES #1, 2, 3, ABOVE]
- Microbiology and Immunology: insert "microbiology and immunology."
- Biological Sciences: insert "evolutionary biology, ecology, neurobiology, cell biology, molecular biology, biochemistry, genetics, developmental biology and physiology."
- Genetics: insert "genetics."
- Plant Biology: insert "plant biology."
- Neurobiology and Behavior: insert "neurobiology and behavior."
- Developmental and Cell Biology: insert "developmental and cell biology."
- Biochemistry and Molecular Biology: insert "molecular biology and biochemistry."

(3) Students will demonstrate scientific quantitative skills, such as the ability to evaluate experimental design, read graphs, and understand and use information from scientific papers. [SAME AS EEB OUTCOME #4 ABOVE]
(4) Students will demonstrate skill in communication of scientific data in standard format. [SAME AS EEB OUTCOME #5 ABOVE]

D. Current departmental action (Fall 2009)

The department chair, Dr. Brandon Gaut, has convened an "Ad Hoc Undergraduate Teaching Committee" to evaluate the undergraduate curriculum this quarter. The committee will examine the entire departmental teaching portfolio and make a report in December. Assessment plans will be adjusted to any curricular changes.