

Name of Program/Department:	Department of Biology
Year:	2020 - 2021
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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 (61%) exceeded the benchmark for both SLO's 1 & 2 (SLO 1: 60%, SLO 2: 59%). In addition, the year's average increased about 1% from last year. Achievement in the separate areas of content (SLO 1: 64.5%) met the benchmarks but critical thinking (SLO 2: 58%) did not. Achievement in the separate areas increased in three of six of the areas and remained the same in the other three areas this year.

In the fall 2020 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 Plant Biology and Cell and Molecular. However, exit exam results did not improve in the areas of Genetics and Evolution nor in Ecology.

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. Although perhaps not the identical cohort of students, the 2016 and 2017 freshman classes included at least a portion of the students that graduated in fall 2020 or spring 2021. The overall exam averages showed that students in the 2016 and 2017 incoming classes began the major with an average achievement of 40% and by the time they are seniors they have increased their achievement to 61%.

The Biology Department is in the process of examining the 2020-2021 results by core area to determine where instruction needs to be enhanced to improve performance and are also investigating ways to improve our assessment methods for 2021-2022.

The department measured student achievement on use of the scientific approach and communication (SLO 3 and 4) through student research project laboratory reports and presentations. The department used scoring criteria they developed as a more objective "direct measure" of Biology majors' competence. The average proportion of laboratory reports that achieved our goal score of 3.0 out of 4 (75%) met the benchmark of 75% for overall average but did not meet the benchmark for the individual scoring criteria. The average proportion of presentations at RED that achieved our goal score of 4.0 out of 5 (67%) exceeded both the benchmark and target of 40%.

The Biology Department administered an indirect assessment of all SLO's (*Attitude Survey*) to 92% of graduating seniors in Fall 2020 and Spring 2021. At least 80% or more of students responded "strongly agree" or "agree" for the majority of questions (13/15) meeting that benchmark.

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 60%, Benchmark of 60%, Target (3 year set in 2019) of 62%

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 58%, Benchmark of 59%, Target (3 year set in 2019) of 62%

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 to cogently communicate results at or above a score of:

- a. 3.0 out of 4 (laboratory reports). The proportion of students that achieve a score of 3.0: Baseline (we have no baseline for comparison this year because this is the first year implementing the assessment tool at a lower score in freshman courses), Benchmark of 75%, Target 90%.
- b. 4 out of 5 (RED presentations). The proportion of students that achieve a score of 4: Baseline (2018-2019 results): 36%; Benchmark: 40%; Target (5 year set in 2019): 40%

SLO 4.0: Students will cogently communicate about biology at or above a score of:

- a. 3.0 out of 4 (laboratory reports). The proportion of students that achieve a score of 3.0: Baseline (we have no baseline for comparison this year because this is the first year implementing the assessment tool at a lower score in freshman courses); Benchmark: 75%; Target: 90%.
- b. 4 out of 5 (RED presentations). The proportion of students that achieve a score of 4: Baseline (2018-2019 results): 36%; Benchmark: 40%; Target (5 year set in 2019): 40%

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 60%,
- Benchmark of 60%,
- Target (3 year set in 2019) of 62%.

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 58%,
- Benchmark of 59%,
- Target (3 year set in 2019) of 62%.

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 2020 Senior Seminar course, enrolled students that would not be graduating until Spring 2021 did not take the exam. We followed the same procedure with the Spring 2021 Senior Seminar course. Graduating students that did not take the exam were contacted, arrangements made, and they took the exam in Spring 2021.

The common Biology Exit Exam was administered via Blackboard again this year in part due to COVID-19 protocols but also to make it easily available and accessible to all graduating students.

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 106, Bio 107, and Bio 108). These courses are required of all biology majors. Students were given a different but comparable form of the exit exam to ensure that the student is not taking the same exam twice. The exam was administered on the first laboratory class day within the first two weeks of the beginning of each semester since 2016. Because of COVID restrictions we were not able to administer the exam to the Fall 2020 introductory courses. However, we did administer the exam in the Spring courses.

