

Student Learning Outcomes Assessment Summary

Biological Sciences, BA

College of Natural Science and Mathematics

2014-15 and 2015-16

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Date: 15 May 2016

Background The goal of the BA degree program in biological sciences is to provide students with the knowledge and skills necessary to succeed in the job market or advanced or additional study. Students in the BA program take the same set of required courses as those in the larger BS program, but fewer science and math courses and more courses in the social sciences and humanities. Most BA seniors report that they plan to pursue an advanced or additional degree in a biology-related discipline following graduation (Fig. 1a). Many seniors plan a career in the health sciences, but the range of reported career plans includes conservation, environmental assessment, conservation, and education (Fig. 1b). The BA program contained 67 students in fall 2015.

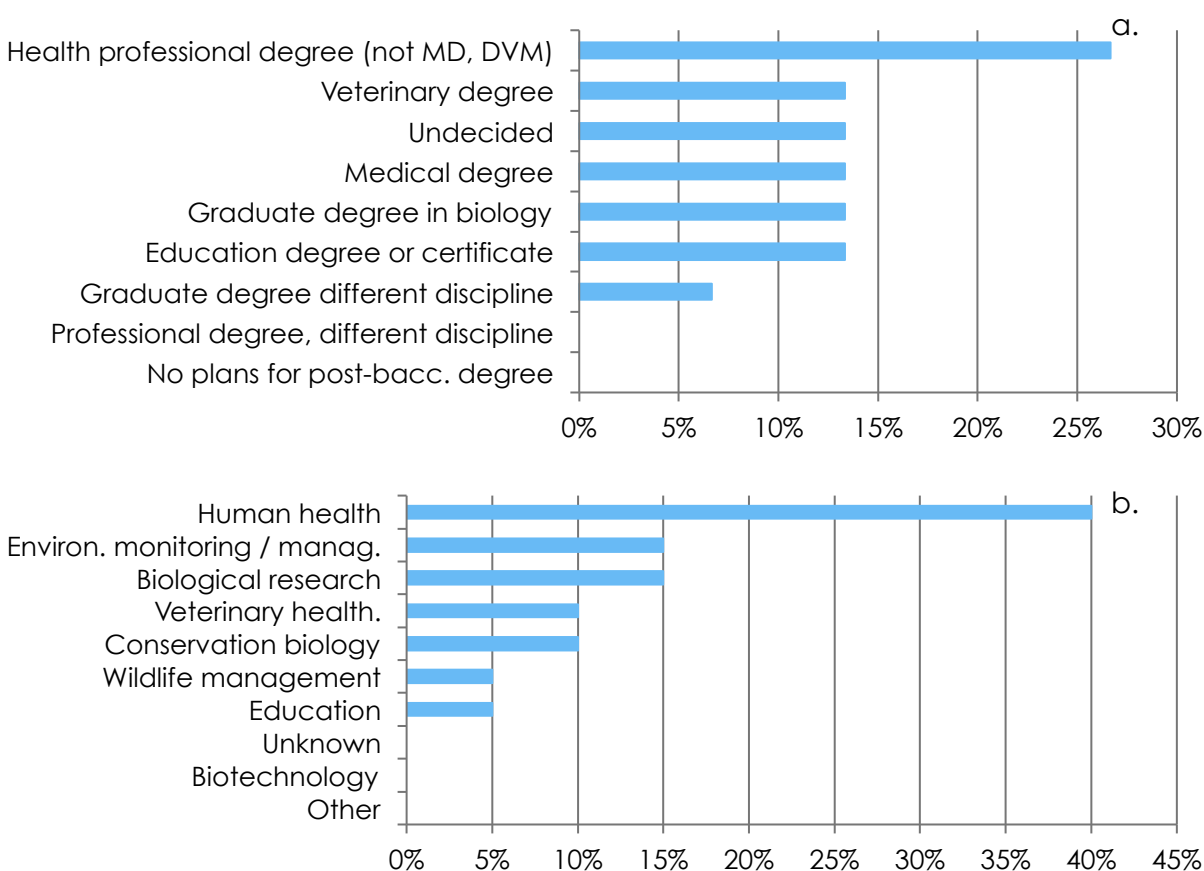


Fig. 1. Continued education (a) and employment (b) plans reported by seniors in the program, surveyed 2014-2016 in a required, senior-level course (BIOL F481, n = 12).

