UNIVERSITY OF SAN FRANCISCO

Department of Biology

Academic Program Review
Self-Study Document

Fall 2022

Academic Program Review: Self Study - Spring 2022
Department of Biology, University of San Francisco

I. INTRODUCTION

A. Mission Statement

The core mission of the University of San Francisco is to educate students in the knowledge and skills required to succeed as professionals and as persons, while also teaching the sensitivity and values necessary to participate in a world shared by all people.

The Department of Biology particularly emphasizes the core Jesuit value of advancing the freedom and responsibility to pursue truth and to follow evidence to its conclusion. In pursuit of these values, the faculty of the Department of Biology educate undergraduate students in current biological concepts, methodologies, and ethical practices in the laboratory and the natural environment. This prepares our students to succeed personally and professionally with the potential for advanced training in the biological sciences.

B. History

Established in 1855 by the Jesuits, the University of San Francisco is more than 150 years old and the first University in the city of San Francisco. There are over 10,000 students enrolled at the university, including 5,566 undergraduate students in programs associated with the College of Arts and Sciences (CAS), the School of Management, and the School of Nursing and Health Professions. There are an additional 3,686 graduate students in these programs and in the Schools of Law and Education. Many USF graduate degrees are from professional Master's programs, and there are no PhD programs in the College of Arts and Sciences.

The College of Arts and Sciences has eight science departments: Biology, Chemistry, Engineering, Physics and Astronomy, Mathematics, Computer Science, Environmental Science, and Kinesiology. Biology is one of the oldest departments, and for at least the last fifty years, has consistently had the largest number of majors within the sciences. Currently, there are 3,496 undergraduate majors in CAS, including 459 Biology majors. There are 928 graduate students in the sciences, with eight in our Master of Science program and 50 students in the Professional Science Masters in Biotechnology program.

The department provides three lower division and numerous upper division required courses (most with laboratories) for hundreds of students every semester. It also provides an array of service courses for the university to satisfy core requirements and supporting major courses for Nursing and Kinesiology. Our faculty also provides advising for all biology majors, meeting with students each semester to ensure they are on track to graduate within four years. In addition to teaching and extensive advising responsibilities, Biology faculty are active participants in all

aspects of the academy, and some of the faculty have strong research programs. We serve on numerous committees, are faculty advisors for student organizations, and participate as volunteers in many activities.

Since the last review in 2014, the department faculty has recruited four new tenure-track faculty and three new term faculty to replace retiring positions and/or to fill new faculty lines. A new full-time Lab Coordinator staff member and a Pre-health Advisor were added as well. There have been some minor renovations to offices and work space that have resulted in the creation of a new office suite, updated shared research lab space, and a cell culture facility. We also now have a research-grade greenhouse for use in faculty research.

C. Previous Biology Program Reviews

The USF Biology program has had formal external reviews in 1993, 2006 and 2014. The two common challenges highlighted in all three of our self studies and agreed on by the external reviewers have been: 1) inadequate number of faculty and support staff to accommodate the number of Biology majors admitted to USF and the number students taking the service courses we are required to offer and 2) insufficient or unsuitable space for courses and the research requirements of tenured/tenure-track faculty.

The major issues noted by the 2014 program external reviewers and the current status of these issues are summarized below and detailed updates are provided as Appendix A.

2014 Review Observation 1: Faculty members have significant teaching and advising loads.

- Teaching Loads: The number of Biology majors has increased significantly (by 20% since 2014). The number of full-time faculty in Spring 2022 has also increased from 15 to 19, but the number of tenured/tenure-track faculty has only increased by one (total = 12)
- Advising Loads: To assist with advising, in Fall 2014 we set up a Peer Advising program, but the program was unsuccessful. A full-time Pre-Health Professions Advisor position was created in Fall 2018 and has been very helpful for our students.

2014 Review Observation 2: Resources are needed for faculty research space and increased student research opportunities. .

- Harney Science Center has not been renovated, and a renovation plan has yet to be adopted by the administration.
- Faculty Research Space: A suite of eight faculty offices and a shared research space with assigned bays has been added from the renovation of two faculty offices, teaching and research lab space, and a cold room. Additional growth is limited until the administration completes further renovation of the Harney Science Center.
- Student Research Support: Two new funding opportunities to support student research, the Student Travel Fund and the Whitehead Summer Research Fellowship, have been developed since the last review.

2014 Review Observation 3: Improvements to the graduate program are needed.

- Incoming MS students are now guaranteed a prep TA assistantship during their first semester and are offered TA positions in subsequent semesters. Many research labs have initiated a mentorship model where undergraduate students work directly with graduate students.
- A graduate student lounge space was provided but has been recently repurposed by the administration.

2014 Review Observation 4: Overall Curriculum – course offerings can be improved with greater emphasis on ecology, research ethics, and modern biological approaches.

- Ecology emphasis: four new ecology-focused upper division courses have been added to the curriculum - Urban Ecology, Pollination Biology, Biology of Marine Mammals, and Biology of Galapagos - and students are now required to take Ecology (BIOL 319).
- Ethics: Biological ethics is covered in Genetics and other upper division courses and research ethics is also discussed in BIOL 490 Undergraduate Seminar, which is required for all Biology majors.
- Modern Approaches: New courses, such as Bioinformatics, have been developed and added to the curriculum; in addition, we have integrated modern statistical and computational techniques (e.g. R programming) into existing and new courses including Ecology, Insect Biology, Pollination Biology, and Urban Ecology.

2014 Review Observation 5: There is an immediate need to improve assessment.
A committee of Biology faculty now completes annual assessment reports, which has greatly improved the assessment of all Biology major program learning outcomes. The Department now routinely is awarded a "gold star" from the CAS Associate Director of Assessment for exhaustive and contemplative evaluation of our curriculum. We continue to administer a senior exit survey, which is highly valuable in refining our curriculum.

D. Goals and Learning Outcomes

The goals of the Biology Program are to develop the following knowledge and skills in its students:

1. An understanding of major biological concepts.
2. Problem solving, analytical, and communication skills as they apply to biological sciences
3. The ability to apply the scientific method and critical thinking in an ethical fashion to biological problems
4. An awareness of career pathways in the biological sciences.

The learning outcomes for all Biology degree programs have recently been revised. Prior and current PLOs are included in Appendix B.

The learning outcomes for these goals are for **Biology majors** to be able to:

1. Analyze scientific questions using both in-depth and broad knowledge of concepts that comprise the biological sciences.
2. Implement the scientific process by designing and conducting experiments, testing hypotheses, analyzing and evaluating results, and communicating conclusions.
3. Use laboratory, field, and analytical techniques to address complex questions in the life sciences.
4. Evaluate, synthesize, and communicate information from the primary scientific literature.
5. Apply principles of social awareness and responsibility to scientific investigations in the life sciences.

The learning outcomes for these goals are for **Biology minors** to be able to:

1. Articulate and explain principles of cell and molecular biology, organismal biology, ecology, and evolution.
2. Apply the scientific process and prepare written reports that analyze and evaluate results of scientific investigation.
3. Perform laboratory techniques that assess scientific problems.
4. Examine and evaluate the primary scientific literature.
5. Apply principles of social awareness and responsibility to scientific investigations in the life sciences.

The learning outcomes for these goals are for **Masters in Biology students** to be able to:

1. Describe, synthesize, and apply concepts and techniques in the current literature within a specific research area.
2. Develop mastery of content through direct instruction of basic biological concepts.
3. Conduct original research, evaluate data, and demonstrate research skills within a specified research area.
4. Communicate results of independent scientific inquiry through oral and written discourse.

II. CURRICULUM

A. General Overview of the Curriculum

Through a combination of lecture, seminar, field-laboratory, and bench-laboratory courses, the department strives to expose USF students to the range of sub-disciplines that comprise the field of biology. Thus, the curriculum includes courses in cell & molecular biology, genetics, evolutionary biology, organismal biology, and ecology. In addition to offering students the opportunity to major or minor in biology, the Biology Department also offers courses that fulfill requirements in the nursing major, the kinesiology major, the neuroscience minor, and the gerontology minor.

Most of the courses offered by the Biology Department at USF are primarily, and sometimes exclusively, taken by biology majors. General Biology I and II are required courses for those in the biology major as well as students majoring in Biochemistry (offered through the Chemistry Department), Kinesiology, and Environmental Science. The Department offers service courses in Human Anatomy, Human Physiology, and Microbiology, which are taken by kinesiology and nursing majors. Each semester, the Biology Department offers a few courses that are geared toward non-science majors wishing to fulfill their Core B2 (natural or laboratory science) requirement. These courses, which include Human Biology, The Biology of Aging, and The Science of Life, are quickly filled to capacity each semester, and it is an ongoing frustration that the department lacks the available staff to teach additional Core courses geared toward non-majors.

Learning outcomes for all undergraduate and graduate programs administered by the department are included as Appendix B. Curriculum maps for all programs in Biology are included as Appendix C.

B. Undergraduate Programs

Overview: The undergraduate program in Biology is composed of a series of required foundation and supporting courses, upper-division elective courses, and a senior capstone course and research seminar. The required courses in the major are as follows:

- General Biology I and II lecture and lab,
- General Chemistry I and II lecture and lab,
- Introductory Physics I and II lecture and lab,
- at least one semester of Organic Chemistry lecture and lab,
- Biostatistics,
- Cell Physiology,
- Genetics,
- Biology Seminar (1 unit),
- Evolution (our capstone course).

In addition, students complete five upper division Biology courses, at least three of which must include supporting laboratory instruction. One of these three courses must be a field course;. the field designation is reserved for courses that specifically cover a field-research subdiscipline of biology such as herpetology, ornithology and pollination biology that allow students to participate in hands-on field activities. Two additional courses must be laboratory (i.e. endocrinology, immunology, or microbiology) or other field courses (for a total of 66-70 units). An overview of the sample curriculum for the Biology Major is available in Appendix D.

Concentrations within the major. A student is not required to choose a concentration, but may opt to complete concentrations in either Molecular Biology or Ecology.

- Molecular Biology Concentration: requires Molecular Biology and four electives chosen from a list of approved courses, three of which must be laboratory courses.

- Ecology Concentration: requires Ecology and four courses chosen from a list of approved courses for the concentration, two of which must be field courses.

We believe that the program's design is logical, sequential and consistent. In particular, applied prerequisites are essential to the academic quality of the program and the student's experience as a Biology major (see pre- and co-requisite grid, Appendix E). Courses offered by the Biology department cover a broad range of topics from molecular biology through ecology. Our foundational courses introduce students to the historical roots of the field, touching upon some of the landmark studies that shaped our understanding of the natural world. In upper division courses and the required Seminar course, students are introduced to current literature in the field and cutting-edge research from seminar speakers. In addition, as a department, we periodically review the courses offered in the department and evaluate whether courses or materials should be updated. For example, in 2019 a department committee was formed to review the General Biology courses, suggesting adjustments to each course structure to include greater emphasis on ecology and evolution and evaluate new texts for use in the course.

***Minors*.** The department administers minors in Biology and Natural Sciences.

- The Biology Minor consists of General Biology I and II lecture and lab, Cell Physiology, Genetics lecture and lab, and Ecology.
- The Natural Sciences Minor is for non-science majors looking to complete the following health professions program prerequisites: General Biology I and II, Organic Chemistry I with lab, Organic Chemistry II, and Introductory Physics I and II.

Biology Honors Program. *S*tudents with a grade point average of at least 3.2 overall, and at least a 3.4 in Biology major courses may complete the major with Honors. They must apply to the Honors Thesis Program Committee in their third year, and complete a research project and thesis that culminates with a written thesis and departmental seminar. The Honors designation is noted on the student's transcript.

Research for Undergraduate Students. Students may find positions in laboratories within the department. For most students, this begins in the second or third year and continues through graduation. These students may earn upper division units (no more than four units total) or simply participate as a volunteer. The assessment of the student's research endeavors is accomplished in various ways: students present their research during lab meetings and compose and present posters for local, national and international research conferences. Faculty members are enthusiastic about undergraduates participating in research, and they do their best to accommodate and support this interest. However, research positions within the department are limited, as fewer than half of full-time faculty within the department maintain research programs. Students may struggle to find a research placement within the department, and many students search for research and internship opportunities off campus.

Our program provides students graduating as Biology majors a solid footing on which to build as an employee of an academic, clinical, government, or industrial laboratory. Students are

likewise well positioned for success in a Masters or PhD programs in the biological sciences. Outside of graduate programs in biology, students also pursue careers in health professions, including advancing to medical school, dental school, and other health-related postgraduate programs.

C. Graduate Programs

The Biology Department offers two Masters programs – the MS in Biology program and the Professional Science Masters (PSM) program in Biotechnology. The PSM program in Biotechnology recently completed its own Academic Program Review (APR) and will not formally be assessed in this Biology APR.

MS in Biology Mission and PLOs. The graduate program has modified its Goals and Learning Outcomes to better reflect the Program Mission. The current Program Mission Statement reads:

> *The Master's of Science program in Biology is a two-year, research-intensive degree in which students undertake an active research project that culminates in a formal written thesis. A student who successfully completes the program will be well prepared to pursue further postgraduate work (e.g., PhD or MD) or acquire a technical position in various types of research laboratories, state agencies, non-governmental organizations, and industrial/commercial laboratories.*

Recruitment and Admissions. To recruit students we use mailings, our website, and host open information sessions via the Graduate Admissions office and/or online sessions once a semester. Some of the students also find our program through reading faculty publications or seeing them give a talk at a scientific meeting. Prospective students contact faculty in their area of research prior to applying in order to discuss areas of overlap in research interest and the feasibility of joining a particular lab. During the application process, students select a specific research lab to apply to, and faculty evaluate the applicants who wish to work in that area of expertise. As a small department, there is little overlap in research specialties among faculty members. However, if after arrival, a student and faculty mentor determine that they are not a good fit, it is possible for a student to move to a different host lab by mutual agreement of all parties involved.

Applicants who hold a bachelor's degree in biology are preferred. Applicants who do not have an overall GPA of 3.2 or higher, and/or a 3.2 or higher in upper-division biology coursework may be admitted in a probationary status. If they do well in their first semester, they then become a normally enrolled student. Students with a degree in other scientific fields (e.g. biochemistry, chemistry, physics) may also apply; additional coursework at USF might be required at the discretion of the Graduate Committee at the time of admission. The average GRE general exam scores of our admitted students are: Verbal – 153 (54%); Quantitative – 156 (63%); Analytical Writing – 4.3 (68%).

Coursework and degree requirements. Our graduate program is coordinated by a Graduate Director and Committee. The Graduate Committee is made up of four tenured or tenure-track research faculty plus the Graduate Director, and meets several times a year to coordinate the program, make admission decisions, and make policy changes as needed.

