

Name of Program/Department:	Department of Biology
Year:	2019 - 2020
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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 in our Senior Seminar courses both semesters. The overall mean on the exam (60%) met the benchmarks for both SLO 1 and 2 (SLO 1: 60%, SLO 2: 59%). Achievement in the separate areas of content (SLO 1: 61%) and critical thinking (SLO 2: 59%) also met the respective benchmarks. The year's average increased slightly from last year (2%). Achievement in the separate areas increased in two of four of the areas and remained the same in the other two areas this year.

In the fall 2019 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 in Plant Biology and Ecology and exceeded the benchmark in Ecology (63%). However, exit exam results did not improve in the areas of Genetics and Evolution nor in Cell and Molecular.

In order to get a better understanding of the level of achievement at which Francis Marion University 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 freshman class included at least a portion of the students that graduated in Spring 2020. The overall exam averages showed that students in the 2016 incoming class began the major with an average achievement of 40% and by the time they are seniors they increased their achievement to 60%.

The Biology Department is in the process of examining the 2019-2020 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 2020-2021.

The Biology Department measured student achievement on use of the scientific approach and communication through student research project laboratory reports (SLO 3 and 4). The department used a rubric they developed as a more objective "direct measure" of Biology majors' competence in the application and communication of the scientific approach to evaluate student research project laboratory reports. The average proportion of laboratory reports that achieved our goal score of 3.5 or greater (25%) did not meet the benchmark of 33% for either the average score for each report or the average score for each criterion used to evaluate the report.

The Biology Department administered an indirect assessment of all SLO's (*Attitude Survey*) to 93% of graduating seniors in Fall 2019 and Spring 2020. At least 80% or more of students responded "strongly agree" or "agree" for the majority of questions (12/15). However, did not meet the benchmark of 13/15 questions answered "strongly agree" or "agree" at 80% or higher.

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 (last year's results) of 59%, 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 (last year's results) of 57%, 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 3.5 out of 5. The proportion of students that achieve a score of 3.5: Baseline (we have no baseline for comparison because this is first year implementing the assessment tool), Benchmark of 35%, Target (4 year set in 2019) of 40%.

SLO 4.0: Students will cogently communicate cogently about biology at or above a score of 3.5 out of 5. The proportion of students that achieve a score of 3.5: Baseline (we have no baseline for comparison because this is first year implementing the assessment tool), Benchmark of 35%, Target (4 year set in 2019) of 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 of: Baseline (last year's results) of 59%, Benchmark of 60%, Target (3 year set in 2019) of 62% as evaluated by the Biology Exit Exam.

SLO 2.0: Biology majors will demonstrate competence in critical thinking and the application of the scientific approach at an overall average of: Baseline (last year's results) of 57%, Benchmark of 59%, Target (3 year set in 2019) of 62% as evaluated by the Biology Exit Exam.

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 course work. To

address this issue of timing of exam administration, we administer the exam only to students in the semester they are graduating. In the Fall 2019 Senior Seminar course, enrolled students that would not be graduating until Spring 2020 did not take the exam. We followed the same procedure with the Spring 2020 Senior Seminar course. Graduating students that did not take the exam were contacted and arrangements made and they took the exam in Spring 2020.

The common Biology Exit Exam was administered in person in Fall 2019. However, in Spring 2020, due to the campus closure because of COVID-19 the exit exam was administered via Blackboard.

To get an indication of how students entering the biology major perform, the cumulative exam has been administered to those students in Biological Sciences I Laboratory (BIO 115L) who were taking the biology majors lecture and laboratory courses for the first time every semester since 2016. This course is 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. This past year's results (2019 – 2020) are not available at this time.

We regard the mean percent score of the exam results to be a reasonable indicator of student-success in meeting the learning outcomes. This year's benchmarks are SLO 1: 60% or higher, SLO 2: 59% or higher (baseline is last year's results: SLO 1: 59%, SLO 2: 57%, 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 3.5 for student laboratory reports as measured by a rubric developed by Biology Department used to evaluate student laboratory reports. The proportion of students that achieve a score of 3.5: Baseline (we have no baseline for comparison because this is first year implementing the assessment tool), Benchmark of 35%, Target (4 year set in 2019) of 40%.