1. Assessment information collected

1.1. Knowledge

Graduates from the Biological Sciences program should possess knowledge of core biological concepts, including evolution, inheritance and the expression of genes, cellular and organismal structure and function, and biologically-relevant pathways and transformations of energy. The Biology & Wildlife Department assesses the knowledge of biological sciences majors using the Educational Testing Service's Biology Major Field Test (Biology MFT) (<http://www.ets.org/mft>). The test has been administered every semester since 2010 in to majors enrolled in a required, senior-level course, Principles of Evolution (BIOL F481). The Biology MFT is designed to assess the “mastery of concepts, principles and knowledge by graduating Biology students” (ETS). It consists of 150 multiple-choice questions covering the four major biology subject areas (Table 1). Our aim is to score above the top 50th percentile of participating institutions for all major subject areas.

Table 1. Biology subject areas assessed by the ETS Biology Major Field Test.

Subject	Percent of Exam
Cell Biology	21
Molecular Biology and Genetics	20
Organismal Biology	33
Population Biology, Evolution and Ecology	26

In this report we present data from 120 students who took the MFT between September 2014 and May 2016. All were biological sciences majors and data for student pursuing BS and BA degrees are combined. (In future years we plan to parse the BS and BA data.) The performance of UAF students is reported in comparison to seniors at 328 domestic institutions who also took the exam during 2014 and 2015 (data from ETS).

UAF's institutional percentile ranks ranged from 58 to 82 over the three semesters (Fig. 2). UAF's institutional percentiles tend to be at or above 75 for Organismal Biology and Ecology & Evolutionary Biology. Results for Cell Biology varied from just below the 50th percentile to the 80th percentile. Molecular Biology and Genetics was the only major subject area where the institutional percentile was often below the 50th percentile, but scores were considerably higher in spring 2016 than in earlier semesters (Fig. 2).

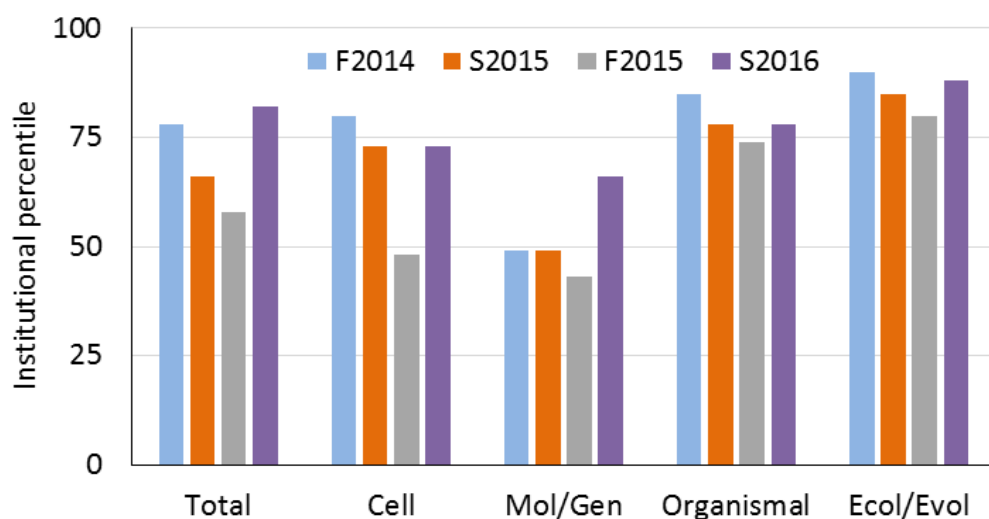


Fig. 2. Biology MFT institutional percentiles for the total score and each of the four subject areas. Comparative data is for seniors at 328 domestic institutions tested between September 2014 and June 2015.

A finer scale look at UAF's performance compared to other institutions suggests that we are doing well in most areas but have relative weaknesses in Organismal – Plants and Molecular Biology and Molecular Genetics (Fig. 3).

