SCHOOL OF SCIENCE & TECHNOLOGY

DEPARTMENT OF BIOLOGY

UNDERGRADUATE PROGRAM

REVIEW SELF STUDY

APRIL 25, 2017

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1. BASIC INFORMATION*

Department or Program: Biology

School or Academic Division: Science and Technology

Date: April 25, 2017

Department Chair: Professor Murali Pillai
Programs Offered:
Bachelor of Arts in Biology Bachelor of Science in Biology Minor in Biology
Master of Science in Biology

Number of majors: 375
Number of Minors: 35
Number of permanent faculty: 12
Number of temporary instructors: 8
Number of courses: undergraduate – 53, graduate – 10
Number of GE courses: 12
BIOL 110 Biological Inquiry
BIOL 115 Introduction to Biology
BIOL 130 Introductory Cell Biology and Genetics
BIOL 131 Biological Diversity and Ecology
BIOL 220 Human Anatomy
BIOL 224 Human Physiology
BIOL 308 Environmental Toxicology
BIOL 309 Biology of Cancer
BIOL 311 Sexually Transmitted Diseases
BIOL 314 Field Biology
BIOL 318 Biology of Aging
BIOL 385 Contemporary Issues in Biology
Number of Service Courses: 3
BIOL 220 Human Anatomy
BIOL 224 Human Physiology
BIOL 240 General Microbiology
Number of Degrees: 3 – B.A., B.S., M.S.
Number of concentrations: 5
BA: Zoology
BS: Molecular Cell Biology; Ecology and Evolutionary Biology; Marine Biology; Physiology

*Data presented in the self-study are derived from the Sonoma State Catalog or supplied by the Office of Reporting and Analytics, unless noted otherwise.

2. INTRODUCTION AND HISTORY

The Department of Biology, one of the nine departments in the School of Science & Technology, currently has 12 tenure track faculty members (8 professors, 1 associate professor and 3 assistant professors), 1.5 administrative coordinators, and 2 instructional support technicians. In addition, there are two temporary faculty members on 3-year contracts. As of Spring 2017, the department serves 375 majors and 35 minors. The department's faculty of professional scientists and its highly dedicated administrative and support staff strive to provide excellent educational experience to our majors and minors. Over the years the faculty has practiced a teacher-scholar model that embraces active participation in teaching and scholarship, with strong student involvement in faculty supervised research, to create and maintain a vibrant learning environment for our majors.

2.1 Summary of Programs

The Department of Biology offers two broadly based bachelor's degree programs (Bachelor of Arts and Bachelor of Science) and a Master of Science degree. Within each undergraduate degree program, there are opportunities for selecting a concentration. A congenial atmosphere allows students to develop a close relationship with peers, graduate students, and faculty. An emphasis is placed on laboratory and field courses, and on participation in research experience. Laboratory instruction provides students with hands-on opportunities with variety of physiological equipment, ultracentrifugation, PCR, electrophoresis, epifluorescence and laser scanning confocal microscopy, and various microbiological techniques. Adequate laboratory and greenhouse facilities, such as the Raymond Burr Greenhouse, exist for maintaining live material for classroom use and student research. A radioisotope laboratory is also available. Field courses draw upon the unparalleled diversity of habitats in the North Bay region. They also capitalize on two spectacular nature preserves: Fairfield Osborn Preserve and Galbreath Wildlands Preserve, both administered by the School of Science and Technology. In addition, the department maintains museum collections of local plants and fungi (North Coast Herbarium of California), vertebrates (Jack Arnold Vertebrate Collection), and insects and other invertebrates.

The Department offers a minor in Biology. The purpose of the minor is to provide the student with a background in biology that supplements the student's major. Students must develop a program in consultation with a faculty advisor in the Biology Department.

The Master's program in the Department of Biology is comprised of an active cohort of 35 graduate students engaged in original research with faculty members in all areas of research specialization covered in the department. Graduate research is often supported by external funding. Other support for graduate students includes teaching assistantships that involve close mentoring relationships with instructional faculty. Many graduates of the Master's program go on to pursue doctoral degrees, and others continue in research, biotechnology, resource management, and education. The Department just completed its graduate program review, including the visitation of an external reviewer. Copies of the Graduate Program Review Self-Study document, external reviewer's report and the department's response are provided in Appendix 1.

***Mission**: The overall mission of our undergraduate and graduate programs is to educate the*

next generation of scholars, professionals and citizens so that they are prepared to meet the biological, environmental and technological challenges of the future.

3. RESPONSE TO PREVIOUS PROGRAM REVIEW

The previous Undergraduate Program Review was completed in spring 2010 (Appendix 2) after the Graduate Program Review in 2009. Although the external reviewers (Dr. Rick Grosberg, Univ. of California, Davis for the undergraduate program; and Dr. Edward Connor, San Francisco State University for the graduate program) focused on the different levels, both identified a common issue – a needed revision of the undergraduate curriculum. The Self-Study and External Reviews guided the program's development of the Action Plan in 2010. The main issue identified in the action plan focused on the structure and offering of the curriculum. Other issues revolved around staffing and student preparation.

The driving force behind most concerns in the previous program review was the budget. This followed the budget crisis the State of California experienced from the 2009 recession, and the concomitant reduction in state funding to the California State University system. Since then, the budget has stabilized although the CSU has not fully recovered. With respect to SSU, the General Fund budget allotment has increased by 0.9% from academic year 2009/10 to 2015/16, while enrollment has increased by 13.2% (CSU Budget Office: Final Budget and Actual Summaries http://www.calstate.edu/budget/final-budget-summaries/, and Enrollment Actuals http://www.calstate.edu/budget/enrollment_sufrev/).

One response the Biology program instituted to serve the growing number of applications was declaring impaction in 2011/12. Impaction allows the program to limit the incoming freshmen class to meet projected capacity in the introductory majors courses, and in future upper-division courses. By stabilizing the capacity in the program at approximately 400 majors, our course offerings are more predictable. With a better estimate of the student population from year to year, we gained needed input to guide changes in the curriculum. The curricular changes (described below and in the next section) in turn provide more stability in the lower- and upper-division core sequences and a more even spread across upper-division courses.

Another aspect of impaction is the setting of secondary admission criteria. This has allowed the program, in part, to address the concern from the previous program review of student preparation. In deciding on the criteria to use, the program weighed the use of only high-school GPA versus a higher admission eligibility criterion (based on high-school GPA plus college admission test scores, i.e., SAT or ACT). Currently, the program has been using higher eligibility criteria. Therefore, in addition to meeting all subject requirements for admission to Sonoma State University, all incoming first time freshmen Biology majors are ranked and reviewed by eligibility index. For the past five admission cycles, the minimum eligibility requirement for entry into the Biology program has been between 3500 to 3600 (SAT based) or 830 to 864 (ACT based), compared to the SSU eligibility index of 2900 (SAT) or 694 (ACT) for local area students. Using the higher eligibility indices brings in a Biology freshman class of between 90 – 100 students.

With respect to transfer students, the Biology program has two levels of secondary admission criteria:

1. First year students or students who have completed less than 25 units (i.e., adding Biology as a major)
    a. an eligibility index equal to or greater than 3600 (SAT based) or 864 (ACT based); and,
    b. a recommendation from a Biology Department advisor
2. Students who have earned more than 25 units may apply if they have completed courses in calculus or statistics, first semester chemistry for majors, and one year of introductory biology for majors, all with a grade of "C" or better.

Application of the secondary admission criteria for transfer students results in approximately 50 new major per year.

In response to needed improvement of the curriculum, the program undertook several rounds of curricular revision for the B.A. and B.S. degrees. The guiding principles employed in the revisions were:

- provide degree plans with flexibility so students can customize their electives towards their future careers, interests, or strengths;
- balance course and unit requirements across concentrations to provide equity in degree plans; and,
- remove log jams and bottlenecks to enable our majors to successfully complete the degree in four years.

The major changes to the curriculum were the sequencing of our lower-division and upper division cores. The lower-division sequence of three classes was changed to a two-class sequence, and the upper-division of four core areas (choice among 17 courses) was changed to two required classes plus a diversity class (choice among 5 courses). The previous upper-division core sequence classes are now electives or requirements within a concentration. In addition, several large enrollment upper-division lecture-only electives were instituted. These courses are typically offered on a two-year cycle, allowing flexibility of offerings for the students and the faculty.

Along with restructuring the lower- and upper-division cores, we have also reconfigured our concentrations. Previously, the B.A. had a general (no concentration) option, and two concentrations. For the B.S., students were required to choose one of five concentrations. Our curricular restructuring now provides a general degree option for both the B.A. and B.S., reduces the total number of concentrations, and has redesigned concentrations for greater flexibility, and balanced course and unit requirements across concentrations. Further details of the restructuring are provided in the Curriculum section (following page).

A final outcome of our curriculum revision was an examination of the course listing in the catalog. The reduction in required courses in both the B.A. and B.S. degrees, and change in faculty expertise and interest since the previous program review, highlighted a number of courses no longer offered or needed by the program. The following table summarize the changes that will be in the 2017/18 catalog.

Number of listed Biology courses from AY 2010/11 and 2017/18 catalogs		
Course type	**2010/11**	**2017/18**
Undergraduate (all)	58	53
GE	15	12
Graduate	17	10

With respect to staffing, the program has undergone several changes in the permanent faculty. However, the number of full-time permanent faculty is 11, with a 12th member joining the Department in the Spring 2017 semester. Although the number of permanent faculty has not decreased, there has been an increase in the need for part-time lecturers since 2010. Thus the Department is still working on finding the balance between the undergraduate and graduate student population's needs and meeting permanent faculty's time commitment to teaching, research, and service.

