| Name of Program/Department: | Department of Biology |
|---|---|
| **Year:** | **2024 - 2025** |
| **Name of Preparer:** | **Jason Doll, Ph.D. and Jeremy Rentsch Ph.D.** |

**Biology Department Mission**

The mission of the Department of Biology is to produce scientifically literate graduates who display robust knowledge of biological principles from molecules to ecosystems. We train our undergraduate students to use their critical thinking skills and mastery of biological principles to perform inquiry into the biological world and effectively convey biological information. We are committed to experiential learning including laboratory, field, and research experiences. Students graduating from this program will be well prepared for a variety of professional careers or entry into graduate school programs.

**Program Learning Outcomes:**

The Biology Department prepares students who:

1. understand major concepts in the biological sciences.
2. think critically and apply scientific principles to reach conclusions.
3. use the scientific approach.
4. communicate cogently.

**Executive Summary of Report**

Presented in this report are the Biology Department's Mission, Program and Student Learning Outcomes, the assessment and results of each, and action items.

Achievement of our senior biology majors on concept knowledge and critical thinking skills (SLO 1 and 2) was assessed with a cumulative exam administered to graduating seniors in their final semester in both fall and spring. The overall mean on the exam (72.7%) met the benchmark for both SLO's 1 & 2 (SLO 1: 66%, SLO 2: 70%). In addition, the year's average continued to show an increase from previous years. Achievement in the separate areas of content (SLO 1: 72.9%; SLO 2: 73.6%) exceeded the baseline for SLO 1 and SLO 2. Achievement in the separate areas increased in all areas.

In the fall 2024 semester the department examined the previous year's results by concept area and determined that more concepts in the core areas of Plant Biology, Genetics and Evolution, and Cell and Molecular needed to be reinforced in the appropriate courses. The faculty enhanced their instruction in these areas by devoting additional time in lecture or lab to review. Student performance improved and exceeded the benchmark in all areas.

In order to get a better understanding of the level of achievement at which FMU biology majors begin the major curriculum, we have also administered the Senior Exit Exam to students enrolled in the first course in the biology major each semester since 2016. Most of the graduating seniors in 2024/2025 began their academic career during the COVID pandemic and thus we do not have scores when they began (no assessments were given in 2020 due to the COVID pandemic). However, entrance scores have been consistent every year they have been administered. The overall exam averages across all years showed that students scored 36.3% and ranged from 30.4 to 40.0% (Table 2) and by the time they are seniors they have improved their achievement to 65.7%, on average.

The department measured student achievement on use of the scientific approach and communication (SLO 3 and 4) through student research projects and presentations at RED and PURE. The department used scoring criteria they developed as a more objective "direct measure" of Biology majors' competence. This year, only RED (Research Exhibition Day) presentations were evaluated, as the PURE symposium was not held. Across 11 RED poster presentations, 11 of 11 questions (100%) met or exceeded the benchmark of 3.6 (Table 1). This marks a continued improvement over the prior year, where only 9 of 11 questions met the benchmark.

The Biology Department administered an indirect assessment of all SLO's (*Attitude Survey*) to 100% of graduating seniors in Fall 2024 and Spring 2025. At least 80% or more of students responded "strongly agree" or "agree" for the majority of questions (13/15) meeting that benchmark. Two new questions designed to capture the percentage of students involved with outside the classroom experience (e.g., internships and research). 33.3% of graduating seniors participated in an internship in their field and 27.8% participated in faculty mentored research.

**Student Learning Outcomes**

SLO 1.0: Biology majors will identify key concepts in the core areas of Plant Biology, Ecology, Cell and Molecular Biology, Genetics and Evolution at: Baseline (average of past 2 year's SLO results) of 64.9%, Benchmark of 66.0%, Target of 67.0%.

SLO 2.0: Biology majors will demonstrate competence in critical thinking and the application of the scientific approach at:
Baseline (average of past 2 year's SLO results) of 68.5%, Benchmark of 70.0%, Target of 72.0%.

SLO 3.0: Students will explain and demonstrate how to 1) ask a question, 2) generate a credible literature review, 3) generate hypotheses, 4) execute hypothesis testing procedures, 5) organize and analyze data or information, 6) draw conclusions, and 7) produce a report, poster, or oral report to cogently communicate results, as evaluated by our faculty using a scoring rubric (questions 1–11 on the FMU Biology Department Scoring Rubric). We expect each question average to be at or above a score of 3.5 out of 4.0. Our current benchmark is for all 11 questions to receive average scores of 3.5 or higher, assessed separately across events (i.e., RED and PURE are not averaged together). Our three-year target is to improve these scores such that 11/11 questions receive average scores of 3.6 or higher.

SLO 4.0: Students communicated cogently about biology at or above a score of 3.5 on Research Exhibition Day presentations, as measured by questions 12 and 13 on the department rubric. Our benchmark remains that all questions receive average scores of 3.5 or higher, with a three-year target of 3.6 or higher across all communication-related items.

**Assessment Methods**

**Student Learning Outcomes 1 and 2:**

SLO 1.0: Biology majors will identify key concepts in the core areas of Plant Biology, Ecology, Cell and Molecular Biology, Genetics and Evolution at an overall average as evaluated by the Biology Exit Exam of:
-Baseline (average of past 2 year's SLO results) of 64.9%,
-Benchmark of 66.0%,
-Target of 67.0%.