We regard the mean percent score of the exam results for all students to be a reasonable indicator of student-success in meeting the learning outcomes. This year's:

- Baseline (average of past 2 year's SLO results): SLO 1: 60%, SLO 2: 58%,
- Benchmarks are SLO 1: 60% or higher, SLO 2: 59% or higher;
- Target: (3 year set in 2019): 62%.

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 to cogently communicate results at or above a score of:

- a. 3.0 out of 4 for student laboratory reports as measured by a rubric developed by Biology Department used to evaluate laboratory reports and presentations. The proportion of students that achieve a score of 3.0: Baseline (we have no baseline for comparison this year because this is the first year implementing the assessment tool at a lower score in freshman courses), Benchmark of 75%, Target 90%.
- b. 4 out of 5 at Research Exhibition Day virtual poster presentations as measured by a rubric developed by Biology Department used to evaluate laboratory reports and presentations. The proportion of students that achieve a score of 4: Baseline (2018-2019 results): 36%; Benchmark: 40%; Target (5 year set in 2019): 40%

SLO 4.0: Students communicated cogently about biology at or above a score of:

- a. 3.0 out of 4 for student laboratory reports as measured by a rubric developed by Biology Department used to evaluate laboratory reports and presentations. The proportion of students that achieve a score of 3.0: Baseline (we have no baseline for comparison this year because this is the first year implementing the assessment tool at a lower score in freshman courses); Benchmark: 75%, Target: 90%.
- b. 4 out of 5 at Research Exhibition Day virtual poster presentations as measured by a rubric developed by Biology Department used to evaluate laboratory reports and presentations. The proportion of students that achieve a score of 4: Baseline (2018-2019 results): 36%; Benchmark: 40%; Target (5 year set in 2019): 40%

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.

Scoring Criteria:

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 laboratory reports faculty were surveyed for a random selection of laboratory reports completed by students as a typical part of course-work during the 2020 – 2021 academic year. We asked for laboratory reports relating to authentic research in the classroom. In this case, authentic refers to hypothesis generating, hypothesis testing, data gathering, and analysis in a dynamic system without a predetermined outcome (a so called ‘cookbook’ laboratory). Last year, the laboratory reports were drawn from all academic levels. This year with the continued COVID-19 protocols in place, only one freshman-level course ran authentic research as part of their spring 2021 coursework. From that freshman-level course, eight laboratory reports were randomly selected for further evaluation. Submitted laboratory reports fulfilling the specified criteria were then de-identified and all eight were sent to three biology faculty volunteers who rated the reports for criteria meant to assess specific learning outcomes of the department. These questions were taken directly from, or adapted from, the rubric we have used previously to assess student oral or poster presentations at various events (see Scoring Criteria listed above). Scoring Criteria were scored on a Likert scale with a score of 1 strongly disagreeing with the question and a score of 4 strongly agreeing. Averages and standard deviations were generated for 1) each laboratory report (1 – 8) and 2) each criterion (1 – 12). The scoring of these laboratory reports using these methods does not necessarily reflect the grade the student received on the same piece of work in a classroom setting.

Because laboratory reports were acquired this year from freshman-level courses at the end of the academic year, we expected students to not perform quite as well as upper-level students. As such, we deem the proportion of students that achieve scores of 3.0 or greater rather than 3.5 (used to evaluate student achievement in upper level courses) as our: Baseline (we have no baseline for comparison this year because this is the first year implementing the assessment tool at a lower score in freshman courses); Benchmark: 75%; and Target: 90%.

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 virtual Research and Exhibition Day in the spring 2021 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. Although we were unable to evaluate oral presentations this year at the department’s PURE Symposium because it was not held in 2020-2021 due to COVID-19 restrictions, the recorded nature of the virtual poster presentations was very similar to how a project would be presented as an oral presentation at PURE.

Because participation in RED is optional and students have basically self-selected to be included, we expect students to perform quite well on average. As such, we deem the proportion of students that achieve scores of 4 or greater out of 5 in all hybrid areas (questions that fit into the same broad category) as: Baseline (2018-2019 results -because no presentations were evaluated in 2019-2020): 36%; Benchmark: 40%; Target (5 year set in 2019): 40%

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 2020 and Spring 2021 with questions added to the Biology Exit Exam (questions are listed in results section Table 5). 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) 13/15 questions,
- Benchmark of 13/15 questions,
- Target (5 year) of 14/15 questions.