A final point raised in the previous program review was the level of institutional support for new faculty start-up funds, and instructional equipment and supplies. With the State budget crisis no longer driving most decisions on the campus, there have been a few improvements. As noted in the last program review, the average start-up packages for new faculty were approximately $16K. Since then, the amount has gone up to $50K. In addition, the Department was successful in obtaining an increase to the instructional laboratory fee for many courses. Plus, the University no longer charges Department operating budgets for phone or copying costs. These changes have allowed the program to be able to direct funds towards needed improvements in our lab/field courses and provides a small buffer against emergency needs.

4. CURRICULUM

The Biology program offers an undergraduate curriculum, supported by physical sciences and mathematics, to provide students with a well-rounded exposure to the breadth of inquiry in the biological sciences. Combining breadth with in-depth instruction allows students to develop the intellectual foundations and the skills needed to deal with the specific biological concerns of today and the flexibility to meet the future needs within the profession.

Consistent with the University's mission, the Department of Biology maintains excellence in its programs of instruction that are grounded in the mission of a liberal arts and sciences institution. The lower and upper division curricula are structured such that students are challenged to develop skills of critical analysis, reasoning, creativity and self-expression. Since the biological sciences encompass a wide variety of specific sub-disciplines, each with its own terminology, research approach, and professional organization, the Department offers a broad-based curriculum with discipline-based options through degree concentrations. Below is a descriptions of the major changes the program undertook since the last program review.

4.1. Program Curriculum Revision

Following the last program review in 2010, the Department spent several years revising the

undergraduate curriculum. Starting in the spring of 2012 and culminating in the 2015/16 academic year, the Department completed revisions to the B.A. and B.S. degrees. The first round of revision focused on reducing the number of concentrations and modifying the capstone research experience in the B.S. degree. The second was revision to the lower- and upper-division core sequences, revival of concentration options and subsequent modification of the degrees to incorporate the revised cores.

The rationale for the revisions came from student feedback and faculty discussion that arose after the last Biology Graduate (2009) and Undergraduate (2010) program reviews on the need for a streamlined baccalaureate curriculum.

In the Undergraduate Program Review Self-Study (2010; Appendix 2), the Department discussed needed changes to the B.A. and B.S. degrees in the action plan:

> "We have had an on-going problem since the last program review in not being able to offer courses listed in our catalog. As our full time faculty have become fewer in number (due to retirements and resignations), and state budgets reduce our ability to recruit new tenure-track faculty or to hire lecturers, we no longer are able to consistently offer upper division courses, especially in the areas of organismal, molecular and cell biology, and microbiology. In 2006/07 we attempted to address this issue through a reorganization of our concentrations so that we would reduce our upper division course offerings and offer the remaining courses more frequently. Even with this approach courses required in the concentrations for the B.A. and B.S. degrees are not all offered on a regular basis. In a number of cases, insufficient staffing (especially through release time) has prevented offering required courses in several concentrations. As a response to the cutback in course offerings in the upper division, we have been using many course substitutions to help students make progress through their declared concentration, which places a direct negative impact on the quality of our program. With our present staff we are not able to cover (we lack the staff expertise due to retirements/resignation/participation in FERP or our staff are assigned to other teaching responsibilities) 34% (23 courses) of the course in the upper division curriculum (300 through 500 level courses)."

The external reviewers for both programs indicted the curriculum for the B.A. and B.S. was too heavy in the number of required units and too prescriptive in the courses required for the various concentrations.

> "It is possible that the overly elaborate undergraduate curriculum potentially contributes to the burdensome teaching load that faculty face. A BA or BS degree in Biology at SSU requires 81-84 semester units, compared to 72 units at CSU-Chico, 67 units at SFSU,…" Dr. Edward Conner – San Francisco State (Graduate Program Review, 2009).

> "The faculty should consider significant changes in the organization of the upper-division curriculum that could reduce the number of courses currently offered in the major and the diversity and number of requirements for both the B.A. and B.S. degrees." Dr. Richard Grosberg – UC Davis (Undergraduate Program Review, 2010).

The curriculum revisions addressed the above-mentioned concerns with specific guiding principles:

- provide degree plans with flexibility so students can customize their electives towards their future careers, interests, or strengths;

- balance course and unit requirements across concentrations to provide equity in degree plans; and,
- remove log jams and bottlenecks to enable our majors to successfully complete the degree in four years.
- maintain the proven teacher-scholar model of engaging students in faculty-active research programs

The curricular revisions encompassed four main components, the first three being common to the B.A. and the B.S. degree plans, while the fourth is specific to the B.S. degree:

1. Restructuring the lower division and upper division core curriculum;
2. Modifying, or eliminating, concentrations;
3. Reducing the units necessary to complete the major and degree; and
4. Modifying the capstone research experience.

4.1.1. Restructuring of the lower division and upper division core curriculum

The previous lower division core sequence consisted of three semesters (12 units) of introductory biology: BIOL 121 (Diversity, Structure, and Function), BIOL 122 (Genetics, Evolution, and Ecology), and BIOL 123 (Molecular and Cell Biology). BIOL 123 was the third course in the sequence and it had a prerequisite of one year of general chemistry. Upper division courses in the major required completion of either BIOL 121 and 122 (mostly for upper division organismal, evolution, and ecology courses) or BIOL 121, 122, and 123 (for physiology, cell, and molecular courses).

The new lower division core sequence consists of two semesters (8 units) of introductory biology: BIOL 130 (Introductory Cell Biology and Genetics) and BIOL 131 (Biological Diversity and Ecology). Upper division courses in the major require completion of both. The revised lower division sequence is consistent with the lower division curriculum offered by most other biology programs within the CSU and across the nation (one year of introductory biology for majors). The new sequence now allows students to complete their lower division requirements by the end of their freshmen year, while also taking general chemistry, and be able to begin their upper division course work sooner.

The new upper division core sequence replaces the previous requirements in four upper-division core areas (Organismal Biology, Physiology, Molecular & Cell Biology, and Ecology & Evolutionary Biology) for a total of 16 units, with two upper-division core courses, BIOL 320 (Ecology & Evolution – An Integrated Approach) and BIOL 321 (Molecular Biology, Cell Biology & Physiology) for a total of 8 units. The revision was adopted for two main reasons. First, on-going budget cutbacks over the years impacted the ability to staff courses in all four core areas with sufficient frequency and capacity to meet student needs. The interim fix was the use of course substitutions, placing a negative impact on the quality of the program. Second, it was apparent that the variety of courses covering the core areas (along with frequent substitutions) could result in students being unevenly prepared in some core concepts in biology (e.g., not taking upper division course work in Evolution, Ecology, Cell Biology, etc.). Thus an opportunity arose to reexamine how to prepare students and to become compliant with core concepts and competencies for biology (National Science Foundation, “Vision and Change in Undergraduate Biology” http://www.nsf.gov/discoveries/disc_summ.jsp?cntn_id=122728).

In the new upper division core, BIOL 320 exposes students to the fundamental concepts of ecology and evolution while integrating across the two disciplines. The course reveals how ecological and evolutionary processes combine to generate biodiversity. BIOL 321 provides students with a strong foundation in contemporary molecular, cellular and physiological processes and their regulatory mechanisms. The course is highly integrative between molecular biology, cell biology and physiology and is designed to prepare students to understand structure-based function at all levels and address issues regarding how organisms respond to changing environment.

With the elimination of the upper-division core areas, the Department added an upper division Organismal Biology/ Diversity course requirement (4 units) of all majors in order to maintain the breadth of key foundational concepts in biology. The courses that previously satisfied the Organismal Biology core area now comprise the list of courses that fulfill the new requirement (see University Catalog page 66, Appendix 3).

From a scheduling perspective, the change in the upper division core increases capacity by changing from a lecture/lab model to a lecture/discussion model. Seat capacity is no longer an issue for these courses as discussions are run in University-available classroom space whereas laboratory courses were limited by Department-available laboratory space.

4.1.2. Modifying concentrations

Early in the curriculum revisions, a number of concentrations were removed in an effort to streamline the curriculum during the early stages of the budget crisis imposed on the CSU. Since then, all the concentrations have been reexamined, and several have been reconstituted and revised to attract and retain quality students. The following concentration options are currently provided:

- Within the B.A., experience demonstrated that the Zoology concentration was a key deciding factor in the loss of highly qualified students to other programs or campuses. With new faculty expertise, the concentration has been revived and provides majors a sought after study option. The revised concentration has reduced concentration specific upper division course requirements, from 24 to 13-16.
- A revised Ecology and Evolutionary Biology concentration (B.S.; formerly Ecology, Evolution & Conservation). Reduced concentration specific upper division course requirements from 16 to 8 units.
- A revised Molecular Cell Biology concentration (B.S.; formerly Molecular and Cell Biology). Reduced concentration specific upper division course requirements from 16 to 9 units.
- A revised Physiology concentration (B.S.). This concentration was historically one of the most popular concentrations in the biology curriculum and was a frequent choice among many of pre-health professions students. However, the concentration attracted a broad array of students with interest in comparative physiology, physiological ecology, conservation physiology and evolution. To provide a concentration with greater flexibility, the concentration specific upper division course requirements of 12 units has been replaced with students choosing courses with careful advising to match their interests and preparation for graduation.

