ANNUAL PROGRAM REPORT

College	College of Science
Department	Biological Sciences
Program	B.A., B.S. and M.S. in Biological Sciences
Reporting for Academic Year	2021-2022
Last 5-Year Review	2018-2019
Next 5-Year Review	2022-2023
Department Chair	Brian A. Perry
Authors of Review	Brian A. Perry, Ana Almeida, Maria Gallegos
Date Submitted	October 1, 2022

I. SELF-STUDY

A. Five-Year Review Planning Goals

- *Increase student participation in the B.S. in Ecology and Evolutionary Biology (EEB) concentration*
- *Increase student opportunities in the B.A. in Biology Education concentration*
- *Increase student opportunities in the B.S. in Forensic Science concentration*
- *Increase enrollment in the M.S. in Biology graduate program*
- *Increase student success within the major as demonstrated by improved graduation rates and student retention*
- *Build community among the undergraduate and graduate populations through seminar series and research symposia*
- *Improve connections with our alumni*

B. Progress Toward Five-Year Review Planning Goals

Will be addressed in the 5-Year Review being prepared this academic year.

C. Program Changes and Needs

Will be addressed in the 5-Year Review being prepared this academic year.

II-a. SUMMARY OF ASSESSMENT – UNDERGRADUATE PROGRAMS

A. Program Learning Outcomes (PLO)

Students graduating with a B.S. or B.A. in Biological Sciences from Cal State East Bay will be able to:

1. *Explain core biological concepts, including evolutionary processes, structure-function relationships across all levels of biological organization, homeostasis, information flow, matter and energy transformations, and the interactions and interconnectedness of living systems (ILO 6);*
2. *apply quantitative reasoning to explain biological phenomena and to address biological problems (ILO 1);*
3. *clearly communicate biological information in a variety of formats (written, oral, visual) using a style appropriate for the intended audience (ILO 1,2,6);*
4. *apply methods of scientific inquiry by formulating testable hypotheses, collecting and analyzing data, and reporting conclusions (ILO 1,6);*
5. *gather, interpret, and evaluate published scientific information (ILO 1,6).*

B. Program Learning Outcome(s) Assessed

According to our 5-year Assessment Plan, the AY 2021-22 Assessment focused on PLO5 (gather, interpret, and evaluate published scientific information), in partial alignment with the Senate-approved Information Literacy Institutional Learning Outcome. No other program learning outcomes were assessed for these programs during AY 2021-22.

C. Summary of Assessment Process

Instrument: PLO5 was assessed based on an Annotated Bibliography activity administered during the Spring 2021 semester for biology majors taking BIOL320 – Principles of Evolutionary Biology. After choosing a research topic, students were requested to search and gather five scientific references relevant to their topic of choice. Based on these references, and their search criteria, students were asked to: **(i)** briefly describe the question, problem or concept as it relates to Evolutionary Biology, making sure to clearly articulate the relevance of the chosen topic as well as specific question, problem or concept; **(ii)** list at least three keywords used for the literature search; **(iii)** list the databases used for the literature search (students were required to use at least two databases from a list provided to them); **(iv)** describe the search strategy used in each database, including details on the searches, combinations of keywords used, etc; **(v)** provide descriptive information on each chosen source, including title, year of publication, journal, type of publications, number of citations, and number of times cited; **(vi)** justify the choice of the 5 papers included in the annotated bibliography, especially taking into consideration their relevance to the question, problem or concept; and, **(vii)** describe the evidence used to support the credibility of the 5 papers included in the annotated bibliography.

Sampling procedure: All 73 students enrolled in BIOL 320 during the Spring 2021 semester participated in the assessment.

Data Collection: The assessment instrument was implemented through Google Forms. Students' answers to the questions described above were assessed based on three main criteria: **(i)** ***Scope***, which assessed student's ability to identify a relevant question/problem/concept for investigation within the field of Evolutionary Biology; **(ii)** ***Gather***, which assessed student's use of search strategies to gather a range of sources; and, **(iii)** ***Evaluate***, which assessed student's ability to evaluate the collected sources for relevance and credibility.

Data Analysis: Each criteria (Scope, Gather and Evaluate) was assessed based on the categories established by the Senate Approved CSUEB ILO Information Literacy rubric, and ranges from 1 (insufficient and/or incomplete performance) to 4 (exemplary performance), and a score of 3 or higher represents competency.

D. Summary of Assessment Results

Main Findings: Figure D1 presents the results for all three criteria assessed here (i.e., Scope, Gather, and Evaluate). In general, biology majors performed well in all three criteria, with more than half of the assessed artifacts considered as competent (categories 3 or 4). Students performed the best in the criteria *Scope*, with a mean score of 3.3 and a median of 4.0. In this criterion, approximately 82% (60/73 artifacts) were assessed as competent. The criteria *Gather* was the second best, with a mean score of 2.8 and median of 3.0. Approximately 68% (50/73 artifacts) of assessed artifacts were considered competent for *Gather*. Lastly, *Evaluate* had a mean score of 2.6 and a median of 3.0. In this criteria, 53% (39/73 artifacts) were scored as competent.