Students are paired with a faculty advisor and required to complete 24 units of coursework, much of which is completed through faculty-designed 'directed reading' and 'directed research' courses. This coursework focuses on learning the key background literature and theory, as well as practical scientific skills (laboratory, field, analytical) needed to conduct novel, independent research under the guidance of the faculty mentor. We are unable to offer stand-alone graduate courses (other than the one credit graduate research and writing course offered most years), so students take upper-division undergraduate courses for graduate credit. They are required to complete additional work in those courses, but are seated with the undergraduates and are members of the learning community. Students can also take some relevant courses (e.g., Geographic Informations Systems, Statistics, Data Analysis, etc.) that can be substituted for degree credit from other graduate programs including Chemistry, Environmental Management, and Data Science. Our courses meet our student's needs by providing a combination of personalized training for a student's specific research interests, and classwork that builds their base knowledge and augments and enriches their thesis research.

All students are required to develop a thesis proposal and select a Thesis Committee. The proposal is presented in written and oral form to the Committee at the end of the first semester or the start of the second. The Committee gives feedback to the student and evaluates whether or not the work is likely to provide an acceptable thesis in the available time. In the final semester of the program, students submit their completed thesis to their committee and present their thesis in an oral presentation that is open to the community. They also have a closed discussion with their thesis committee, where the committee evaluates the student's understanding of the material and offers suggestions for improvement prior to formally signing off on the thesis.

Students must also complete one semester as a teaching assistant, typically for a General Biology I or II lab, present their research as a talk once in the Biology Seminar Series, as well as during the Exit Seminar (public) portion of their thesis defense. Most of our graduate students also present their research at USF's annual Creative Activity and Research Day (CARD) at least once.

MS Student Demographics. Our graduate program includes students from a diverse set of backgrounds, experiences, ethnicities, and regions. The current student body includes: 5 females, 3 males, 3 white, 2 Asians, 1 Hispanic, 1 Multi-race. One current student is international. Most of our graduate students received their undergraduate degrees at other institutions though some USF undergraduate students apply to the Masters program.

Our students have been highly successful at winning competitive research grants and scholarships. One recent student was awarded a National Science Foundation Graduate Research Fellowship (NSF-GRFP; 3-years; $12k a year towards tuition + $34k/year for a stipend), and another student received an Honorable Mention from this program. Our students have also been awarded thousands of dollars for their thesis research including scholarships and awards from the California Native Plant Society - Marin Chapter, California Botanical Society, Northern California Botanist, and Sigma Xi. Finally, our students have also been awarded numerous USF Whitehead Summer Research Fellowships (open to USF undergraduate and graduate Chemistry and Biology students) since this fellowship program started in the summer of 2017.

Students are prepared for opportunities and alternatives available to them within and outside the university upon graduation in a number of ways. All graduate students are required to take the 1-unit seminar course at least once a year. In this course they are exposed to a very wide range of research, presented by visiting scholars that span from postdoctoral fellows to senior faculty. The Research and Writing Methods class taken by students in the program teaches them the skills they will need to succeed in graduate research (managing references, dealing with data and code, doing a literature search, presenting at conferences, applying for funding, etc) as well as in the soft skills needed to find a position after graduate training is complete (elevator pitches, informational interviewing, types of careers and how to find them, etc).

We have had a successful group of students pass through the program over the last five years, as evidenced by their post-graduation placements as well as their success in securing funding for their research. Placements of students who have graduated since 2016 are included as Appendix F.

Graduate Tuition Remission and Support. The graduate program is relatively small and enrollment tends to vary from year to year. The program oscillates between 12 and 8 students in a given academic year. The primary reasons for this variation are the additional faculty workload required to host the additional students and financial constraints imposed by the College. Faculty supervising graduate student research do not receive workload compensation for this very large time commitment, so faculty members accept students at their own discretion.

In addition, USF is a private University situated in a very expensive city, and the lack of funding for graduate student stipends makes it all the more challenging for the students. We offer a maximum of eight full tuition scholarships (this level is set by the College each year) and provide graduate students a small salary (~$4,000 per semester depending on the course) for serving as a teaching assistant. With the hire of four research faculty since the last self-study, we now are often constrained in the students we can admit. Faculty have not been able to admit high quality candidates into their lab due to limited tuition scholarships.

The department has a Grants-in-Aid program for supporting undergraduate and graduate student research and travel costs for scientific meetings.(up to $2,500 per year). This support is made possible by the generous contributions of donors to the Biology Gift Fund. This fund, in conjunction with the Dean's office student travel awards (typically for 50% the cost of attending a scientific meeting, for example) gives students financial resources to attend and present at scientific meetings and travel to conduct field research. One recent addition to the financial picture for our students is the Whitehead Summer Fellowship program, which has been offered over the past 4-5 years to USF Biology and Chemistry undergraduate and graduate students. Students apply with a series of essays and a research proposal, and a committee selects top proposals to make 4-5 awards each year. These awards encompass $10,000 for a summer, including $7,000 stipend, $2,000 for research supplies, and $1,000 for research or conference travel.

In terms of physical space, graduate students generally work within faculty labs. For labs with more space, graduate students may be afforded a bench or desk; in labs with less available space (some labs are shared among up to 3 faculty), students share space with the faculty member and other students or trainees in the lab. Currently there is no dedicated space for graduate students outside of research labs.

The MS graduate program makes an important contribution to research conducted in the Biology Department as well as the scholarly atmosphere of the department. Graduate students can commit to relatively long-term projects, increasing the lines of research that can be pursued in a laboratory. By providing supplemental training and supervision, graduate students can enhance a faculty member's capacity to mentor undergraduates in research. Graduate students also contribute importantly to the research productivity of the Department, collaborating with faculty members on publications as co- and first authors.

D. Advising

The biology faculty currently advise nearly 500 students, with each faculty member advising on average about 40 students per semester. Prior to matriculation at USF, all incoming students participate in WebTrack, an online advising system featuring short videos that describe curriculum requirements. Students then register for courses, and that schedule is reviewed by a faculty member from the department who contacts the student via email or phone to discuss any recommended changes. The University has an online system, Early Alert, for advisors to document advice and conversations with students, which has proven useful for the WebTrack system and for students who seek advice from several different faculty members and/or from University advisers in CASA (Center for Academic and Student Achievement). Immediately upon arrival at USF, students participate in an Orientation to the Biology Major event, where they are introduced to the faculty and staff, learn more about curriculum requirements and course schedules, and meet a panel of current Biology students.

Students are encouraged to meet with their faculty advisors as often as they wish, both to discuss their progress in the biology major as well as to discuss their future career goals and

trajectories. All first year, second year, and new transfer students along with upper level students with science GPAs lower than 2.0 are required to meet with their biology advisors prior to registration. This is an official two-week advising period that falls approximately two-thirds of the way into each semester, and students typically sign up for twenty or thirty minute time slots to speak with their advisors.

The previous program review emphasized that USF Biology faculty spend substantial time advising, and recommended that we move to a peer advising or group advising model. During the spring 2013 semester first-year Biology majors were asked to attend a group "pre-advising" session led by a biology faculty member in order to help them be better prepared for their one-on-one appointments the following week. Many, but not all, students attended the group advising session. The group advising session seemed to be useful, in the sense that faculty reported that those students who attended the group advising session were better prepared to discuss their upcoming course schedules during their official advising appointments. However, group advising prior to individual advising has not become standard practice.

A Peer Advising Program was instituted in the Spring 2014. The peer advisors were upper division students who were recommended by faculty members, underwent training, and held office hours during which students could drop in with general questions about courses, scheduling, and other topics. This system was not intended to replace academic advising by the faculty, but rather to supplement it and help students come to their advising appointments better prepared. While the students who provided the advising enjoyed their connections to the faculty, this program did not attract many undergraduate biology majors and was discontinued.

Although there is no formal evaluation process for advising, the Biology Department does conduct an optional survey of graduating biology majors each spring semester. The Students tend to agree with the statement: "My academic advisor was consistently available, informed, and helpful." For example, in answer to this question, the following numbers of students agreed or strongly agreed, in 2017, 2018, and 2019, respectively: 30 out of 38; 26 out of 29, and 14 out of 15. This suggests students think that the biology faculty are doing a good job with advising, although a larger sample size would be required to draw a stronger conclusion. The survey was not conducted in 2020 or 2021 due to the pandemic.

E. Overall Academic Quality

The biology faculty are very satisfied with the quality of the curriculum, given the breadth of offerings in biology and the strong foundation courses in mathematics, chemistry and physics. Add to this our relatively small class sizes, and this presents superb opportunities for student learning and assessment through a range of approaches. Even in the face of increasing student enrollment in the biology major, we continue to maintain relatively small classes that foster close student-professor interactions.

Several positive changes have recently been made to the curriculum. For example, a laboratory component was added to the required genetics course in 2014, and it continues to be very effective in students' comprehension of complex concepts in genetics. Also, to place the focus on biology in a broader sense, we have replaced our upper division Human Anatomy and Human Physiology laboratory courses with Comparative Anatomy and Comparative Animal Physiology. With the addition of new faculty, we now have more field biology courses to offer, but there is demand far beyond available seats in these courses. In addition, some of these courses have been approved as CEL (community-engaged learning) courses, which are very popular among our majors, and are full to capacity with long waitlists each semester.

A student's academic experiences may be supported and reinforced by pursuing a research project. Although biology students are not required to do research, many seek it out. The Biology Department strives to provide opportunities for undergraduates to perform laboratory research. Several professors in the Biology Department actively recruit undergraduates into their labs each year, and undergraduates engaged in research are encouraged to present their research at the annual Creative Activity and Research Day (CARD) event. In addition, the UCSF/USF Partnership for Undergraduate Mentoring and Teaching (PUMT) program, organized and led by Biology Professor Dr. Deneb Karentz, helps place USF students into research labs at the nearby University of California, San Francisco, affording USF Biology majors additional research opportunities off campus. Professor Karentz also manages the Biology Department Canvas website, which is accessible to all biology majors. This is the principal mode for advertising research opportunities available through PUMT as well as those at USF and elsewhere in the Bay Area. However, given the rapid increase in the number of biology majors, there simply are not enough faculty to offer research opportunities to the number of undergraduate students seeking them out.

III. ASSESSMENT AND STUDENT LEARNING

The department is responsible for assessment of the Biology Major (BS), Biology Minor, Natural Sciences Minor, and the MS in Biology program. Program Learning Outcomes (PLOs) for these programs are available in Appendix B. Recent annual assessment reports for these programs are available in Appendix G. The department received a Gold Star of Distinction from the College in 2018 for its 2016-2017 assessment of the Biology BS program.

Assessment of PLOs is completed primarily by collecting work from students and rating the work using rubrics that state clear expectations of the work and the criteria for rating the work. Student work is categorized as exceeding expectations, meeting expectations, needing improvement in some areas to meet expectations, or failing to meet expectations. Rubrics are specific to the learning outcomes being assessed and are available in the annual assessment reports for the program. Ratings of student work are used in reflections during faculty meetings to evaluate whether specific learning outcomes are being met and to promote discussion of ways in which the curriculum can be adjusted to improve attainment of learning outcomes by students. Ratings of student work during annual assessment generally indicate

that PLOs are being achieved, but have also prompted closer examination and revision of specific segments of the curriculum (see below). Reflections on assessment by the faculty also involve periodic evaluation and revision of PLOs to ensure that they encompass the goals the department has set for student learning.

As noted above, assessment efforts and departmentmental reflections have prompted discussions leading to revision of program curricula aimed at enhancing student attainment of PLOs. Some of these revisions are summarized below.

Evaluation of Foundational Courses. During the 2017-2018 academic year, the department assessed student learning in foundational courses required in the Biology major and minor (General Biology I, General Biology II, Cell Physiology, Genetics), which prompted evaluation and revision of these courses. During the 2019-2020 academic year, our department formed a committee to review and recalibrate the content of the lower division foundational courses (General Biology I & II and Cell Physiology). The goals of the committee were to: 1) review major topics and the level of detail/depth to avoid redundancy between courses and formulate changes to improve student learning, 2) introduce more evolution/ecology into the general biology curriculum, 3) select a textbook more in-line with the material covered. We were able to meet all of these objectives. We implemented the new syllabi with revised course learning outcomes and new general biology textbook starting in the fall of 2020. The rationale for our changes and new syllabi can be viewed in Appendix H.

Revision of General Biology I Assignments. In its assessment of the Natural Sciences Minor in 2018-2019, the department rated student lab reports from General Biology I. In response to these ratings, the department modified assignments in General Biology I in which students prepare lab reports. In particular, checkpoints at which students receive input and feedback from lab instructors were added to improve students' ability to understand and apply the scientific method. A summary of these modifications is available in Appendix I.

***Revision of the Biology Minor*.** Various departmental reflections led to revision of the Biology minor. General Chemistry and Organic Chemistry were removed as requirements for the Biology minor. Ecology, an upper division course, was added to the minor in place of an upper division elective chosen by the student. The rationale for the change was to provide more in-depth learning of ecology and evolution, building on the framework for these topics introduced in the General Biology sequence.

Revision of Program Learning Outcomes (PLOs) for the Biology Major and Minor. Assessment of the Biology BS, Biology Minor, and Natural Sciences Minor in 2020-2021 included an overall reflection on these programs, which led to revision of the PLOs. At one point, the PLOs were the same for the Biology major and minor. The PLOs for the Biology Minor were re-written to reflect a fundamental ability to explain and apply biological concepts and the scientific method, whereas the PLOs for the Biology Major were re-written to reflect a more

sophisticated mastery of the ability to apply and evaluate biological principles and the scientific method. Former and current PLOs are found in Appendix B.

***Proposed Writing Guidelines*.** During departmental reflection in the 2020-2021 program assessment, faculty members suggested that a document with guidelines for writing about scientific investigation and for more general scientific writing (e.g., a review of primary literature) would be useful for faculty members to help achieve learning outcomes related to communication. The department plans to prepare such a document in the near future.

The department has created curriculum maps that align PLOs with: 1) USF's Institutional Learning Outcomes, 2) courses offered within a program, and 3) the specific Course Learning Outcomes of courses offered within a program. These maps help the department ensure that programs in the Biology Department contribute to USF's overall goals for students, and that individual courses within programs contribute to their PLOs. In addition, rating of student work during annual assessment of PLOs facilitates spot checks on whether individual courses are meeting PLOs. Curriculum maps for the programs assessed in the Biology Department are available in Appendix C.

Like all programs, Biology faces constraints in creating ideal learning experiences for students (e.g., limitations on available space, pressure to increase class sizes). Despite these challenges, Biology has overall been successful in educating students and enabling them to achieve PLOs. The Biology BS program does have attrition of students during their initial time in the major when they take challenging foundational courses. The rigor in these foundational courses is vital for preparing students to meet learning outcomes in their future academic work. Biology has made efforts to improve student success in the foundational Biology courses in the BS program. Biology recently evaluated its foundational courses and revised coverage of topics and approaches within courses to improve student learning (see above). Moreover, the department contributed to a course in USF's JumpStart program, the aim of which is to better prepare students for success in their first year courses. The Biology BS program would benefit from any resources that would help facilitate participation of Biology faculty members in summer programs that help prepare Biology majors for challenges they might encounter in their first year courses. The department also invests strongly in advising Biology BS students during their first two year in the major. Students meet regularly with their advisors to review requirements in the major, check on progress within the major, and to discuss strategies for successful attainment of learning outcomes. Students in their first two years of the major are required to meet with their academic advisors at least once per semester.