SLO 2.0: Biology majors will demonstrate competence in critical thinking and the application of the scientific approach at an overall average as evaluated by the Biology Exit Exam of:
-Baseline (average of past 2 year's SLO results) of 68.5%,
-Benchmark of 70.0%,
-Target of 72.0%.

*Direct Assessment*

Performance on student learning outcomes 1 and 2 utilized a cumulative exam-(multiple choice format). Historically, the exam had been administered to students in the Senior Seminar course but because students take that course in one of their last two semesters prior to graduation some students may not be currently enrolled in nor have completed all their biology major course work. To address this issue of timing of biology major course work, we administer the exam only to students in the semester they are graduating. However, because students in Senior Seminar are seniors and some are graduating in that semester, we use that course as a means of grouping the graduating students. In the Fall 2024 Senior Seminar course, enrolled students that would not be graduating until Spring 2025 did not take the exam. We followed the same procedure with the Spring 2025 Senior Seminar course. Thus, only students graduating in Fall 2024 or Spring 2025 were contacted, arrangements made, and they took the exam in the respective semester.

The common Biology Exit Exam was administered via Blackboard again this year. The exam was moved to Blackboard following the COVID-19 pandemic. This method has remained because it makes it easily available and accessible to all graduating students. Administering the Biology Exit Exam online has shown to be successful and has resulted in high completion rate (95% or higher since moving to online only).

To get an indication of how students entering the biology major perform, since 2016 the cumulative exam has been administered to those students in the introductory biology courses who were taking the biology majors lecture and laboratory courses for the first time (BIO 115L, Bio 105, and Bio 107). These courses are required of all biology majors. Students were given the same exit exam that they will receive as graduating seniors to control for variation due to different questions. Thus, this represents a pre- and post-test design. The exam was administered during first two weeks of the beginning of each semester since 2016. This exam has been administered online since 2021.

For security the Biology Exit Exam is not provided in the appendix. Copies are available upon request to the department.

**Student Learning Outcome 3 and 4:**

> SLO 3.0: Students will explain and demonstrate how to 1) ask a question, 2) generate a credible literature review, 3) generate hypotheses, 4) execute hypothesis testing procedures, 5) organize and analyze data or information, 6) draw conclusions, and 7) produce a report, poster, or oral report to cogently communicate results, as evaluated by our faculty using a scoring rubric (questions 1–11 on the FMU Biology Department Scoring Rubric). We expect each question average to be at or above a score of 3.5 out of 4.0. Our current benchmark is for all 11 questions to receive average scores of 3.5 or higher, assessed separately across events (i.e., RED and PURE are not averaged together). Our three-year target is to improve these scores such that 11/11 questions receive average scores of 3.6 or higher.
>
> SLO 4.0: Students communicated cogently about biology at or above a score of 3.5 on Research Exhibition Day presentations, as measured by questions 12 and 13 on the

department rubric. Our benchmark remains that all questions receive average scores of 3.5 or higher, with a three-year target of 3.6 or higher across all communication-related items.

*Direct Assessment*

Students apply the process of science (SLO 3) and build communication skills (SLO 4) in courses in our Biology curriculum. There are opportunities to apply the process of science and to build communication skills with assignments and exercises in the laboratory portions of courses and through research projects outside of class. Students may complete independent research projects and receive credit (e.g., Bio 497, Honor's Thesis) or they may take part in projects and not receive credit but receive a stipend (e.g., Biology Research Experience Program Fellows (BREP) that are supported by our INBRE grant and REAL, the University's quality enhancement program).

After completing their project students may write a report, a thesis, or a paper on their work or they may produce a poster or do an oral presentation (SLO 3 & 4). FMU has two venues on campus for presentations. One is PURE, the Biology Department's research symposium held once per semester. Another is the campus-wide Research and Exhibition Day held every spring.

The Biology Department evaluated student competence in application and communication of the scientific approach (SLO 3 & 4) in two ways: 1) evaluating laboratory reports and 2) evaluating presentations.

The assessment rubric below (Scoring Criteria) was used to evaluate both the laboratory reports and presentations. The rubric was initially developed to assess a self-selecting group of research students and is now being more broadly applied to laboratory reports that more students will be subject to.

<u>Scoring Criteria</u>:

1. The student clearly states a thoughtful question.
2. The student clearly states a research hypothesis or question.
3. The significance of the research is clearly framed in terms of the 'big picture'.
4. The method of the investigation is appropriate to the problem.
5. All data are sufficiently documented.
6. Student collected sufficient data to justify conclusions made.
7. The data were analyzed in a way that justifies the conclusions made.
8. The student's own work is clearly reflected in the work.
9. The work represents a complete story or concept.
10. The work is self-explanatory (mostly in relation to reports or poster presentations).
11. Charts, figures, and diagrams aid in the understanding of the project.
12. The works cited is sufficiently robust.

To evaluate presentations, we used a more objective "direct measure" of Biology majors' competence in the application and communication of the scientific approach in student projects presented as pre-recorded posters at the campus-wide in-person Research and Exhibition Day in the spring 2025 semester. Biology Department faculty (4) not involved with the research independently evaluated each pre-recorded RED virtual presentation utilizing the Scoring Criteria. The Scoring Criteria (listed above) were scored on a Likert scale with a score of 1 strongly disagreeing with the question and a score of 5 strongly agreeing was used.

