

Office of General Education

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**LINKING STUDENT LEARNING BENCHMARKS**

**BETWEEN GENERAL EDUCATION AND SCIENCE COURSES**

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| Date of report: | 9/23/19 |
| Course: | BIO 22800, Ecology and Evolution |
| Materials used, n:  | 83 lab assignments  |
| Date/semester of assessment: | Spring 2019 |
| Assessment Team Members: | Melina Giakoumis and Michael Hickerson; Biology |
| Coordination / Oversight: | Elizabeth Rudolph, Division of Science; Ana Vasovic, General Education  |

**Purpose:**

This assessment was conducted with the goal of connecting student learning outcomes in General Education and major courses. The study involved assessment of student learning in Bio 22800 Ecology and Evolution, course typically taken by Junior and Senior Biology majors. The aim was to assess key competencies – writing, critical thinking and information literacy – which are introduced in General Education courses and further developed/mastered through major coursework and determine through benchmarks if students accomplishment of these skills is as desired.

**Background Information:**

This learning assessment is based on an assignment from the lab sections of Biology 228: Ecology and Evolution. There are four sections of Bio228 lab each semester, and in the Spring 2019 semester there were two Teaching Assistants (hereafter TAs) for this course, each teaching two sections. The course has a lecture component, taught by Dr. Michael Hickerson in the Spring of 2019. The lecture meets once per week and pools the four lab sections’ students. The lecture and the labs were designed and operate independently. As this is a course that involves studying wildlife and the environment, the lab sections tend to involve many field trips, several of them outdoor. Weather, therefore, is the dominant factor in deciding the schedule of the labs, rather than correlation with lecture content. TAs meet regularly, about 1-2 times per week, and design the lab activities, assignments and presentations together in order to keep lab content consistent across sections.

The lecture grade is worth 50% of each student’s final grade, and the lab grade constitutes the other 50%. The lab grades are based on the following:

Laboratory reports and writing assignments: 15%

Midterm exam: 10%

Final exam: 10%

Class participation: 5%

Oral presentation on a scientific paper with a partner: 5%

An iNaturalist Project, in which each student is responsible for identifying 20 species of varied taxa and uploading their data to a citizen science app: 5%

A typical laboratory session will begin with a class “icebreaker,” usually science-themed, followed by a short PowerPoint presentation by the TA to cover concepts that are important to understand for the lab activity. Lab presentations usually last anywhere from 30 minutes to over an hour, dependent on the level of engagement from the students and the complexity of the concepts. After the presentation, the students are sometimes asked to complete a writing activity. Writing has been emphasized in this course as a way to improve student ability to communicate scientific concepts, which could help the students succeed in their scientific careers. The students are asked to read portions Strunk and White’s *Elements of Style* (4th edition), in which they learn stylistic rules of writing as well as some review of proper grammar. In about half the lab sessions, we ask the students to bring a printed copy of their completed lab assignment, and have them exchange their assignments with a partner. The students give each other comments and criticisms of the writing assignment, keeping in mind the content from *Elements of Style* assigned that week. Following the writing activity, the students are then asked to complete a laboratory activity with the supervision of the TA. Most lab activities are done in groups of 2-4 and typically last 1.5-2.5 hours.

The students are then assigned a lab report which is largely based on the activity completed in lab and the content from the TA’s presentation, and which sometimes involves independent research. The lab reports typically involve some calculations to be performed on the data collected during the lab, and subsequent interpretation of the calculated metrics. Some lab reports are more writing intensive, and ask the students to use the content they learned in the lab to answer a larger question in ecology in evolution. These assignments typically require some independent research in order to provide examples or context related to the student’s answer.

The writing sample used in this learning assessment was the assignment associated with the “Systematics and Macroevolution” lab. This lab session was dedicated to discussing the importance of understanding evolutionary relationships between species. We discussed the representation of these evolutionary relationships as trees, and how scientists will sometimes use trees to understand how traits have evolved in a lineage. We also defined and discussed the concepts of homology (similarity resulting from common ancestry), homoplasy (similarity not due to common ancestry), derived and ancestral characters, and convergent evolution. We also described different methodologies for creating evolutionary trees, and defined monophyly (a group consisting of a common ancestor and all of its descendants). Every week, the description of the lab activity is printed out and handed to the students. These lab handouts also include a vocabulary list and the corresponding definitions for the week, so that the students have the relevant terms accurately defined for future reference.

The lab activity for this week involved using morphological traits of mollusk shells collected on a previous field trip to build evolutionary trees. This allowed the students to learn the process of using specimens to collect morphological data, and how to use that data to infer the evolutionary history of a group. The students were then given a writing-based homework assignment that asked them to do independent research, and to apply the concepts they learned in the lecture and during the lab activity.

