Program Assessment Report (PAR)

Biological Sciences, BS (BIO) Baccalaureate Degree

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ACADEMIC YEAR COVERED BY THIS REPORT: 2020-2021

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

To estimate the extent to which students met each of the eight Program Learning Outcomes (Table 1), we utilized grade distributions derived from Biology courses and physical science courses with which the learning outcomes were matched. Many of these courses were taught in multiple sections; however, it was assumed that each section of the same course addressed similar outcomes. In the case of the physical science outcome (O2), we looked at the BIO and CHM/PHY courses separately to provide an estimate of the effect of removing the biology-specific disciplinary context. Table 1. Summary of the eight Program Learning Outcomes desired for Biological Sciences majors, and selected courses aligned to these objectives which were offered in 2020. Outcome Statement Courses Representing O1 Demonstrate proficiency in the knowledge of essential concepts of biology at molecular, organismal, and ecosystem scales. BIO2110,2310,4020,4920 O2 Demonstrate proficiency in the knowledge of concepts in chemistry and physics

necessary to understand the foundations of biology. BIO2110,2120,2310,3530 O3 Utilize mathematics and statistics to apply quantitative reasoning to biological concepts. BIO2110,2120,2310,3530,4020,4200,4920,4950,4990 O4 Evaluate data using quantitative analysis and graphical representation. BIO2110,2120,2310,3530,4020,4200,4920,4950,4990 O5 Apply observational strategies, formulate testable hypotheses, and design experiments with appropriate controls and variables. BIO2120,2310,4020,4200,4920,4950,4990 O6 Exhibit problem solving skills and trouble-shoot procedures. BIO2110,2120,3530,4020,4200,4920,4950,4990 O7 Effectively communicate biological concepts and interpretations to varied audiences orally and in writing. BIO2120,4020,4200,4920,4950,4990 O8 Discuss the ethical implications of biological understanding and discoveries. BIO2110,3530,3920,4020 O2a Demonstrate proficiency in the knowledge of concepts in chemistry and physics necessary to understand the foundations of biology. CHM1210,1220,2110,2120,PHY1110,1120 a Included to compare conclusions from biology and non-biology science courses. The grade distributions in each course section were used to calculate a pass rate defined as the percentage of students earning grades "A", "B", "C", "D", or "P" in each course. An aggregate percent achievement rate for each Program Learning Outcome was then calculated as the average pass rate of each course section which contained the target Program Learning Outcome weighted by the enrollment in that section. The motivation behind this approach was to obtain a measure of the extent to which our majors met the objective which was relatively independent of the nuances of a particular course. The aggregate "Percent Achievement Rate" score for each Program Learning Outcome is reported in Table 2.

B. Scoring of Student Work

Grade Distributions of Selected courses that meet learning outcomes.

C. Indirect Assessment

This will be done with the development of a Qualtrics survey to graduating students going forward.

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.

Aggregate percent achievement scores above 80% were reached for all of the Program Learning Outcomes (Table 2). Knowledge of essential biology concepts was the most difficult outcome with an achievement of 86%. Understanding of concepts in physics and chemistry was slightly higher at 87% when taught within the disciplinary context of biology. When this disciplinary context was removed, achievement dropped to 84%. Understanding of ethical considerations in biology had an achievement rate of 88%. Outcomes 3, 4, and 5 which address scientific practices related to quantitative analysis and experimental design, had achievement rates of 89%. Troubleshooting and solving problems had an achievement rate of 91%, and ability to communicate orally and in writing had the highest achievement rate at 92%. 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. Objective Learning Outcome Summary % Achievement O1 Knowledge of essential biology concepts 85.9 O2a Concepts in physics and chemistry (BIO courses) 87.4 O2a Concepts in physics and chemistry (CHM and PHY courses) 83.9 O3 Apply quantitative reasoning 88.9 O4 Data analysis and graphical representation 88.9 O5 Design of experiments 89.4 O6 Problem solving and troubleshooting 90.5 O7 Oral and written communication 91.7 O8 Ethical considerations in biology 88.2 aComparison between %Achievement derived from courses inside and outside of biology. The Table 2 calculations include courses from Lake Campus. Table 3 gives the comparisons in enrollment and pass rate for the same course taught at the Dayton and Lake campuses. We observe that the classes at Lake Campus are smaller and that the pass rates tend to be higher. This suggests that an effort to make classes smaller may lead to higher achievement of our Program Learning Outcomes. Table 3. Differential pass rates between common courses at the Dayton and Lake campuses. Lake Campus Dayton Campus Course Enrollment Pass Rate Enrollment Pass Rate BIO 2310 7 100 115 82 BIO 3710 4 75 8 50 BIO 4990 1 100 31 97

[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 the aggregate achievement measures are well over 80% for all learning outcomes, the data show that courses getting at essential concepts in biology and the physical sciences have lower achievement on average than courses which focus more on open-ended problems and higher-order thinking skills. Is this difference real, or is it due to the assessments in courses focused on essential concepts being more difficult? If course grades continue to be used, fitting individual-level data with a model that adjusts for course difficulty and the fact that a student may take multiple courses could generate measures for each Program Learning Outcome which are relatively free of biases associated the specific types of assignments and grading difficulty of a particular course. Another option we are considering is collecting an indirect assessment of our graduates using an exit survey which asks the extent to which they feel an outcome has been met and/or relative comfort pursuing work after graduation that aligns with a specific outcome. We acknowledge that reported

achievement does not necessarily align with actual achievement. However, this approach could be more useful from a marketing perspective since responses would align better with how graduates are likely to communicate with others about the quality of the Biological Sciences program and their satisfaction with the program.

V. SUPPORTING DOCUMENTS

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