**SLO 1, 2, 3, and 4**

*Indirect Assessment: Attitude Survey*

We administered a survey of student attitudes to indirectly assess our four SLO's to the graduating seniors in Fall 2024 and Spring 2025 (questions are listed in results section Table 5). Two new questions were added to the survey to in 2023 to quantify the number of students participating in experiences beyond the classroom that help prepare them for a career or graduate school.

1. Were you involved with any faculty mentored research while at Francis Marion University? This could include any lab or field research that was completed with a faculty member outside of a normal class.
2. Were you involved in an internship while at Francis Marion University? This can include the medical mentors program, job shadowing, paid or unpaid work, volunteering. This internship should be in your area of study but you don't need to have earned internship credits to select "Yes". This question is designed to capture the number of students that received outside the classroom experience.

The questions were answered on a Likert scale with a score of 1 = strongly disagreeing with the statement and a score of 5 = strongly agreeing. The survey was administered via Blackboard. In addition to offering indirect assessment of our SLO's, survey results also provide data about our courses and program.
The number of questions answered "strongly agree" and "agree" at 80% or greater:

-Baseline (average of past 2 year's results) 12/15 questions,
-Benchmark of 13/15 questions,
-Target (5 year) of 14/15 questions.

**Assessment Results**

**Student Learning Outcomes 1 and 2:**

*SLO 1:* Biology majors will identify key concepts in the core areas of Plant Biology, Ecology, Cell and Molecular Biology, Genetics and Evolution: Baseline (average of past 2 year's SLO results) of 64.9%, Benchmark of 66.0%, Target of 67.0% as evaluated by the Biology Exit Exam.

> SLO 1.0: Biology majors identified key concepts in the core areas of Plant Biology, Ecology, Cell and Molecular Biology, Genetics and Evolution, at an overall average of 72.9% as measured by a common Biology Exit Exam. Since our benchmark (64.9%), this was achieved. This continues the trend of increasing scores since 2022-2023.

*SLO 2:* Biology majors will demonstrate competence in critical thinking and the application of the scientific approach: Baseline (average of past 2 year's SLO results) of 68.5%, Benchmark of 70.0%, Target of 72.0% as evaluated by the Biology Exit Exam.

> SLO 2.0: Biology majors demonstrated competence in critical thinking and the application of the scientific approach at the 73.6% level as evaluated by the Biology Exit Exam. Since our benchmark was 68.5%, this was achieved.

Tables 1 and 2 summarize the results for each learning outcome and includes the questions in the exam that pertain to each learning outcome. Table 1 summarizes the results for the graduating seniors and includes the results from 2020 – 2024 for comparison. Table 2 summarizes the results for students entering the major from 2018 – 2024 (administered in introductory biology courses: 105, and 107).

The overall mean on the exam for Fall and Spring combined, 72.7.0%, was above the benchmark for SLO 1 (64.9%) and SLO 2 (68.5%). In addition, this year's average is the highest recorded since the 2019/2020 academic year. Achievement this year in the separate area of content (SLO 1) increased for all areas and was the highest scores recorded since we started monitoring achievement.

Performance consistently increased in all of the core areas of Plant Biology, Ecology, Cell and Molecular, Genetics and Evolution, Fundamentals, and Animal Diversity compared to the 2022-2023 academic year. All core areas except Cell and Molecular Biology and Fundamentals exceeded the benchmark of 64.9% in both Fall and Spring Semesters. The area of Fundamentals (those questions that are broadly applicable to multiple areas of biology but not a separate area in the major) declined from 79.6% in 2019/2020 to 56.9% in 2023/2024. However, we observed a rebound in 2024/2025. Increased emphasis on the fundamentals across our courses likely contributed to this increase.

In the Fall 2021 semester, the department reviewed SLO's for the core areas of organismal, genetics, cell and molecular biology, and ecology. This review consisted of faculty identifying common concepts addressed in each of their courses. The meetings resulted in a shared set of SLO's to guide broad topics while maintaining academic freedom within their course. Following this review, it was determined that the exit exam will be assessed to ensure the questions are directly addressing key concepts within each core area. The exit exam was thoroughly reviewed in 2022-2023 and it was determined that not all questions adequately evaluate student success at meeting the new core area SLO's. During the development of a new assessment, the department began discussing a curriculum revision. In the Spring of 2023, a curriculum committee was formed. Development of a new assessment has been paused until a new curriculum has been established. The committee worked through the 2023/2024 academic year to identify changes to the core curriculum. The Department has designed a new curriculum that will be proposed in the 2025/2026 academic year. Dr. Brauss gave an SLO workshop for our department in the summer of 2024 and we have developed new course level SLO's to accompany our new courses. We will begin drafting the curriculum proposals this summer. Discussions are ongoing between the Biology Department and other Departments that could be affected by the changes (e.g., Mathematics, Physics, Nursing, etc.). These conversations will continue through the summer 2025.