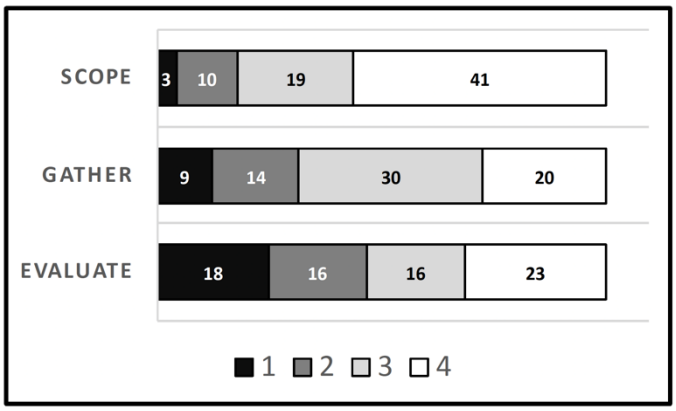


Figure D1 – Number of artifacts in each category (1 through 4) for each of the three assessed criteria (Scope, Gather, and Evaluate). Categories 3 and 4 represent competency. Overall, biology majors performed well, especially in the Scope and Gather criteria, for which approximately 82% and 68% of artifacts were considered competent, respectively. For the criteria Evaluate, 53% of artifacts were assessed as competent.

Limitations: The results presented here are encouraging and suggest that biology majors are being exposed to learning experiences that promote information literacy overall. These results, however, should take into account that the artifacts assessed came from a single assignment within a 300-level course, in which students are still developing concepts and skills. This might explain why the criteria *Evaluate* had the lowest scores, since it is the one that demands most advanced skills and analyses. Another point for consideration is the fact that these artifacts were assessed by a single assessor (Dr. Almeida) that, albeit experienced, might introduce personal bias into the analysis. In the future, it is recommended that a group of assessors is recruited for the assessment in order to produce more robust results.

Recommendations for Program Improvement: In order to close the loop, the Department should provide students the opportunity to further develop information literacy skills in 100- and 200-level classes offered to biology majors, especially focusing on the evaluation of relevance and credibility of sources. Lastly, the Department should review the current 5-year Assessment Plan in order to promote a more granular, and potentially more accurate, picture of student learning outcomes during their time at CSUEB.

Next Step(s) for Closing the Loop: The Department will discuss ways to integrate information literacy across the curriculum, especially within 100- and 200-level courses. The Department envisions that a task force comprising 3-5 faculty could plan incrementally more complex activities to be administered throughout the first three years of the biology major. These activities would gradually develop skills and competencies to allow students to adequately gather, interpret, and evaluate published scientific information.

Other reflections: Although the current assessment strategy is a somewhat effective way for assessing whether our students are meeting our program learning outcomes, a more refined assessment plan needs to be developed. A more granular assessment of student learning would not only help the Department understand when, along the curriculum, more effective changes could be made, but could also inform what student demographics might need more support or a different kind of support that is not yet being provided. Undoubtedly, the use of the same assessment approach over time will increase our statistical power, allowing the Department to better evaluate if any of our programmatic changes

make a difference in student learning outcomes. However, the standardization of assignments for the purpose of assessment should go hand-in-hand with other efforts.

II-b. SUMMARY OF ASSESSMENT – GRADUATE PROGRAM

A. Program Learning Outcomes (PLO)

Students graduating with a M.S. in Biological Sciences from Cal State East Bay will be able to:

1. *Demonstrate a broad and sophisticated understanding that contributes to biological concepts and principles across all levels of biological organization, from ions to ecosystems (ILO 1,2,6);*
2. *demonstrate expertise in a specific area of biological science (ILO 6);*
3. *independently apply the scientific method to formulate testable biological hypotheses, analyze empirical data, and synthesize the results of the analysis (ILO 1,2,6);*
4. *clearly communicate the design and results of an observational or experimental analysis in a variety of formats, including the graduate thesis, scientific paper, scientific poster, and oral presentation (ILO 1,2,6);*
5. *gather and evaluate primary scientific literature and judge the value of the information presented in relation to particular biological questions (ILO 1,6).*

B. Program Learning Outcome(s) Assessed

Instrument: For the M.S. program we used the "Inquiry and Analysis Rubric" and the "Oral Communication Rubric" to assess the oral defense, a capstone event in partial fulfillment of the Master of Science Degree. A copy of these rubrics is included in the Appendix (Fig. A3). These rubrics are based on the VALUE rubrics developed by teams of faculty experts representing colleges and universities across the United States. The Value Rubric Development Project was sponsored by the Association of American Colleges and Universities.