- The Marine Biology concentration (B.S.) is a critical recruitment feature for a number of incoming freshman. Some of the recent hires in Biology provide a wealth of new expertise and the existing curriculum contains extensive coursework in this area. Therefore, this popular concentration was revised to leverage faculty expertise and proximity to the coast and re-establish an ability to recruit and retain highly qualified students. As in the other revised concentrations, the concentration specific upper division course requirements are reduced from 12 to 3 units.
- Discontinuance of Botany (B.A.) and Microbiology (B.S.) concentrations due to a combination of budget issues, reduced student demand, and/or reduced faculty expertise. Since removal of these options, sufficient faculty expertise has increased in plant biology, but there has been no further discussion to revive the Botany concentration.

4.1.3. Reduction of units to the major and the degree

Since the last program review, the University General Education program reduced the minimum required units in GE from 51 to 50. These units contribute to the increase in general elective units for the B.A. (6-7 unit increase) and B.S. (1 unit increase).

Upper division elective units in the B.A. and B.S. are increased by 5 and 4, respectively. This makes the degree plans somewhat less prescriptive with greater flexibility for students to choose classes based on their interest, strength and career plans, thus increasing marketability up on graduation.

The total units for the B.A. major have been decreased by 5: 2 in Physical Science and Math and 3 in Biology. This allows greater opportunity to take general electives (3 additional units) without going over the total units required for the degree (120 units). For the B.S. degree, the units required in the major have been decreased by 6: 2 in Physical Science and Math and 4 in Biology. In addition, the CSU required all degrees in the system (save for a handful) to be completed with 120 units total. Thus, the Biology B.S. degree was further reduced from 126 to 120 units. Summaries of all the degree changes since the last program review are provided in Appendix 4.

4.1.4. Modified the capstone research experience

With the revision to the B.S. degree, an increasing number of students were declaring the B.S. in their major. Within any term, 20% or more of all majors were registered as seniors in the B.S. Completion of the B.S. requires a capstone research experience and the single option had been a semester of BIOL 494 (Independent Research Design, 1 unit) and a semester of BIOL 496 (Senior Research, 2 units). Given the increasing number of majors aiming to complete their research experience in their final year, and limited openings in faculty labs, students would scramble to find any opening in a lab to complete any available research. This led to students settling for a research experience that did not match their interests, or students changing to the B.A. degree to be able to graduate. To address the problem, two routes to complete the capstone research experience were formulated. The first is Honors Thesis, a two-semester research experience (BIOL 496A and 496B, for a minimum 3 units) that requires a higher GPA (3.0 or greater) to ensure that students are properly prepared to undertake a focused research project. For students who either do not have sufficient qualifications for conducting a two-semester research project, or simply wish to have a shorter research experience, BIOL 494 Independent Research

(3 units minimum) is used. This avenue provides students the opportunity to either conduct a shorter research project, or to undertake research activities in field, laboratory, or museum situations. Contracts and requirements for both forms of capstone research are provided in Appendix 5.

In addition to the one-on-one faculty supervised student research project (BIOL 496A/B or 494), a third option for the research experience has been recently added (BIOL 490). Faculty may design a senior level elective course that incorporates the research experience into the laboratory/field component. The permanent course proposal that has already been approved is provided in Appendix 6.

4.2. Learning Objectives

The extensive revision to the undergraduate curriculum for both the B.S. and B.A. degrees has required a reexamination of the learning outcomes within the Biology program, while maintaining fidelity to the overall learning goals stated in the introduction to this chapter. In the previous program review, learning outcomes or guidelines were developed at multiple levels in the program:

- Lower Division
- Courses in Lower-Division Core
- Upper Division
- Upper Division Core Areas
- B.A. Concentrations
- B.S. Concentrations
- Biology Degree
- B.A. Degree
- B.S. Degree

It is now clear that these are overly ambitious if assessment is to be carried out in a regular and meaningful manner. With the initiation of the current self-study, the program has reexamined the learning outcomes with the goal of simplicity, designing embedded assessments, and focusing on outcomes that are assessed at or near graduation.

In the Fall 2016 semester, the program reviewed the learning objectives from the previous program review, and decided the upper-division and Biology degree learning objectives were most appropriate for further reflection:

Upper Division Learning Objectives

The following guiding principles are common to the Core:

- Continue development of quantitative and analytical tools
- Increase understanding of the critical role of evidence-based hypotheses testing
- Deepen awareness of structure-function relationships and emergent properties at various scales
- Facilitate increasing comfort with and understanding of the dynamic nature and open process of science, as well as technical literacy through exposure to the primary scientific literature.
- Expand understanding of the integrative nature of biology

Biology Degree Learning Objectives

Overall, the degrees in our program have a common set of values:

- Understanding the depth and rigor of active investigation in any skill applied to biological science.
- Evaluate and analyze evidence by understanding the relationship between causality and correlation.
- Understand the context and progression of knowledge in science.
- Appreciate the relationship between science and technology.
- Understand the ethical dimension in the application of science.
- Understand the role of science in informing public debate about different policy decisions.
- Cultivate a balance between openness and skepticism.

The next step was a survey of the full-time faculty. Each participating faculty member rank ordered their preferences for the above learning objectives. The number of responses with a rank of 1-5 were totaled and demonstrated fairly good agreement among faculty. Four of the original 12 learning objectives clearly rose to the top of faculty preference, providing an approved list of program learning objectives:

- Continue development of quantitative and analytical tools
- Increase understanding of the critical role of evidence-based hypotheses testing
- Deepen awareness of structure-function relationships and emergent properties at various scales
- Expand understanding of the integrative nature of biology

The faculty next examined their upper-division courses (for juniors and seniors), and using the program learning outcomes (PLOs), gave input on specific student learning outcomes (SLOs) that are covered within their courses. The responses were then summarized and generalized into 14 department approved student learning outcomes for the degree:

PLO: Continue development of quantitative and analytical tools

I. Students will collect, interpret and graphically represent data.
II. Students will perform appropriate calculations to analyze data for addressing specific questions.
III. Students will analyze biological data using a variety of statistical approaches/tools.
IV. Students will apply inductive and deductive reasoning to experimental information and data.

PLO: Increase understanding of the critical role of evidence-based hypotheses testing

V. Students will appraise published data in evaluating models, hypotheses, or theories.
VI. Students will design appropriate experiments to evaluate hypotheses.
VII. Students recognize how experimentation leads to understanding mechanistic processes.
VIII. Students will critique concepts and data in written and oral form.

PLO: Deepen awareness of structure-function relationships and emergent properties at various scales

IX. Students are able to describe components of biological structure/complexity at multiple levels of organization
X. Students are able to explain how biological function arises from structure at both the same and higher level of organization.
XI. Students will explain the mechanistic reasons behind biological processes.

PLO: Expand understanding of the integrative nature of biology

XII. Students will dissect complex problems into key components.
XIII. Students will explain complex problems from different, integrative perspectives.
XIV. Students understand the roles various components within organisms play in development or interaction with the environment.

No single course covers all the student learning outcomes, or even all four program learning outcomes. But by the time of graduation, the program feels a student will have taken sufficient course material to be proficient in knowledge covered by the program learning outcomes.

4.3. Meeting Learning Objectives

The Department attempts to meet its program learning objectives in a manner consistent with the University's mission. The Department seeks excellence in its program of instruction grounded in the context of liberal arts and sciences. Students are challenged to develop skills of critical analysis, reasoning, creativity and self-expression in our General Education, Service Courses, and the Biology Major. Because the biological sciences encompass a wide variety of sub-disciplines, each with its own terminology, research approach, and professional organization, a broad-based curriculum is provided. Therefore, the program learning objectives are supported through course- specific methodologies and assessment, and through the structure of the curriculum.

In general, the program learning objectives are supported using the following methodologies:

a. Conceptual, factual, and visual lecture content that integrates information from laboratories and other methodologies.
b. Hands-on laboratory experience that feature methodologies and conceptual content that integrates with lecture content.
c. Electronic resources such as course web pages, eReserve or Moodle.
d. Computer simulation and modeling.
e. Data management, statistical analysis, and results presentation using computer software.
f. Experiences at field sites, research facilities or museums.
g. Incorporate, train and mentor paid laboratory instructors.
h. Involvement of undergraduate or graduate student assistants in laboratory or field instruction.
i. Assignments requiring students to draw on external resources (e.g. research literature or community engagement) to satisfy course requirements.

The general methodologies outlined above are integrated into a number of aspects of the curriculum to aid student obtainment of knowledge and experience within biology.

4.3.1. Hands-on laboratory experiences in the curriculum

Laboratory courses are designed to provide students with the conceptual framework to understand and participate in scientific developments in diverse areas of biology, and the practical framework to gain hands-on experience in modern laboratory techniques in the biological sciences. Courses emphasize techniques in recombinant DNA technology; applications of DNA sequence analysis for molecular geneticists, biomedical researchers, and evolutionary biologists; techniques in advanced microscopy; gross anatomical dissection techniques; acquisition and analysis of physiological data; etc. Students also conduct group research projects and independent research as a part of many Biology courses. These projects involve use of various library resources and laboratory facilities made available in the Department. Some courses require that students present their research as a part of the laboratory; others require preparation of an independent research paper. Students also gain hands on experience in experimental design, statistical analysis, and computer-based methods using laptop computers in the classroom. In past years, faculty members have obtained educational and research grants which have been used to modernize and upgrade laboratory facilities for teaching and research. The equipment purchased through external funding has enhanced the ability of Biology faculty to offer instruction using modern biological research tools. In addition, the School of Science & Technology has an older, but still well-equipped Microanalysis Laboratory (William Keck Microanalysis Laboratory) available for use in teaching and student research. This laboratory houses a variety of advanced microscopic imaging equipment including, an environmental scanning electron microscope, atomic force microscope, and epifluorescence and laser scanning confocal microscopes.