SLO 4.0: Students will communicate cogently about biology at or above a score of 3.5 for student laboratory reports as measured by a rubric developed by Biology Department used to evaluate student laboratory reports. The proportion of students that achieve a score of 3.5: Baseline (we have no baseline for comparison because this is first year implementing the assessment tool), Benchmark of 35%, Target (4 year set in 2019) of 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 (SLO 3) 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 transition from face-to-face instruction to online instruction in the spring of 2020 eliminated our ability to assess SLOs 3 and 4 at RED and PURE. To compensate, we evaluated laboratory reports. Faculty were surveyed for a random selection of laboratory reports completed by students as a typical part of course-work during the 2019 – 2020 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). Of 12 laboratory reports received from various faculty, eight of them fulfilled the criteria for being assessed here (e.g. they were authentic research experiences). Submitted laboratory reports fulfilling the specified criterion were then de-identified and sent to four biology faculty volunteers, who rated at least four 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 Appendix 1). The criteria (see below) were scored on a Likert scale with a score of 1 strongly disagreeing with the proposal and a score of 5 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.

The assessment rubric was initially intended 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 poster presentations).
11. Charts, figures, and diagrams aid in the understanding of the project.
12. The works cited is sufficiently robust.

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 2019 and Spring 2020 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. In Fall 2019 the survey was administered in person but due to campus closure in Spring 2020 due to COVID-19 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 (last 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 61% 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 59% level as evaluated by the Biology Exit Exam. Since our benchmark was 59%, this target was achieved.

SLO 1: Baseline (last year's results) of 59%, Benchmark of 60%, Target (3 year set in 2019) of 62 %

SLO 2: Baseline (last year's results) of 57%, Benchmark of 59%, Target (3 year set in 2019) of 62 %

Tables 1 and 2 summarize the results for each learning outcome and include 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 2018-2019 for comparison. Table 2 summarizes the results for students entering the major from 2016 – 2019 (administered in BIO 115L).

The overall mean on the exam (60%) met the benchmark for both SLO's 1 & 2 (SLO 1: 60%, SLO 2: 59%). In addition, the year's average increased about 2% from last year. Achievement this year in the separate areas of content (SLO 1) and critical thinking (SLO 2) also both increased about 2% when compared to last year's results.

Performance in the core area of Ecology and separate area of Fundamentals (those questions that are broadly applicable to multiple areas of biology but not a separate area in the major) were well above the benchmark (averages: Ecology 63.5%, Fundamentals 79.6%).

In fall 2019 semester, the department examined the breakdown of 2018-2019 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 was close to the benchmark in Plant Biology (59%). However, student performance remained the about same in the core areas of Genetics and Evolution and Cell and Molecular. 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 three academic years (2016 – 2019). Although perhaps not the identical cohort of students, the 2016 freshman class included at least a portion of the students that graduated in Spring 2020. The overall exam averages showed that students in the 2016 incoming class began the major with an average achievement of 40% (Table 2) and by the time they are seniors they improved their achievement to 60% (Table 1).

Test reliability based on Kuder-Richardson Formula 20 results indicated that the Biology Exit Exam is reliable (Kuder- Richardson Formula 20 results greater than 0.5 are considered good for an in-house prepared exam; 2019 - 2020 = 0.63).

Table 1. Summary of results of the cumulative exam given to graduating seniors in Fall 2019 and Spring 2020. Results from 2018- 2019 are included for comparison.

Learning Outcome	Assessment (Exam question that pertains to each learning outcome)	Results (Mean percent correct)			
		2018 - 2019	Fall 2019	Spring 2020	2019 - 2020
	Fall 2019 - Spring 2019				
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 59% (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	59	54	68	61
a. Plant Biology	5, 16, 22, 25, 27, 31, 39, 47	57.6	52.6	66	59.3
b. Ecology	3, 12, 28, 29, 40, 44, 48	60.4	63.9	63.1	63.5
c. Cell and Molecular Biology	2, 7, 9, 10, 11, 18, 20, 21, 24, 26, 28, 30, 33, 36, 37, 41, 42, 49, 50	56.3	48.8	64.8	56.8
d. Genetics and Evolution	4, 13, 17, 23, 32, 35, 38, 46	52.1	47	58.5	52.8
e. Fundamentals	8, 15, 19, 34, 43	72.9	75.8	83.3	79.6
f. Animal Diversity	1, 6, 14, 45	50.1	47.4	61.8	54.6
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	57	55	63	59
Number of graduates		81	22	36	58
Number of students completed exam (% of graduating seniors)		72 (89%)	19 (86%)	36 (100%)	55 (95%)
Overall Exam Mean		58	54.5	65	60