We began administering the exit exam to students entering the major in 2016. Table 2 summarizes the results for those students for five academic years (2018 – 2024). The 2024/2025 graduating class would have taken the exit exam as Freshman in the 2021/2022 academic year. Thus, we can use the exam scores from 2021/2022 to assess improvements to graduation. Ideally, this would be a pre- post-test design but we are not able to match students. We will compare the "cohort" instead. The overall exam average for the 2021/2022 cohort was 30.4. Scores for this same cohort at graduation was 75.8 (Spring 2025). This represents a substantial increase, indicating that students see a significant improvement in outcomes after completing the Biology degree at FMU. Across time, entrance scores have been consistent every year they have been administered. The overall exam averages across all years showed that students scored 36.3% and ranged from 30.4 to 39.8% (Table 2) and by the time they are seniors they have improved their achievement to 65.7%, on average (Table 1). The lowest score was observed in 2021/2022 (Table 2: no assessments were given in Fall 2020 due to COVID-19 restrictions and exams were given in-person at the time) and the highest score was observed in 2024/2025.

Test discrimination (ability for a question to differentiate between students that understand the material and those that do not) was measured using Blackboards generated "discrimination" score. Scores range from -1.0 to 1.0 with higher values suggesting better discriminatory power. Discrimination scores for questions that are below 0.10 are considered poor questions. Individual question scores ranged from -0.01 to 0.63 and averaged 0.26. Overall, the exam questions provide a reliable indicator of students' knowledge in the subject area. We will continue tracking this metric and investigate questions that fall below 0.1 and determine if they need improvements.

Nearly all benchmarks were achieved during the 2024/2025 academic year. However, the COVID-19 pandemic seems to have reduced the scores for students entering the Biology program in 2021/2022. We have observed an increase in the entrance scores each year with the highest in 2024/2025. We will closely monitor these students as they move through our program. Development of the new Biology curriculum with core area SLO's will give faculty the guiding concepts to build their course work around and will serve to focus on specific areas so graduating seniors have mastered the identified areas.

**Table 1**. Summary of results of the cumulative exam given to graduating seniors in Fall 2024 and Spring 2025. Results from 2020-2024 are included for comparison.

| **Learning Outcome** | **Assessment** (Exam question that pertains to each learning outcome) | **Results** (Mean percent correct) | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | | 2020 - 2021 | 2021 - 2022 | 2022 - 2023 | 2023 - 2024 | Fall 2024 | Spring 2025 | 2024 - 2025 |
| 1. Biology majors will identify key concepts in the core areas of Plant Biology, Ecology, Cell and Molecular Biology, Genetics and Evolution. | Concepts: 1, 2, 5-7, 9, 10, 12, 14-17, 20-24, 26, 27, 34-36, 41, 43, 44, 47-49 | 64.5 | 67.9 | 64.0 | 65.7 | 69.6 | 76.1 | 72.9 |
| a. Plant Biology | 5, 16, 22, 25, 27, 31, 39, 47 | 65.1 | 65.8 | 64.1 | 70.5 | 72.0 | 79.0 | 75.5 |
| b. Ecology | 3, 12, 28, 29, 40, 44, 48 | 55.7 | 64.0 | 58.4 | 61.0 | 70.7 | 73.5 | 72.1 |
| c. Cell and Molecular Biology | 2, 7, 9, 10, 11, 18, 20, 21, 24, 26, 28, 30, 33, 36, 37,41, 42, 49, 50 | 61.9 | 62.6 | 71.4 | 72.1 | 69.6 | 75.4 | 72.5 |
| d. Genetics and Evolution | 4, 13, 17, 23, 32, 35, 38, 46 | 49.7 | 59.6 | 57.0 | 60.8 | 60.7 | 70.1 | 65.4 |
| e. Fundamentals | 8, 15, 19, 34, 43 | 76.2 | 72.0 | 57.4 | 56.9 | 63.5 | 67.9 | 65.7 |
| f. Animal Diversity | 1, 6, 14, 45 | 59.0 | 62.0 | 71.2 | 71.6 | 79.8 | 88.4 | 84.1 |
| 2. Biology majors will demonstrate competence in critical thinking and the application of the scientific approach. | 3, 4, 8, 11, 13, 18,19, 25, 28-33, 37-40, 42, 45, 46, 50 | 58.0 | 61.4 | 67.6 | 69.4 | 71.0 | 76.2 | 73.6 |
| Number of graduates | | 74 | 61 | 44 | 73 | 21 | 28 | 49 |
| Number of students completed exam (% of graduating seniors) | | 70 (95%) | 58 (95%) | 43 (98%) | 70 (96%) | 21 (100%) | 28 (100%) | 49 (100%) |
| **Overall Exam Mean** | | **61.3** | **64.4** | **63.9** | **66.0** | **69.6** | **75.8** | **72.7** |

**Table 2.** Summary of results of the cumulative exam given to students in BIO 105 and 107 taking the course for the first time in Fall 2024 and Spring 2025. Results from 2018- 2024 are included for comparison.