4.3.2. Field experiences in the curriculum

Field courses in our curriculum offer students the opportunity to learn about the high diversity of organisms that live in the rich natural environment surrounding Sonoma State University. Field trips provide students with direct exposure to vernal pools, oak woodlands, coastal marine habitats, thermal springs and geothermal stream fields near campus. Many field trips are taken to the School of Science and Technology's Nature Preserves. In several Biology courses, students also gain experience regarding local environmental problems, including demographic problems associated with the decline of the Western Pond Turtle and the threat of invasive introduced species, the pathogen causing Sudden Oak Death.

The Department maintains extensive collections of vertebrates, vascular plants, insects, and bacteria. Specimens are made available to students, members of the community, and scientific researchers. Collections are also used for outreach purposes. For example, the Entomology Outreach Program, an arm of the Sonoma State University Field Stations and Nature Preserves, brings displays of insects and live insects to public events and classrooms to enhance awareness of the diverse ways that insects interact with humans. This externally supported program promotes more ecologically sound methods for managing insects in ornamental landscapes, and it emphasizes the importance of insect diversity for the health of natural habitats (e.g. streams and vernal pools). Students participate in the program as presenters and are engaged in curriculum development and alignment of offerings to statewide educational standards for K-12

instruction.

4.3.3. Service-learning

Faculty members also use of Service-Learning to achieve curricular objectives. Students receive points for serving a University or community partner for several hours. The Service-Learning activity is designed to help achieve the learning objectives of the course. For example, students in BIOL 323 (Entomology) participate in activities organized by the Entomology Program.

4.3.4. Special courses

A number of course are offered on an "as needed" basis and are open to all qualified students. All faculty are involved in offering one or more of these classes. As such, the offerings vary yearly in content, objectives, and student need. The courses fall into three categories (see Appendix 3 for course descriptions):

a. **Specialized classes to cover topics not available in the curriculum (BIOL 385, 390, 497).** These one to four unit classes provide opportunities for the department to offer students insights into a broad range of issues in biology. All are open to any faculty member to participate and all can be repeated by students as the topics change. BIOL 385 provides faculty the opportunity to offer a General Education class on a trial basis, while BIOL 497 provides the opportunity to offer a major's class on a trial basis. The Department may decide to incorporate trial classes into the regular curriculum.
b. **Professional development style classes (BIOL 398, 498, 499).** One to four unit classes that give students the ability to develop professional skills along with the opportunity to apply their knowledge within an academic, professional, or community-based experience.
c. **Research courses (BIOL 393, 494, 495 and 496A/B).** Students seeking research experience under the guidance of a faulty member take these one to four unit courses. BIOL 494 and 496A/B are required courses providing the research experience in the B.S. degree.

4.4. General Education and Service Courses

The Department of Biology offers multiple courses that serve the University in fulfilling General Education requirements and/or service for particular majors. The table below provides an overview of the courses and students served on a yearly basis.

General education and service courses in the Department of Biology. Data represent AY 2016/17

Course	Description	GE Area	Students Served Yearly
BIOL 110 Biological Inquiry	Lower-division, non-majors, lecture-lab, 4 units	B2	845
BIOL 115 Introduction to Biology	Lower-division, non-majors, lecture, 3 units	B2	678
BIOL 130 Introductory Cell Biology and Genetics	Lower-division, majors, lecture-lab, 4 units	B2	186
BIOL 131 Biological Diversity and Ecology	Lower-division, majors, lecture-lab, 4 units	B2	144
BIOL 220 Human Anatomy	Lower-division, non-majors, lecture-lab, 4 units	B3	215
BIOL 224 Human Physiology	Lower-division, non-majors, lecture-lab, 4 units	B3	120
BIOL 240 General Microbiology	Lower-division, non-majors, lecture-lab, 4 units	--	72
BIOL 308 Environmental Toxicology	Upper-division, non-majors, lecture, 3 units	B3	Offered occasionally
BIOL 309 Biology of Cancer	Upper-division, non-majors, lecture, 3 units	B3	Offered intermittently
BIOL 311 Sexually Transmitted Diseases	Upper-division, non-majors, lecture, 3 units	B3	Offered occasionally
BIOL 314 Field Biology	Upper-division, non-majors, lecture-lab, 4 units	B3	Offered intermittently
BIOL 318 Biology of Aging	Upper-division, non-majors, lecture, 3 units	E	149

The lower-division GE courses are offered to non-majors in a combined lecture/lab format (BIOL 110) or lecture only (BIOL 115). Students taking the lecture only option are often majors in the sciences and have GE lab courses within their major. Although the Department offers over 1400 seats per year for these courses, there is continued demand, especially for BIOL 110, which has been consistently identified as one of the top 5 wait-listed courses each semester. The main limitation is available lab space. The Department has one laboratory dedicated to this course. Scheduling labs (currently 18 sections) and providing sufficient time for lab set-up and break-down, continues to be a challenge.

The 200 series of courses are service courses for Nursing and Kinesiology majors. If seat space is available, other students with pre-requisites are permitted to register. Both Nursing and Kinesiology are impacted majors and part of the reason is limitation on available seats in the 200 series courses. This is especially an issue with BIO 220 which requires specific expertise (utilizes cadavers for the laboratory) and the Department utilizes a part-time faculty member whose schedule is filled with this one course. Since BIOL 220 and 224 are B3 courses, they do not fulfill a required area in GE, but are options for students to take additional area B units.

The upper-division GE courses tend to be offered less frequently as most fall into the B3 area. Biology of Aging (BIOL 318) is offered in both semesters as it fulfills GE area E (The Integrated Person) and is a high-demand course as it is sought after by students wishing to pursue a career in health services.

Biology has also supported the School of Science and Technology's integrated year-long freshman year experience course for students exploring science: Science 120 A Watershed Year (developed under an NSF grant to SST). The course covers GE areas A3 (critical thinking), B2 (biological sciences), and B4 (quantitative reasoning), while focusing on biological and physical processes in the local Russian River watershed. Two tenured faculty members have been instructors (Drs. Karina Nielsen and Nathan Rank [also a co-PI on NSF grant]) and the Department provides laboratory space for the fall semester. Further information can be found at http://www.sonoma.edu/s3/ and http://contentbuilder.merlot.org/toolkit/html/snapshot.php?id=72153204932952).

5. STUDENT BODY

5.1. Enrollment

Majors: With the declaration of impaction in 2011/12, enrollment in the major has become more predictable. Over the past 6 years, the entering freshman class is maintained at ~ 100-130 students in the fall with approximately 1/3 entering in the B.A and 2/3 in the B.S. (see table below). The program does not have a spring term entering freshman class.

First-time Freshmen enrollment, Biology majors			
Term	**BA**	**BS**	**Totals**
Fall 2011	50	77	127
Fall 2012	39	87	126
Fall 2013	32	79	111
Fall 2014	36	99	135
Fall 2015	41	73	114
Fall 2016	40	68	108
Average %	33%	67%	100%

The transfer student population adds approximately 40 to 60 students per year (see table below). Transfer students are both external (i.e., community colleges, other 4-year institutions) and internal to SSU (declaring or changing major).

Transfer student enrollment, Biology majors					
Term	**BA**		**BS**		**Totals**
	Junior	Senior	Junior	Senior	
Fall 2011	3	24	4	24	55
Fall 2012	4	9	6	23	42
Fall 2013	5	13	5	26	49
Fall 2014	2	15	6	24	47
Fall 2015	5	13	7	26	51
Fall 2016	4	13	11	33	61
Average %	36%		64%		100%

The number of majors in the program varies between 350 to 420, and averages at 383 over the past 5 years. Within the program, approximately 38% of the majors are declared as a B.A. and 62% as a B.S (see table below). The full-time equivalent students served over the past 5 years has averaged 407.3 for the fall term and 342 for the spring term. With proper scheduling, the program has reduced wait lists in major's courses to a minimum. One of issues the program has noted is the continued need to serve the large number of B.S. majors requiring completion of the B.S. capstone research experience.

Biology majors by term									
Term	**BA**				**BS**				**Totals**
	Freshman	Sophomore	Junior	Senior	Freshman	Sophomore	Junior	Senior	
FA 2011	50	35	31	61	78	48	32	68	403
SP 2012	28	34	24	55	57	45	35	73	351
FA 2012	39	24	25	45	87	54	38	75	387
SP 2013	26	19	39	44	55	51	40	72	346
FA 2013	32	26	29	57	79	57	40	76	396
SP 2014	21	25	29	62	56	62	46	65	366
FA 2014	36	23	27	66	99	52	45	69	417
SP 2015	24	20	33	68	69	50	51	57	372
FA 2015	41	20	33	66	73	57	59	71	420
SP 2016	32	22	21	65	34	55	60	77	366
FA2016	40	33	24	49	68	43	50	89	396
Average %	38.0%				62.0%				100%

The number of graduates in the Biology program has been slowly increasing over the past several years. In the 2011/12 academic year, 65 majors graduated, while 79 graduated in the 2015/16 academic year.