In 2017, the Biology Department contributed to assessment of Area B2: Natural or Laboratory Science in USF's Core Curriculum. The department collected samples of student work from all of its Core B2 courses and submitted the work to the Core Area Working Group (CAWG). Biology faculty members assisted CAWG in rating student work from the university's Core B2 courses and provided feedback on drafts of the Core Area Assessment Report prepared by CAWG. A copy of the final report is available in Appendix J.

IV. FACULTY

A. Demographics

Of the 19 full-time faculty members in the Department (see Appendix K for biographies), seven are Term faculty and 12 are Tenure Track faculty (4 pre-tenure and 8 tenured). The department relies on part-time adjunct faculty to staff a significant portion (at least ~40%) of our undergraduate courses, which includes laboratory sections.

Overall, 53% (ten) of full-time faculty are male and 47% (nine) are female. A 2018 study by the National Center for Education Statistics reports the same ratio of 53% male, 47% female at universities in the United States. The same report found that 12% of college and university faculty were Asian/Pacific Islander, 6% were black, 6% were Hispanic, <1% were American Indian/Alaska Native, and about 75% were White. Of the 16 USF faculty who responded to a questionnaire, 2 identified as Asian/Pacific Islander, 1 identified as Multiracial, and 13 as White. This shows that although the faculty demographics of the department do not mirror the diversity of the student body that it serves, they are reflective of the demographic trends in higher education in general.

	Full Time Term		Full Time Tenured/ Tenure-Track	
	Female	Male	Female	Male
Assistant Professor	2	2	2	2
Associate Professor		2		2
Full Professor		1	4	2

B. Teaching

Full-time Faculty Teaching. The Collective Bargaining Agreement negotiated in 2016 (in force until July 2024) between the USF Faculty Association (the USF faculty union) and the University of San Francisco continues a workload of 30 units per academic year. For tenured and probationary tenure-track faculty, 18 units minimum must be spent on teaching, six units on research and six units on service (e.g., USF committee work, student academic advising, service to the profession, etc.). Since term faculty do not maintain research programs, the contract stipulates that they teach 24 units per academic year with six units of service. During the 2016 negotiations, the University Administration refused to provide salary increases for current full time faculty unless certain concessions were made. As a result, a side letter was approved by union members and the Administration, providing Deans with the option to assign new term faculty to 32 units of teaching per academic year with no service obligations. This new policy affects only the most recent term hire in Biology (Spring 2022); the other term faculty were

hired before the current contract was ratified and are held to teaching 24 units per academic year with six units service.

Faculty teaching loads are audited on a two-year basis with a 36-unit cycle for tenure-track faculty and 48-unit cycle for term faculty. Biology courses with a laboratory or field component have four units of credit for students; but in recognition of the extra work and contact hours required, faculty receive six units of compensation. So, a typical two-year teaching pattern for tenure-track Biology faculty is three semesters of one lecture course with lab/field (six units) and one lecture-only course (four units) to total ten units each semester, and one "light" semester of one lecture course with lab/field (six units) to reach a biennial total of 36 units teaching.

Course offerings. In recent semesters, approximately 2/3 of the courses offered by the department have been upper division courses. While our core required courses (General Biology I and II, Cell Physiology, Genetics, Seminar, and Evolution) are offered every semester, the selection of specific upper division electives rotates from semester to semester and year to year. In recent semesters, approximately 16 upper division elective courses have been scheduled each term. These courses include a combination of lecture, lab, and field courses that fulfill requirements for the major and both concentrations. Given that the number of Biology students has increased each year and we prefer to keep upper division elective course enrollments to approximately 16 (lecture) and 12 (lab) in order to facilitate discussion in class, a student is sometimes not able to register in a "first choice" upper division elective. In order to ensure that students are able to take the courses they need in order to graduate, the department typically reserves one or two seats in each course and maintains a waitlist with priority for graduating seniors. When there is high demand for seats in upper division elective courses, the needs of students may be met by: 1) increasing enrollment in a class, 2) adding a second course section to the schedule in order to accommodate more students, or 3) hiring an adjunct instructor to teach an additional upper division elective. Also, with relatively little duplication of faculty expertise, changes due to retirement, sabbaticals, maternity leaves or health issues make it challenging to continue to offer certain courses.

Class sizes. General Biology I and II lecture courses are among the largest undergraduate courses on campus. Recently, we have begun to divide our General Biology students into four or more sections, with a cap of 50-60 students per section, and each laboratory section is capped between 20 and 24 students. This recent increase in sections is both to accommodate a growing number of Biology majors and to reduce the lecture class size in an effort to aid retention of first year students in the major. Cell Physiology, which is typically taken by majors in the fall of the second year, has recently been limited to approximately 60 students per section (two sections in the fall and one in the spring), while Genetics lecture has been offered in two sections of 45 students in spring and one section of 30 in the fall. Along with the Genetics lecture, students are required to attend a laboratory section, with each section capped at 20-24 students. Evolution is offered in two or three sections each semester with a

cap of fewer than 18 students per section. Keeping the enrollment under 18 students per section is critical to the seminar and discussion style of this capstone course.

Teaching assignments. Teaching assignments are made by agreement between the Department Chair and faculty. This process requires considerable work by the Chair to ensure that required workloads are fulfilled and the schedule is acceptable. There are also many considerations such as conflicts with other classes both within the program and with other programs offering courses required by Biology majors (i.e., Chemistry, Physics and Math). Many faculty members teach either the same or very similar sets of courses from year to year, but requests for changes are always considered and the climate is one that is open to negotiation.

Faculty teaching smaller upper division lab/field classes are responsible for most or all of the preparation and clean-up associated with their labs, adding considerably to the work required to teach these courses. Since the last program review, one staff position, Instructional Laboratory Coordinator, was created to provide support for General Biology labs. This position has been a tremendous asset to the program; however, turnover in lab staff and program assistant positions is quite high, and all three staff positions dedicated to Biology have seen turnover. The individuals filling the lab support positions are often required to work outside of normal working hours, and most of their time is devoted to the larger introductory lab classes. While undergraduate and graduate student workers are hired to assist the technical staff, more full-time support staff is necessary to relieve the work burden on these positions, and to provide more consistency and reliability to the services needed to keep labs running smoothly.

Outside Support. There is support for teaching by the university: The Center for Instruction and Technology provides workshops on teaching techniques, assistance with integration of new technology into the classroom, and hosts “Open Classroom” sessions that invite faculty to visit other instructor’s classrooms in order to learn from their techniques. Classroom technology is generally well supported, with LCD projectors in nearly all classrooms. The atmosphere in the department is inviting for junior faculty to seek advice from other faculty on any professional matters.

The faculty are extremely enthusiastic about teaching and enjoy the classes that they teach. Some would like to teach a wider variety of classes, or have specific additional classes that they would like to add to the curriculum; however, the current teaching needs of the department usually makes this impractical. For example, rarely are full time faculty assigned to teach the science Core courses that are required of all students at USF. The Science of Life (BIOL 100/100L), Human Biology (BIOL l103/103L) and Biology of Aging (BIOL 108/109) are all lower division lab courses that are not part of the Biology major but satisfy the Core B2 (science with laboratory) for non-Biology majors. All existing faculty have full teaching loads, and thus there are few options for covering course changes. Some faculty take additional units (“paid overloads”) to cover needed classes, or in some cases decline course releases that they are due for administrative work, in an effort to help the Department maintain its current curriculum. In academic year 2020-2021, Biology faculty reported 16 units of overload teaching in fall and

21 units of overload in spring; in previous semesters, biology faculty have routinely taught >20 units of overload each semester.

Space, equipment, and budgets for labs affect how classes are taught. Field class instructors have commented that they would teach their field classes differently if they had a room that was better suited and equipped for field studies. In 2018 the University accepted funding from a donor to renovate a teaching lab, purchase equipment and hire an instructor of the donor's choosing to teach an Interdisciplinary Life Sciences course. The course is open to upper division students in Physics, Computer Science, Mathematics, Chemistry or Biology and includes hands-on experience in molecular biology techniques, as well as providing students with insight into careers in industry.

Despite the challenges outlined above, faculty find many ways to successfully interact with and mentor students in and out of the classroom. Many tenured and tenure-track faculty members mentor undergraduate and graduate students in research, serve as advisors for a number of student science clubs, and make exceptional efforts to be available to students for advising beyond scheduled office hours. These close relationships with the students are a point of pride for the Department.

Part-time (Adjunct) Faculty Teaching*.* The department heavily relies on part-time instructors to teach lower division lab sections,100-level Core science lecture/lab combination classes, and frequently some upper division Biology courses. The dependence on part time faculty has increased considerably over the years and is especially significant when full time faculty are on sabbatical or other leave. For example, in Fall 2021 nine out of 34 sections of lecture (26%) were taught by adjunct faculty, including four upper division courses (five sections); and of 45 lab sections offered, 29 were taught by part-time faculty (64%) and six by USF MS students (TAs). Some part-time faculty teach multiple lab sections, but part-time faculty are not allowed to teach more than 8 units per semester. We typically have 20-30 adjuncts working in the department each semester to teach 40-50 sections that cannot be filled with full-time faculty.

To address the need for adjunct faculty, in 2006 we formed the USF/UCSF Partnership for Undergraduate Mentoring and Teaching (PUMT). This is a collaboration with the UCSF Office of Career and Professional Development (OCPD). One of our faculty, Deneb Karentz, is the USF Coordinator of this program. PUMT has three objectives:

1. To provide UCSF graduate students, post-doctoral researchers and other staff who want to pursue faculty careers with opportunities to teach and mentor undergraduate students,
2. To provide USF undergraduate science majors with highly qualified instructors for lecture and laboratory classes, and
3. To provide opportunities for USF undergraduate students to gain research experience working in UCSF research labs.

Since 2006, USF has hired hundreds of UCSF graduate students, post-doctoral researchers and other staff as part-time faculty to teach semester-long classes (lectures and lab sections), along with other qualified applicants who are not associated with UCSF. These part-time faculty are essential to our program because we do not have enough full-time faculty to staff all of the courses we need to offer for our Biology majors or the service classes we are expected to provide for other programs (majors in Nursing, Kinesiology, Biochemistry, Environmental Science; and minors in Gerontology, Health Sciences, Neuroscience). At one time we relied solely on undergraduates to serve as laboratory teaching assistants and this was generally not very effective. Having a direct connection to UCSF has relieved some of the pressure in staffing our courses and lab sections, and these hires have greatly enhanced student learning at USF. In turn, the part-time faculty have gained valuable hands-on experience in teaching undergraduates and by being mentored in teaching by USF full-time faculty. However, with limited increases in full time faculty lines and increased numbers of majors in Biology, the pipeline from UCSF seems to have reached and surpassed capacity.

Most of our part-time lecturers start as lab instructors at USF, so we have some knowledge of their teaching expertise. While some UCSF graduate students and postdocs are qualified and eager to gain teaching experience in full courses, most do not have the time to take on a full course and also fulfill their full-time research obligations. Therefore, expanding PUMT to compensate for our deficiency of full-time faculty is not a viable option. While we do not view PUMT as a recruiting tool for full-time faculty, three of our current term faculty first came to USF as adjunct instructors.

A component of the PUMT program is research mentoring of USF undergraduates by UCSF graduate students and postdocs. This part of the program was added in 2011 to allow for a more flexible time commitment from UCSF personnel than teaching formal courses, and to increase research opportunities for our students. This aspect of the PUMT program has not gained much momentum. A number of students have been placed in UCSF labs and several of those research opportunities have turned into full-time jobs after graduation or have transitioned to a graduate student position in the lab. And while we have many students inquiring about research, only a small number apply for the available positions advertised, and not all of the applicants have strong enough academic backgrounds to be successful in the selection process.

C. Faculty Research

The majority (11/19) of full-time faculty maintain active research labs. Faculty conduct research spanning a wide range of disciplines. Faculty have been successful at publishing their work in journals that are highly regarded in their respective fields and present the results of their research at professional conferences nationally and internationally. However, finding time for research is challenging. Research faculty teach two lecture courses and one lab course per semester, and advise numerous students throughout the academic year. Due to the increasing number of Biology majors without additional faculty hires, faculty are spending more and more time advising and grading at the expense of research productivity.

Biology faculty obtain both internal and external grants to fund their research. Funding opportunities provided by USF include the Faculty Development Fund and the Lily Drake Cancer Research Fund. Biology Faculty make use of these resources to fund research supplies and equipment, provide student wages, and travel to meetings. There are currently eight active externally funded grants awarded to Biology faculty and one NSF RUI (Facilitating Research at Primarily Undergraduate Institutions) proposal under review; a list of funded grants from external sources since 2014 can be found in Appendix L.

D. Service

Faculty are contracted to spend the equivalent of three units each semester in service activities. Biology faculty members are dedicated to providing quality service to the community, the University, our colleagues, and our students.

Committees. At USF, Biology faculty serve on a wide array of committees both within the department and across the university. Biology-specific committees include The Assessment Committee, Diversity Committee, Honors Committee, Exceptions Committee, Awards Committee, Graduate Program Committee, and Senior Dinner Committee. Broader College and University committees include, the Arts and Sciences Writing Retreat Selection Committee, the Arts and Sciences Peer Review (Promotion and Tenure) Committee, the Valedictorian and Dean's Medal Selection Committees, the Arts and Sciences Curriculum Committee, the Faculty Development Committee, the University of San Francisco Admissions Advisory Board, Faculty Advisory Board on Internationalization, Distinguished Research Committee, Distinguished Teaching Award Committee, Diversity in STEM Council, Conversations on Racial Pedagogy, Honors College Steering Committee, Honors College Admission Task Force, Covid Rapid Response Team, and the New Science Building Committee, just to name a few. In addition, our faculty members are active in the USF Faculty Association, with as many as two faculty members at any given time holding elected positions and providing significant leadership for the union.

***Other Service Contributions*.** Biology faculty members provide a wide variety of other services to students and the University. These include:

- Writing letters of recommendation for scholarships, internships, employment, and applications to medical schools and graduate programs.
- Serving as faculty advisors to student organizations and regularly attending and participating in student-centered and student-organized events. Among these organizations are:
    - *Beta Beta Beta National Biological Honor Society, Omicron Alpha Chapter*: Tri-Beta functions as an honor and professional society for students in the biological sciences.
    - *LGBTQ Caucus*: The Lesbian, Gay, Bisexual, Transgender and Queer Caucus is an organization of USF faculty, staff, graduate students and alumni with the mission of promoting LGBTQ scholarship, community, and social justice.