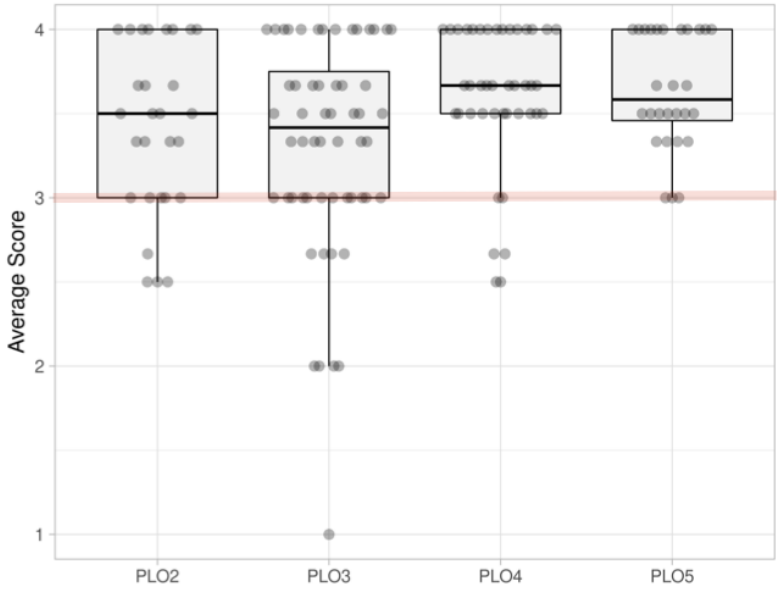
Sampling Procedure: The combined "Inquiry and Analysis" and "Oral Communication" rubric was applied to all 14 M.S. students that scheduled an oral defense in during AY 2021-22. The oral defense is one of the final requirements that our M.S. students complete. By the time a student schedules the oral defense, the University Thesis has been written and submitted for format review.

Data Collection: For the M.S. program, all three committee members (including the thesis advisor) are tasked to complete a combined "Inquiry and Analysis" and "Oral Communication" rubric just after the completion of the oral defense by the student. This rubric was converted to a Google Form and can be reviewed here: (Link: https://docs.google.com/forms/d/e/1FAIpQLScK-3JmxzQKct2i2TLc-zrJoirCol6LoRW19tJjIIv59qLSRg/viewform?usp=sf_link). For each student that passes the oral defense, the graduate coordinator forwards a Completion Memo to the University Graduate Evaluator. For assessment purposes, the Graduate Coordinator simply downloads the raw data now available in excel format. This year, a majority of students (n=8) were reviewed by three faculty members. Where that failed, two faculty members submitted an assessment.

Data Analysis: For the M.S. program, the results shown in section C below (Summary of Assessment Results) include all individual data points (filled black circles). The black horizontal line represents the average. The gray boxes represent the first and third quartile and the vertical lines represent the minimum and maximum. Figures C1 through C3 below include data for all 14 students evaluated in AY 2021-22.

C. Summary of Assessment Process

Main Findings: For the M.S. program, we aim for all of our students to score at 3 (proficient) or above for all PLOs assessed. By looking at the data for individual PLOs assessed (Figure C1), you can see that on average we are meeting our goal. That said, the same graph shows that some students (individual data points) are scoring between 1 and 3 (2= basic, 1=minimal) for PLOs 2, 3 and 4 (not 5). In fact, one student scored a 1 for PLO3 (*independently apply the scientific method to formulate testable biological hypotheses, analyze empirical data, and synthesize the results of the analysis).* In Figure C2, the average earned score for individual assessment criteria is provided. This data also demonstrates that on average, we again are meeting our goal of 3 or above. That said, the average score for **background knowledge** was at 3 and was the lowest among all the criteria assessed. This was true last year as well. Finally, in the assessment of individual students (Figure C3), one can see that only two of the fourteen students (1 and 3) earned an average score below 3. This is a drop from last year although numbers are small and is not likely a significant difference. In summary, while the data look acceptable on average, we can still make improvements for individual students and individual categories (i.e., background knowledge. See "Next Step(s) for Closing the Loop" below.



PLO2 through PLO5:

2. Demonstrate expertise in a specific area of biological science.
3. Independently apply the scientific method to formulate testable biological hypotheses, analyze empirical data, and synthesize the results of the analysis.
4. Clearly communicate the design and results of an observational or experimental analysis in a variety of formats, including the graduate thesis, scientific paper, scientific poster, and oral presentation.
5. Gather and evaluate primary scientific literature and judge the value of the information presented in relation to particular biological questions.

Figure C1. Average rubric score for each PLO evaluated. Please note that PLOs were evaluated by more than one criteria (see rubric in Appendix and list of individual criteria in Figure C2). The red line marks the position of proficient.