| **Learning Outcome** | **Assessment** (Exam question that pertains to each learning outcome) | **Results** (Mean percent correct) | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | | 2018 - 2019 | 2021-2022 | 2022 - 2023 | 2023 - 2024 | Fall 2024 | Spring 2025 | 2024 - 2025 |
| 1. Biology majors will identify key concepts in the core areas of Plant Biology, Ecology, Cell and Molecular Biology, Genetics and Evolution. | Concepts: 1, 2, 5-7, 9, 10, 12, 14-17, 20-23, 26, 28, 32, 34-36, 41, 43, 47-49 | 37.4 | 33.9 | 38.3 | 41.3 | 46.6 | 40.9 | 43.7 |
| a. Plant Biology | 5, 16, 22, 27, 29, 31, 39, 47 | 28.9 | 24.8 | 36.4 | 35.8 | 40.3 | 37.3 | 38.8 |
| b. Ecology | 3, 11, 12, 40, 44, 48 | 46.7 | 29.6 | 34.9 | 39.6 | 41.0 | 32.9 | 37.0 |
| c. Cell and Molecular Biology | 2, 7, 9, 10, 18, 20, 21, 25, 26, 28, 30, 32, 33,36, 37,41, 42, 49, 50 | 36.4 | 25.8 | 37.6 | 39.1 | 43.7 | 37.7 | 40.7 |
| d. Genetics and Evolution | 4, 13, 17, 23, 35, 38, 46 | 30.6 | 32.5 | 34.5 | 35.4 | 41.3 | 36.0 | 38.7 |
| e. Fundamentals | 8, 15, 19, 24, 34, 43 | 50 | 32.2 | 37.9 | 37.0 | 40.5 | 38.8 | 39.6 |
| f. Animal Diversity | 1,6, 14, 45 | 50.1 | 33.3 | 36.5 | 38.2 | 45.7 | 39.5 | 42.6 |
| 2. Biology majors will demonstrate competence in critical thinking and the application of the scientific approach. | 3, 4, 8, 11, 13, 18, 19, 24, 25, 27, 29-31, 33, 37-40, 42, 44-46, 50 | 39.3 | 26.0 | 36.0 | 37.0 | 40.2 | 35.0 | 37.6 |
| Number of students completed exam | | 321 | 151 | 178 | 216 | 140 | 76 | 216 |
| **Overall Exam Mean** | | **38.3** | **30.4** | **35.0** | **37.9** | **42.4** | **37.3** | **39.8** |

**Student Learning Outcome 3 and 4:**

SLO 3.0: Students will explain and demonstrate how to 1) ask a question, 2) generate a credible literature review, 3) generate hypotheses, 4) execute hypothesis testing procedures, 5) organize and analyze data or information, 6) draw conclusions, and 7) produce a report, poster, or oral report to cogently communicate results, as evaluated by our faculty using a scoring rubric (questions 1–11 on the FMU Biology Department Scoring Rubric). We expect each question average to be at or above a score of 3.5 out of 4.0. Our current benchmark is for all 11 questions to receive average scores of 3.5 or higher, assessed separately across events (i.e., RED and PURE are not averaged together). Our three-year target is to improve these scores such that 11/11 questions receive average scores of 3.6 or higher.

This year, only RED (Research Exhibition Day) presentations were evaluated, as the PURE symposium was not held. Across 11 RED poster presentations, 11 of 11 questions (100%) met or exceeded the benchmark of 3.5 (Table 3). This marks a continued improvement over the prior year, where only 9 of 11 questions met the benchmark.

SLO 4.0: Students communicated cogently about biology at or above a score of 3.5 on Research Exhibition Day presentations, as measured by questions 12 and 13 on the department rubric. Our benchmark remains that all questions receive average scores of 3.5 or higher, with a three-year target of 3.6 or higher across all communication-related items.

A rubric developed by the Biology Department was used to evaluate RED student poster presentations. The rubric includes 13 questions rated on a Likert scale from 1–4, where 1 reflects poor performance and 4 reflects exemplary performance. Questions 1–11 are used to assess SLO 3.0, and questions 12–13 assess SLO 4.0. Biology faculty volunteer as evaluators, and student scores are compiled into a spreadsheet for statistical analysis. Because RED and PURE presenters are self-selected and typically more experienced, the department sets a high benchmark of 3.6 per question and a target of 3.6 within three years. This year, only RED (Research Exhibition Day) presentations were evaluated.

Several areas showed continued strength or improvement over last year's performance. Notably, Questions 6 and 7, focusing on data collection and data analysis respectively, improved to meet or exceed the benchmark this year. Overall, the results indicate strong student proficiency in core scientific reasoning and communication, with only minor areas for continued focus.

2024-2025 (current year) outcomes

| | RED | |
|---|---|---|
| | 2024 - 2025 average | |
| | Average | STD |
| Question 1 - State thoughtful question | 3.74 | 0.37 |
| Question 2 - State clear hypothesis | 3.74 | 0.43 |
| Question 3 - Explain research significance | 3.77 | 0.40 |
| Question 4 - Investigate appropriately? | 3.74 | 0.37 |
| Question 5 - Sufficiently document | 3.65 | 0.45 |
| Question 6 - Enough data collected? | 3.5 | 0.63 |
| Question 7 - Analyzed correctly? | 3.52 | 0.54 |
| Question 8 - Student contributions clear? | 3.64 | 0.48 |
| Question 9 - Represent a complete story? | 3.66 | 0.40 |
| Question 10 -Self-explanatory poster or clear presentation? | 3.60 | 0.50 |
| Question 11 - Clear figures, charts, etc? | 3.56 | 0.44 |