Biology major graduates, by degree			
Term	**BA**	**BS**	**Totals**
Fall 2011	15	10	25
Spring 2012	26	14	40
Fall 2012	8	9	17
Spring 2013	13	21	34
Fall 2013	10	12	22
Spring 2014	19	22	41
Fall 2014	15	11	26
Spring 2015	24	19	43
Fall 2015	18	8	26
Spring 2016	28	25	53
Fall 2016	6	8	14
Spring 2017 (est.)	35	26	61

Minors: The number of minors in the program has been steadily decreasing (see table below). Five years ago, approximately 100 students declared the Biology minor. More recently, the number has dropped to less than 60. The revisions in the curriculum may be a factor, or reduced interest among students in declaring the minor. The program has been aggressive in not allowing students to declare a minor without first having a declared major. In the past, the program recognized a number of students attempting to add Nursing or Kinesiology as a major and using the Biology minor as a holding place. Concerted advising among Nursing, Kinesiology, and Biology has helped guide students into alternate majors. One potential outcome in the reduction of declared minors is the reduction of waitlists in major's courses.

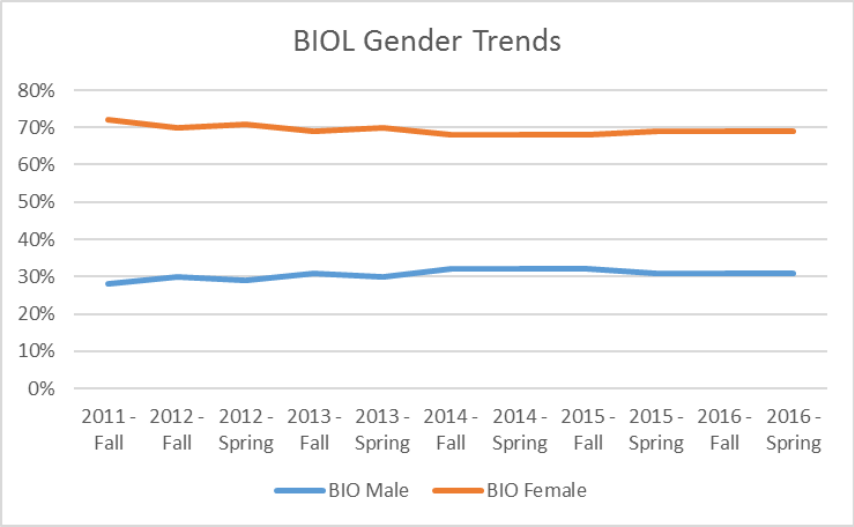
Biology minors, by term					
Term	**Freshman**	**Sophomore**	**Junior**	**Senior**	**Totals**
Fall 2011	6	19	29	42	96
Spring 2012	7	16	28	50	101
Fall 2012	9	16	27	51	103
Spring 2013	14	23	25	49	111
Fall 2013	9	10	25	43	87
Spring 2014	3	24	26	39	92
Fall 2014	2	12	27	44	85
Spring 2015		5	27	47	79
Fall 2015		1	17	44	62
Spring 2016	2	5	10	43	60
Fall 2016		5	9	26	40

In summary, the declaration of impaction has appeared to stabilize the enrollments in the major, provided consistent course offerings for the majors, and seems to be slowly increasing graduation within the major. The program will need to work with the administration on tracking

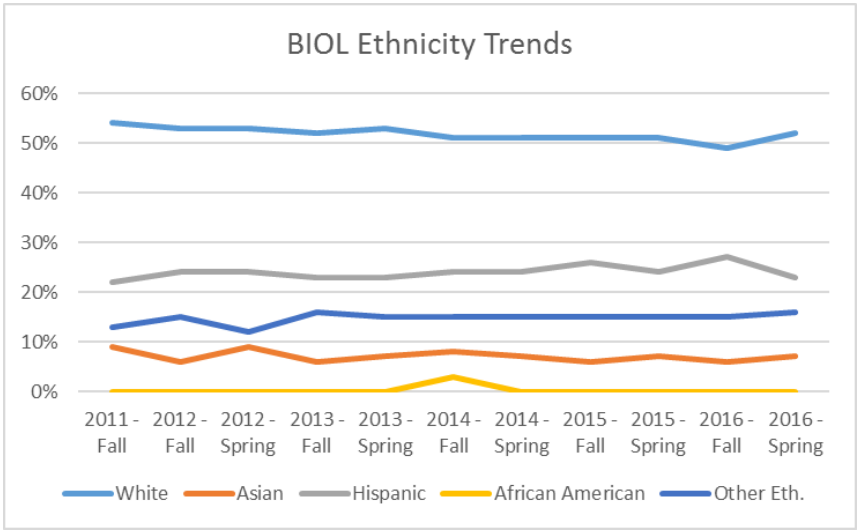
students through the program as all departments will be expected to contribute to the CSU Graduation Initiative 2025.

5.2. Diversity

The student body in Biology has consistently trended towards a higher female to male ratio (see figure below, data from CSU Student Success Dashboard).



The ethnicity of the majors is 54-49% white over the past 5 years, followed next by a 22-27% proportion of Hispanics and 6-9% Asian (see figure below, data from CSU Student Success Dashboard). The program's population of majors is in line with SSU's average of 33% Hispanic student population which was the basis for the recent HIS designation for the institution.



To serve the student population, the program is actively involved in increasing participation of underrepresented groups. This is most effectively carried out through recruitment of students into research, one of the most attractive aspects of our program to most students. Programs in place at SSU that integrate with the Department include the California State University Louis

Stokes Alliance for Minority Participation (LSAMP), the McNair Scholars National Graduate Student Achievement Program (NoGAP) and the Mathematics, Engineering, Science Achievement (MESA) program. The Department is an active participant in these programs by providing faculty, staff, and facilities to increase research training and life-long learning for underrepresented groups. Faculty also rely on minority students for participation in NSF funded RUI research grants.

5.3. Advising

The Department maintains a web page (http://www.sonoma.edu/biology/) of general information for the department and its programs, faculty profiles including research areas, course descriptions, class schedule, updates on registration, student resources, departmental news and announcements, and descriptions and links to natural preserves and other programs. The Department strongly encourages its majors to develop an ongoing advising relationship with a faculty member whose area of expertise matches the student's interest. The Department Chair prepares and updates a list of biology majors with their assigned advisors. This list is updated on the University's Central Management System (PeopleSoft). The Department Chair is needed for general advising, including GE advising, throughout the year and typically participates, along with one or two other faculty members, in freshmen orientation during the summer. The School of Science and Technology also has a half-time general advisor to help students with GE advising and undeclared students considering the various major options within the School.

The Biology portion of the University catalog contains advising information such as: list of Biology degree concentrations (for both B.A. and B.S. tracks), sample prerequisite courses for applying to various health professions schools, information about degree unit requirements, and sample four year programs for prospective majors (Appendix 3). The Department also provides advising handouts for all degree plans on the Department website (handouts in Appendix 7).

The California State University System has implemented the Graduation Initiative 2025 plan, https://www2.calstate.edu/graduation-initiative-2025, which has the goal of increasing 4-year graduation rates within the system and eliminating the achievement gap of underrepresented students. Sonoma State submitted the campus plan for achieving its goal of increasing 4-year graduation rates from 29% to 54%, and 2-year (transfer) graduation rates from 52% to 64%, and eliminating the 8% achievement gap. One of the main aspects of the SSU plan, both for the short- and long-term, is a greater emphasis on advising. The first of these is graduation advising of majors after reaching 90 units (Junior status). The advising would be to help each student plan out a two-year schedule to graduation, and to gather data from all students so programs would be aware of potential impediments to graduation and institute proactive measures.

A second advising plan for SSU is to institute summer advising for students early in the major, especially URM students, who are not on a 4-year plan (less than 15 units per semester). Advisors would not only aid students in building graduation pathways as well as direct financial resources to summer or intersession coursework for students with demonstrated financial need.

Both of the above outlined advising plans require additional resources (staff or summer faculty). Given the large number of students requesting information about the Biology Program, and the

secondary admission criteria resulting from impaction, the Department Chair has often been called upon to fulfill the role of providing this information, especially during the summer months. Additionally, the Chair is needed to be on-call during freshmen summer orientation/registration to approve adjusting seat availability in the large-enrollment major's and non-major's courses. Finally, prospective students and their parents visit SSU during the summer months and the Chair is needed to explain the program.

In the past, the Biology Program had a 12-month chair appointment to cover summer advising and outreach. The budget crisis of 2009 removed this position, and the Dean has since funded 10 days of a summer chair position. With the CSU emphasis on aiding students to meet their graduation goals within 4 years, it is becoming increasing clear to the program that a return to a 12-month Chair position would be the most beneficial approach to serve the program's ~400 majors and potential majors. A department chair has more direct knowledge of the program and schedules than either staff advisors or other faculty, and the program feels is the most viable option to serve students.

6. FACULTY

6.1. Pedagogy

The program maintains a commitment to preparing majors to be capable of pursuing fulfilling careers in biology in a changing and competitive world. With this in mind, the program employs a comprehensive research-based instructional program in scientific inquiry encompassing observation and interpretation of experimental results. In addition, the curriculum is designed to be accessible to California's growing and diverse student population and meet the occupational needs of the state's technology-based economy. The major revision over the past several years has not changed the program's focus on keeping faculty and students immersed in the excitement of discovery and the active learning of science found only by engaging in the leading edges of research and professional activities. The faculty are actively engaged in externally funded research and are extremely competent in training students in scientific methods as well as recent scientific and technological advances. Currency within the discipline is further maintained through active scholarship and professional activities. Outcomes of these activities are typically incorporated into our curriculum planning and individual courses. The department always recruits faculty who are committed to teaching and scholarship in their areas of expertise. All tenured/tenure-track faculty CVs are provided in Appendix 8.