  - *Pre-American Medical Student Association (Pre-AMSA):* A student organization dedicated to helping all aspiring doctors gain the exposure necessary to build a competitive application, as well as explore common interests in the medical profession.
  - *USF Corpus Clinical Pre-meds*: This is a volunteer program that gives USF pre-med students a chance to volunteer at the St. Vincent De Paul Homeless Center Clinic.
- Recruiting new students for USF: Faculty are often asked by the Admissions Office, the Dean's Office, ROTC or the Athletics Department to meet with prospective students and their families. We always have at least one representative at any of the Admissions or College events to which we are invited (e.g., USF Preview Day, Major/Minor Fair).
- The Biology Department maintains two awards for Biology majors. The Chihara Awards are given out each semester to upper division Biology majors who demonstrated a high level of academic achievement in the previous semester. Three awards ($500 each) are given each semester at a departmental luncheon for faculty and recipients. The Edward Kessel Award ($1000) is given to an outstanding graduating senior based on academic achievement, service to the department and career potential. The award is presented at a dinner for graduating seniors. Awards are funded from donations to the Biology Gift Fund.
- Faculty members volunteer to organize and present seminars for the LCSI seminar series and Biology Department Seminar series.
- Attendance at events sponsored by department-related groups (e.g., Pre-professional Health Committee events, "Meet the Faculty Night", etc.).

Biology faculty serve the community in several ways: by preparing and serving meals to homeless people at the Gubbio Project, assisting at the St. Vincent de Paul Ozanam Wellness Center, volunteering at San Francisco Animal Care and Control and the Presidio Trust, providing docent training for the Fitzgerald Marine Reserve and Seymour Discovery Center, volunteering time at local schools by giving science presentations or helping with administrative work, membership with a local committee supporting international scholarship, and serving on the board of a local multilingual, multicultural private school.

Finally, in response to the Covid-19 pandemic, all faculty members took on extra service activities including working as a department on creative ideas for remote teaching, completing additional training in remote instruction and new teaching technologies, as well as developing ways to engage our students remotely as part of departmental-wide events. Many faculty members also devoted a substantial amount of time with the faculty union bargaining with the administration over fair budget cuts in response to projected shortfalls. Specifically, one of our faculty members spent the majority of their time during the summer of 2020 involved with assessing university finances, analyzing financial data, working with and communicating with faculty across all colleges, and regularly meeting with the administration.

E. Relationship with other Departments and Programs

One member of the Biology Faculty has a joint appointment in the Environmental Science Department, and as a result teaches classes in both disciplines. Other faculty members engage in research collaborations with faculty from the Environmental Science and Chemistry Departments, including research utilization in collaborative projects at Star Route Farms.

Discussions of curriculum development also occur between Biology and departments that provide support courses for Biology majors, including the Chemistry, Mathematics & Statistics, and Physics Departments. Biology majors must take a year of general chemistry and a year of organic chemistry as a requirement for the major, and Chemistry majors with an emphasis in Biochemistry must take the core Biology courses as well as the Genetics course offered by the Biology Department. All Biology majors must enroll in a statistics course, preferably Biostatistics, and a year of General Physics. These support courses require some coordination between the departments, in particular in regard to scheduling of classes so as to avoid conflicts. In the past, the Biology Department has discussed the content and delivery of the Biostatistics course with faculty in the Math Department, who have been amenable to incorporating topics that Biology faculty feel are relevant to our majors. The Biology Department has worked with both the Chemistry and Environmental Science Departments to allow Biology majors to enroll in their courses for upper division credit, such as biochemistry or field courses.

Challenges in scheduling often exist for Biology majors, particularly with General Chemistry and Organic Chemistry courses. Inevitably each semester, the department must make requests for additional seats in Chemistry courses to accommodate our majors, since many biology courses have corequisites with chemistry classes. Similar challenges exist with upper division Biochemistry courses.

The Biology Department does not currently participate in any degree-granting interdisciplinary programs though several Biology faculty have taught 2-unit forum or global jump start courses in the USF Honors College.

F. Recruitment and Development

The Biology Department is very much understaffed. With over 550 majors and the need to provide service courses, it is impossible to meet our program needs with only 19 full-time faculty. Areas in which we could use additional expertise vary based on teaching and research. The department needs to recruit faculty who can teach in several critical areas including, but are not limited to human anatomy and physiology, plant/algal physiology, and genetics. In addition, the department seeks to recruit tenure-track faculty who conduct research in the fields of algal/plant physiology, model system genetic screens, and cell biology:

- *Rationale for Anatomy/Physiology:* We offer eight service courses in Human Anatomy and Human Physiology, including 30 lab sections, each academic year for Nursing and Kinesiology majors (which is equivalent to 102 teaching units or 8

full-time term faculty positions). In addition, we teach upper division courses in Comparative Anatomy, Comparative Physiology, Neurobiology, and Endocrinology that are in high demand and are often not staffed with full-time faculty due to sabbatical leave rotations.

- *Rationale for Algal/Plant Physiology*: While we have recruited two plant biologists within the last decade, both are focused on ecology and evolutionary biology but not on plant form and function. Adding courses and research programs in the area of plant/algal physiology would fill a considerable gap in the disciplines represented in the department.
- *Rationale for Genetics:* All Biology majors complete the Genetics course, usually in their fourth semester. With the rapid increase in biology majors, we have expanded the number of Genetics sections, which are still taught with enrollments of over 50 students, which is not ideal given the challenging conceptual nature of this course. We have multiple faculty who conduct research using genetic tools, such as reverse genetics or phylogenetics, no current tenure-track faculty utilize model organisms and genetic screens, which is the hallmark of a Genetics course.
- *Rationale for Cell Biology:* All Biology majors complete the Cell Physiology course, usually in their third semester. Several biology faculty rotate in teaching this course, but there are limited active research programs focused on understanding the biology of the cell directly. Recruiting a faculty member with an active research program in cell biology would be very attractive to the many students who declare the Molecular Biology concentration and seek undergraduate research experience.

Several Biology faculty have expressed interest in recruiting a full-time faculty member with expertise in Science Education, focused on curriculum and pedagogy in higher education. In addition to conducting valuable research in life science education and teaching methods, this colleague could play a role in evaluating the current curriculum and pedagogical strategies utilized within the department.

The employment history of current Biology faculty covers a range from newly hired in 2021 to 30+ years. Despite unparalleled growth in the number of Biology majors, the department has only been able to add three new full-time faculty positions since the last program review. An additional temporary term faculty position was provided to the department through Spring 2023. In Fall 2021, nearly a half of our courses were staffed by part-time faculty. Retirement plans of faculty are not known, but there are potentially several (3-5) faculty who may retire within the next ten years or less.

The department does not have any of its own formal programs for full-time faculty development and relies on the College and University to provide these opportunities. New full-time faculty are mentored through the College where the Dean's Office identifies a current faculty member to serve as a first point of contact as new faculty settle into USF. All faculty in the Biology Department are very willing to provide support and share advice on teaching, research and service. In addition, the USF Faculty Association has information sessions for

faculty preparing tenure and promotion applications. These meetings are organized by members of the Peer Review Committees and the Faculty Union Executive Board, and are intended to make the application review process as transparent as possible. In the past 15 years, Biology faculty have had a 100% success rate when applying for tenure and promotion.

V. DEPARTMENTAL GOVERNANCE

As part of a unionized faculty, the department operates within the framework of the USF Faculty Association (USFFA) contract and the policies established by the Provost and Dean's Offices. In addition, the Biology Department adopted its own set of bylaws by unanimous vote on October 29, 2020 (included as Appendix M. The Department Chair election procedure is formally stated in the USFFA Collective Bargaining Agreement (CBA) Article 25; however, the department typically determines the next Department Chair by discussion and consensus, generally resulting in only one 'candidate' for the position, who is then elected. The Chair is generally elected for a 3-year term and provides leadership for the department. The Chair is compensated with release time of five workload units per semester. The department has at times, through departmental discussion, elected two co-chairs of the department, who split the release time and work responsibilities. The Chair of the Department is a member of the USF faculty union and as such, is an equal colleague to the faculty, not part of the administration.

The Chair is accountable to the Dean in areas such as communication with faculty, student advising, course scheduling and staffing, budgeting, program development, report writing, oversight of Department programs (minors, concentrations, etc), planning department functions, recommending part-time faculty, and approval for student forms (e.g., course substitutions and waivers, petitions to enroll at another University, change of program, directed study registration, etc.). In other departments the instructor of record is allowed to control class size, but we have found it more practical and efficient for the Chair to monitor student enrollments and manage waitlists for courses. The Chair determines the schedule of Department meetings at the beginning of each semester, based on faculty teaching schedules. Agenda items are requested from the faculty and meetings are typically held for 90 minutes once per month during the semester. Minutes are recorded and distributed by a faculty volunteer; minutes from the preceding meeting are approved at the start of each faculty meeting and are kept on file in a shared department drive. The Chair also represents the department at monthly College Council and College of Science Executive Council (COSEC) meetings, and is the primary point of contact for all other administrative interactions.

Unlike the situation at many institutions, where a program assistant filters all contact with the Department Chair, the USF Biology Chair is directly accessible by phone, e-mail or a knock on the door. As a result, much time is spent as an *ad hoc* advisor fielding questions from students (majors and non-majors), non-departmental faculty, administrators and the general public. The Chair has frequent contact with the Department program assistant, lab manager, and lab coordinator, and provides final approval on matters of budget. However, because of the union

structure, the Dean (or staff in the Dean's office), and not the Department Chair, is the actual supervisor of the office and laboratory staff.

The two graduate programs (MS Biology and the PSM Biotechnology) each have a Director, a faculty member who manages the day-to-day operations and receives release time from teaching or paid overloads for their service. Currently, Dr. Naupaka Zimmerman serves as Director of the MS Biology Program, with an associated 2 credits of course release per academic year. The PSM program has its own governance and program review process, though its faculty have joint appointments in the Biology department and its director and associate director (currently Dr. Cary Lai and Dr. Brian Young, respectively) may be appointed from the Biology department faculty and receive associated course release (3 units and 1 unit, respectively). Due to the large number of adjunct faculty that need to be hired each semester, primary responsibility for part-time faculty is delegated to another faculty member, Dr. Deneb Karentz, who receives course release for this service.

All full-time faculty (term and tenure-track) are included in all faculty meetings and departmental discussions and are given equal weight in all voting matters. There are frequent opportunities for faculty to engage in leadership outside of the chair or director positions by participating in standing or *ad hoc* committees. Membership of these committees is generally determined by open discussion in faculty meetings and is finalized by the department chair, in accordance with the guidelines in the department bylaws. The current permanent standing committees are the Awards Committee, Exceptions Committee, Honors Committee, Assessment Committee, and MS Program Committee. Various *ad hoc* committees are formed each year, with goals such as curriculum review or course catalog revisions.

VI. STUDENTS

Student Demographics. In the past seven years, the number of declared majors in the Biology Program has increased from 410 in fall 2014 to 513 in fall 2021 (Figure 1). The number of students pursuing the biology minor held at 9 to 12 from 2014 to 2017 and fluctuated from a high of 17 (2018) to 13 in fall 2021 (Figure 1).

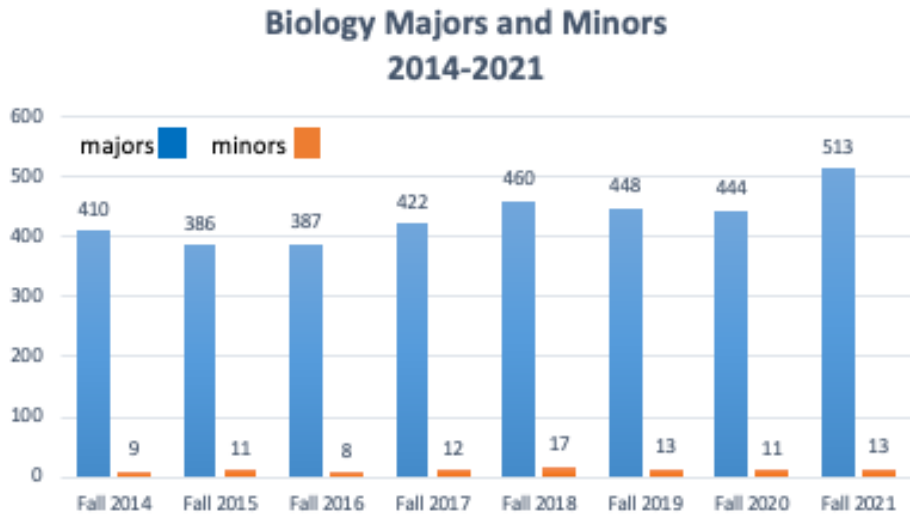

Figure 1. Number of students majoring and minoring in biology 2014-2021

The number of undergraduate degrees awarded in biology increased from 71 in 2013-2014 to 81 and 90 in the following two academic years. Since 2015-2016 the number of degrees awarded annually has remained relatively constant, with approximately 70 degrees awarded per year (Figure 2).

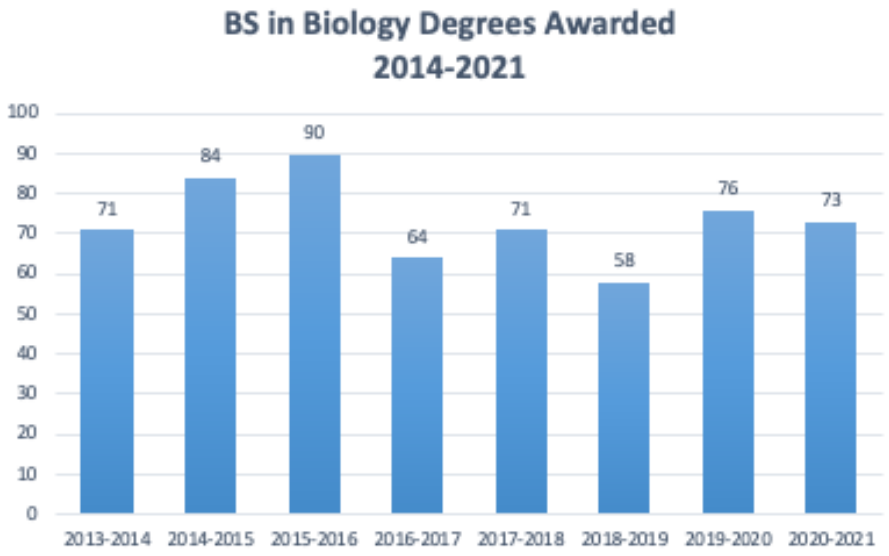

Figure 2. Number of biology degrees awarded (Fall-Summer) 2014-2021

Biology Major students have primarily self-identified as female (71±4%) and Asian (37±1%) (Figure 3). While the ethnic makeup of Biology majors has remained somewhat constant from 2014 to 2021 (Figure 4), the percentage of Biology majors reporting as African American rose from 2.0% in Fall 2014 to 7.4% in Fall 2021.