**Table 3:** Average and standard deviation scores for RED poster presentations evaluated in Spring 2025 using the FMU Biology scoring rubric. Questions 1–11 correspond to Student Learning Outcome 3.0 (scientific reasoning, execution, and reporting). In total, 11 RED posters were evaluated with multiple faculty assessments per poster. Ten of eleven questions met the departmental benchmark of 3.5.

| | RED | |
|---|---|---|
| | 2024 - 2025 | |
| | Average | STD |
| Question 12 - Clear project description? | 3.65 | 0.40 |
| Question 13 - Effective response to questions? | 3.55 | 0.67 |

**Table 4:** Average and standard deviation for RED poster presentations evaluated in Spring 2025 using the FMU Biology scoring rubric. Questions 12 and 13 corresponds to Student Learning Outcome 4.0 (communication of biological research). Question 13 failed to meet the benchmark of 3.6 meaning one of eleven questions met the departmental benchmark of 3.6.

**2023-2024 (previous year) outcomes**

| | RED | |
|---|---|---|
| | 2023 - 2024 average | |
| | Average | STD |
| Question 1 - State thoughtful question | 3.6 | 0.4 |
| Question 2 - State clear hypothesis | 3.8 | 0.5 |
| Question 3 - Explain research significance | 3.8 | 0.5 |
| Question 4 - Investigate appropriately? | 3.8 | 0.3 |
| Question 5 - Sufficiently document | 3.6 | 0.5 |
| Question 6 - Enough data collected? | 3.3 | 0.7 |
| Question 7 - Analyzed correctly? | 3.1 | 0.7 |
| Question 8 - Student contributions clear? | 3.7 | 0.5 |
| Question 9 - Represent a complete story? | 3.5 | 0.4 |
| Question 10 -Self-explanatory poster or clear presentation? | 3.6 | 0.6 |
| Question 11 - Clear figures, charts, etc? | 3.6 | 0.5 |

**Table 5:** Truncated scoring rubric questions with PURE symposium and RED presentation results. Questions 1-11 are relevant for SLO3.0. In the spring of 2024, there were 12 poster presentations with an average of 8 evaluations each. With regards to the PURE symposium presentations, questions 6-11 all failed to meet the current benchmark of a score of 3.5 or higher, while for RED posters, questions 6, 7, and 10 did not achieve the benchmark score of 3.5.

| | RED | |
|---|---|---|
| | 2023 - 2024 | |
| | Average | STD |
| Question 12 - Clear project description? | 3.55 | 0.35 |
| Question 13 - Effective response to questions? | 3.82 | 0.22 |

**Table 6:** Truncated scoring rubric questions with PURE symposium and RED presentation results. Questions 12 & 13 of the rubric are relevant for SLO4.0. In the spring of 2024, there were 10 poster presentations with an average of 7 evaluations each Each of these questions met the current benchmark.

**SLO 1, 2, 3, and 4**

*Indirect Assessment: Attitude Survey*

The number of questions answered "strongly agree" and "agree" at 80% or greater:

-Baseline (average of past 2 year's results) 13/15 questions,
-Benchmark of 14/15 questions,
-Target (5 year) of 15/15 questions.

We administered a survey of student attitudes about the biology SLOs to graduating seniors in Fall 2024 and Spring 2025. In addition to offering indirect assessment of our SLO's, survey results also provide data about our courses and program. The number of questions answered "strongly agree" and "agree" at 80% or greater was 13/15 questions (average of 93%) and did meet the benchmark of 13/15 questions.

Table 7 lists the questions used on the survey and summarizes the attitude survey results. At least 80% or more of students responded "strongly agree" or "agree" for the majority (13/15 questions) of the questions. Students felt less strongly (< 80% "strongly agree or "agree") on one question: "Courses in biology have strengthened my understanding of biological concepts in plant biology" (55%) and "The Biology department at FMU offers a sufficient variety of courses." (77%). Overall average ranking of "strongly agree or agree" was 90%. In previous years, students have held lower opinions on their ability to demonstrate the relationship between multiple variables by using statistical analysis. The average for this questions was 77.5% between 2020 and 2024. However, this increased to 90% in the 2024/2025 graduating seniors. The department has increased emphasis on statistical analysis in all their courses and have now made Biostatistics a required course beginning in the 2025/2026 academic year. Although the new requirement doesn't affect graduating seniors, the increases attitude of the graduating seniors reflect the departments increased emphasis on statistical analysis in all courses.

Students in the Biology department must select a single "organismal" course. This can include plants, ichthyology (fish), ornithology (birds), vertebrate zoology, or herpetology (reptiles and amphibians). Thus, students are not required to take a plant course. This could explain the lower ranking for "Plant Biology". This is one reason the department has began the process of evaluating the current curriculum. Reduced enrollment since COVID and faculty retirements (without replacement yet, although we had a failed search this semester and have approval to rehire one position in the fall of 2025) have resulted in fewer courses being offered. We expect this to change when we are able to replace these two positions next year.