This was the 9th lab assignment of 12 for the semester, and as such is very indicative of the students’ capabilities, as it was a late-semester assignment and the students were, at this point, familiar with the expectations of the course and their TAs. The assessments were based on the students’ responses to the following question:

*In one paragraph of 5-6 sentences address the following prompt: Troglodytism (cave dwelling habit), is associated with multiple drastic morphological changes. Choose one troglodytic organism and identify at least 2 character states you suspect are associated with lightless habits. For each character state you list, identify at least one other organism that shares this character state a say whether the shared character state is homologous or homoplasyous. Identify the ancestral state for each character, and say something about why you think this character changed state in the troglodytic organisms.*

For the purpose of this report, the students were evaluated on this assignment based on their ability to meet the Science Learning Outcomes and the Gen Ed Learning Outcomes. The ability to understand the prompt, deduce what type of information was needed, formulate a proper response based on their gathered evidence, and to communicate that information succinctly and in the proper format were all major factors in deciding their grades.I used a three-tiered grading system for each benchmark. A score of 1 is given to those who do not meet expectations. A score of 2 is given to those who meet expectations. A score of 3 is given to those who exceed expectations.The scores for all four lab sections were then combined and described in the chart below.

**Assessment Findings: Quantitative**

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|  | **Gen Ed Learning Outcome** | **Benchmark Level II courses (2nd year)** | **Science Learning Outcome** | **Brief description of findings** | **Rank**  |
| Writing skills | Context of and purpose for writing  | Demonstrate an understanding of purpose of the experiment | PO 2: Formulate questions, design experiments, test hypotheses and interpret results. | ~12% did not meet expectations. ~67.5% met expectations. ~20.5% exceeded expectations.  | Above Average |
| Thesis   | Thesis is an arguable position ORThesis is defended with argument | PO 2: Formulate questions, design experiments, test hypotheses and interpret results. | ~11% did not meet expectations. ~66% met expectations. ~23% exceeded expectations.  | Exceeds Expectations |
| Sources and Evidence  | Provide credible, relevant evidence in support of the thesis | PO3: Perform experiments using lab equipment used in research.PO 4: Represent data with graphs or maps.PO 5: Demonstrate concept of statistical significance | ~16% did not meet expectations. ~51% met expectations. ~32% exceeded expectations.  | Exceeds Expectations |
| Structure and Organization  | Follow structure/format of Lab Report | PO 6: Write reports in the format of a scientific paperPO11: Use mathematical models or computer simulations | ~6% did not meet expectations. ~68% met expectations. ~25% exceeded expectations.  | Exceeds Expectations |
| Control of Syntax and Mechanics | Use appropriate language that conveys meaning and is grammatically correct | PO 6: Write reports in the format of a scientific paper | ~16% did not meet expectations. ~54% met expectations. ~30% exceeded expectations.  | Exceeds Expectations |
|  |  |  |  |  |  |
| Critical Thinking skills | Explanation of issues  | Clearly state issue/problem delivering relevant information | PO 2: Formulate questions, design experiments, test hypotheses and interpret results. | ~13% did not meet expectations. ~66% met expectations. ~21% exceeded expectations. | Above Average |
| Analysis/synthesis of evidence   | Analyze and/or synthesize evidence derived from appropriate sources | PO3: Perform experiments using lab equipment used in research.PO 4: Represent data with graphs or maps.PO 5: Demonstrate concept of statistical significance | ~17% did not meet expectations. ~52% met expectations. ~31% exceeded expectations. | Exceeds Expectations |
| Student's Position   | Formulate and argue a clear position on an issue taking into account different points of view | PO 2: Formulate questions, design experiments, test hypotheses and interpret results. | ~25% did not meet expectations. ~47% met expectations. ~28% exceeded expectations. | Average  |
| Conclusions  | Develop logical conclusions based on evidence  | PO 6: Write reports in the format of a scientific paperPO11: Use mathematical models or computer simulations | ~18% did not meet expectations. ~52% met expectations. ~30% exceeded expectations. | Above Average  |
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| Information Literacy skills | Understand info needs/ search efficiently  | Understands research question and performs research |  | ~20.4% did not meet expectations. ~67.5% met expectations. ~12% exceeded expectations. | Average to Below Average  |
| Evaluate info sources (as appropriate to the discipline)  | Understand materials needed |  | ~12% did not meet expectations. ~81% met expectations. ~7% exceeded expectations. | Average |
| Articulate credibility of sources  | As appropriate to the discipline |  | ~88% did not meet expectations. ~7% met expectations. ~5% exceeded expectations. | Below passing |
| Use info ethically  | Acknowledge sources and cite accurately; No misuse of data | PO 6: Write reports in the format of a scientific paper | ~88% did not meet expectations. ~7% met expectations. ~5% exceeded expectations. | Below passing |