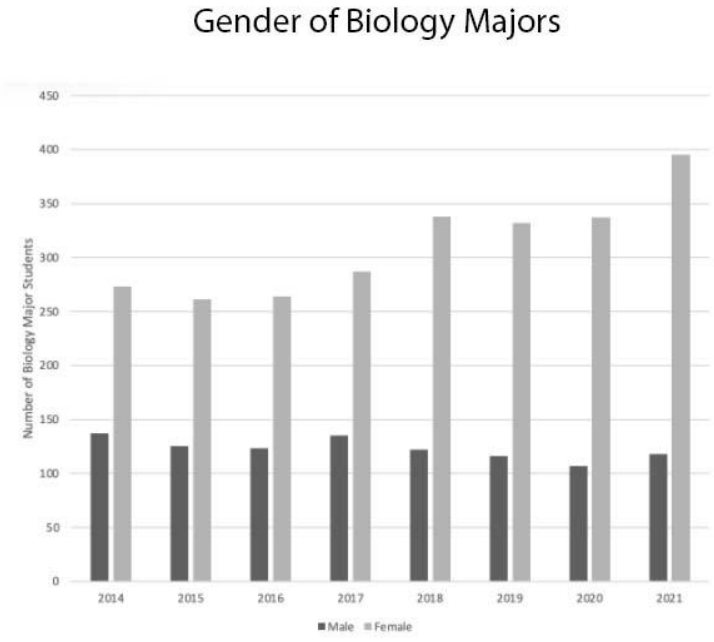

Figure 3: Total number of males and females in the Biology major from 2014 to 2021.

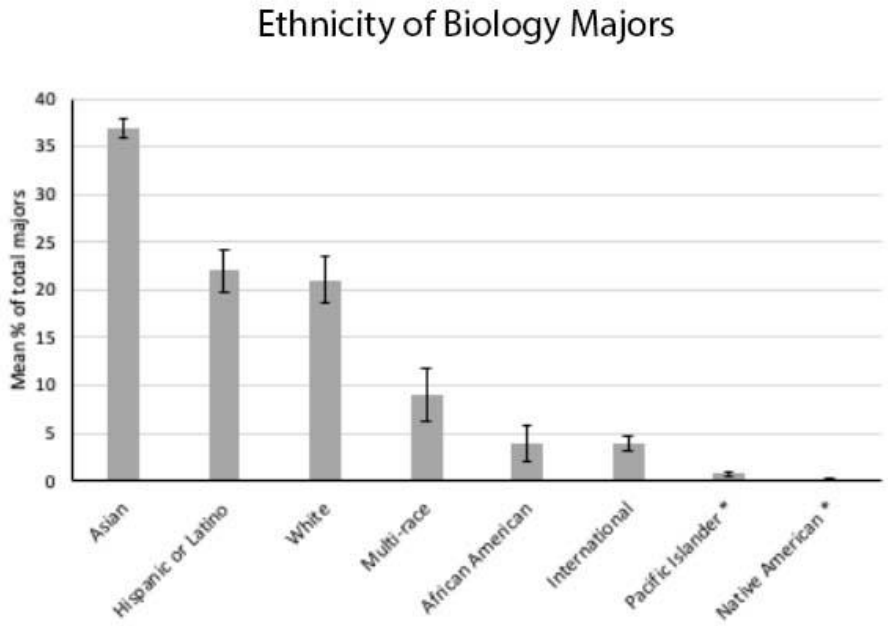

Figure 4. Mean self-reported ethnicity of Biology majors from 2014 to 2021.
(* Pacific Islander: 0.8 + 0.2%; Native American: 0.2 + 0.02%)

Student Recruitment. Faculty members have minimal involvement in recruitment of new students, which is essentially a University function. Faculty members continue to support recruitment by answering questions from prospective and admitted students and their parents via email, phone calls, Zoom, and campus visits. We also accommodate special requests from the Admissions Department. When asked, we participate in USF Admissions events on campus and online (Zoom panels, webinars, etc.) and the University's transfer student pre-advising program. Students are not involved in the policy and operations of the Biology Department.

Student Engagement. Our program serves a wide variety of students with many aiming to use their biology degree for careers in health services. To create an intellectual and social climate that fosters student development and supports achievement of the program's objectives, there are several organizations, awards, and opportunities available to students. The Tri-Beta Biology Honors Society is an active and well-attended club on campus. There are also awards each semester for students who achieve high science GPAs in upper-division classes (the Chihara Award) as well as an annual graduating senior award for high achievement in the Biology

program (the Kessel Award). In addition, students are required to take a one-unit Biology Seminar course where they are exposed to research presented by guest speakers from a variety of biological fields. To foster a positive social environment, the department hosts informal social events for students to meet each other and faculty. Finally, an online message board via a dedicated Canvas site exists to advertise and promote research and internship opportunities for students.

Student Outcomes. Program expectations are communicated to students throughout their time as Biology majors, most frequently through syllabi of each class (all of which include the PLOs). Furthermore, students receive advising each semester where program expectations are discussed; this is a key opportunity for feedback if learning outcomes are not being met. In addition, the university Early Alert system allows faculty to notify students who are not performing up to program expectations. This notification is also provided to the Biology academic advisor, who can also ensure that the student is aware of the program expectations.

Based on data tracked since 2017, 21-25 Biology major students reported applying to medical programs (DO or MD programs) each year. An average of 34±10% of these students are accepted (in line with the national average of 36% acceptance). During this time, three students applied to podiatric medicine (PDM) programs; 100% were accepted. Alumni data are not well-tracked. However, of the 595 Biology major alumni tracked by USF, 122 had listed current career fields (Figure 5). Our Biology alumni are employed in a wide variety of fields, including health profession programs (nursing, veterinary programs, etc.), laboratory research positions at universities, research institutes, pharmaceutical and biotechnology companies, government agencies, Masters and PhD programs, and various non-science professions.

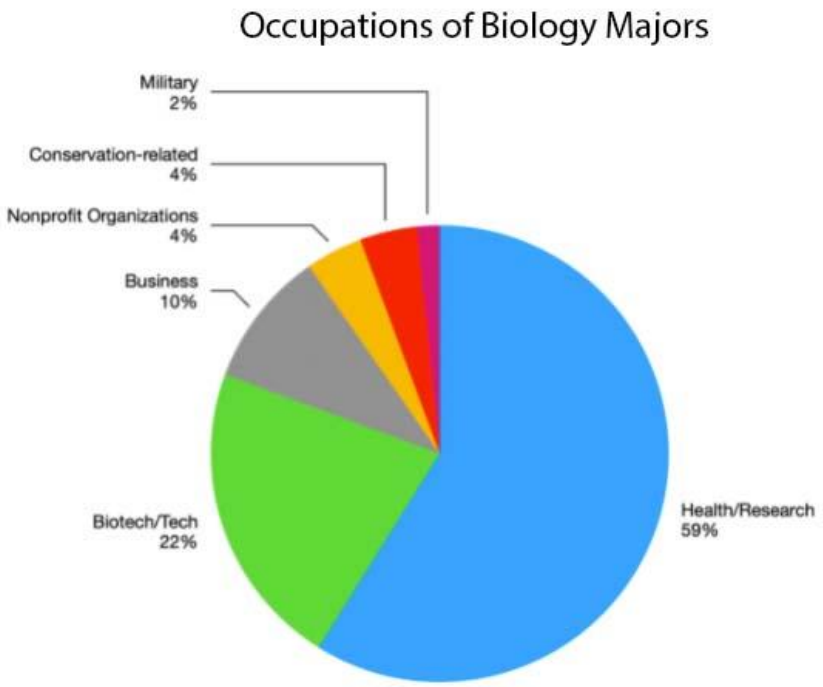

Figure 5. Self-reported professions of 122 Biology Major alumni graduated since 2014.

VII. STAFF

As the largest STEM department on campus, the logistical demands of the Biology department are complex and varied. Classes are provided to a diverse array of student majors and delivery of these courses involves a considerable number of adjunct faculty, many of which are relatively new and/or teach for a short period of time. Addressing this complexity requires strong, consistent support staff. Turnover of support staff is a critical challenge Biology faces in continuing to provide excellent instruction. The challenge of keeping these positions filled can be considerable as the prospect of significantly higher salaries and benefits in industrial biotechnology make keeping talent difficult —in particular for technical positions. Opportunities for increased salaries and benefits for these positions have the potential to enhance the strength of the department.

Sandra Hakanson is the full-time Program Assistant for the Biology department. The Biology Program Assistant manages the Biology department office and interacts directly with current students, prospective students, staff, faculty, and other visitors to the office. The Program Assistant handles a diversity of administrative duties for the department such as coordinating events and meetings, managing faculty hiring searches, student assistant hiring and onboarding, ordering of office supplies, receiving shipments, and processing invoices. They also organize the complex student advising period, including assigning advisees, organizing faculty advising appointment times prompting student advising sign-up and maintaining advisee files. Since 2014, personnel staffing this position has changed three times.

Peter Baketa is the full-time Lab Manager for the Biology department. His responsibilities include preparing, setting up, and taking down each section of our Microbiology, Anatomy, and Physiology undergraduate labs. Additionally, he does laboratory course supply ordering and receiving, oversees lab cleaning and maintenance, and trains/supervises student workers who help with all of these activities. Peter helps maintain the upper division and Biotech Master's labs, but all of the setup and takedown of these labs is done by the professors who teach each lab. General lab maintenance, such as periodic cleaning and removal of biohazard and chemical waste, is done or overseen by the Lab Manager. He also monitors the Biology department budget when purchasing supplies and equipment. Since 2014, personnel staffing this position has changed three times.

Noah Christe is the full-time Lab coordinator. His responsibilities include preparing, setting up, taking down, ordering and receiving for the many sections of General Biology I & II. He also provides training to the large number of adjunct faculty that teach these courses and help with upper division courses when requested. Since its inception in 2015 this position has turned-over three times.

Matt Helm and **Jeff Oda** both serve as staff Instrumentation Specialists. In these roles, they maintain the instrumentation in the science teaching labs at USF. This includes training students and faculty to use equipment, performing equipment maintenance and coordinating repairs, and assuring lab safety. Both of these staff members support all of the science

departments at USF, including Biology, Chemistry, Physics and Astronomy, Kinesiology, Environmental Science, and Engineering. Because their responsibilities are spread out over so many departments, they spend only a percentage of their time (around 25%) assisting the Biology program specifically. Jeff Oda has served in this position since the last program review and Matt Helm has held his position since its inception in 2017 and has been Director of the technical staff since 2020.

Marie Dutton is USF's Director of Pre-Health Professions Advising. This position serves pre-health students across campus departments, but is particularly important to Biology, with its large concentration of pre-health students. Primary responsibilities include advising undergraduate, graduate, and post-baccalaureate students seeking entrance to health professions programs, maintaining each candidate's pre-health professions advising file, scheduling practice interviews, submitting letter packets to health professions programs, organizing the annual 'Health Professions Alumni-Student Dinner' each Spring, maintaining and assembling acceptance data for other University offices, and publicizing pre-health professions advising services and events through the email list and various communication channels. In addition, Ms. Dutton advises pre-health student organizations, writes cover letters for the composite process for dental and medical school applicants; and collaborates with USF alumni for events. In the past, pre-health advising responsibilities have shifted between administration and faculty. Between 2000-2018 this role was performed by Mary Jane Niles, a Biology faculty member.

Craig Conforti is the Lab Safety Manager for the College of Arts and Sciences. This position is responsible for the safe operation of labs and studio spaces in Biology, Physics, Chemistry, Environmental Science and Art + Architecture and serves as the College's 24/7 emergency contact for safety-related issues. Primary duties of the Lab Safety Manager are providing safety training for faculty, staff, and students who handle hazardous materials, overseeing the disposal of hazardous waste, ensuring safety equipment and materials are available, administering the Chemical Hygiene Plan, inspecting labs, and responding to and documenting incidents that happen within the college. The Lab Safety Manager supports Biology with around 25-35% of the position's time.

VIII. DIVERSITY AND INTERNATIONALIZATION

The demographics of the faculty and students are well-described in the detailed data provided by the Dean's office as part of the departmental self-study. In general terms when compared with the College of Arts and Sciences as a whole, the composition of the Biology student body is more Asian, less white, and less international than the overall College averages, with other racial/ethnic categories being generally similar. With respect to full-time faculty in the Biology department, gender and ethnic makeup are not dissimilar to that seen in other US colleges and universities. USF Biology faculty (n = 19) are predominantly white, with the representation of Asian/Pacific Islanders (10.5%; n = 2, one Assistant and one Associate Professor), and those identifying as Multiracial (5.3%, n = 1), but lacking Hispanic/Latino, Black, Native American, or representatives from other groups. For comparison, according to the National Center for

Education Statistics (NCES) as of Fall 2019, the national average for full-time faculty at higher education institutions is 70.6% white, 11.8% Asian, 5.4% Black, 4.6% Hispanic, 0.3% Indian/Alaska Native, and 0.9% Multiracial. According to the NCES for Fall of 2019 (the most recent year available), the nationwide average for the percentage of female-identified faculty is 50.4%. In the USF Biology Department, 9 out of 19 full-time faculty members are women (47%), placing the department just below the national average. However, this is substantially lower than the percentage of female-identified students in the department as of Spring 2022 (77.5%). In terms of staff, of the 7 technical and administrative staff that support the department, 2 are female (29%) and 5 are male (71%); the racial backgrounds of staff are 14% African American, 14% mixed race, and 72% white.

Attracting and retaining undergraduate students from under-represented groups is primarily a function of university admissions and other administrative units, although certainly individual departments can work to create an inclusive climate. The Biology Department can most likely best promote diversity and inclusion by working with existing university leadership in USF's Office of Diversity Engagement and Community Outreach. Numerous Biology faculty serve on the College of Arts and Sciences Diversity in STEM council, which aims to create a more welcoming environment for underrepresented students and faculty and to understand the challenges facing the different underrepresented groups. In this college-wide group, Biology faculty are the best represented of the disciplines (7 of the 19 full-time faculty serve on this volunteer committee). Through this and other related initiatives, department faculty and staff are working to improve policies and pedagogies that are more welcoming to individuals of diverse identities that span racial, gender, LGBTQ+, disability, veteran status, and other categories. These topics have been focused areas of discussion at faculty meetings over the past 2 years in particular.

While the recruitment and matriculation numbers for underrepresented student groups are generally quite strong at USF and in the department specifically (2021 US News and World Report has USF tied for 1st place among most diverse student bodies in the country), retention within the department could be strengthened by helping new students find a strong peer cohort in their first few years at the university. In terms of faculty and staff, the high cost of living in the Bay Area, as well as family job concerns can impede the department and University's ability to recruit and retain talented faculty. We argue that attracting, hiring, and retaining faculty from under-represented groups requires that the administration make a serious commitment of financial and physical resources; the current shortage of such candidates means qualified candidates will likely have many options.

The resources necessary to make serious improvements in faculty diversity, besides targeted incentives, are essentially the same as those needed to improve how the Department functions and thus will be more attractive to *any* candidate. These include hiring more faculty to handle the increased load of students, renovating facilities to create more and better research space and offices, increasing the Department budget, etc.

***Internationalization*.** While international issues have not yet been incorporated systematically across the Biology curriculum, faculty highlight the contributions of international researchers to the discipline and the effects of different countries' decisions on issues of global concern (such as climate change, biodiversity loss, and global health challenges). The number of Biology students that participate in study abroad programs is low compared to some other programs because of the high number of course requirements and the large number of courses with prerequisites. During advising, if students are interested in studying abroad, the discussions about how and when to fit in the semester abroad begin in freshman year and generally are appropriate only for students who are otherwise doing very well in the major.