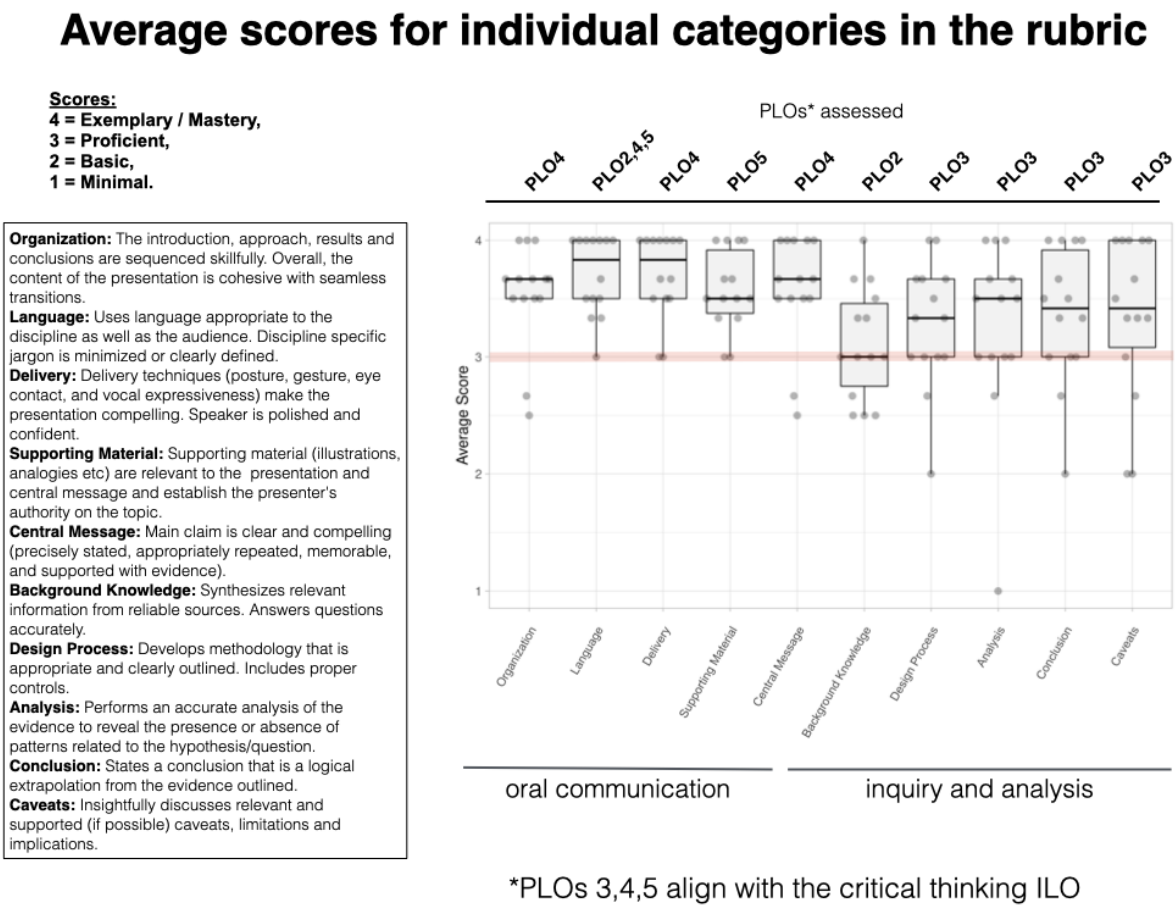


Figure C2. Average rubric score for each criteria outlined in the rubric. A list of categories listed in the rubric is found at right. The red line marks the position of proficient.