**Level I:** FIQWS/ENGL 110;

**Level II:** ENGL 210, BIO 228

**Assessment Findings: Qualitative**

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| *Briefly summarize overall findings by identifying* ***strengths*** *in students’ accomplishment of learning outcomes/specific benchmarks.* **Writing:** Most of the students were able to write relatively clearly and coherently. They were also able to provide evidence that was relevant and that answered our questions. Most students’ writing had a main thesis, but it was not always explicitly stated. **Critical Thinking:** The majority of students were able to understand the question, synthesize relevant research and make logical conclusions based on the evidence they gathered. I was impressed by how well they were able to apply their knowledge of evolution to this particular question, the content of which we had not discussed previously (in either lecture or lab). **Information Literacy:** Students were able to do relevant research and apply it to the question at hand. We did not cover any of this material in class, so they were required to search for examples that fit the requirements of the question. While not everyone achieved this, most of the students did a commendable job.**Content Knowledge:** The students were able to apply the course content on evolutionary processes and patterns to answer the question. We asked the students to speculate about the evolutionary history of groups of species, given a set of environmental conditions, and many of them were able to do so.  |
| *Briefly summarize overall findings by identifying* ***challenges*** *in students’ accomplishment of learning outcomes/specific benchmarks.* **Writing:** Most of the students had some difficulty structuring their writing in a way that was logical and easily understandable. It was clear that most students did not proofread their assignments before submitting them, as there were many obvious typos and grammatical errors. **Critical Thinking:** Some ofthe students clearly did not fully grasp the question. The most common issue in this category was the inability to effectively synthesize the research they did in a way that was understandable. In these cases, the conclusions derived from the research were not entirely logical or accurate, and they seemed to miss the point of the question. **Information Literacy:** This was definitely the category in which the students struggled most. The vast majority of students did not cite any sources at all, despite the fact that the entire premise of the question required them to independently research examples of evolutionary outcomes and describe what they found. They certainly did the research, otherwise they would not have been able to answer the question, but is seems that students don’t understand that they are always required to cite their sources. For those that did cite something, very few used sources besides Wikipedia. Even fewer of these students formatted their citations properly (never in-text, and mostly just listing the website at the bottom of the page). **Content Knowledge:** There were many instances in which the students made mistakes which clearly indicated they did not grasp the content (e.g. describing convergent evolution, but calling the trait homologous). They also struggled to use the terminology correctly, in ways that sometimes made it difficult to understand what they were trying to say.  |
| *How useful are the text and other resources assigned to this course?*We do not assign a text for the lab portion of the course. The resources are written and designed by the teaching assistants, and include lectures for each week as well as handouts with background information and lab procedures.  |
| **Conclusions** / “Closing-the-loop” plans to improve student learning/success |
| *Based on your assessment of student learning, do you plan to implement or recommend at instructional level changes to improve student learning? Specify topics and pedagogical changes, if applicable.** From now on, I think I may spend some time in the beginning of the course discussing the expectations we have for the students in each of these categories. Many times throughout the semester, I made it clear that we expected them to understand the concepts on a theoretical level rather than being able to memorize information from the lecture. Some students understood this, and made an effort to think critically about the content so that they could apply the concepts to our questions, but many students seemed uncomfortable with this type of learning and testing, and would often ask what they would “need to know” for the exam.
* I often engaged the students throughout the lecture, challenging them to apply their knowledge to conceptual questions. But perhaps a different strategy for these conceptual thought exercises in class would be helpful. In retrospect, it was usually the same handful of students who would participate and those were the students that often had little trouble applying these techniques to the homework and the exam questions. If I asked the students to discuss these questions in small groups, it may force all students to participate in these exercises.
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| *Provide suggestions, if any, to be done on a departmental or institutional level to support student learning/success in this course.* * The students most struggled with information literacy. This was a pattern throughout the semester. They need more instruction on how to find good resources as well as how and when to cite them properly. I believe that if the students were required to take a short seminar in their first year, in which they were given all this information, they could be held accountable in these higher-level classes. Given how pervasive this problem was, I did not feel that this was the students’ failing, and therefore did not often penalize them for this lack of citation throughout the semester. Even if these skills were addressed formally in a lower-level biology class, I believe it would be an improvement.
* I think one of the sources of difficulty for this course was the separation of lab and lecture. The students sometimes complained that they felt as though they were taking two separate courses. I think that integration of lecture and lab content and activities could be helpful to the students.
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