Since the last program review, Dr. James Sikes has developed an undergraduate international field course to the Galapagos Islands, which has been highly successful with students (although it has been put on hold for the last several years due to COVID-era restrictions). Dr. Sikes also teaches global jumpstart courses for the Honors College, with a focus on natural history and ecology in Costa Rica. Another Biology faculty, Dr. Deneb Karentz, has been a leader of international collaboration efforts in research and training in Antarctica, and has included USF Biology majors in field teams. Much of her work over the past decades has been funded through the National Science Foundation. Outside of these initiatives, we currently do not have international partnerships and collaborations with educational institutions and public or private sector organizations.

Over the past decade, 3.3% to 6% of USF Biology students have been international, with 4.6% of all Biology students coming from abroad in Spring of 2022. The highest percentages were in 2016 and 2017, with recent years in line with the average prior to 2016. The department does not currently directly recruit international students, but they are certainly recruited by the University-wide admissions department. In terms of faculty recruitment, tenure-track job advertisements in the department are posted in publications and websites with international reach, and search committees seek the strongest candidate for the position regardless of nationality.

Challenges in this area include the restrictions placed on international travel due to COVID restrictions and the lingering apprehension caused by federal policies during the Trump administration. Coupled with the high cost of living in San Francisco, these challenges may have contributed to the lower percentage of international students in the department in recent years. One of the challenges faced by students for whom English is not a first language (which includes but is not limited to many international students) may have trouble getting up to speed on college-level scientific writing skills. Since the last program review, the department has introduced several curricular changes to help address this issue, including changes in how lab reports are written at the lower and upper-division levels, as well as a greater emphasis on scientific writing skills in the senior-year required departmental seminar course.

IX. TECHNOLOGY AND INFORMATION

Almost all Biology classes are taught in 'smart classrooms' with digital projectors and computers installed in the classroom. All full-time faculty in the department receive their choice of laptop or desktop from the University. All laptop computers are on a three-year replacement cycle and desktop computers are on a five-year cycle. There is a standard suite of software provided by the University and the department purchases additional software as required. The computing needs of the Biology department faculty are met satisfactorily. For teaching, the department pays for two floating licenses to the Geneious Prime bioinformatics software for use both in teaching and research.

Most faculty use an online course management system (Canvas) for their classes to share lecture slides and class assignments, to make course announcements, and as an online grade book. Some faculty leverage the Google Suite platforms available through our USF accounts, including using Google Forms for in-class assessments and Google Sheets for pooling class data in lab sessions.

Our Bioinformatics class and faculty make use of a large Linux server housed in a shared server room in the Lo Schiavo Center. It is powerful enough to allow several dozen students to run analyses in parallel, and includes 1.5 TB of RAM, dual 22 core Intel Xeon processors, and a 32 TB RAID 10 for working with large datasets.

***Distance or Online Learning*.** Before 2020 (pre-pandemic), the Biology department did not have any distance learning or online programs. Most of the laboratory courses that are key components of many classes can not easily be transferred to an online only format. For the second half of the Spring 2020 semester and the entire Fall 2020 and Spring 2021 semesters, classes were switched to fully online and remote due to the COVID-19 pandemic. Most faculty taught in a synchronous format utilizing Zoom.

As of Spring 2022, almost all Biology classes have returned in an in-person format although some faculty have been using a Hyflex format to accommodate a handful of students that have to attend remotely because of the continuing pandemic. A small number of classrooms have been outfitted for teaching in the hyflex modality with additional cameras and microphones installed, but these are currently in high demand and hard to reserve. The Biology department maintains a small selection of webcams and microphones for faculty use in classrooms not currently outfitted for remote instruction. Our expectation is that all Biology classes will eventually return to fully in person post-pandemic.

***Library & Information Resources*.** The faculty members rarely use the library's physical holdings. They do routinely access scientific journals for both research and teaching purposes that can be downloaded from the USF Gleeson library journal finder website and through a variety of library databases. The collection of journals that the USF libraries can access is somewhat limited – articles from recent years of major journals are usually available, but many specialized journals cannot be found. The library's subscriptions have shrunk in recent years due to budget constraints. The Biology department's library liaison, librarian Claire Sharifi, has

been a useful resource – she conducts in class tutorials on using journal search software and directly assists students with performing literature searches and retrieving full-length versions of articles. In addition, Claire developed a collection of anatomy models accessible to students from the Gleeson library front desk beginning Spring 2022. Randy Souther, head of Reference and Access Services, also developed an online tutorial for students in General Biology on proper citation formatting.

***Vehicles*.** University vehicles are used most frequently to take students on trips as a part of their Field Biology classes - trips with the professor and 12-14 students are made throughout the greater Bay Area, usually within a 1-2 hour drive of campus. The vehicles available for Biology Department use are owned by the College of Arts & Sciences and can be reserved by faculty members. The vehicles include Mercedes Sprinter vans with a capacity of 12 and Suburbans with a capacity of 9. The Sprinter vans are often not requested by Biology faculty given the challenges in driving such a large vehicle. The Suburbans are usable, but their smaller capacity requires multiple vehicles per field course. Graduate students in the department are often hired as additional drivers on field trips when multiple vehicles are needed to transport the class to distant off-campus sites. The College of Arts & Sciences has plans to purchase new and replacement vehicles.

X. FACILITIES

The teaching, research, and office spaces of the Biology Department are located within Harney Science Center (HR) and Lo Schiavo Center for Science and Innovation (LS). The Biology Department office is located in HR 256B. The Biology office space was renovated in fiscal year 2016 to create an additional faculty/staff office within the larger space. All faculty offices and staff office or cubicle spaces are located in Harney, with eight faculty offices renovated in 2016. Biology faculty members with active research programs have research lab space in HR (Appendix O). An updated shared research lab was renovated in Fiscal Year 2016 and houses three faculty members and their research groups. Other research labs are assigned primarily to specific faculty members, are generally small, and reflect the age of the building (constructed in 1966). In addition, since the last program review, one new teaching lab has been renovated in Harney (HR 323, Interdisciplinary lab), and two shared instrument spaces (The Kai Chong Tong Cell Culture Facility in HR 252 and the -80 degree C freezer room in HR 314) have been created through renovation projects. Outside of HR and LS, there is a research-grade greenhouse (located in the USF Community Garden, adjacent to the School of Education building) that currently supports the research carried out by three Biology faculty.

The Biology Department strives to provide both undergraduate and graduate students research opportunities through work with faculty members in the department. In addition to gaining research experience and contributing to the research programs of faculty members, graduate students serve as mentors and role models for undergraduates. Training students in research typically involves a substantial investment of time and effort by faculty members, but faculty in the Biology Department enthusiastically engage in research training and find it a rewarding part of the job. Space for research is limited and in dire need of renovation in the Biology

Department, and throughout the university, which places constraints on providing research opportunities for students. Increased research space would enhance faculty research and increase learning opportunities for students by 1) expanding the scope of existing research programs by increasing space for equipment and student work, and 2) making it feasible to hire additional research faculty as the number of students in the Biology major continues to grow.

Many courses offered in the Biology Department have a laboratory component. The department has access to multiple teaching lab rooms (Appendix N) that are in use throughout the day with classes, preparation for classes, or open lab time for additional student work and review. Despite the availability of multiple teaching lab rooms, some courses face constraints related to limited space or the suitability of available space. Some of the challenges facing specific courses are described below.

- ***General Biology I*:** Biology majors typically take General Biology I in fall of their first year. Currently, one laboratory classroom is available to teach General Biology I labs, which limits the number of lab sections that can be scheduled each week. Recently the Biology Department has been at the limit for accommodating students with General Biology I lab sections in the fall. An increase in the number of students in the Biology major or in other programs that require General Biology would require availability of another lab room in which to schedule General Biology lab sections as well as additional teaching materials such as microscopes for the lab room.
- ***Field courses:*** The department lacks a classroom ideally suited to teach field courses. Field courses require different arrangements than a classical teaching lab space. This need has been met for many years by the use of a small room (HR 243) that is awkwardly arranged. The small size of the room and placement of the lab benches limits the learning activities that can be conducted in the room.
- ***Courses for Nursing and Kinesiology majors:*** The Biology Department offers foundational courses required in the Kinesiology and/or Nursing major: BIOL 113/114-Human Anatomy, BIOL 115/116-Human Physiology, and BIOL 134/135-Microbiology. These courses are taught in laboratory rooms that have not been updated in a long time. The arrangement of the lab benches in the rooms is not ideal for student interaction, and the lab room in which Human Anatomy and Human Physiology is taught lacks adequate storage and prep space.
- ***Molecular Biology/Biotechnology courses:*** Because of the aging ventilation and electrical systems in HR, it is difficult to house these courses in these spaces, thereby limiting options to hold these lab courses.

Most of the teaching, shared equipment and research spaces in Harney have not been updated since Harney has been built. The mechanical, electrical, and plumbing (MEP), which also is mostly original to the building, is outdated and is limited in its capacity to support current teaching and research needs. As noted above, this can create challenges for teaching, and can

also place constraints on faculty research programs. Some efforts have been made to address these challenges.

- Through the recent gift of a donor, we have started the planning stages for a light renovation of HR 249. This will include updating the seating and AV equipment, updating the lab prep space to support aquaria and plants and reconfiguring the space to make it ADA compliant.
- Since the time of the last program review, the Dean's office created the Harney Space Committee. This committee, made up of faculty members from each of the science departments housed in Harney as well as staff members that support the labs and spaces in Harney, works with the Associate Dean of Sciences to discuss utilization of spaces in Harney and create a process to address teaching and research needs in Harney. Suggestions, concerns or issues regarding space are then brought to the University Space Committee (by the Dean's office) for approval or denial.

Despite the efforts described above, many challenges related to facilities remain. Below is a summary of some of the most urgent needs to improve the quality of the programs and educational experiences offered by the Biology Department.

- **Renovation of Harney Science Center:** The Harney Science Center is in critical need for a large-scale renovation in order to support the teaching and research needs of not just the Biology department, but all of the science departments at USF. While the addition of the Lo Schiavo Center for Science and Innovation has increased the number of teaching classrooms and laboratories, laboratory prep space and student working space, it has not replaced the urgent need for Harney to be updated.
- **Field Biology Teaching Lab:** The current teaching lab used for field courses is very small and not designed for storage of field equipment or to facilitate student interaction.
- **Faculty Research Space:** Limited space constrains the number of research faculty in the department, which limits research opportunities for students. In addition, the research space that does exist has not, for the most part, been updated since Harney was built and does not efficiently use the space that is available in the building.
- **Computational Space:** Space that can be shared across science departments would provide much needed support of computational needs in courses and research labs.
- **General Biology Teaching Lab:** An additional teaching lab for General Biology along with equipment such as microscopes is needed to accommodate increases in the numbers of science and/or pre-med students. Enrollment in General Biology labs is at the capacity that the current lab rooms can handle.

XI. CONCLUSIONS

The greatest strength of the department is the outstanding commitment of our faculty to student success. Our faculty are experts in their fields and are dedicated teachers, researchers, and scholars who continuously work to improve the curriculum and incorporate innovative methods into their teaching. The department aims to provide research and critical thinking skills that prepare students for graduate study and employment upon graduation. Despite having an ever-increasing number of undergraduate Biology majors, faculty work diligently to provide pedagogical experiences in the classroom, laboratory, and field. We involve students in research, provide students with real-world experience and better understanding of the scientific process and provide invaluable opportunities for students to take field-courses across a diverse array of topics that provide hands-on, experiential learning. The department has a sincere desire and need to increase retention of students of color by continuing and enhancing our diversity and inclusion endeavors.

The challenges faced by the department are largely centered around a growing undergraduate major population. This includes a fundamental lack of full time faculty to meet the course demands of our current student population both in lower-division foundational courses and support courses for other departments as well as in upper-division major courses. Recruiting additional tenure-track faculty will provide expanded research opportunities for our undergraduate students who often cannot find research placements within the department. A primary aim of the department is to increase retention of students of color, but this requires additional faculty to reduce class sizes in introductory courses and to reduce the overloads placed on current faculty to allow development of enrichment programs aimed at improving student success. Another fundamental challenge is the need for updated and renovated facilities for both teaching and research. The failing infrastructure in the Harney Science Center prohibits faculty from fully delivering pedagogical and research innovations.

XII. COMPREHENSIVE PLAN

The Biology Department is well poised for continued improvement and innovation over the next five years. Based on the self study and departmental discussions in preparing for assessment of the program, we have identified five key areas that will be central to the improvement of the Biology program over the next 5 years.

Curriculum - We aim to continue to offer a wide range of upper-division major courses that include both field and laboratory components. We acknowledge that some key subdisciplines within the life sciences are not represented in our course offerings and/or research endeavors. With the addition of additional research (tenure-track) faculty to the department, we will add both new courses and provide innovative new research opportunities for our students.

Research - We strongly advocate for the increase in full-time tenure-track faculty to the department. This will not only improve our upper-division curriculum, but also ameliorate many of the challenges identified in this self study. As tenured faculty retire, we aim to maintain these positions and recruit both early-career and endowed mid-career faculty to the department to diversify and increase the research productivity of the department. We

advocate for increasing support for the Masters program in Biology, which will increase the number of graduate students housed in our research laboratories with a goal that all research faculty could recruit and retain 2-3 graduate students concurrently.

Facilities - There is a fundamental lack of research space that is constraining departmental growth and as a result research opportunities for undergraduates fail to meet the demands of an ever-increasing number of students enrolled in the program. We advocate for complete renovation of the Harney Science Center, but also smaller renovations to meet current demands until the entire building can be renovated. We also advocate for expansion of Biology facilities outside of the Harney and Lo Shiavo buildings, potentially in newly acquired laboratory facilities adjacent to the current campus footprint.

Faculty recruitment and development - A primary goal of the Biology Department is to expand our current number of full-time tenure-track faculty. While recent searches for term faculty positions have been challenging and many have failed, we have repeatedly run highly successful searches for tenure track faculty; all tenure-track searches since 2012 have ended with the recruitment of the top-rated candidate and these faculty are now an integral part of the Biology Department. With the addition of new faculty, we can also meet our goals of diversifying the faculty to more closely resemble the demographics of our highly diverse student population.

Diversity goals - We have short term goals to improve retention in our foundational courses, especially among students of color. With increased faculty positions and administrative support, the Department aims to develop strategies to foster opportunities for enrichment and increasing student engagement in introductory courses that are often the largest at the university. With more faculty, we can reduce class sizes and more effectively meet the needs of first generation and minority students. As we replace retiring faculty and gain additional faculty positions, we aim to recruit diverse faculty to fill these positions.

Goals and Projected Outcomes - The most immediate goal of the Biology Department is to increase the number of full-time tenure-track faculty – this goal will have far-reaching implications for many of the core areas listed above, including improving curricular offerings, expanding and diversifying research opportunities, and increasing the diversity of our faculty. A second, nearly as immediate, goal is to renovate, modernize, and expand the facilities where we teach and conduct research in the life sciences. Similarly, this goal will also impact many of the challenges outlined in this self study.