The faculty continue to maintain excellence in scholarship and teaching. Two faculty members (Drs. Hall Cushman and Nathan Rank) have been recognized in the recent past with the Bernie and Estelle Goldstein Awards for Excellence in Scholarship. Last year, Dr. Daniel Crocker became an elected Fellow of the California Academy of Sciences, while, in the previous year, Dr. Joseph Lin won the Sonoma State University Excellence in Teaching Award. Many faculty seek improvement in their course offerings and approach to teaching. Drs. Derek Girman and Nathan Rank participated in the CSU Course Redesign with Technology Professional Learning community where they learned about and applied technologies and leading edge pedagogical approaches to improving teaching. Drs. Joseph Lin and Michael Cohen participated in the NSF sponsored Widening Implementation & Demonstration of Evidences-Based Reforms (WIDER)

project let by the UC Berkeley Lawrence Hall of Science which focused on bringing active learning pedagogy into courses.

6.2. University Service

The Department of Biology has a strong history of participation in university governance (Appendix 9). Within the past 5 years two faculty members have been members of the Academic Senate. Others have been elected as representatives of the School of Science and Technology to seven committees of the Senate, with four serving in leadership positions (chair or coordinator). Many faculty have been actively involved in University committees such as the Animal Care Committee, Scholarship Committee (appointed by President), Enterprise Board, Campus Planning Committee, Campus Reengineering Committee, the Athletic Advisory Council, and the Green Music Center Advisory Board.

Several faculty members have also played a leading role in various professional organizations that have direct impact on the campus, department, and faculty professional growth and development. These organizations include COAST (Council on Ocean Affairs, Science and Technology), CSUPERB (California State University Program for Education and Research in Biotechnology) and CeNCOOS (Central and Northern California Ocean Observing System – SSU signatory).

6.3. Professional Accomplishments

Faculty members in Biology actively engage in externally funded research and publishing in peer reviewed journals. During 2010-2016, external funding of over $7.6 M has been received from a wide variety of agencies, including the National Science Foundation, US Fish & Wildlife Service, USDA Forest Service, National Parks Service, Office of Naval Research, National Environment Research Council (UK), as well as CSUPERP, and COAST. These funds support faculty/student research, department educational activities and purchasing equipment for core facilities. Results from faculty and student research has produced over 100 publications in peer-reviewed journals.

The faculty continue to build local, regional, national and international research collaborations, including the Sonoma County Water Agency, Sonoma Land Trust, the Presidio Trust, Golden Gate National Recreation Area, Point Reyes National Seashore, UC Davis, UC Berkeley, UC Riverside, Santa Clara Univ., Cornell, Univ., Northwestern Univ., North Carolina State Univ., Stockholm Univ., University of Brussels, and Okinawa Institute of Science & Technology. Collaborative efforts and grants with other institutions support purchase of equipment used extensively in the delivery of delivering the undergraduate curriculum, and provide students future graduate/professional opportunities.

The level and breadth of the program's faculty has been called upon to serve the academic community in manuscript reviews and editorial boards. In addition to the numerous manuscripts reviewed since 2010, faculty have served as editors, associate editors, or on editorial boards for many publications, including AoB Plants, Biological Invasions, Journal of Plant Research, Marine Biology, Functional Ecology, Physiological and Biochemical Zoology, Frontiers in Aquatic Physiology, and PloS One.

The department offers several supervision/contract courses which are designed to enhance student professional development, career goals and interest in research. Department faculty (tenured and tenure-track) participate in these courses with different levels of involvement reflecting student interests, faculty expertise and other aspects of faculty workload. During the last five years, Biology faculty supervised 281 undergraduate students in their senior research projects, 242 in independent [research] studies, and 194 in biology practicum or supervised internship courses. Because of the Department's success in attracting external funding, many opportunities exist for undergraduate majors to participate in funded, original and publishable research projects through Special Studies electives or paid summer internships. Many of the experiences provided to the majors often lead to placements at research institutions, agencies, or graduate programs.

7. INSTITUTIONAL SUPPORT

7.1. Physical Facilities

The Department consists of 8 teaching laboratories, 10 faculty research laboratories (CSU classification, instructional support space), 2 stock/lab preparation rooms, a combined museum (herbarium, vertebrate, insect), a walk in cold room containing a recirculating cold seawater system, a small animal room, and a greenhouse complex of three houses. Office space consists of a main department office and 16 offices allocated to full time and part time faculty, and one dedicated to graduate student office space.

7.2. Financial Resources

The operating budget for the Department is about $22,000 per year. This is to cover office, laboratory and field supplies. In addition, the Department receives temporary faculty funds of approximately $280,000 per year to cover lecturer salaries and $138,000 per year to cover teaching associate salaries. Through the Office of Administration and Finance, faculty and staff are provided computer refresh opportunities every 5-7 years, on average.

Previously, the program relied on the modest Department operating budget, supplemented by community donations of supplies and faculty research grants, to support instructional laboratory expenses. Recent administrative changes of no longer charging departments for phone service or regular photocopying, has helped to stretch the Department's operating budget. On the negative side, the Office of the Provost no longer supplements travel funds for course field trips for the institution. It was thus fortunate that the Department was successful last year (after multiple attempts) to procure approval for expansion of modest laboratory fees (see table below). With the increase, the program has an additional $18,490 to cover the increase in student demand.

Biology course fees and operating budget					
Non-majors					
Course	Previous fee	Current fee	Enrollment	Previous revenue/yr.	Current revenue/yr.
BIOL 110	0	$5	700	0	$3,500
BIOL 220	$90	$120	220	$19,800	$26,400
BIOL 224	0	$10	96	0	$960
BIOL 240	0	$25	54	0	$1,350
BIOL 314	0	$65	20	0	$1,300
Sub-total			1090	**$19,800**	**$33,510**
Majors					
BIOL 130	$15	$15	192	$2,880	$2,880
BIOL 131	$30	$15	180	$5,400	$2,700
BIOL 322	$30	$55	20	$600	$1,100
BIOL 323	0	$70	20	0	$1,400
BIOL 325	0	$15	72	0	$1,080
BIOL 327	0	$140	20	0	$2,800
BIOL 328	0	$45	24	0	$1,080
BIOL 329	0	$10	20	0	$200
BIOL 330	$30	$15	20	$600	$300
BIOL 333	0	$30	40	0	$1,200
BIOL 335	0	$65	40	0	$2,600
BIOL 338	0	$15	18	0	$270
BIOL 340	0	$25	18	0	$450
BIOL 341	0	0	60	0	0
BIOL 342	0	$40	32	0	$1,280
BIOL 344	0	$30	32	0	$960
BIOL 346	0	0	20	0	0
BIOL 347	0	$20	48	0	$960
BIOL 348	0	0	16	0	0
BIOL 349	0	$15	48	0	$720
BIOL 383	0	$25	16	0	$400
BIOL 472	0	$25	16	0	$400
BIOL480	0	$30	16	0	$480
BIOL 485	0	0	20	0	0
Sub-total			1008	**$9,480**	**$23,260**
Total: Majors + non-majors				**$29,280**	**$56,770**
OE portion				**$22,000**	**$22,000**
Provost's travel funds				**$9,000**	**0**
Total budget				**$60,280**	**$78,770**

7.3. Human Resources

The Department has a workload policy for tenure/tenure track faculty of a minimum of 18 Weighted Teaching Units (WTU) of direct class instruction per year and a maximum of 6 WTU of supervisory coursework per year (see Appendix 10). The Department identifies this approach

as the “9+3” model, with 9 WTU per semester of direct instruction plus 3 WTU of supervisory instruction. The supervisory instruction is needed in support of the research-based graduate program, and required capstone research experience for the B.S. degree. The Department Chair and Curriculum Committee are responsible for enforcement of workload. Faculty often carry several units of assigned time for School and University service, including Department Chair (16 WTU/year), Radiation Safety Officer (4 WTU/year) Health Professions Advisory Committee Chair (4 WTU/year), or have buyout from grants or reassigned time for School or University service. Assigned time is reimbursed to the School and comes back to the Department as part of the temporary faculty budget. Finally, all faculty are assigned 6 WTU per year to cover non-teaching associated workload such as advising (typical advising load of 33:1, students:faculty) and university governance.

The Department workload policy is a mechanism to insure a balance between direct instruction, assigned time, and supervision. Although the workload policy identifies up to 6 WTU per year for supervisory courses, demand can push the averages over this amount as several faculty carry a heavy supervisory load to meet the needs of students in the B.S. degree track.

The Department has two temporary faculty members on 3-year contracts. These faculty are critical in staffing lower division General Education (BIOL 110, 115), Service course (BIOL 220), and upper division GE (BIOL 318). Both have been with the Department for more than 10 years and have consistently received highly favorable student, peer and annual reviews of their teaching effectiveness. The Department relies on several part-time lecturers when budgets permit. Like the 3-year contract lectures, they are utilized in lower division courses, and for gaps in the upper division. The Department also utilizes graduate student teaching associates in the lower division (BIOL 110, 130, 131) laboratories and upper-division core discussions (BIOL 320, 321). The use of TA’s allows an efficiency of offering large lecture sections and smaller laboratory/discussion sections.