**Table 7:** Attitude survey questions asked and the results (percentages) from graduating in 2019 – 2022 results for the total of Strongly Agree and Agree are provided. Previous year's results are included for comparison.

| SLO | Question on the Attitude Survey | Total of Strongly Agree & Agree | | | | |
|---|---|---|---|---|---|---|
| | | 2020-2021 | 2021-2022 | 2022-2023 | 2023-2024 | 2024-2025 |
| 1 | Courses in biology have strengthened my understanding of biological concepts in: | | | | | |
| | a. Genetics and Evolution | 89 | 92 | 95 | 91 | 96 |
| | b. Cell and Molecular Biology | 84 | 88 | 98 | 91 | 90 |
| | c. Ecology | 90 | 88 | 91 | 90 | 90 |
| | d. Plant Biology | 76 | 72 | 60 | 53 | 55 |
| 2, 3 | I am able to demonstrate the relationship between multiple variables by using statistical analysis. | 74 | 78 | 86 | 72 | 90 |
| 3 | I am able to identify a hypothesis or purpose of a study. | 99 | 96 | 98 | 96 | 100 |
| 3, 4 | I feel prepared to write a comprehensive lab report. | 91 | 88 | 96 | 88 | 88 |
| 3 | I understand and can employ a range of laboratory techniques/methods to study biological processes. | 98 | 92 | 93 | 95 | 94 |
| 3 | I am able to identify primary sources. | 92 | 92 | 98 | 95 | 98 |
| 3 | I am able to use the correct citation methods in my work cited. | 97 | 92 | 98 | 91 | 94 |
| 4 | I can explain biological concepts to others. | 91 | 94 | 98 | 91 | 96 |
| 2 | Courses in Biology at FMU have strengthened my ability to think critically. | 92 | 92 | 98 | 90 | 92 |
| NA | The Biology department at FMU offers a sufficient variety of courses. | 84 | 74 | 86 | 82 | 77 |
| NA | The methods and skills I have mastered as a biology major at FMU will help me in my future pursuits. | 94 | 92 | 98 | 86 | 94 |
| NA | It is important that the Biology department introduces students to various careers in biology. | 95 | 94 | 95 | 97 | 98 |
| NA | Were you involved in an internships? | NA | NA | NA | 51.3 | 33.3 |
| NA | Were you involved with faculty mentored research? | NA | NA | NA | 26.3 | 27.8 |
| | **Overall average (Does not include last two questions)** | **90** | **88** | **92** | **87** | **90** |
| | Number of students completed survey (% of graduating seniors) | 68 (92%) | 50 (83%) | 42 (95%) | 71 (96%) | 49 (100%) |

**Action Items**

To address the concerns below we are developing an action plan to be implemented during the next academic year.

**Student Learning Outcomes**

SLO 1.0: Biology majors will identify key concepts in the core areas of Plant Biology, Ecology, Cell and Molecular Biology, Genetics and Evolution at: Baseline (average of past 2 year's SLO results) of 64.1%, Benchmark of 66.0%, Target of 67%

SLO 2.0: Biology majors will demonstrate competence in critical thinking and the application of the scientific approach at:
Baseline (average of past 2 year's SLO results) of 64.5%, Benchmark of 66%, Target of 67%

**SLOs 1 and 2:**

1. The program scheduled the administering and scoring of the Exit Exam to better assess students only in the semester in which they are graduating and so therefore would be taking or have taken all relevant course work. We administered the exam to only students in the semester in which they graduate. In Fall 2023, the exam was administered to only those students graduating at the end of Fall semester. Likewise, at the end of Spring 2024, the exam was administered only to those students graduating in Spring 2024. Any student who completed the Senior Seminar course in the Fall 2023 semester but will not graduate until spring and therefore did not take the exam in fall, was contacted and took the exam at the end of the Spring 2024 semester. This procedure was successful again this year with the majority of graduating students completing the exam (100% in Fall 2024 and Spring 2025) and will be continued in the future.

2. The breakout of the 2024-2025 results into the four core areas showed that student achievement did not meet the benchmark in the areas of Cell and Molecular Biology and Fundamentals. However, scores increased in all areas compared to 2023-2024. In Fall 2024, the Biology Program ensured that certain core principles and concepts in those areas were reinforced in upper level courses where this material is included in the 2023-2024 academic year (taught in 2024 -2025 including but not limited to: Bio 105 and 106 Biological Sciences I and II, Bio 107 and 108 Integrated Biological Concepts I and II, Bio 301 Cell Biology, Bio 407 Immunology, Bio 302 Developmental Biology, Bio 401 Genetics, Bio 409 Evolutionary Biology, BIO400 Fisheries Management and Ecology).

3. The Biology Department reviewed the four core areas (Cell Biology, Genetics, Organismal Biology, and Ecology) and exit exam. This review consisted of all faculty teaching in these areas to identify shared SLO's that are covered. This resulted in a new set of shared SLO's that faculty can use to guide their courses to ensure students taking any class within the core area will be taught similar broad concepts. It was determined that the exit exam does not adequately assess the new shared SLO's. Further, the Department determined that a

curriculum review is necessary before establishing a new exit exam. The Department formed a new curriculum committee and has been working since the 2023/2024 academic year to address this issue. We have developed a new curriculum that was approved by the Department and we have been discussing the changes with departments that will be affected by the redesign to ensure any changes will continue to meet their needs (e.g., Physics, Mathematics, Nursing, etc.). We anticipate submitting the curriculum modification paperwork to academic affairs in the spring 2026.