Assessment Results

Student Learning Outcomes 1 and 2:

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 64.5% as measured by a common Biology Exit Exam. Since our benchmark was 60%, this target was achieved.

SLO 2.0: Biology majors demonstrated competence in critical thinking and the application of the scientific approach at the 58% level as evaluated by the Biology Exit Exam. Since our benchmark was 59%, this target was not achieved.

SLO 1: -Baseline (average of past 2 year's SLO results) of 60%, Benchmark of 60%, Target (3 year set in 2019) of 62% as evaluated by the Biology Exit Exam.

SLO 2: -Baseline (average of past 2 year's SLO results) of 58%, Benchmark of 59%, Target (3 year set in 2019) of 62% as evaluated by the Biology Exit Exam.

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 2019-2020 for comparison. Table 2 summarizes the results for students entering the major from 2016 – 2021 (administered in introductory biology courses: Bio 115L, 106, 107, 108).

The overall mean on the exam (61%) exceeded the benchmark for both SLO 1 & 2 (SLO 1: 60%, SLO 2: 59%). In addition, this year's average increased about 1% from last year. Achievement this year in the separate area of content (SLO 1) improved about 4% whereas critical thinking (SLO 2) decreased slightly (about 1%) when compared to last year's results.

Performance improved in the core areas of Plant Biology and Cell and Molecular and along with the separate area of Fundamentals (those questions that are broadly applicable to multiple areas of biology but not a separate area in the major) were above the 60% benchmark (averages: Plant Biology 65%, Cell 62%, Fundamentals 76%).

In fall 2020 semester, the department examined the breakdown of 2019-2020 results by area. The breakdown of the results suggested a need to enhance instruction in the core areas of Plant Biology, Genetics and Evolution, and Cell and Molecular and the department worked to reinforce concepts in those areas. More reinforcement was incorporated and student performance improved and exceeded the benchmark in Plant Biology (65%) and Cell (62%) this year. However, student performance decreased in the core areas of Genetics and Evolution (50%) and Ecology (55%). Performance in the separate area of Animal Diversity (not a separate area of the major) increased but did not meet the benchmark this year.

We began administering the exit exam to students entering the major in 2016. Table 2 summarizes the results for those students for four academic years (2016 – 2021). Although

perhaps not the identical cohort of students, the 2016 and 2017 freshman classes included at least a portion of the students that graduated in Fall 2020 or Spring 2021. The overall exam averages showed that students in the 2016 and 2017 incoming classes began the major with an average achievement of 40% (Table 2) and by the time they are seniors they have improved their achievement to 61% (Table 1).

Test reliability based on Kuder-Richardson Formula 20 results indicated that the Biology Exit Exam used is reliable. Kuder- Richardson Formula 20 results greater than 0.5 are considered good for an in-house prepared exam. The average Kuder-Richardson Formula 20 for the version used this year 2020-2021 derived from spring 2019 and 2019 - 2020 exams = 0.69). Blackboard Exam Item Analysis does not calculate a reliability index however so we do not know if the reliability of the exam has changed.

Table 1. Summary of results of the cumulative exam given to graduating seniors in Fall 2020 and Spring 2021. Results from 2019- 2020 are included for comparison.