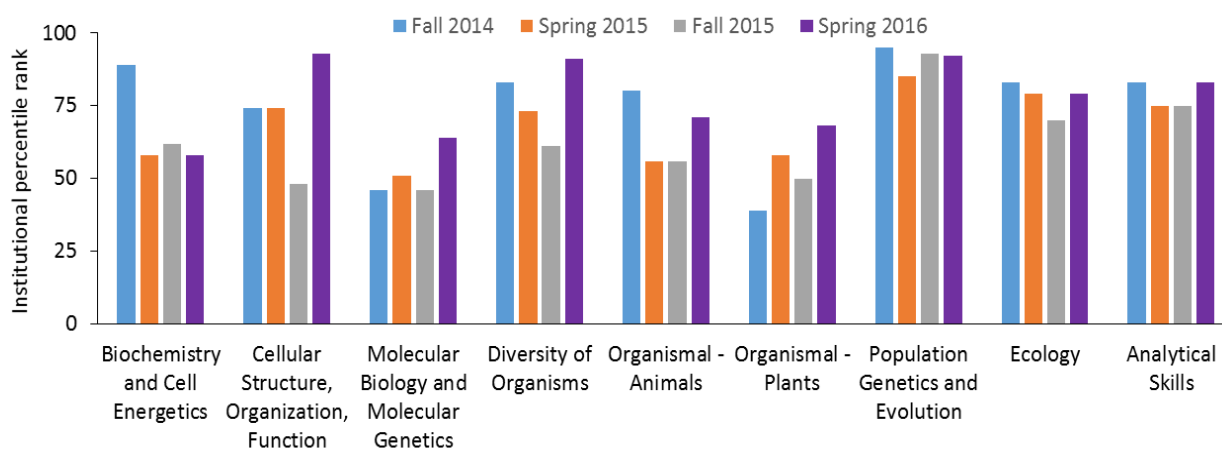


Figure 3. Biology MFT assessment indicators for the last four semesters. Assessment indicators are only calculated at the institutional level.

If we consider the individual percentile scores of our students (Fig. 4), it is clear that they vary a great deal. In most subject areas, we have students with an excellent command of biological knowledge, and others with very low scores suggesting poor retention of information from their biology classes. Correlations of individual scores among subject areas are fairly high (51 to 69%), suggesting that students doing poorly in one subject area are often poor across multiple areas.

