Biological Sciences, BS (BIO) Baccalaureate Degree

REPORT PREPARED by: Calkins, Laura L.

ACADEMIC YEAR COVERED BY THIS REPORT: 2021-2022

I. PROGRAM LEARNING OUTCOMES

Students completing a Bachelor of Science in Biological Sciences will be able to Demonstrate proficiency in the knowledge of essential concepts of biology at molecular, organismal, and ecosystem scales. Demonstrate proficiency in the knowledge of concepts in chemistry and physics necessary to understand the foundations of biology. Utilize mathematics and statistics to apply quantitative reasoning to biological concepts. Evaluate data using quantitative analysis and graphical representation. Apply observational strategies, formulate testable hypotheses, and design experiments with appropriate controls and variables. Exhibit problem solving skills and trouble-shoot procedures. Effectively communicate biological concepts and interpretations to varied audiences orally and in writing. Discuss the ethical implications of biological understanding and discoveries.

II. PROCEDURES USED FOR ASSESSMENT

A. Direct Assessment

Direct assessment was not used. Per the recommendations from the prior year, we used indirect assessment.

B. Scoring of Student Work

Survey questions took a Likert scale: 0 = Not at all, 1 = Somewhat, and 2 = Very much and was administered in Qualtrics.

C. Indirect Assessment

To estimate the extent to which students met each of the eight Program Learning Outcomes (Table 1), the Biological Sciences Assessment Committee developed a survey of students' confidence in applying each of the competencies to their working lives after graduation. These questions took a Likert scale: 0 = Not at all, 1 = Somewhat, and 2 = Very much. In order to better contextualize students' Likert responses, we also asked students open-ended questions about their perceived strengths and weaknesses of the Biological Sciences Bachelorette program and courses they found most and least useful in their preparation. The survey was delivered online through Qualtrics. The link was provided to students by the students' advisors as well as via an e-mail message from the director of the Biological Sciences Assessment Committee. Six graduates completed the survey. Table 1. Summary of the eight Program Learning Outcomes desired for Biological Sciences majors and survey questions to measure students' perceived mastery of each objective (0 = not at all; 1 = somewhat; 2 = very much). Outcome Statement Survey Question O1 Demonstrate proficiency in the knowledge of essential concepts of biology at molecular, organismal, and ecosystem scales. I feel like I have mastered the essential concepts of biology well enough to excel as a biologist O2 Demonstrate proficiency in the knowledge of concepts in chemistry and physics necessary to understand the foundations of biology. My knowledge of the physical sciences, including physics and chemistry, is outstanding O3 Utilize mathematics and statistics to apply quantitative reasoning to biological concepts. I would succeed at a job that required quantitative reasoning and use of math and statistics O4 Evaluate data using quantitative analysis and graphical representation. I would succeed at a job that required regular analysis and summarization of data. O5 Apply observational strategies, formulate testable hypotheses, and design experiments with appropriate controls and variables. I have strong skills in designing and conducting experiments, including formulating testable hypotheses and accounting for appropriate controls and variables. O6 Exhibit problem solving skills and trouble-shoot procedures. I would succeed at a job that required me to trouble-shoot and solve problems on a daily basis. O7 Effectively communicate biological concepts and interpretations to varied audiences orally and in writing. I am capable of talking and writing about biology to academic audiences. O8 Discuss the ethical implications of biological understanding and discoveries. I would succeed in a job that required me to understand the ethical implications of biological understanding and discoveries.

III. ASSESSMENT RESULTS/INFORMATION:

Summary of the eight Program Learning Outcomes desired for Biological Sciences majors, and upper level courses aligned to these objectives which were offered in 2020. Qualitative open-response data is also presented to help contextualize students' survey responses and give more strategic information for departmental decision making.