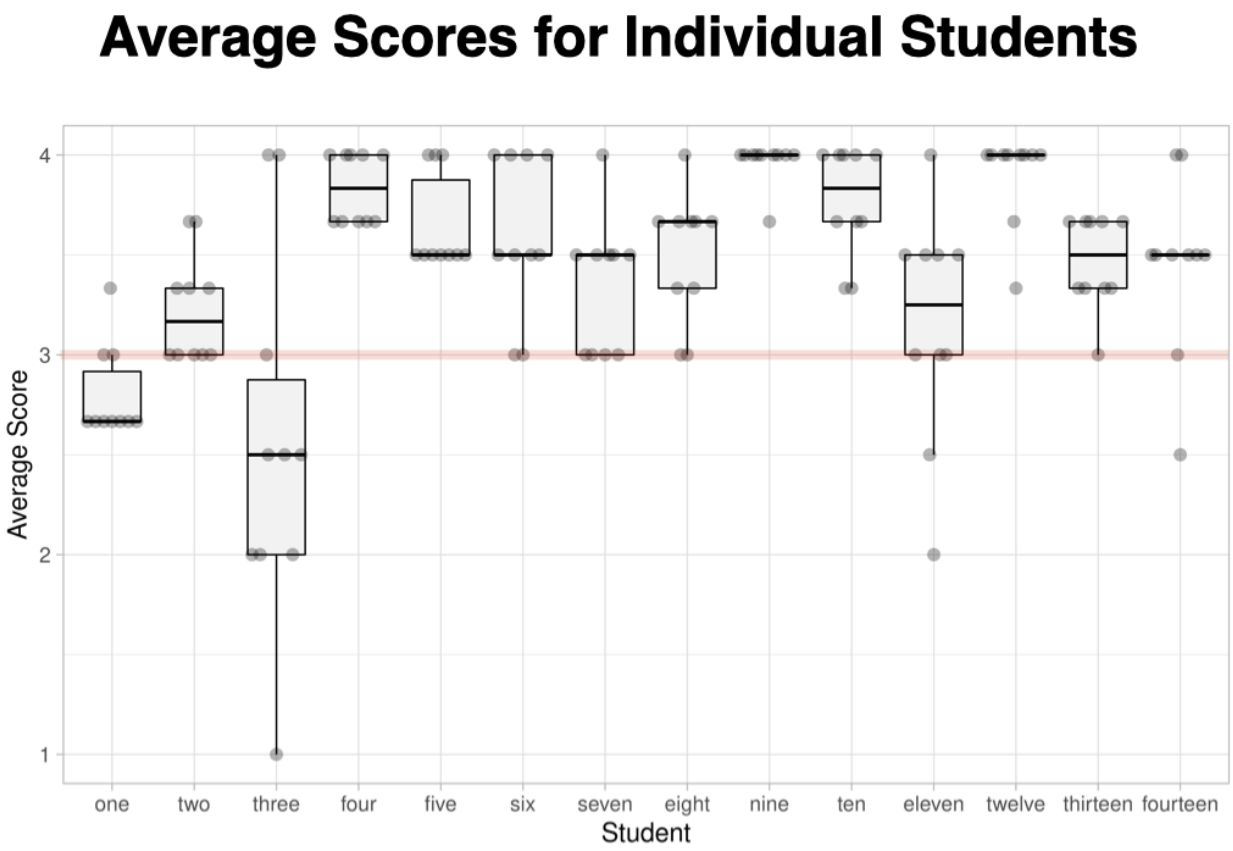


Figure C3. Average scores for each student. Students were numbered 1-11 from left to right. The red line marks the position of proficient.

D. Summary of Assessment Results

Recommendations for Program Improvement: We are aware of the areas in which our students require additional instruction and experience, and have decided upon steps that should be taken to improve student outcomes (see Next Step(s) below).

Next Step(s) for Closing the Loop: It is clear, that some of our students need more guidance as they progress through the program. Faculty have discussed the possibility of instituting a departmental requirement that students meet with committee members once a semester to demonstrate progress towards completion of their degree courses and thesis research. Unfortunately, we have yet to agree on making this a requirement. Instead, it is remains, "strongly encouraged." Most faculty cite a lack of time. While we attempt to make a policy change that we can agree on, our new Graduate Policy Committee met twice last year to discuss other steps we can take to 1) increase the likelihood that students get useful feedback from thesis committee members during the proposal writing process and 2) facilitate progression through the program in a timely manner.

First, we changed the Proposal Submission Process to be more specific about deadlines. The instructions now include the following instructions: "In order to enroll in University Thesis units (BIOL 691), **a completed proposal submission form signed by the advisor must be emailed along with the advisor-approved proposal to the *graduate coordinator AND thesis committee* no later than 7 days *prior* to**

the 1st day of classes. It is the student's responsibility to meet this deadline. This deadline ensures that the committee has at least two weeks to read, provide feedback and solicit corrections and clarifications. *The graduate coordinator will be responsible for gathering the other committee member signatures."* Again, the aim of this change is to ensure that committee members have more time to evaluate the proposal and provide feedback to the students. By bringing the Graduate Coordinator into the mix, we can make sure the policy is being followed by all. This new policy was implemented for the first time this Fall (2022). What we found was that the implementation of this policy was time consuming for the Graduate Coordinator. Going forward, we hope to streamline this process by asking IT to build an online version of the Proposal Submission Form so that the graduate coordinator can still monitor adherence to the policy but that signatures can be gathered through Adobe Sign.

The Graduate Policy Committee has also been discussing new rules about who can TA in an effort to encourage students to progress through the program in a timely manner. While this is still a work in progress, we have discussed the following new departmental rules related to TA eligibility: 1) Students must be in good academic standing (3.0 GPA); 2) Students that have NOT submitted a research proposal but have completed all other coursework cannot *apply* for TAships until after their proposal is written and approved by their committee; 3) Students become ineligible to TA once two years have elapsed since completion of their University thesis units; and 4) No student can serve as a TA for more than 6 semesters in total (summers excluded). These rules will be discussed in an upcoming faculty meeting and will hopefully ratified in the near future.