Table 2. Summary of results of the cumulative exam given to students in BIO 115L taking the course for the first time in 2016 - 2019.

Learning Outcome	Assessment (Exam question that pertains to each learning outcome)	Results (Mean percent correct)			
		2016-2017	2017-2018	2018 - 2019	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 59% (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	38.1
a. Plant Biology	5, 16, 22, 27, 29, 31, 39, 47	28.7	26.4	28.9	
b. Ecology	3, 11, 12, 40, 44, 48	50.5	45.3	46.7	
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	
d. Genetics and Evolution	4, 13, 17, 23, 35, 38, 46	34.8	38.1	30.6	
e. Fundamentals	8, 15, 19, 24, 34, 43	n/a	n/a	50	
f. Animal Diversity	1,6, 14, 45	n/a	n/a	50.1	
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	39.7
Number of students completed exam		132	235	321	229
Overall Exam Mean		40.3	40	38.3	39.5

Several factors may be responsible for some of the exam mean results being 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)). In addition, results show that students performed better on the content-based questions (SLO 1) than they did on the critical thinking questions (SLO 2) but students. 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 3.5 for student laboratory reports as measured by a rubric developed by Biology Department used to evaluate student laboratory reports with an overall average of 25% on the report as a whole and 33% of the individual scoring criterion evaluated. Since our benchmark was 35%, this target was not achieved.

SLO 4.0: Students communicated cogently about biology at or above a score of 3.5 for student laboratory reports and as measured by a rubric developed by Biology Department used to evaluate student laboratory reports with an overall average of 25% on the report as a whole and 33% of the individual scoring criterion evaluated. Since our benchmark was 35%, this target was not achieved.

A rubric 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 2019 – 2020 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. Of 12 laboratory reports received from various faculty, eight of them fulfilled the criteria for being assessed (*e.g.* they were authentic research experiences). A random subset of four of those eight reports were sent to each of the four faculty volunteers who scored them for the 12 scoring criteria listed above. Not all reports were evaluated the same number of times.

The proportion of student papers that scored an average of 3.5 or greater (2 of 8 reports, 25%) that did not meet the benchmark of 35% (Table 3). However, even though 75% of the average scores and the overall average were below the 3.5 score goal, all fell within one standard deviation of that 3.5 score.

The average score for each criterion is shown in Table 4. Of the 12 criteria, four had an average score of 3.5 or greater (33%) but that did not meet the benchmark of 35%. Those questions were: 1) The student clearly states a thoughtful question, 2) The student clearly states a research hypothesis or question, 4) The method of the investigation is appropriate to the problem, 8) The student's own work is clearly reflected in the work.

Although the majority of the average scores (75%) and the overall average were below the 3.5 score goal, average scores of all the criteria fell within one standard deviation of that 3.5 score goal. In addition, almost half of the reports (46%) had scores of 3.5 or higher on each criteria (Table 4).

Table 3: Average score (out of 5 choice Likert scale) and standard deviation for each of the eight laboratory reports assessed for the spring of 2020.

	Response average	Standard deviation	Meets score of 3.5 or greater?	Number of evaluations
Report 1	3.6	0.8	Yes	4
Report 2	3.2	0.9	No	4
Report 3	3.3	0.7	No	4
Report 4	3.1	0.8	No	4
Report 5	2.8	1.2	No	3
Report 6	2.6	1.2	No	3
Report 7	2.8	1.1	No	2
Report 8	3.6	1.1	Yes	2
Average	3.125	0.975		
Proportion of reports with score of 3.5 or greater			2/8 = 25%	

Table 4: Average score (out of 5 choice Likert scale) and standard deviation for each of 12 criteria (questions) used to assess each of eight laboratory reports.