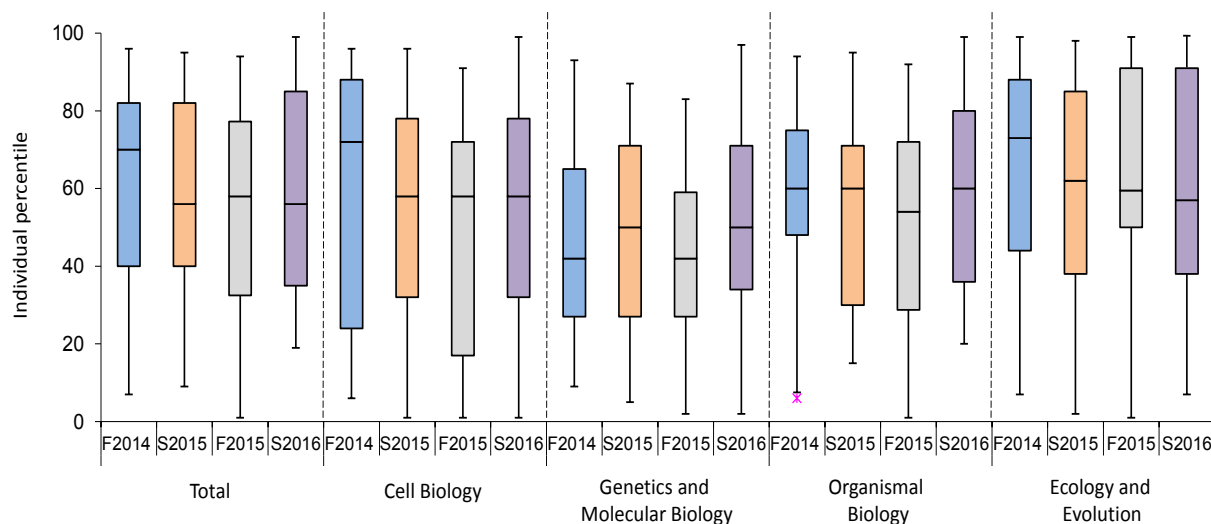


Fig. 4. Individual percentile scores on the Biology MFT over the past four semesters. The box encloses the 1st to 3rd quartile, whiskers extend to the lowest and highest datum within 1.5 interquartile range of the box, and outliers are displayed as a pink x.

1.2. Communication and Information Literacy

Graduates from the Biological Sciences program are expected to communicate clearly and accurately about biology in both oral and written form. In particular, the department aims to produce graduates who can use the published biological literature effectively, argue cogently from evidence, write a report describing the findings of a biological study in the format of a scientific paper, and give an effective oral presentation on a biological subject. We assess the students' performance in communication and information literacy within courses and through assessment of the required capstone project.

One measure of our majors' ability to communicate biology is the successful completion of oral and written intensive courses in biology. All communication-intensive courses in biology require students to access and interpret literature sources, thereby providing instruction in information literacy as well. The rate of successful course completion was high (Table 2) and similar to the previous period of review. A priority for the department for some years has been to increase the

number of students fulfilling their core communication requirements within biology. Numbers of students taking biology O and O/2 courses has not increased substantially over the past 6 years but numbers of students taking BIOL W courses in 2014-16 was 70% higher than in 2012-14 and 350% higher than in 2010-12.

Table 2. Number of Biological Sciences majors taking and passing communication-intensive courses with a BIOL designator during fall 2014 , spring 2015, and fall 2015.

Type	Number enrolled	Number earning passing grade*	% Earning passing grade*
W courses	182	162	89%
O or O/2 courses	96	88	92%

* A passing grade was C or better in 2014-15 and C- or better in 2015-16.

Another measure of our students' ability to communicate is the capstone project (covered in section 1.4 below). Briefly, the capstone project is a faculty-mentored research project chosen by the student and communicated in writing and (additionally and optionally during the period of review) in an oral report. The quality of information literacy and communication figures centrally into the project evaluation (Table 3: 9 of 12 assessment points pertain to communication).

1.3 Quantitative Skills

Biological Sciences majors must be able to apply quantitative approaches to problem solving in biology. Like biological knowledge, the quantitative proficiency of Biological Sciences majors is assessed using the ETS Biology Major Field Test. Approximately 25% of the Biology MFT's 150 questions evaluate the student's analytical skills, as well as their biological knowledge. Content covered by the test includes: experimental design; inductive reasoning; application of data to problem solving; units of measure; probability theory and statistics; and interpretation of graphs, tables, and statistical analyses. UAF's institutional percentiles for analytical skills on the MFT were 70-75% during the period of record. This level of performance was similar to the previous period of record.

Quantitative proficiency is also assessed as part of the capstone project. The analysis and interpretation of data is a required component of the capstone project and is formally assessed as part of the standard rubric (Table 3, assessment point 5).

1.4 Technical Skills and Collaboration

Biological Sciences majors are expected to be competent in basic laboratory skills and techniques. Instruction on the use of essential biological tools and practices is integrated into the laboratory exercises of three lower division courses required by all Biological Sciences majors: Fundamentals of Biology I and II (BIOL F115X and F116X) and Principles of Genetics (BIOL F260). Within these courses, TAs provide informal, formative assessment of technical proficiency. There is no formal, summative assessment of this outcome.

Biological Sciences majors are expected to collaborate effectively, leading to a productive outcome. Training in effective collaboration begins in the Fundamentals of Biology series (BIOL F115X and F116X), in which collaboration is a required component. Across the two courses, students complete a total of four collaborative research projects. For each, students develop a group contract as part of their project plan. TAs review the plan, track the collaborative skills of the students, and provide formative assessment in the form of feedback. At the end of the project, students enforce their group contracts and may impose penalties on group members who did not collaborate effectively, adding a summative component to the assessment. Collaboration is a common expectation of upper division biology courses, especially those including a lab.