We have also begun to implement changes to our year-long foundations course (1 unit/semester) entitled, "Foundations of Scientific Research". The description of BIOL 601A includes verbiage that the course involves "*critical review of sample thesis proposals and drafting original thesis proposal.*". Last year we agreed that asking our first semester students to begin work on a research proposal was premature. Instead, we argued that students need to gain more practical skills that will help them with that effort. While the course description has not yet formally changed, the course instructor for BIOL 601A is introducing more skills (how to access the primary literature, how to manage citations, how to create figures etc) and less proposal writing. The same instructor will be teaching BIOL 601B (for continuity). During the second semester, the students will focus on writing the research proposal. By the end of the year, we should know better if we are successful. Our goal is that students have a useable first draft of their research proposal by the end of the academic year.

<u>Other Reflections</u>: We are also confident that the modifications we are making to our year-long course in the curriculum that specifically focuses on the PLOs of the program will have a positive impact on the success of our M.S. students. We also anticipate that the changes we are making to our Proposal Submission process and TA eligibility will also help our students progress through the program.

<u>Assessment Plans for Next Year</u>: In general, the faculty continue to value the rubric as an effective measure for assessing if our students are meeting our program learning outcomes. Thus, we plan to continue to use this same rubric to assess our MS students during the oral defense. By using the same rubric year after year, we will increase our statistical power and be able to evaluate if any of our programmatic changes make a difference in student outcomes. The Graduate Policy Committee will also discuss whether or not we should implement new rules to ensure our students obtain the **content knowledge** they need master PLO2 (*Demonstrate a broad and sophisticated understanding that contributes to biological concepts and principles across all levels of biological organization, from ions to ecosystems)*. This process may require that we assess PLO2 at an earlier stage of the program. These conversations are ongoing.

III. DISCUSSION OF PROGRAM DATA & RESOURCE REQUESTS

A. Discussion of Trends & Reflections on Notable Trends

Only those trends that relate to resource requests are included here. All other trends will be addressed in the 5-Year Review being prepared this academic year.

Notable Trends: University Dashboard (APR) summary data is presented as tables and graphs in the appendix to this document. The student data presented in this truncated report only includes Biology major enrollment by concentration from Fall 2018 through Fall 2021.

The following trends can be observed from the student demographics:

- Of the six concentrations the department offers, Cell and Molecular Biology, Physiology and Microbiology & Biomedical Sciences account over 70-75% of our majors annually. (Fig. A2).
- Of the six concentrations the department offers, Cell & Molecular Biology and Microbiology & Biomedical Sciences continue to increase in the percentage of our total enrollments they account for (Fig. A1).
- Forensic Science, Ecology & Evolutionary Biology and the BA in Biology Education have lower overall enrollments, but have remained consistent in the percentage of our majors each concentration accounts for (Figs. A1 & A2).
- The Physiology concentration has shown the greatest decrease in enrollments since Fall 2018 (Figs. A1 & A2).

Reflections on Notable Trends: Will be addressed in the 5-Year Review being prepared this academic year.

B. Request for Resources

The department is well aware of budget uncertainly going forward, and does not expect to be able to fill both of the following positions in the next academic year. However, the requests have been included here as we feel these represents the department's greatest faculty hiring needs going forward.

1. Tenure-Track Hires

Microbiologist – AY 2020-21 saw the departure of two tenure-track microbiology faculty (Drs. Pakpour and Guiton), and the retirement (FERP) of Dr. Carol Lauzon. With these losses and partial retirement, the department effectively went from 3.0 to 0.5 microbiology faculty. At the same time, enrollment in the department's Microbiology and Biomedical Lab Sciences concentration continues to grow. Even with an overall drop in student enrollment throughout the program, enrollment in the concentration continues to make up an increasing percentage of our majors (a 5.4% increase since Fall 2018). With the loss of Drs. Pakpour and Guiton, and the partial retirement of Dr. Lauzon, finding faculty to cover our required microbiology courses, and offer specialized upper division electives, has become increasingly challenging. As a result, the department has not been able to offer several upper division electives since Fall 2021 and have scrambled to find qualified lecturers to offer our general microbiology courses. The need to replace these faculty losses with additional tenure-track hires is imperative if we are to continue providing our students with the courses they require to meet their career goals. The department was approved to search for two tenure-track microbiology positions in AY 2022-23. However, due to anticipated budget shortfalls, the department was recently informed that only a single position from this search is likely to be approved by the Provost. Given this news, the department requests the approval to fill an additional microbiologist position at the assistant professor level in AY 2023-24.

Cell and Molecular Biologist – Spring 2022 was the last semester of FERP teaching for Dr. Donald Gailey. With Dr. Gailey's departure we are once again left with a shortage of qualified faculty to cover basic courses such as Genetic Analysis I (BIOL 310) and upper division Cell and Molecular Biology electives. As our Cell and Molecular Biology concentration continues to account for a greater percentage of our enrollments (4% increase from Fall 2018 to Fall 2021), so does our need for faculty to offer the courses required by these students. We request the hiring of a Cell and Molecular Biologist at the assistant professor level that can offer specific courses in the field, as well as teach general biology courses for majors and non-majors.