Scoring Criterion	Response average	Standard deviation	Number of reports at 3.5 or greater for each criteria (%)	Meets 3.5 or greater scoring goal?
1	3.5	0.9	4 (50%)	Yes
2	3.5	1.2	5 (63%)	Yes
3	2.8	1.0	2 (25%)	No
4	3.5	0.9	5 (63%)	Yes
5	2.7	1.0	3 (38%)	No
6	3.1	1.1	3 (38%)	No
7	3.2	0.8	5 (63%)	No
8	3.5	0.9	5 (63%)	Yes
9	2.9	0.8	3 (38%)	No
10	3.0	1.0	4 (50%)	No
11	2.7	0.8	2 (25%)	No
12	3.1	1.0	3 (38%)	No
Average	3.125	0.95	3.67 (46%)	
Proportion of questions scored 3.5 or greater				4/12 = 33%

The number of student laboratory reports and faculty evaluators was limited this academic year because we used this assessment method only because the transition from face-to-face instruction to online instruction in the spring of 2020 eliminated our ability to assess presentations at RED and PURE. The resulting small sample size and limited evaluators may be partially responsible for the low overall achievement and high standard deviations in the scores.

SLO 1, 2, 3, and 4

Indirect Assessment: Attitude Survey

We administered a survey of student attitudes about the biology SLOs to graduating seniors in Fall 2019 and Spring 2020. 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 12/15 questions (80%) and did not meet the benchmark of 13/15 questions (88%).

Table 5 summarizes the attitude survey results. At least 80% or more of students responded "strongly agree" or "agree" for the majority (12/15 questions, 80%) of the questions. Students felt less strongly (< 80% "strongly agree or "agree") on three questions: "I am able to demonstrate the relationship between multiple variables by using statistical analysis" (70%), "Courses in biology have strengthened my understanding of biological concepts in plant biology (76%), and "Courses in biology have strengthened my understanding of biological concepts in cell and molecular biology (70%)." Overall average ranking of "strongly agree or agree" was 87%.

The survey was administered via Blackboard in the spring 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 does not match that of the exit exam (was 100% in Spring 2020).

Table 5: Attitude survey results (percentages) from graduating in 2019-2020. Spring 2019 results for the total of Strongly Agree and Agree are provided.

SLO	Question on the Attitude Survey	Spring 2019	2019-2020
		Total of Strongly Agree & Agree (2019)	Total of Strongly Agree & Agree (2019-2020)
1	Courses in biology have strengthened my understanding of biological concepts in:		
	a. Genetics and Evolution	91.3	88.9
	b. Cell and Molecular Biology	89.1	70.4
	c. Ecology	82.6	83.3
	d. Plant Biology	71.8	75.9
2, 3	I able to demonstrate the relationship between multiple variables by using statistical analysis.	71.8	70.4
3	I am able to identify a hypothesis or purpose of a study.	100	94.4
3, 4	I feel to prepared to write a comprehensive lab report.	89.1	94.4
3	I understand and can employ a range of laboratory techniques/methods to study biological processes.	93.5	92.6
3	I am able to identify primary sources.	95.7	92.6
3	I am able to use the correct citation methods in my work cited.	93.5	92.6
4	I can explain biological concepts to others.	91.3	90.7
2	Courses in Biology at FMU have strengthened my ability to think critically.	100	87
N/A	The Biology department at FMU offers a sufficient variety of courses.	93.5	79.6
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
N/A	It is important that the Biology department introduces students to various careers in biology.	93.5	96.3
	Overall average	90	86.5
	Number of students completed survey (% of graduating seniors)	46 (96%)	54 (93%)

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 (last year's results) of 59%, 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 (last year's results) of 57%, 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 2019, the exam was administered to only those students graduating at the end of Fall semester. Likewise, at the end of Spring 2020, the exam was administered only to those students graduating in Spring 2020. Any student who completed the Senior Seminar course in the Fall 2019 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 2020 semester. This procedure was successful again this year with the majority of graduating students completing the exam (86% in Fall 2019, 100% in Spring 2020, overall 95%) and will be continued in the future.
2. The breakout of the 2018-2019 results into the four core areas showed that student achievement did not meet the benchmark in the areas of Plant Biology, Genetics and Evolution, and Cell and Molecular. In Fall 2019, 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 2019-2020 academic year (taught in 2019 -2020 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 206 and 207 Flora, Bio 201 Conservation Biology, Bio 303 Plant Kingdom, Bio 307 Plant Anatomy/Physiology, Bio 320 Plant Evolution/Diversity, Bio 401 Genetics, Bio 409 Evolutionary Biology).