The number of full-time tenure/tenure-track (TT) faculty in the Department over the past 5 years has ranged from 10 to 12. With faculty service and reassignments, the full-time equivalents for TT faculty is consistently below demand for student needs (FTES). Thus, the Department has seen a slow increase in use of lectures. The program is able to staff lower-division laboratory and discussion sections with a robust graduate student population as Teaching Associates. Even with these additions, the program’s student-faculty ration (SFR) has also been increasing over the past 5 years, given an increase of 78 FTES since FA 2011 (see table below).

Faculty full-time equivalents (FTEF), student full-time equivalents (FTES), and student-faculty ratio (SFR). Lec = part-time faculty lecturers, TA = graduate teaching associates, TT = full-time, tenure/tenure track faculty.							
Term	**Total FTEF**	**Lec FTEF**	**TA FTEF**	**TT FTEF**	**TT Head Count**	**Total FTES**	**Dept. SFR**
FA 2011	16.712	2.0	3.3	11.412	11.5	379.8	22.7
SP 2012	14.723	3.5	2.8	8.423	11.5	316.5	21.5
FA 2012	16.52	2.2	3.8	10.52	11.5	384.3	23.3
SP 2013	13.83	3.3	3.1	7.43	11.5	313.0	22.6
FA 2013	16.889	3.4	4.6	8.889	10.5	402.9	23.9
SP 2014	16.616	4.1	3.8	8.716	10.5	347.1	20.9
FA 2014	17.646	5.2	4.8	7.646	11.0	447.3	25.3
SP 2015	17.607	5.5	3.5	8.607	11.0	390.0	22.1
FA 2015	16.295	4.7	4.6	6.995	10.0	463.6	28.4
SP 2016	16.26	4.9	3.9	7.46	10.0	390.2	24.0
FA 2016	16.06	4.2	4.4	7.46	12.0	458.6	28.6

The Department has 1.5 Administrative Coordinators to cover all administrative aspects of the Department, and to serve the School's Health Professions Advisory Program. The Department also has 2 FTE for Instructional Support Technicians who oversee the preparation and set up of over 40 laboratory sections per semester. They are also responsible for general maintenance of the Department's physical facilities, including safety oversight.

8. ASSESMENT AND FINDINGS

8.1. Program Assessment via Student Learning Objectives

In the Fall of 2016, the Department agreed upon four program learning outcomes and 14 student learning objectives (see Curriculum section). From discussions at Department meetings, the Department decided to use an imbedded assessment approach to gather data on student performance in the major. Faculty reviewed the 14 student learning objectives and matched, where appropriate, the learning objectives with in-class exam or quiz questions, projects, or other forms of class assessment. The total points for an in-class assessment were scaled to a range of 10 (providing equal scaling across questions and courses). Within in a course a class average was calculated for individual learning objectives that were assessed multiple times. The following table shows the courses and SLOs covered in the assessment.

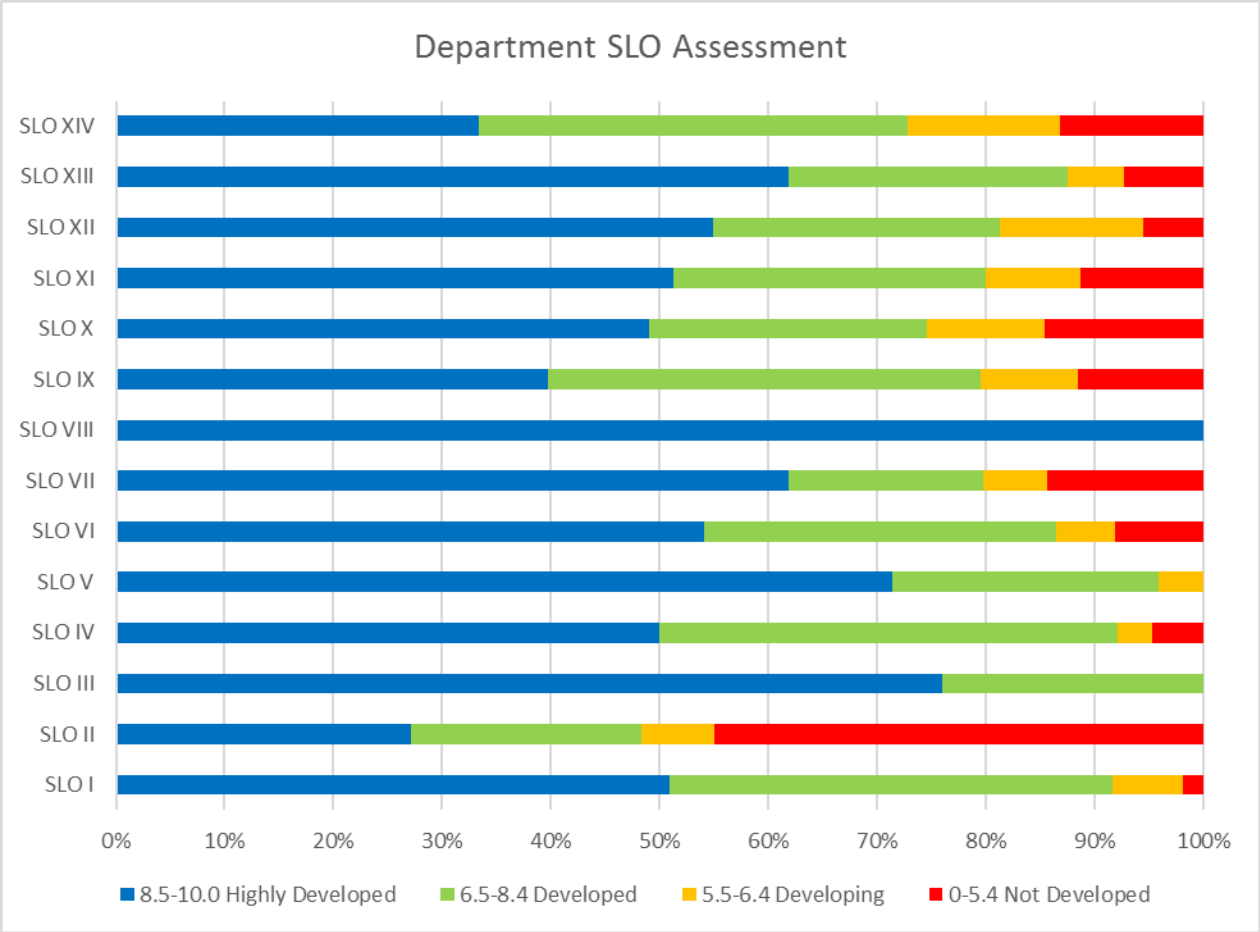
Source of assessment data, 2016/17 academic year				
Course Number	**Title**	**Semester**	**Source**	**SLOs**
BIOL 325	Molecular and Cellular Lab Techniques	SP 17	quiz	II
BIOL 332	Marine Biology	FA 16	exams	IX, X, XI, XIII, XIV
BIOL 340	General Bacteriology	FA 16	assignment, report, exams	I, II, III, X, XI, XIV
BIOL 341	Evolution	FA 16	exams, final project	I, II, VII, XII, XIII
BIOL 344	Cell Biology	FA 16	exams	IV, VI, VII, XI, XIII
BIOL 347	Environmental Physiology	FA 16	exams, quizzes	I, II, IV, V, VIII, IX, XI, XIV
BIOL 349	Animal Physiology	SP 16	problem sets	XI, XII, XIII, XIV
BIOL 472	Developmental Biology	SP 16	exams	I, V, VI, VII, IX, XII, XIII
BIOL 485	Biometry	FA 16	exams, final project	I, III, IV, V, VIII

Following collection of the SLO data, the Department discussed levels of achievement to be used in the assessment. The agreed upon scale follows:

8.5-10.0 highly developed
6.6-8.4 developed
5.5-6.4 developing
0-5.4 not developed

SLO scores were collected across classes and percentages for each performance level calculated. The table below provides the sample size for each SLO and the graph the results.

Sample sizes for SLOs used in program assessment.														
SLO	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII	XIII	XIV
n	108	118	25	64	49	37	84	29	78	55	150	91	152	129



At least 72% of the students demonstrate developed or highly developed levels of learning on 13 of the 14 learning objectives, and 50% or more students demonstrate a highly developed level of learning on 10 of the 14 learning objectives.

The first four SLOs are associated with the PLO on development of quantitative and analytical tools. The assessment indicates students are performing well on collecting, interpreting, analyzing and reasoning with biological information (SLOs I, III, and IV), but are not able to perform the appropriate calculations for addressing questions (SLO II). This indicates the curriculum may not be providing sufficient practice in performing actual calculations, but rather relies more heavily on training students on the proper software to use for data analysis. The department will continue to monitor the development of students for this outcome and discuss how to strengthen overall performance. One thought faculty shared is to encourage more in class calculation experiences. These would be most effective in the introductory major's courses (BIOL 130 and BIOL 131) and in the upper-division core classes (BIOL 320 and BIOL 321).

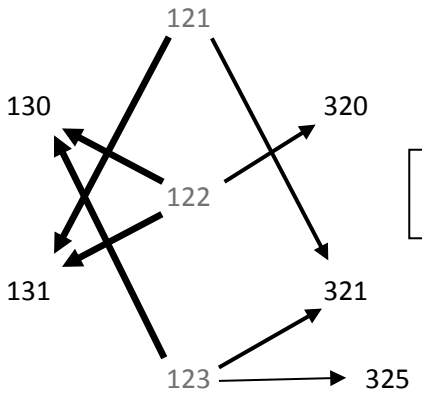
SLO XIV is the only other result where the combined highly developed and developed scores fall below 75%. Only one third of the students demonstrate highly developed learning for this SLO. An explanation may be understood in light of how this learning outcome represents a complex conceptual understanding of biological function. Even with this result, an additional 40% of students demonstrate developed performance on the SLO, so the combined results

indicate reasonable success.