2. Staff Hires

Equipment Technician Brian Sowers (ET-II) retired in Fall 2019. The department initiated a replacement search to fill this position, but this was closed during the CSU-wide hiring chill in Spring 2020. The position was opened again in Fall 2020 but has remined vacant due to the required level of qualifications and experience coupled with the below-market salary offered by the University. This is reflected in the surprisingly small pool of candidates that have applied for the position (none of which had adequate qualifications or experience). Until the salary issue can be remedied and/or the level of the position is reduced to an ET-I, it is very unlikely this position will be filled. The Biological Sciences and Chemistry departments, as well as the College of Science, rely heavily on this position for maintenance, upkeep and repair of numerous pieces of equipment, and currently have no other option but to hire outside vendors when repairs or service are needed. The department requests that the salary level for this position be re-evaluated and increased so that this position can be filled with a qualified candidate.

IV. APPENDIX

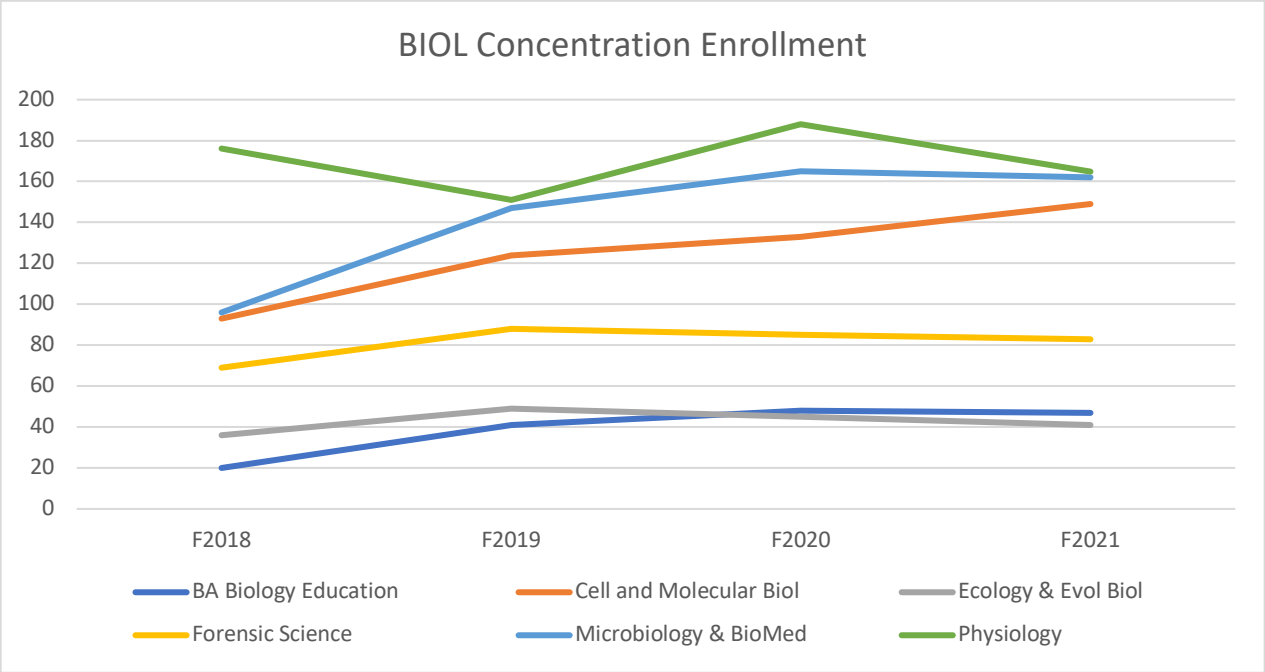


Fig. A1. Biological Sciences enrollment by concentration (Fall 2018 through Fall 2021).