Learning Outcome	Assessment (Exam question that pertains to each learning outcome)	Results (Mean percent correct)				
		Fall 2020 - Spring 2021	2019 - 2020	Fall 2020	Spring 2021	2020 - 2021
1. 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 of 60% (benchmark) as measured by a common Biology Exit Exam.	Concepts: 1, 2, 5-7, 9, 10, 12, 14-17, 20-24, 26, 27, 34-36, 41, 43, 44, 47-49		61	65	63.9	64.5
a. Plant Biology	5, 16, 22, 25, 27, 31, 39, 47		59.3	68.5	61.7	65.1
b. Ecology	3, 12, 28, 29, 40, 44, 48		63.5	56.6	54.8	55.7
c. Cell and Molecular Biology	2, 7, 9, 10, 11, 18, 20, 21, 24, 26, 28, 30, 33, 36, 37, 41, 42, 49, 50		56.8	62.9	60.9	61.9
d. Genetics and Evolution	4, 13, 17, 23, 32, 35, 38, 46		52.8	49.1	50.3	49.7
e. Fundamentals	8, 15, 19, 34, 43		79.6	73.5	78.5	76.2
f. Animal Diversity	1, 6, 14, 45		54.6	57.1	60.8	59
2. Biology majors will demonstrate competence in critical thinking and the application of the scientific approach at an overall average of 59% (benchmark) as evaluated by the Biology Exit Exam.	3, 4, 8, 11, 13, 18, 19, 25, 28-33, 37-40, 42, 45, 46, 50		59	59	57	58
Number of graduates			58	24	50	74
Number of students completed exam (% of graduating seniors)			55 (95%)	21 (88%)	49 (98%)	70 (95%)
Overall Exam Mean			60	62.3	60.5	61.3

Table 2. Summary of results of the cumulative exam given to students in BIO 115L taking the course for the first time in 2016 - spring 2021.

Learning Outcome	Assessment (Exam question that pertains to each learning outcome)	Results (Mean percent correct)				
		2016-2017	2017-2018	2018 - 2019	2021 (sp)	Average
1. 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 of 60% (benchmark) as measured by a common Biology Exit Exam.	Concepts: 1, 2, 5-7, 9, 10, 12, 14-17, 20-23, 26, 28, 32, 34-36, 41, 43, 47-49	39.5	37.4	37.4	29.6	36.4
a. Plant Biology	5, 16, 22, 27, 29, 31, 39, 47	28.7	26.4	28.9	19.2	25.8
b. Ecology	3, 11, 12, 40, 44, 48	50.5	45.3	46.7	31.5	43.5
c. Cell and Molecular Biology	2, 7, 9, 10, 18, 20, 21, 25, 26, 28, 30, 32, 33,36, 37,41, 42, 49, 50	37.9	35.6	36.4	25.5	33.9
d. Genetics and Evolution	4, 13, 17, 23, 35, 38, 46	34.8	38.1	30.6	25.8	32.3
e. Fundamentals	8, 15, 19, 24, 34, 43	n/a	n/a	50	43.5	46.8
f. Animal Diversity	1,6, 14, 45	n/a	n/a	50.1	28.2	39.2
2. Biology majors will demonstrate competence in critical thinking and the application of the scientific approach at an overall average of 59% (benchmark) as evaluated by the Biology Exit Exam.	3, 4, 8, 11, 13, 18, 19, 24, 25, 27, 29-31, 33, 37-40, 42, 44-46, 50	41.1	38.6	39.3	27.6	37.3
Number of students completed exam		132	235	321	54	194.2
Overall Exam Mean		40.3	40	38.3	28.7	37.4

Several factors may be responsible for some of the average exam results falling below the benchmark. One issue is that some questions in both learning outcomes assessed by the exam may cover content from courses that the student may have completed early in their course progression or are based on material in a subject area that is not reinforced in subsequent upper level courses (e.g., plant biology and animal diversity (Biology 106, 108)). In addition, results show that students performed better on content-based questions (SLO 1) than they did on critical thinking questions (SLO 2). Critical thinking questions are expected to be more difficult. Additionally, poor performance on the critical thinking questions may be exacerbated if a critical thinking question combines content from an early course and is not reinforced later.

Student Learning Outcome 3 and 4:

SLO 3.0: Students explained and demonstrated 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 to cogently communicate results at or above a score of:

- a. 3.0 out of 4 for student laboratory reports as measured by a rubric developed by Biology Department used to evaluate student laboratory reports and presentations with an overall average of 75% on the report as a whole and 58% of the individual scoring criterion evaluated. Our benchmark (75%) was achieved for the overall average but not for the individual scoring criteria.
- b. 4 out of 5 for virtual poster presentations at Research Exhibition Day as measured by a rubric developed by Biology Department used to evaluate laboratory reports and presentations with an overall average of 67%. Since our benchmark and target were 40%, both were achieved.