Given the consistent increase in Biology majors over the last decade, we expect our Department to continue to grow, similar to nationwide trends in STEM enrollments. We believe that today is an exciting and innovative time of discovery, and we have the opportunity to impact the future through both pedagogy and research. We aim to continue to strengthen our connections to the wealth of local Biotechnology, Health, and Conservation organizations in Northern California. With increased full-time tenure-track faculty and modern, cutting-edge

research facilities, we are confident we can meet these challenges and integrate these collaborations into our curriculum and research opportunities.

XIII. APPENDICES

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Appendix A. Updates on Progress since 2014 APR

The major issues noted by the 2014 program external reviewers and the current status of these issues are summarized below.

2014 Review Observation 1: Faculty members have significant teaching and advising loads.

The 2014 Review Committee noted that additional full-time faculty members and support staff are needed to meet the teaching and advising needs that have increased with significant enrollment increases in the Department. In 2014 we had nine tenured, two tenure-track and four term faculty (total = 15). The number of full-time faculty in Spring 2022 has increased from 15 to 19, but the number of tenured/tenure-track faculty has only increased by one (total = 12). The ratio of tenured/tenure-track to term appointments has shifted from 73% in 2014 to 63% in 2022. We have asked about additional tenure-track faculty, but the Dean's Office has not approved any new tenure-track faculty lines since 2016. Searches for two temporary term faculty were conducted in the last academic year, but only one ended with recruitment of a term faculty member for a one-year contract. An additional laboratory support position was created in Fall 2014, so now we have three full time support staff for Biology, but this complement is still considered less than needed.

In the absence of support from the administration to hire additional full-time faculty, the Biology department has been placed in a situation where every semester many students do not get to register in their first or even second choice of courses, and some students are unable to register for any upper division courses. Upper division classes often close the first or second day of registration, some seniors and many juniors are often left with no upper division courses in categories they need to graduate. The result is a great deal of anxiety and frustration for students, and a great deal of work for the department chair to juggle enrollments to address the situation. Eventually, nearly all students will get into a class, but not necessarily one they were initially interested in taking. The process is demoralizing for everyone, students and faculty alike; and especially leaves students feeling disenfranchised.

To assist with advising, in Fall 2014 we set up a Peer Advising program where some of our most successful Biology majors were recruited to help other students with regular drop-in office hours. This program lasted a few semesters, but was not very successful.

The Review Committee suggested that USF create an administrative position and/or provide student worker support for our Pre-Professional Health Committee (PPHC) that has traditionally been the responsibility of a Biology faculty member. A full-time position was created in Fall 2018, the Pre-Health Professions Advisor. This new format for pre-professional health advising has been very helpful for our students, and for the faculty member who was previously responsible.

2014 Review Observation 2: Resources are needed for faculty research space and increased student research opportunities.

The 2014 Review Committee recommended that the University renovate the Harney Science Center as soon as possible to create badly needed research laboratories for faculty, offices for faculty and staff, and community spaces for graduate and undergraduate students. We wholeheartedly agree, but recognize that this will take time for planning and fundraising; and it has been made clear by the Administration that a complete renovation of the building is probably a decade away.

Since 2014, two previous faculty offices, teaching and research lab space, and the cold room have been renovated into a suite of eight faculty offices, a general use molecular biology laboratory and a shared research space with assigned bays. Other teaching and research labs are in need of repair and renovation; however, with the intent to fully remodel Harney, the administration is reluctant to proceed with what might be short term changes.

In 2017 the Dean of Arts and Sciences created the Harney Space Committee, an advisory board with representatives from all science departments. An initial task was to compile a list of specific space needs from each department in the building. That has been done, but there has been little else for this committee to do since.

With regard to increasing student research opportunities, this is still an issue. Student requests are greater than what research faculty can handle. The issue of student research is addressed in more detail in Undergraduate Curriculum (Section II. B.). The reviewers suggested that we work with the administration to create more undergraduate research opportunities. Even though USF does not provide workload compensation for mentoring students in research, we do provide such opportunities for students, both with faculty on campus and through the Partnership for Undergraduate Mentoring and Teaching (PUMT) with the University of California San Francisco (UCSF). However, there is usually very low student response to research opportunities at UCSF, and we do not have enough research faculty or space to accommodate all of the requests for research experiences on campus. Requests to faculty have increased with the recently created USF Honors College that has an Honors College Capstone requirement that can be satisfied by completing the Biology Honors program. If the administration would provide workload compensation and/or financial support, that would improve the ability of tenure/tenure-track faculty to provide research opportunities for more undergraduate students.

Two new funding opportunities have been developed since the last review. The Student Travel Fund and the Whitehead Fellowship. The Student Travel Fund began in 2017 and provides funding for students to present their research at scientific conferences. The Whitehouse Fellowship began in 2018, when a private donor gave a $50,000 gift to USF to support students in Chemistry and Biology utilizing biochemistry or molecular biology tools to carry out their research. The award grew to $70,000 in 2019 and to $100,000 in 2020. With these donations, we developed a competitive process to determine which students will receive fellowships each year. The Whitehead Fellowship provides $5000-$10,000 of summer research funding to individual students in the form of a stipend for living expenses and/or research funding. To date, awards have been given to 1 undergraduate and 13 graduate students in Biology. Although

these awards have been very helpful in improving our ability to mentor student researchers over the summer, this funding is from a private donor and therefore could go away in the future without institutional support. Further, this award only covers costs incurred over the summer months whereas the duration of most research projects extend well beyond this period.

2014 Review Observation 3: Improvements to the graduate program are needed.

Graduate students serve a vital role in the department because they help faculty obtain data for grant proposals and publications; however, the University does not recognize or appreciate the role of traditional graduate programs. Professional graduate programs, on the other hand, are viewed as profit and their development is encouraged. One large challenge we have for our Biology MS program is that, unlike other universities, USF does not allow students to receive stipends, they can only be paid hourly as student workers.

Another recommendation was to improve integration of undergraduate researchers into the research lines pursued by our graduate students. We do provide opportunities for graduate students to mentor undergraduates, but this process is highly variable and depends on the personalities and motivation of graduate student mentors, undergraduate mentees, and individual faculty members. Since 2014, four new tenure track faculty members were added to the department, each of which have mentored several undergraduate students through their graduate students. Together, this new cohort of faculty have mentored 14 graduate students and 48 undergraduate students. Although this is an improvement, there has been much more interest in research opportunities by undergraduates than these faculty have been able to provide.

Finally, it was suggested that we provide graduate student space (e.g., a lunch area) with food storage. We did provide two spaces, Harney 272 as a dedicated graduate student office and students were given access to the faculty/staff lounge in the LoSchiavo Science Center (LS203). However, Harney 272 has since been repurposed by the Administration as an office for the Program Assistant for the Biotech PSM program, and other departments requested that graduate students not be allowed to use the faculty lounge.

2014 Review Observation 4: Overall Curriculum – course offerings can be improved with greater emphasis on ecology, research ethics, and modern biological approaches.

To address these issues, the Department requires resources from the administration (e.g., new faculty with expertise in these areas to provide instruction and establish research programs). Since the 2014 External Review, two tenured faculty members have retired (an animal ecologist and a marine biologist), one tenured faculty member has left (microbiologist), and one term faculty (generalist) has left. These positions were not immediately replaced and two term hires were made as a stop-gap measure. Since 2014, the Biology Department has received one new tenure-track line and three new term faculty lines. One of the term positions is for the Professional MS in Biotechnology and a second term position is a temporary appointment for

Spring 2022. Since 2014, four tenure track (Microbial Ecology/Bioinformatics Spring 2017, Marine Biology/Physiology Fall 2018, Plant Ecology/Evolution Spring 2019, Microbiology/Virology Fall 2019) and three term positions have been filled (renewable Anatomy/Physiology Fall 2015, renewable General Biology Fall 2019, temporary Molecular Biology Spring 2022). There have also been several failed searches for term faculty, causing us to shift to part time hires for full courses.

The Ecology emphasis was revised as suggested, substituting BIOL319 Ecology for the BIOL 346/347 General Microbiology requirement. One limitation we faced was adequate means for transporting students for field work, however in the past few years the University has increased the vehicle fleet to address this issue. One ongoing issue with the current fleet is that several of the vehicles are large Mercedes Sprinter vans, and while they can seat 15 people, they are not easy for some faculty to drive.

Biological ethics is already covered in Genetics and other upper division courses, and has now been included in sessions on research ethics for BIOL490 Undergraduate Seminar, which is required for every Biology major. We have ensured that exposure to this important topic is firmly embedded in the Biology curriculum, and we have provided a structured forum for discussion and critical thinking.

The reviewers also mentioned that we should work with administration and alumni relations to create a Biology alumni database and track the Biology majors through their career and after they graduate. We agree that these are fantastic ideas, but Alumni Relations has not cooperated with our previous efforts to build an alumni database and we do not have enough staff to be able to track alumni on our own.

The reviewers also encouraged us to work to lower the attrition rate within the major. We have observed that the biggest drop off occurs between General Biology I and General Biology II. It is likely that many of these students lacked the skills and aptitude for science. We attempt to identify these students early on and help them switch into other majors where they have a greater chance for success. Furthermore, if every student who took General Biology I continued on in the program, it would not be possible to provide enough upper division courses to accommodate them all. If decreased attrition is a goal the administration would like us to achieve, then we would require a commitment to hiring additional faculty, a budget increase for laboratory supplies and equipment, and more teaching spaces in order to accommodate all of these students. Alternatively, increasing the academic qualifications and accepting fewer Biology majors might also result in a lower attrition rate and allow us to effectively deliver the Biology curriculum.

The reviewers observed that the coverage of modern biological approaches (e.g., genomics, systems biology, statistics, computational biology) was sparse in the 2014 curriculum. Recent new hires and their development of new courses as well as involvement in existing courses have addressed this criticism. For example, we now offer a course in Bioinformatics to both undergraduate and graduate students. Further, recent hires have integrated modern statistical

and computational techniques (e.g. R programming) into existing and new courses including Ecology, Insect Biology, Pollination Biology, and Urban Ecology.

2014 Review Observation 4: There is an immediate need to improve assessment.

The committee suggested that we work with the administration to revise, strengthen, and implement an assessment plan, including increasing direct evidence of student learning. We have significantly strengthened assessment of the MS, BS, and minors administered by the Biology Department by the formation of a standing committee of Biology faculty who work each academic year to develop assessment reports centered around a specific program learning outcome. This strategy has resulted in much more thoughtful reflection on how we meet our program learning outcomes and has resulted in changes to the program as outlined in Assessment (Section III).

We have continued to request examples of successful assessment strategies from the administration, while also working to refine our assessment methods. We have collected student work to begin generating an online portfolio, showcasing examples of student work. We believe this can serve as a source of student work for direct assessment of program learning outcomes. Finally, we continue to administer a senior exit survey, which we have found to be highly valuable in refining our curriculum.

Below is the list of actions the Biology Department developed in response to the 2014 Program Review and current status is indicated for each:

Actions for the Department:

1. Hire two term replacements that have already been approved, one temporary, one renewable.

   New faculty hires, both tenure-track and term have been made, but we still need more tenure-track faculty lines to support the number of Biology majors enrolled in the program.

2. Schedule a meeting with Peter Novak to discuss the long-term future of the pre-professional health program.

   A new position focused on pre-health advising was created and staffed.

3. Work with the administration to renovate Harney 302 and 306.

   Faculty offices have been created and a communal lab space for research has been constructed. However, these improvements are still not sufficient for all of our space needs.

4. Hire two new tenure-track faculty members, one with expertise in Microbial Ecology, one with expertise in Ecology/Bioinformatics.

   We added tenure-track faculty members in these areas.

5. Provide training during orientation on mentoring undergraduates in research.

   Undergraduate mentoring in research is now commonly coordinated with graduate students in respective laboratories.

6. Suggest that TAs prepare their own mid-semester evaluations.

   TAs are now included in the formal course schedule and their teaching is evaluated with the same tool used for full- and part-time faculty.

7. Emphasize research ethics more prominently in our courses and seminar series.

   Research ethics has been incorporated in the undergraduate seminar series along with Genetics courses as well as in selected upper-division Biology courses

8. Increase visibility of our investigative and interactive coursework by including photos, updates, and featured highlights on the department web site

   This has been challenging given restrictions placed on web layouts and content by ITS. We look forward to a redesign of the USF website that will include more photos, biographies, and student interest stories.

9. Create an online portfolio to showcase examples of student work and assess student learning outcomes.

   We have been diligent in gathering student work for annual assessment reports, but have not fully integrated student work into online portfolios for continued evaluation.

10. Continue to administer a senior exit survey to assess student learning and refine our curriculum based on the results

    The senior survey has been administered annually since the 2014 APR. While the senior survey was not administered during 2022-2021 due to online learning, we have plans to administer the senior survey to the graduating students in Spring 2022.

Action from the Administration:

1. Provide three additional term faculty lines to reduce teaching and advising loads.

Additional term positions were provided to the Department but only one full-time position was dedicated teaching exclusively in Biology (Fall 2015), one term position for the Biotech PSM program (Fall 2015), and one temporary term position (Spring 2022).

2. Take a more proactive approach to assign undeclared science students faculty advisors in other science departments.

   All undeclared science students are now advised by an advisor in the Center for Academic and Student Achievement (CASA) and no longer advised by Biology faculty.

3. Provide administrative support staff to aid in tracking students, creating an alumni database, and laboratory prep

   While we have hired a technical position to assist in laboratory prep, we have not received administrative support for developing our alumni network or tracking current students. The Office of Development has not encouraged departments to compile alumni lists or contact alumni. Specific outreach to alumni for website updates and alumni inclusion in newsletters is largely coordinated by the Department Chair currently.

4. Renovate 336 and/or 340 or 349 into an office suite, with one space for graduate students.

   This renovation did occur creating faculty office space and shared research lab space for 3 faculty. While some spaces were designated for use by the graduate students, these areas have since been repurposed by the administration.

5. Provide workload compensation or resources for a summer research program with stipends for students and faculty to increase undergraduate research opportunities. Included in this could be summer support for graduate students and additional training on mentoring undergraduates.

   Thanks to support from a generous donor, the Whitehead Summer Research Fellowship program now competitively awards stipends, funds for research supplies and travel to both undergraduate and graduate students in Biology. However, the University will not provide workload compensation to faculty for mentoring students in research during the academic year or the summer.

6. Purchase new vehicles to improve transportation options for field work and make these courses available to more students.

   New vehicles have been purchased, but are already dated. The purchase of Mercedes Sprinter vans has allowed us to transport more students in a single vehicle but are often challenging for faculty and/or graduate students to drive given their large size.

7. Provide examples of successful assessment strategies from the administration.

   Model assessment reports were provided which led to much stronger assessment of Biology program learning outcomes. In fact, Biology earned the Gold Star of Distinction from the College in recent assessment reports.

8. Provide administrative support from the administration for assessment activities.

   Assessment support and infrastructure has improved dramatically including faculty liaisons who provide guidance and assistance in developing annual assessment reports.

9. Provide support in the form of summer salaries to develop a system of exit/entrance tickets to evaluate progression through the curriculum.

   The administration has not provided summer salary support for faculty to develop this system, which has not moved forward since the 2014 APR.