The breakout of the 2019-2020 results into the four core areas showed that student achievement did not improve in the areas of Genetics and Evolution and Cell and

Molecular Biology. In Fall 2020, 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 2020-2021 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, Bio 301 Cell Biology, Bio 302 Developmental Biology, Bio 407 Immunology, 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 2020 -2021 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 2020 -2021 academic year.

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 3.5. The proportion of students that achieve a score of 3.5: Baseline (we have no baseline for comparison because this is first year implementing the assessment tool), Benchmark of 35%, Target (4 year set in 2019) of 40%.

SLO 4.0: Students will cogently communicate cogently about biology at or above a score of 3.5. The proportion of students that achieve a score of 3.5: Baseline (we have no baseline for comparison because this is first year implementing the assessment tool), Benchmark of 35%, Target (4 year set in 2019) of 40%.

SLOs 3 and 4:

1. If we are face-to-face and the RED and PURE events are 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 as we did in 2018 – 2019. We will also increase the number of evaluators.

2. If we transition to online instruction in 2020-2021, we will not be able to use RED and PURE presentations:
 - 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 2020 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. 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 laboratory reports averages seen here 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. In 2019-2020, we have incorporated more assignments that require students to apply the process of science into our courses.
6. We facilitated the process by which faculty can mentor students in research projects outside of the classroom.
7. 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.
8. Given our rubric was designed primarily for presentation-based assignments, a number of individual questions are not applicable to written assignments. Therefore, in fall 2019 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 2019-2020 academic year.
9. 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 2020-2021 academic year.
10. 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 2020-2021 academic year.

SLO 4: The Biology Program worked on designing a writing assignment program likely using a scaffolding approach to be used in the freshman course sequence. Implementation of a writing program has been rolled into the program's discussion on redesigning our curriculum. We made progress but this objective will be carried over to the 2020-2021 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 Spring 2019 survey results showed that student attitude did not meet the benchmark in the areas of statistical analysis and concepts in Plant Biology. In Fall 2019, 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 2019-2020 academic year.

2. 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 will ensure that certain core principles and concepts in those areas are reinforced in upper level courses where this material is included in the 2020-2021 academic year.

Appendix 1 – Presentation Rubric

Project: _____ (poster number)

What was most impressive about this project/presentation?

What change could most improve this project/presentation?

Low → High

SCIENTIFIC THOUGHT

Degree to which the student clearly states a thoughtful question. 1 2 3 4

Degree to which the student clearly state their research hypothesis or purpose 1 2 3 4

Is the significance of this research clear in terms of the 'big picture?' 1 2 3 4

SCIENTIFIC METHOD

Is the method of investigation appropriate to the problem? 1 2 3 4

Is the information sufficiently documented? 1 2 3 4

Has the student collected sufficient data to justify the conclusions made? 1 2 3 4

Has the student analyzed the data in a way to justify the conclusions made? 1 2 3 4

Is the student's own work clearly reflected in the project? 1 2 3 4

COMMUNICATION

Does the presentation (display) represent a complete story or concept? 1 2 3 4

Is the presentation (display) self-explanatory? 1 2 3 4

Do the text, charts, and diagrams aid in the understanding of the project? 1 2 3 4

COMMUNICATION (In person only)

Does the presenter give a clear and concise description of the project? 1 2 3 4

Does the presenter communicate effectively in oral responses to questions? 1 2 3 4

RATING GUIDELINES
 Low → High
 1 – Fair
 2 – Good
 3 – Excellent
 4 – Superior

Presentation type
 Poster presentation
 Course assignment (BIO _____)
 Other _____

Additional Comments may be place on the reverse

**Adapted from Sigma XI Student Research Conference Template*