SLO 4.0: Students communicated cogently about biology at or above a score of:

- a. 3.0 out of 4 for written student laboratory reports as measured by a rubric developed by Biology Department used to evaluate student laboratory reports and presentations with an overall average of 75% on the report as a whole and 58% of the individual scoring criterion evaluated. Our benchmark (75%) was achieved for the overall average but not for the individual scoring criteria.
- b. 4 out of 5 for virtual poster presentations at Research Exhibition Day as measured by a rubric developed by Biology Department used to evaluate laboratory reports and presentations with an overall average of 67%. Since our benchmark and target were 40%, both were achieved.

A rubric (Scoring Criteria listed in Methods) developed by Biology Department was used to evaluate student laboratory reports. Laboratory reports had been completed by students as a typical part of course-work during the 2020 – 2021 academic year and were based on authentic research in the classroom. In this case, authentic refers to hypothesis generating, hypothesis testing, data gathering, and analysis in a dynamic system without a predetermined outcome. With the continued COVID-19 protocols in place, only one course (freshman-level) ran authentic research as part of their spring 2021 coursework. From that course, eight laboratory reports were randomly selected for further evaluation. As these laboratory reports were all drawn from all academic ranks, we lowered the achievement score goal from 3.5 to 3.0. Last year, the laboratory reports were drawn from all academic ranks. All eight reports were sent to each of the three faculty volunteers who scored them for the 12 scoring criteria listed on the scoring rubric. 75% (6/8) of papers evaluated reached the score of 3.0 (Table 3), however none of them would have reached the higher score used last year (3.5).

The average score for each criterion of the rubric used to evaluate the eight student laboratory reports is shown in Table 4. Of the 12 criteria, seven had an average score of 3.0 or greater (58%). However, this result (58%) failed to meet the benchmark of 75% of criteria meeting a score of 3.0 or higher. The overall average score for all criteria (3.0) met the goal of a score of 3.0 and 50% of the papers (4/8) met the 3.0 score. Although the average was only 58% (7/12) of the criteria meeting the score of 3.0, 75% (9/12) of the criteria had scores of 3.0 on more than half of the papers. Those criteria questions that failed to meet the 3.0 threshold were: 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', 8) The student's own work is clearly reflected in the work, 10) The work is self-explanatory.

Table 3: Average score (out of 4 choice Likert scale) and standard deviation from three faculty evaluators for each of the eight laboratory reports assessed for the spring of 2021. The goal was for the reports to score 3.0 or higher. Results from 2019-2020 are included for comparison.

	2019-2020			2020-2021		
	Response average	Standard deviation	Meets Score 3.5?	Response average	Standard deviation	Meets Score 3.0*?
Report 1	3.6	0.8	Yes	3.00	0.60	Yes
Report 2	3.2	0.9	No	2.50	0.40	No
Report 3	3.3	0.7	No	3.10	0.60	Yes
Report 4	3.1	0.8	No	3.20	0.60	Yes
Report 5	2.8	1.2	No	2.60	0.50	No
Report 6	2.6	1.2	No	3.00	0.60	Yes
Report 7	2.8	1.1	No	3.40	0.60	Yes
Report 8	3.6	1.1	Yes	3.00	0.60	Yes
Average	3.125	0.975		2.98	0.56	
Proportion of reports that meet score goal			2/8 = 25%			6/8 = 75%

*Score was lowered to 3.0 for the 2020-2021 academic year because only freshmen-level laboratory reports were collected for this assessment.

Table 4: Average score (out of 4 choice Likert scale) and standard deviation for each of 12 criteria (questions) used by three faculty evaluators for each of eight laboratory reports assessed for the spring of 2021. The goal was for the reports to score 3.0 or higher. Results from 2019-2020 are included for comparison.