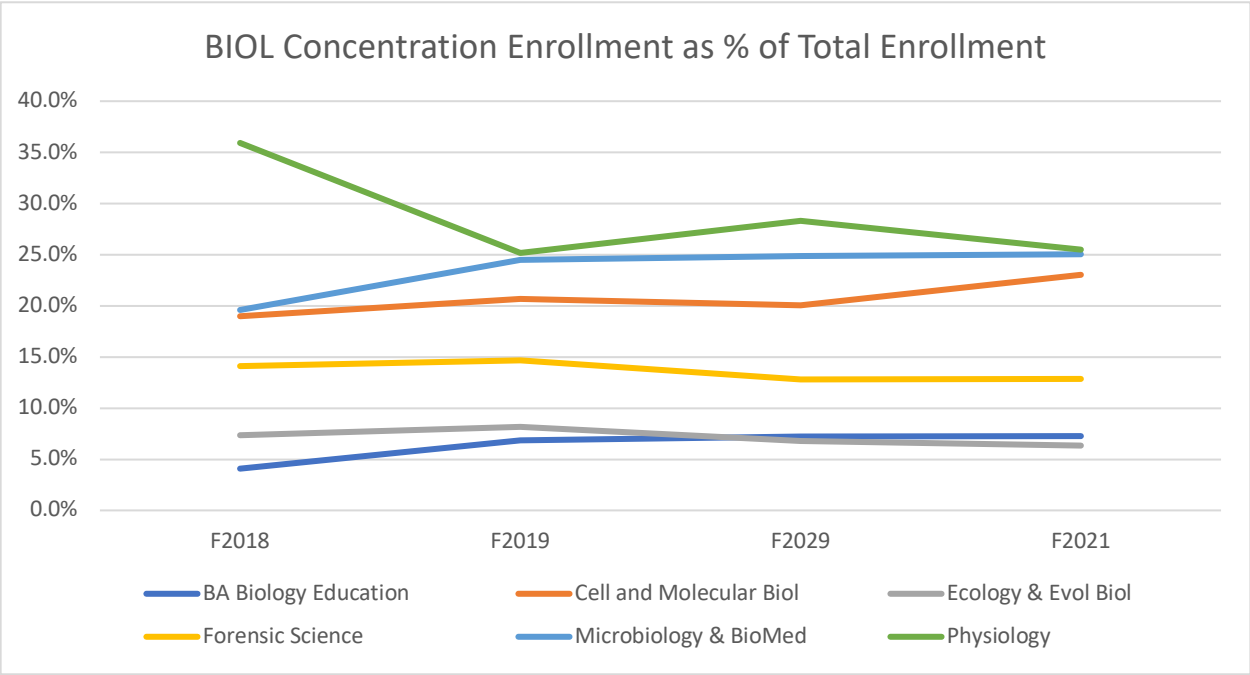


Figure A2. Biological Science concentration enrollment as a percentage of the total BIOL enrollment (Fall 2018 through Fall 2021).

Program Learning Outcomes:

1. Demonstrate a broad and sophisticated understanding that contributes to biological concepts and principles across all levels of biological organization, from ions to ecosystems.
2. Demonstrate expertise in a specific area of biological science.
3. Independently apply the scientific method to formulate testable biological hypotheses, analyze empirical data, and synthesize the results of the analysis.
4. Clearly communicate the design and results of an observational or experimental analysis in a variety of formats, including the graduate thesis, scientific paper, scientific poster, and oral presentation.
5. Gather and evaluate primary scientific literature and judge the value of the information presented in relation to particular biological questions.

A description of an exemplary score is provided for each criteria listed below. An exemplary score is obtained for a given criteria when the description is true. A proficient score is obtained when the description is mostly true. A basic score is obtained when the description is somewhat true. ***Scores: 4 = Exemplary / Mastery, 3 = Proficient, 2 = Basic, 1 = Minimal.** *The rubrics below are modified from the VALUE RUBRICS.*

ORAL COMMUNICATION RUBRIC (PLOs 2,4,5):

Criteria	Capstone / Mastery	SCORE*	PLO
Organization of the Presentation	The introduction, approach, results and conclusions are sequenced skillfully. Overall, the content of the presentation is cohesive with seamless transitions.		4
Language	Uses language appropriate to the discipline as well as the audience. Discipline specific jargon is minimized or clearly defined.		2, 4, 5
Delivery	Delivery techniques (posture, gesture, eye contact, and vocal expressiveness) make the presentation compelling. Speaker is polished and confident.		4
Supporting Material	Supporting material (illustrations, analogies etc) are relevant to the presentation and central message and establish the presenter's authority on the topic.		5
Central Claim(s)	Main claim is clear and compelling (precisely stated, appropriately repeated, memorable, and supported with evidence).		4

INQUIRY AND ANALYSIS RUBRIC (PLO 3):

Criteria	Capstone / Mastery	SCORE*	PLO
Hypothesis/Question (not used for Thesis Defense)	Develops a creative, manageable and testable hypothesis or question related to a topic that is significant yet poorly understood.		3
Background Knowledge	Synthesizes relevant information from reliable sources. Answers questions accurately.		2
Experimental Design	Develops methodology that is appropriate and clearly outlined. Includes proper controls.		3
Accurate Analysis	Performs an accurate analysis of the evidence to reveal the presence or absence of patterns related to the hypothesis/question.		3
Logical Conclusions	States a conclusion that is a logical extrapolation from the evidence outlined.		3
Recognizes Limitations and Implications	Insightfully discusses relevant and supported (if possible) caveats, limitations and implications.		3

Figure A3. Rubric used in assessment of M.S. student oral defense of thesis.