Average achievement scores above the "somewhat = 1" level were reached for all of the Program Learning Outcomes (Table 2). We found it promising that Outcome 6 (problem solving skills) was rated as "Very much" by all six respondents given the ability of this outcome to transfer across a variety of careers. Outcomes 4 (data/quantitative analysis), 7 (communication of biological sciences concepts), and 8 (understanding ethical implications) were also rated very highly with a mean of 1.8. Perceived mastery of Objectives 1 (perceived mastery of essential concepts) and 3 (math and statistics) took mean values of 1.5 which sit between the "somewhat" and "very much" categories. The lowest ratings were given to Objectives 5 (experimental design) and 2 (chemistry and physical science knowledge). Table 2. Summary of self-reported mastery of the eight Program Learning Outcomes for the BS Program in Biological Sciences. Rows are ordered from highest to lowest level of mastery. Outcome Statement Meana SD O6 Exhibit problem solving skills and trouble-shoot procedures. 2.0 0.0 O4 Evaluate data using quantitative analysis and graphical representation. 1.8 0.4 O7 Effectively communicate biological concepts and interpretations to varied audiences orally and in writing. 1.8 0.4 O8 Discuss the ethical implications of biological understanding and discoveries. 1.8 0.4 O1 Demonstrate proficiency in the knowledge of essential concepts of biology at molecular, organismal, and ecosystem scales. 1.5 0.5 O3 Utilize mathematics and statistics to apply quantitative reasoning to biological concepts. 1.5 0.8 O5 Apply observational strategies, formulate testable hypotheses, and design experiments with appropriate controls and variables. 1.3 0.5 O2 Demonstrate proficiency in the knowledge of concepts in chemistry and physics necessary to understand the foundations of biology. 1.2 0.4 aScale is: 2=Very much, 1=Somewhat, 0=Not at all These scores make sense in light of students' open-ended comments. Several of the students expressed frustration with the Organic Chemistry coursework, indicating that they didn't see its relevance to the Biological Sciences discipline. One student stated: I don't believe that we should have to take higher level chemistry course beyond general chemistry. In the words of another student: Organic Chemistry was my least favorite course. I know this isn't considered a biological course but I was required to take it. I don't think that the professors teach very well and the lab is not organized well at all. Another student expressed dissatisfaction with the diversity of the department's course offerings in general: …I do think more [course] options should be added. This past semester registering for classes it was hard because I needed specific class levels to take and there was a limited amount of students and classes to take. I think this should definitely be improved considering this could cause people to get behind due to the class they needing not being available. In particular, Mycology, Entomology, and Respiratory Physiology were courses that students requested in their responses which apparently weren't offered. These responses indicate that our graduates wanted opportunities to specialize through appropriate coursework but that these relevant opportunities were not provided. This relates to previous departmental discussions of the considerable tension between focusing on the higher-enrollment courses which make money and the need to allocate resources to upper-level electives which allow students to specialize, pursue their interests, and prepare for life after graduation. More regular specialization opportunities are needed, and it would be worth discussing how we might facilitate this through a less resource-intensive format such as offering 1-hour seminar specialty courses more regularly in lieu of a full 3-hour course every few years. To the end of helping students specialize in

their field, undergraduate research has been a focus area in our department. Students' comments indicated that they perceive these opportunities positively. One student stated: I have been able to participate in undergraduate research through the honors program. Since freshman year, I worked in a lab where I learned about respiratory mechanisms of insects and how to measure their metabolic rates. I was also able to complete my departmental honors project on the mechanisms of spiracular control in Manduca Sexta. Another student stated: I loved helping a grad student with bat research in the Wright State woods. However, other students indicated that they didn't have any research opportunities. Making undergraduate research more mainstream may be a way to help improve students' preparedness across all eight of the outcomes.

[Analysis]

IV. ACTIONS TO IMPROVE STUDENT LEARNING

Program learning outcome data will be shared with program faculty and staff at the department meetings. It will be shared with other stakeholders including faculty and staff in other departments and department sponsors upon request by these parties. Although ratings are well above the "1" level aligning with "Somewhat", the data show that understanding of concepts in physical science and chemistry and understanding of experimental design need the most attention. More specialized upper-level coursework or research opportunities may be instrumental in helping students better contextualize the relevance of the physical sciences and experimental design and carry these into their careers with greater confidence. Although these data represent students' perceptions of their mastery as opposed to a performance-based measure, these responses reflect how graduates are likely to communicate with others about the quality of the Biological Sciences program and their satisfaction with the program. To this end, we will use these data to guide discussions of potential reforms taking into account other financial and resource constraints. Regarding the assessments for the upcoming year, the Assessment Committee will discuss strategies for improving the response rates which we hope will increase the representativeness of the sample. Although we cannot necessarily require completion of the survey for graduation, there may be other ways to incentivize participation, and revisions of the survey will focus on optimizing brevity and simplicity while also retaining our ability to extract informative data.

V. SUPPORTING DOCUMENTS

Additional documentation, when provided, is stored in the internal Academic Program Assessment of Student Learning SharePoint site.