Scoring Criterion	2019-2020				2020-2021			
	Response average	Standard deviation	No. of reports at 3.5	Meets score 3.5?	Response average	Standard deviation	No. of reports at 3.0	Meets score 3.0*?
1	3.5	0.9	4	Yes	2.9	0.4	5	No
2	3.5	1.2	5	Yes	2.5	0.4	2	No
3	2.8	1.0	2	No	2.7	0.5	4	No
4	3.5	0.9	5	Yes	3.5	0.8	6	Yes
5	2.7	1.0	3	No	3.1	0.7	4	Yes
6	3.1	1.1	3	No	3.3	0.8	4	Yes
7	3.2	0.8	5	No	3.2	0.6	4	Yes
8	3.5	0.9	5	Yes	2.6	0.6	3	No
9	2.9	0.8	3	No	3.2	0.5	4	Yes
10	3.0	1.0	4	No	2.6	0.6	3	No
11	2.7	0.8	2	No	3.1	0.4	5	Yes
12	3.1	1.0	3	No	3.1	0.5	4	Yes
Average	3.1	1.0	3.7		3.0	0.5	4.0	
Proportion of criterion meet score goal				4/12 = 33%				7/12 = 58%

*Score was lowered to 3.0 for the 2020-2021 academic year because only freshmen-level laboratory reports were collected for this assessment.

The Scoring Criteria developed by Biology Department was also used to evaluate student research projects presented as virtual pre-recorded poster presentations at the Research Exhibition Day in spring 2021. Research projects completed by students may be independent research projects they receive credit for (e.g., Bio 497, Honor’s Thesis) or they may take part in projects and not receive credit (e.g., Biology Research Experience Program Fellows (BREP) supported by our INBRE grant and REAL, the University’s quality enhancement program). The projects were completed during the 2020 – 2021 academic year and were based on authentic research. As with laboratory reports, “authentic” refers to hypothesis generating, hypothesis testing, data gathering, and analysis in a dynamic system without a predetermined outcome. Participation in RED is optional and students basically self-select to be included. With the continued COVID-19 protocols in place, and perhaps because RED was virtual this year there were only three biology RED participants this year.

All three presentations were evaluated by each of four faculty volunteers who were not involved with the research. They scored the presentations for the 12 Scoring Criteria. Individual scoring results were averaged for evaluators and for questions that fit into the same broad

category (“Hybrid” listed in Table 5). Average overall scores for each of the three presentations met the 4.0 score goal. The overall average of 67% as well as 2 of the 3 individual Hybrid categories met both the benchmark (40%) and target (40%) (Table 5).

Table 5: Average score (out of 5 choice Likert scale) and standard deviation for each of three Hybrid criteria (questions) used to assess each of three Research Exhibition Day virtual presentations in Spring 2021. Individual scoring results were averaged for evaluators (4) and for questions that fit into the same broad category (“Hybrid”). The goal for each hybrid criteria was a score of 4.0 out of 5. Results from Spring 2018-2019 are included for comparison (due to COVID-19 no presentations were available for evaluation in 2019-2020).

Poster number	Spring 2021			% of students with a score of 4 or greater	
	1	2	3	2018-2019 (11 posters)	2020- 2021 (3 posters)
Hybrid Scientific Thought Score (Qs 1,2,3)	4.33	4.42	3.83	36%	67%
Standard Deviation	0.82	0.7	0.44		
Hybrid Scientific Method Score (Qs 4,5,6,7,12)	4.13	4.8	4.2	55%	100%
Standard Deviation	0.81	0.71	0.62		
Hybrid Communication Score (Qs 8,9,10,11)	3.92	4.75	3.75	27%	33%
Standard Deviation	0.76	0.67	0.67		
Overall Score	4.12	4.14	3.86	36%	67%
STDEV	0.81	0.73	0.98		

The number of student laboratory reports, RED virtual presentations, and faculty evaluators were all limited this academic year because many classes were still online or hybrid style for COVID-19 protocols. Those protocols also eliminated our ability to assess presentations at PURE. The resulting small sample sizes and limited evaluators may be partially responsible for the low overall achievement in the scores on laboratory reports (in addition to being only freshman-level) and the high achievement for presentations. Participation in RED can be optional and students basically self-select to be included. Also limited numbers of RED participants this year, probably because of COVID restrictions impacting research projects in general implies that likely only the most highly motivated students participated in RED leading in to very good results this year compared to in previous years.