1.5 Synthesis: The Capstone Research Project

The best evidence that a biologist can integrate knowledge and skills gained in coursework and solve problems using critical and creative thinking is successful completion of a research project. Under catalog years 2013-14 and later, all students in the Biological Sciences BA and BS programs are required to complete a capstone research project prior to graduation. Student projects are assessed with a standard rubric (<http://www.bw.uaf.edu/undergraduates/capstone.php>) that includes study design, critical review of the relevant scientific literature, logical interpretation of the results, and effective communication (Table 3). Students must earn an evaluation of "adequate" or better on all 12 elements in order to pass the capstone. Students may revise the capstone paper after receiving feedback from the mentor.

As of April 2016, 25 students across the BA and the BS had completed the capstone and at least another 8 projects were in progress as this report was prepared. Approximately 75% of students completed their projects within a designated capstone course, and 25% worked individually with faculty mentors. We expect the number of students completing the capstone per year to increase next year, as students who matriculated in 2013 enter their senior year.

Table 3. Evaluation criteria for capstone projects in the biological sciences during academic years 2014-15 and 2015-16. All twelve elements must be evaluated "adequate" or better in order to pass the capstone project.

Subject
1. Is the capstone project the product of data collection and/or analysis by the student?
2. Does the capstone paper make a compelling argument for the significance of the student's research within the context of the current literature?
3. Does the capstone paper clearly articulate the student's research goals?
4. Are the methods appropriate given the student's research agenda?
5. Is the data analysis appropriate and accurate?
6. Does the author interpret the results skillfully and accurately?
7. Are the tables and figures clear, effective and informative?
8. Is there a compelling discussion of the implications of findings?
9. Is the literature review appropriate and complete?*
10. Are the citations presented consistently and professionally throughout the text and i list of works cited?
11. Is the writing appropriate for the target audience?
12. Is the paper clearly communicated and free of language errors?

2. Conclusions drawn from the information summarized above

The MFT data suggest that the program is succeeding in educating undergraduates about biological sciences.

On the whole it also appears the department is doing a good job teaching our students to communicate within the discipline. Notably, we have substantially increased the number of our majors taking W classes within biology within the past 4 years, which greatly increases our ability to convey discipline-specific standards and conventions. In addition, increasing numbers of students are completing the capstone project, which places a strong emphasis on the quality of the student's scientific communication.

The capstone requirement is proving to be an effective means for engaging students in biology and assessing their knowledge and skills in a synthetic way. A capstone research project is an individual and original accomplishment that a student can report on their resume as evidence that they have engaged in biological research, from conceptualization and design to analysis and communication of results. As such, we anticipate that that the capstone project will enhance our students' preparedness for graduate studies and professional positions in the discipline.

3. Curricular changes resulting from conclusions drawn above

Although students performed well in most areas of biology, two areas of relative weakness were plant biology and molecular biology/genetics. The department's Teaching Advisory Committee has recommended a programmatic change that will allow students to apply BIOL F239 Introduction to Plant Biology to the biological sciences degree requirements with the intent of exposing more students to plant biology beyond the Fundamentals of Biology (BIOL F115 & 116) series. With regard to molecular biology/genetics, two capstone courses that teach molecular biology and genetics as a sophisticated level are due to appear next year: BIOL F466 Advanced Cell and Molecular Biology Laboratory and BIOL F494 The Human Microbiome.

In spring 2016 the department drafted a communications learning plan that will replace the UAF core requirement for writing and oral intensive courses. The plan incorporates training on written, oral, and visual display of quantitative information into required courses in the curriculum, and adds to the capstone new requirements for an oral report and a non-technical report written for a general audience.

Students in the BA program take substantially more courses outside the sciences than those in the BS program, yet in the past our SLO plans have been identical. In an effort to better differentiate the goals of the BA program from the BS program, future SLO plans for the BA will include the expectation that students integrate their understanding of social science and humanities into their capstone project report by addressing the social relevance of the work.

4. Identify the faculty members involved in reaching the conclusions drawn above and agreeing upon the curricular changes resulting

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