Moving forward, the Department will encourage all faculty to collect SLO information in upper-division courses from final exams, projects, papers, etc. (embedded assessment from end of the course). The data will be summarized and reviewed (every two years) and used in discussions of course and/or curricular matters.

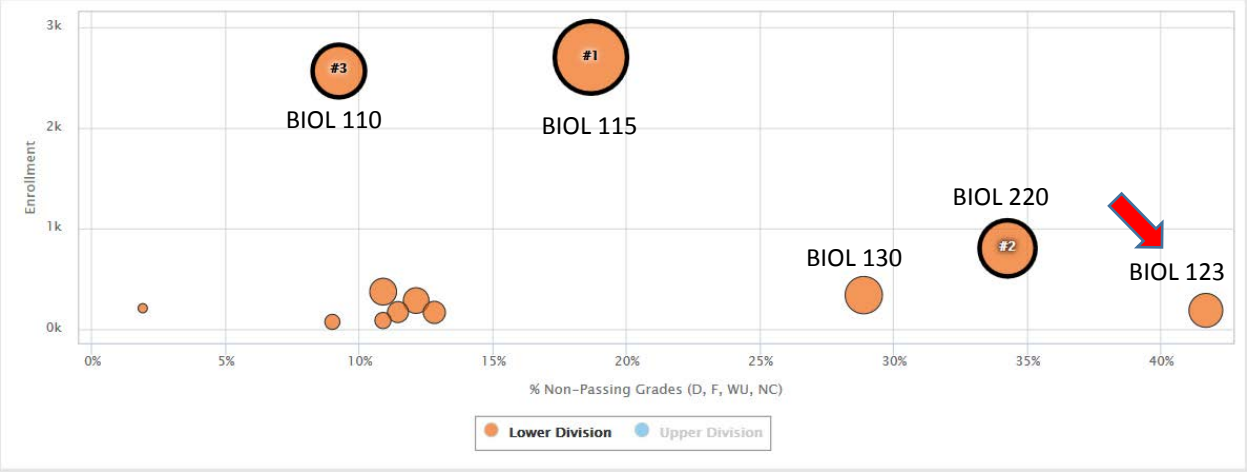
8.2. Student Performance in Revised Lower- and Upper-Division Core Sequences
BIOL 130 (Introductory Cell Biology and Genetics) and BIOL 131 (Biological Diversity and Ecology) represent the new two-semester (8 units) lower division introductory biology series required of Biology majors. These courses replaced the three-semester (12 units) lower division sequence (BIOL 121, 122 and 123). This change was undertaken to facilitate timely progress through the major and promote graduation rates after four years of enrollment. Course content in BIOL 130 includes basic molecular and cell biology material from BIOL 123 (Molecular and Cell Biology) and basic molecular and transmission genetics, and microevolution material from BIOL 122 (Genetics Evolution and Ecology). Course content in BIOL 131 includes basic phylogenetic and biological diversity material from BIOL 121 (Diversity, Structure and Function) and introductory ecological diversity from BIOL 122 (Genetics, Evolution and Ecology). The syllabi for BIOL 130 and BIOL 131 (see Appendix 11) reflect the efforts of faculty members who routinely taught BIOL 121, 122 and 123 to restructure the content and adapt it to a first-year biology majors sequence. Both courses have strong hands on laboratory components. Completion of both BIOL 130 and 131 is required of Biology majors and minors.

BIOL 320 and 321 are large capacity courses that represent the upper-division core sequence for the Biology major. These courses replaced the former four upper-division core-areas (consisting of 17 courses). The former core area courses have become upper-division electives. Replacing the core-area courses (all with laboratories) with large lecture/discussion courses adds greater efficiency in the Biology major. The challenge faced was providing a uniform and novel offering of upper division concepts in biology than had been offered in the previous BIOL 120 series and current BIOL 130 series. The diagram below represents how content was reorganized from the 120 series to the 130 series, and, to a lesser extent into the 320 series. This left some of the laboratory content in the original BIOL 123 not being adequately represented in the curriculum, especially for students in the molecular, cellular, and physiological emphases. The response was BIOL 325, Molecular and Cellular Lab Techniques, a 1 unit laboratory course providing technical skills required for upper division courses in these areas of biology.



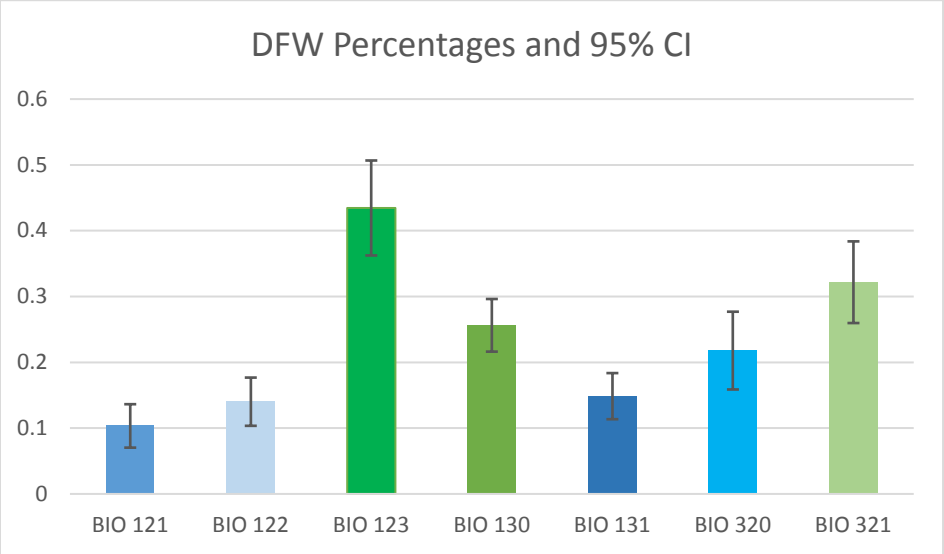
Summary of content reorganization from 120 series to 130 and 320 series.

BIOL 130 and 131 has completed three semesters of offerings, and BIOL 320 and 321 has completed two semesters. Presently, assessment data has not been generated on learning outcomes. Even if assessment data were available, the lack of direct assessment data from the previous BIOL 120 series means there is no comparator. However, one of the driving forces in making the changes to the lower division core was to increase student success. The program's perception was that BIOL 123 was a bottleneck course for our majors. This perception is supported by the CSU Student Success Dashboard (see below). BIOL 123 has the highest reported percentage non-passing and D grades for all lower division biology courses. This was a serious problem as students would retake the course to obtain a higher grade, and thus were prevented from making progress in the degree as BIOL 123 was a prerequisite for the required upper division core courses in Physiology and Molecular Biology.



Combined enrollment and % non-passing and D grades for lower-division courses in Biology, from FA 2012 to SP 2016.

Examination of the percentage of DFW grades for the last 4 semesters of the BIOL 120 series, with those for the new lower and upper-division core, indicates progress in reducing the bottleneck students experienced in BIOL 123 (see below). The DFW percentage of 43% in BIOL 123 has been reduced to 25% in BIOL 130 and 32% in BIOL 321. Clearly, progress is being made in helping students progress through the cores, and the program continues refining course content and pedagogy in these challenging courses. Future work will include assessing the learning outcomes from these courses to provide more detailed data on where efforts should be focused.



DFW percentages and 95% confidence intervals for last 4 semesters of BIOL 120 series, last 3 semesters of BIOL 130 and 131, and last 2 semesters of BIOL 320 and 321.

8.3. Assessment of Biology Minors

No program assessment exists for students within the Biology minor. Indeed, developing one would seem to require gathering and compiling information as to the reasons students majoring in other programs choose to minor in Biology. Then, appropriate learning objectives for these student populations, distinct from those for the Biology major could be developed. Such objectives would likely focus largely on the applicability of biology course content within a variety of other specific disciplines.

9. ACTION PLAN

The past five years have seen major revisions to the undergraduate curriculum, linked to changes in the status of the budget, the student body and the faculty. With a renewed curriculum and greater focus of the CSU on student success and graduation, the program must monitor the progress of majors and assess their success in meeting the program learning objectives. The program should also be vigilant in examining how well the breath of biology is represented and presented to majors, identifying programmatic deficiencies, and using the information in guiding future changes and/or faculty hires and space needs.

Even with the revisions to the B.S. degree, the program maintains its commitment to successfully use the teacher-scholar model in ensuring faculty maintain currency in their fields and provide students a capstone experience in their degree – meeting the “Capstone and Signature Work” goal of the Association of American Colleges & Universities (AAC&U) Leap Challenge https://www.aacu.org/leap-challenge.

Therefore, the continued success of the program will involve undertaking the following:

- Evaluate efficacy and student success through the lower- and upper-division cores.
- Evaluate efficacy and student demand and success in the B.A. and B.S. concentration options.
- Evaluate student demand and success in the B.A. and B.S. degree options.
- Continue development of assessment activities, including within the core sequences.
- Monitor outcomes from the above points and use the results in guiding future tenure-track faculty hires and space needs.
- Work with the administration in support of all the above and towards reinstatement of a 12-month Chair position.

Richard Whitkus,
Program Review Coordinator

Murali C. Pillai,
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APPENDICES