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 13/15 questions,
- Target (5 year) of 14/15 questions.

We administered a survey of student attitudes about the biology SLOs to graduating seniors in Fall 2020 and Spring 2021. 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 (87%) and met the benchmark of 13/15 questions (87%).

Table 5 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, 87%) of the questions. Students felt less strongly (< 80% “strongly agree or “agree”) on two questions: “I am able to demonstrate the relationship between multiple variables by using statistical analysis” (74%) and “Courses in biology have strengthened my understanding of biological concepts in plant biology (76%).” Overall average ranking of “strongly agree or agree” was 90%.

The survey was administered via Blackboard and several of the students that completed the exit exam did not complete the survey. That coupled with a lower proportion in the fall means the percentage of graduates (92%) does not match the percentage that completed the exit exam (95%).

Table 5: Attitude survey questions asked and the results (percentages) from graduating in Spring 2019 – 2021 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		
		Spring 2019	2019-2020	2020-2021
1	Courses in biology have strengthened my understanding of biological concepts in:			
	a. Genetics and Evolution	91.3	88.9	88.6
	b. Cell and Molecular Biology	89.1	70.4	84.1
	c. Ecology	82.6	83.3	89.7
	d. Plant Biology	71.8	75.9	76.4
2, 3	I able to demonstrate the relationship between multiple variables by using statistical analysis.	71.8	70.4	74
3	I am able to identify a hypothesis or purpose of a study.	100	94.4	99
3, 4	I feel to prepared to write a comprehensive lab report.	89.1	94.4	91
3	I understand and can employ a range of laboratory techniques/methods to study biological processes.	93.5	92.6	97.9
3	I am able to identify primary sources.	95.7	92.6	91.8
3	I am able to use the correct citation methods in my work cited.	93.5	92.6	96.8
4	I can explain biological concepts to others.	91.3	90.7	91
2	Courses in Biology at FMU have strengthened my ability to think critically.	100	87	92
N/A	The Biology department at FMU offers a sufficient variety of courses.	93.5	79.6	84.4
N/A	The methods and skills I have mastered as a biology major at FMU will help me in my future pursuits.	93.5	88.9	94.4
N/A	It is important that the Biology department introduces students to various careers in biology.	93.5	96.3	95.3
	Overall average	90	87	90
	Number of students completed survey (% of graduating seniors)	46 (96%)	54 (93%)	68 (92%)

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 60%, Benchmark of 60%, Target (3 year set in 2019) of 62%

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 58%, Benchmark of 59%, Target (3 year set in 2019) of 62%

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 2020, the exam was administered to only those students graduating at the end of Fall semester. Likewise, at the end of Spring 2021, the exam was administered only to those students graduating in Spring 2021. Any student who completed the Senior Seminar course in the Fall 2020 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 2021 semester. This procedure was successful again this year with the majority of graduating students completing the exam (88% in Fall 2020, 98% in Spring 2021, overall 95%) and will be continued in the future.
2. The breakout of the 2019-2020 results into the four core areas showed that student achievement did not meet the benchmark in the areas of Genetics and Evolution and Cell and Molecular. In Fall 2020, 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 2020-2021 academic year (taught in 2020 -2021 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).

The breakout of the 2020-2021 results into the four core areas showed that student achievement did not improve in the areas of Genetics and Evolution and Ecology. In Fall 2021, the Biology Department will ensure that certain core principles and concepts in those areas are reinforced in upper level courses where this material is included in the 2021-2022 academic year including but not limited to: Bio 105 and 106 Biological Sciences I and II, Bio 107 and 108 Integrated Biological Concepts I and II, Ecology courses (Bio 308, 317, 318, 402, 411, 412), Bio 401 Genetics, Bio 409 Evolutionary Biology.