4. The department evaluated the Biology Exit exam question types and quality based on individual exam item analysis results, critical thinking and application of science questions, and for balance between each core area and content vs critical thinking. This action item will be carried over the 2025 -2026 academic year.

5. The Biology Department continued its investigation of validated questions from Concept Inventories to be used on our exams. This action will be carried over the 2025 -2026 academic year.

**Student Learning Outcomes**

*SLO 3.0*: Students will explain and demonstrate how to 1) ask a question, 2) generate a credible literature review, 3) generate hypotheses, 4) execute hypothesis testing procedures, 5) organize and analyze data or information, 6) draw conclusions, and 7) produce a report, poster, or oral report to cogently communicate results as evaluated by our faculty using a scoring rubric (questions 1-11 on FMU Biology Department Scoring Rubric). We expect each question average to be at or above a score of 3.5 out of 4.0 on our rubric. Our current benchmark is for 11/11 questions to receive average scores of 3.5 or higher assessed separately across events (i.e., RED, and PURE data will not be averaged together). Our three-year target will be to improve these scores such that 11/11 questions receive average scores of 3.6 or higher.

*SLO 4.0*: Students communicated cogently about biology at or above a score of 3.5 on Research Exhibition Day poster presentations and PURE symposium talks as measured by questions 12 & 13 on a rubric developed by the Biology Department used to evaluate reports and presentations. Our current benchmark is for 11/11 questions to receive average scores of 3.5 or higher assessed separately across events (i.e., RED, and PURE data will not be averaged together). Our three-year target will be to improve these scores such that 11/11 questions receive average scores of 3.6 or higher.

**SLOs 3 and 4**:

1. Plans for 2024-2025 academic year: Continue reinforcing strong student performance through targeted mentoring. While performance remained strong through most rubric items, the following low-effort actions are recommended:
    - Reinforce Data Collection Discussions (Q6): Faculty mentors should continue emphasizing what constitutes "sufficient data" during the planning and execution stages of research projects.
    - Encourage Student-Led Reflection on Analysis (Q7): While performance improved, further clarity on how data supports conclusions can be fostered through discussion prompts or short written reflections.
    - Promote Poster Review Workshops: Informal poster feedback sessions (e.g., "poster rough draft day") can improve clarity in figures and layouts (Q11) and provide peer insight prior to RED.
    - Revisit Evaluation Rubric: Consider whether Q13 (response to questions) should be retained, revised, or formally dropped from RED evaluations if it continues to go unscored.

2. In Fall 2025 we will ensure that faculty that do projects with students (including course related projects, independent study, and honors thesis) reinforce the areas of the scientific process and communication (those concepts found in the evaluation rubric) with their research students. And that faculty incorporate more assignments that require students to apply the process of science into our courses. Those criteria all represent skills or concepts that scientists in training should be intimately familiar with and should fit seamlessly into any biology course.

3. Facilitate Discussions on Data Analysis (Question 7): Encourage faculty mentors to initiate discussions with students about the importance of data analysis practices. Promote Narrative Development (Question 9): Encourage faculty mentors to emphasize the significance of presenting a cohesive narrative in research presentations. Foster discussions on storytelling techniques and encourage students to explore different approaches to conveying their research findings effectively (posters, talks, lightning talks, elevator speeches, etc.). Encourage Clarity in Presentations (Question 10): Ask faculty mentors to underscore the importance of clarity in presentation materials during mentoring sessions. Create opportunities for students to discuss strategies for enhancing the clarity of their visual aids and presentation materials with their mentors (e.g. look at poster rough drafts more frequently).

4. We will encourage faculty to implement more authentic research into undergraduate classrooms at all levels. Low numbers of laboratory reports and averages seen this year may reflect too few opportunities for students to write. Scores may improve significantly if students are asked to write several more reports over their undergraduate education. In addition, we will remind faculty to encourage use of our writing center for improving students' mastery in writing.

5. To notify students of research opportunities, we continued to use the *Research Opportunities* section of the bulletin board outside the biology office, we increased the frequency of updating of our website section, and we created a new website this year to showcase our active research areas. Additionally, a monitor installed in the main hallway in the biology department will continue to be used to announce opportunities.

**Survey results**
**SLO 1, 2, 3, and 4:**

1. The breakout of the 2024-2025 survey results showed that student attitude did not meet the benchmark in the areas of Plant Biology. Currently, not all biology students take a Plant Biology or statistics course. Because of this, many of the plant biology questions are not sufficient. In Fall 2025, the Biology Department will continue to assess the curriculum. Following the revision, a new assessment will be developed to better capture what students are exposed to.

2. Two new questions were added to assess students participation in outside the classroom activities that help prepare them for a career or graduate school. Each student were asked if they completed an internship (paid or unpaid, credit or no credit) and if they participated in faculty mentored research. The percent of graduating seniors that participated in an internahip decreased to 33.3%. while the percentage of students participating in faculty mentored research remained constant at 27.8%. In today's market having hands-on experience that is only gained through an internship or research is needed. This sentiment is echoed by all professionals and graduate advisors that the authors of this report have had conversations with. The Biology department recently made a change to the course requirements where internship (BIOL 498) or research (BIOL 497) will count towards the Biology electives. Although not required, the ability to count internships and research towards a Biology degree will help increase this number. Faculty will increase emphasis of students to participate in either an internship or research to all Biology students.