3. 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. However, due to COVID-19 and campus closure the process was not completed fully this academic year. This objective will be carried over the 2021 -2022 academic year.
4. The Biology Department continued its investigation of validated questions from Concept Inventories to be used on our exams, however, the process was not completed fully this academic year due to COVID-19 and campus closure. This objective will be carried over the 2021 -2022 academic year.
5. The Biology Department changed the core course requirements of the major effective with 2019-2020 catalog. The change necessitates that the Biology Exit exam be amended to adequately assess this new requirement because students that graduating in 2021-2022 could be graduating under the new requirement. The department will evaluate the exam and make necessary changes in the 2021-2022 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 to cogently communicate results at or above a score of:

- a. 3.0 out of 4 (laboratory reports). The proportion of students that achieve a score of 3.0: Baseline (we have no baseline for comparison this year because this is the first year implementing the assessment tool at a lower score in freshman courses), Benchmark of 75%, Target 90%.
- b. 4 out of 5 (RED presentations). The proportion of students that achieve a score of 4: Baseline (2018-2019 results): 36%; Benchmark: 40%; Target (5 year set in 2019): 40%

SLO 4.0: Students will cogently communicate about biology at or above a score of:

- a. 3.0 out of 4 (laboratory reports). The proportion of students that achieve a score of 3.0: Baseline (we have no baseline for comparison this year because this is the first year implementing the assessment tool at a lower score in freshman courses); Benchmark: 75%; Target: 90%.
- b. 4 out of 5 (RED presentations). The proportion of students that achieve a score of 4: Baseline (2018-2019 results): 36%; Benchmark: 40%; Target (5 year set in 2019): 40%

SLOs 3 and 4:

In 2020-2021 we were unable to hold face-to-face and the RED and PURE events. PURE was not held. RED was virtual in Spring 2021.

1. If in 2021-2022 we are more fully face-to-face and restrictions allow RED and PURE events to be held:
 - a. The department will continue to utilize the rubric in evaluation of student projects in RED and PURE. We will include the fall 2021 PURE presentations in our evaluation.
 - b. To increase the consistency in the evaluation of student presentations, at RED and PURE, we will again task a group with evaluating all the biology students presenting. We will also increase the number of evaluators.
2. If we are able to hold face-to-face RED and PURE presentations in 2021-2022:
 - a. The department will continue to utilize the rubric in evaluation of student laboratory reports. We will solicit more laboratory reports we evaluate.
 - b. To increase the consistency in the evaluation of student laboratory reports, we will task a group with evaluating all the reports. We will also increase the number of evaluators.
3. In Fall 2021 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.
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. We facilitated the process by which faculty can mentor students in research projects outside of the classroom as much as was possible give COVID-19 protocols.
6. 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.

7. Given our rubric was designed primarily for presentation-based assignments, a number of individual questions are not applicable to written assignments. Therefore, in fall 2020 the department began developing additional rubrics for use evaluating other types of student assignments (e.g. oral presentations, in-class poster presentations, and in-class laboratory assignments in appropriate upper-level courses). Work on this objective is not complete and will be carried over the 2021-2022 academic year.
8. We decided to expand the use of the rubric to increase consistency in common courses and lab sections. This objective will be carried over the 2021-2022 academic year.
9. We discussed the feasibility of an evaluation committee to score in-class presentations and written laboratory reports to allow for repeat measures of assignments that would otherwise receive one evaluation from the instructor of record. This objective will be carried over the 2021-2022 academic year.

SLO 1, 2, 3, and 4: We will encourage faculty to implement more statistical analysis into courses where appropriate and to enhance instruction:

1. The breakout of the 2019-2020 survey results showed that student attitude did not meet the benchmark in the areas of statistical analysis, Plant Biology, and Cell and Molecular. In Fall 2020, the Biology Department ensured that certain core principles and concepts in those areas were reinforced in upper level courses where this material is included in the 2020-2021 academic year.
2. The breakout of the 2020-2021 survey results show that student attitude did not meet the benchmark in the areas of statistical analysis and concepts in Plant Biology. In Fall 2021, the Biology Program will ensure that certain core principles and concepts in those areas are reinforced in upper level courses where this material is included in the 2021-2022 academic year.