Appendix B. Program Learning Outcomes

BIOLOGY MAJOR

Program Learning Outcomes, Effective Fall 2022:

The major in Biology prepares students to

1. Analyze scientific questions using both in-depth and broad knowledge of concepts that comprise the biological sciences.
2. Implement the scientific process by designing and conducting experiments, testing hypotheses, analyzing and evaluating results, and communicating conclusions.
3. Use laboratory, field, and analytical techniques to address complex questions in the life sciences.
4. Evaluate, synthesize, and communicate information from the primary scientific literature.
5. Apply principles of social awareness and responsibility to scientific investigations in the life sciences

Program Learning Outcomes, Prior to Fall 2022:

The major in Biology prepares students to

1. Demonstrate both in-depth and broad knowledge of the concepts that comprise the biological sciences
2. Apply the scientific process, including designing and conducting experiments and testing hypotheses
3. Competently perform laboratory, field, and analytical techniques
4. Understand and critically review scientific papers and prepare oral and written reports in a standard scientific format
5. Demonstrate an awareness of the significance ethics plays in the biological sciences

BIOLOGY MINOR

Program Learning Outcomes, Effective Fall 2022:

The minor in Biology prepares students to

1. Articulate and explain principles of cell and molecular biology, organismal biology, ecology, and evolution.
2. Apply the scientific process and prepare written reports that analyze and evaluate results of scientific investigation.
3. Perform laboratory techniques that assess scientific problems.
4. Examine and evaluate the primary scientific literature.
5. Apply principles of social awareness and responsibility to scientific investigations in the life sciences.

Program Learning Outcomes, 2021-2022:

The minor in Biology prepares students to

1. Demonstrate an understanding of the building blocks of life, fundamentals of cells and the foundational theories of biology.
2. Demonstrate an understanding of organismal form, function, and diversity. 3. Demonstrate an understanding of cellular structure and interactions necessary for the maintenance and reproduction of life.
3. Demonstrate an understanding of the principles of genetics, evolution, and ecology.
4. Discuss and critically review biological scientific papers.

Program Learning Outcomes, Prior to Fall 2021:

The minor in Biology prepares students to

1. Demonstrate both in-depth and broad knowledge of the concepts that comprise the biological sciences.
2. Apply the scientific process, including designing and conducting experiments and testing hypotheses.
3. Perform laboratory, field, and analytical techniques.
4. Discuss and critically review scientific papers and prepare oral and written reports in a standard scientific format.
5. Demonstrate an awareness of the significance ethics plays in the biological sciences.

NATURAL SCIENCES MINOR

PROGRAM LEARNING OUTCOMES:

The minor in Natural Science prepares students to

1. Demonstrate broad knowledge of the concepts that comprise the natural sciences of biology, chemistry, and physics
2. Perform laboratory techniques used to evaluate and explore scientific problems 3. Apply the scientific process

BIOLOGY MASTER IN SCIENCE

Program Learning Outcomes, Effective Fall 2021:

The MS program in Biology prepares students to

1. Develop scientific literacy in the areas of biology relevant to selected research interests.
2. Exhibit advanced technical, critical thinking, inquiry and analysis skills.
3. Communicate clearly and persuasively to a variety of audiences.

Program Learning Outcomes, Prior to Fall 2021:

The MS program in Biology prepares students to

1. Describe, synthesize, and apply concepts and techniques in the current literature within a specific research area.
2. Develop mastery of content through direct instruction of basic biological concepts. 3. Conduct original research, evaluate data, and demonstrate research skills within a specified research area.
3. Communicate results of independent scientific inquiry through oral and written discourse.

Appendix C. Curriculum Maps

Program Matrix: **Required Courses in the BS in Biology major**. Key: I = Introductory; M = Intermediate; A = Advanced; (A) or (M) = variable depending on faculty teaching the course

Program Learning Outcomes	BIOL 105 - General Biology I	BIOL 106 - General Biology II	BIOL 212 - Cell Physiology	BIOL 310/311 - Genetics/ Lab	BIOL 390 - Biology Seminar	BIOL 414 - Evolution
Analyze scientific questions using both in-depth and broad knowledge of concepts that comprise the biological sciences.	I	I	M	A	A	A
Implement the scientific process by designing and conducting experiments, testing hypotheses, analyzing and evaluating results, and communicating conclusions.	I			M		(A)
Use laboratory, field, and analytical techniques to address complex questions in the life sciences.	I	I		M		(A)
Evaluate, synthesize, and communicate information from the primary scientific literature.			I	M		A
Apply principles of social awareness and responsibility to scientific investigations in the life sciences.	I	I	I	M		A

Program Matrix: **Elective Courses in the BS in Biology major**. Key: I = Introductory; M = Intermediate; A = Advanced; (A) or (M) = variable depending on faculty teaching the course

Program Learning Outcomes	BIOL 312/313 - Interdisciplinary Life Sciences/ Lab	BIOL 315/316 - Biology of Marine Mammals/ Lab	BIOL 317/318 - Biology of the Galapagos/ Lab	BIOL 319 - Ecology	BIOL 322/323 - Ornithology/ Lab	BIOL 324/325 - Molecular Ecology/ Lab
Analyze scientific questions using both in-depth and broad knowledge of concepts that comprise the biological sciences.		A	A	A	A	A
Implement the scientific process by designing and conducting experiments, testing hypotheses, analyzing and evaluating results, and communicating conclusions.		M	A	M	A	A
Use laboratory, field, and analytical techniques to address complex questions in the life sciences.		A	A		A	A
Evaluate, synthesize, and communicate information from the primary scientific literature.		A	A	M	A	A
Apply principles of social awareness and responsibility to scientific investigations in the life sciences.			A			M

Program Matrix: **Elective Courses in the BS in Biology major.** Key: I = Introductory; M = Intermediate; A = Advanced; (A) or (M) = variable depending on faculty teaching the course

Program Learning Outcomes	BIOL 326/327 - Field Botany/ Lab	BIOL 328/329 - Invertebrate Zoology/ Lab	BIOL 330 - Female Biology	BIOL 331/332 - Herpetology/ Lab	BIOL 333/334 - Endocrinology/ Lab	BIOL 335/336 - Pollination Biology/ Lab
Analyze scientific questions using both in-depth and broad knowledge of concepts that comprise the biological sciences.	A	A	A	A	A	A
Implement the scientific process by designing and conducting experiments, testing hypotheses, analyzing and evaluating results, and communicating conclusions.	M	A		A	A	A
Use laboratory, field, and analytical techniques to address complex questions in the life sciences.	A	A		A	A	A
Evaluate, synthesize, and communicate information from the primary scientific literature.	A	A	A	A	A	A
Apply principles of social awareness and responsibility to scientific investigations in the life sciences.		M	A	M	A	

Program Matrix: **Elective Courses in the BS in Biology major**. Key: I = Introductory; M = Intermediate; A = Advanced; (A) or (M) = variable depending on faculty teaching the course

Program Learning Outcomes	BIOL 340 - Animal Toxicology	BIOL 345 - Virology	BIOL 346/347 - General Microbiology/ Lab	BIOL 350/351 - Comparative Animal Physiology/ Lab	BIOL 352/353 - Comparative Anatomy/ Lab	BIOl 355/356 - Developmental Biology/ Lab
Analyze scientific questions using both in-depth and broad knowledge of concepts that comprise the biological sciences.	A	A	A	A	A	A
Implement the scientific process by designing and conducting experiments, testing hypotheses, analyzing and evaluating results, and communicating conclusions.		A	A	A		A
Use laboratory, field, and analytical techniques to address complex questions in the life sciences.			A	A	A	A
Evaluate, synthesize, and communicate information from the primary scientific literature.	A	A	A	A	A	A
Apply principles of social awareness and responsibility to scientific investigations in the life sciences.				M		A

Program Matrix: **Elective Courses in the BS in Biology major**. Key: I = Introductory; M = Intermediate; A = Advanced; (A) or (M) = variable depending on faculty teaching the course

Program Learning Outcomes	BIOL 362/363 - Histology/ Lab	BIOL 367 - Disease, Physiology, and Immunology	BIOL 368 - Neurobiology	BIOL 379/380 - Conservation Biology/ Lab	BIOL 383/384 - Biology of Insects/ Lab	BIOL 385/386 - Parasitology/ Lab
Analyze scientific questions using both in-depth and broad knowledge of concepts that comprise the biological sciences.	A	A	A	A	A	A
Implement the scientific process by designing and conducting experiments, testing hypotheses, analyzing and evaluating results, and communicating conclusions.			A	A		
Use laboratory, field, and analytical techniques to address complex questions in the life sciences.	A			A	A	A
Evaluate, synthesize, and communicate information from the primary scientific literature.		A	A	A	A	
Apply principles of social awareness and responsibility to scientific investigations in the life sciences.			A	M		A

Program Matrix: **Elective Courses in the BS in Biology major**. Key: I = Introductory; M = Intermediate; A = Advanced; (A) or (M) = variable depending on faculty teaching the course

Program Learning Outcomes	BIOL 387/388 - Hematology/ Lab	BIOL 392/393 - Oceanography/ Lab	BIOL 395/396 - Plant Biology/ Lab	BIOL 398 - Readings for Advanced Undergraduates	BIOL 405 - Molecular Medicine	BIOL 420 - Molecular Biology
Analyze scientific questions using both in-depth and broad knowledge of concepts that comprise the biological sciences.	A	A	A	A	A	A
Implement the scientific process by designing and conducting experiments, testing hypotheses, analyzing and evaluating results, and communicating conclusions.			A		A	
Use laboratory, field, and analytical techniques to address complex questions in the life sciences.	A	A	A			
Evaluate, synthesize, and communicate information from the primary scientific literature.		A	A	A	A	A
Apply principles of social awareness and responsibility to scientific investigations in the life sciences.					A	

Program Matrix: **Elective Courses in the BS in Biology major**. Key: I = Introductory; M = Intermediate; A = Advanced; (A) or (M) = variable depending on faculty teaching the course

Program Learning Outcomes	BIOL 422/423 - Bioinformatics/ Lab	BIOL 424/425 - Urban Ecology	BIOL 443/444 - Immunology/ Lab	BIOL 485/486 - Molecular Genetics and Biotechnology/ Lab	BIOL 498 - Research for Advanced Undergraduates
Analyze scientific questions using both in-depth and broad knowledge of concepts that comprise the biological sciences.	A		A	A	A
Implement the scientific process by designing and conducting experiments, testing hypotheses, analyzing and evaluating results, and communicating conclusions.	A		A	A	A
Use laboratory, field, and analytical techniques to address complex questions in the life sciences.	A		A	A	A
Evaluate, synthesize, and communicate information from the primary scientific literature.	A		A		A
Apply principles of social awareness and responsibility to scientific investigations in the life sciences.			M	A	

Program Matrix: **Elective Courses in the BS in Biology major**. Key: I = Introductory; M = Intermediate; A = Advanced; (A) or (M) = variable depending on faculty teaching the course

Program Learning Outcomes	BIOL 598 - Thesis Research for Biology Honors Program	BIOL 599 - Thesis Writing for Biology Honors Program
Analyze scientific questions using both in-depth and broad knowledge of concepts that comprise the biological sciences.	A	A
Implement the scientific process by designing and conducting experiments, testing hypotheses, analyzing and evaluating results, and communicating conclusions.	A	
Use laboratory, field, and analytical techniques to address complex questions in the life sciences.	A	
Evaluate, synthesize, and communicate information from the primary scientific literature.	A	A
Apply principles of social awareness and responsibility to scientific investigations in the life sciences.		

Program Matrix: **Required Courses in the MS in Biology degree program**. Key: I = Introductory; M = Intermediate; A = Advanced; (A) or (M) = variable depending on faculty teaching the course

Program Learning Outcomes	BIOL 600 - Graduate Seminar	BIOL 695 - Directed Reading	BIOL 698 - Directed Research	BIOL 699 - Thesis Writing	Teaching Assistant Requirement
Describe, synthesize, & apply concepts and techniques in the current literature within a specific research area.	M	M / A	A		
Develop mastery of content through direct instruction of basic biological concepts					M / A
Conduct original research, evaluate data, & demonstrate research skills within a specified research area	M	M	A		
Communicate results of independent scientific inquiry through both oral & written discourse		M		A	M / A

Appendix D. Sample Curriculum - BS in Biology

1. Years one through four of the Biology major, 2. Years two and three of the Biology major with the Molecular Biology emphasis, and 3. Years two and three of the biology major with the Ecology Emphasis. Note: The four-year plan depends upon accepted AP courses and placement tests for writing and foreign language.

1. Biology Major

Fall	Spring
Year 1	
General Biology I Lecture and Lab General Chemistry I Lecture and Lab Core Writing Requirement Core Public Speaking	General Biology II Lecture and Lab General Chemistry II Lecture and Lab Core Writing Requirement Core
Year 2	
Cell Physiology Organic Chemistry I Lecture and Lab Biostatistics Core or Foreign Language I	Genetics Lecture and Lab Organic Chemistry II Core/General Elective/Minor Core or Foreign Language II
Year 3	
Introductory Physics I Lecture and Lab Upper Division Biology Elective (Field) Core/General Elective/Minor Core/General Elective/Minor	Introductory Physics II Lecture and Lab Upper Division Biology Elective (Lab) Core/General Elective/Minor Core/General Elective/Minor
Year 4	
Upper Division Elective (Lab) Core/General Elective/Minor Core/General Elective/Minor Core/General Elective/Minor Biology Seminar (1 unit)	Evolution Upper Division Elective Upper Division Elective Core/General Elective/Minor

2. Molecular Biology Concentration

Year 3	
Introductory Physics I Molecular Biology Core/General Elective/Minor Core/General Elective/Minor	Introductory Physics II Upper Division Elective from approved list Core/General Elective/Minor Core/General Elective/Minor
Year 4	
Upper Division Elective from approved list Upper Division Elective from approved list Core/General Elective/Minor Core/General Elective/Minor Biology Seminar (1 unit)	Evolution Upper Division Elective from approved list Core/General Elective/Minor Core/General Elective/Minor

3. Ecology Concentration

Year 3	
Introductory Physics I Ecology Core/General Elective/Minor Core/General Elective/Minor	Introductory Physics I Upper Division Elective from approved list (field) Core/General Elective/Minor Core/General Elective/Minor
Year 4	
Upper Division Elective from approved list (field) Core/General Elective/Minor Core/General Elective/Minor Core/General Elective/Minor Biology Seminar (1 unit)	Evolution Upper Division Elective from approved list Upper Division Elective from approved list Core/General Elective/Minor

Appendix E. Prerequisite / Corequisite Grid - BS in Biology

Course	#	Sem	Conditions for taking this course
General Biology I	105	both	none
General Biology II	106	both	none (can be taken before BIOL 105)
Cell Physiology	212	F	● completion of General Biology I and II, both with ≥ C ● concurrent enrollment in OChem I (CHEM 230), or completion of OChem II (CHEM 231) or Fund OChem (CHEM 236) with ≥ D-
		S	● completion of General Biology I and II, both with ≥ C ● completion or concurrent enrollment in OChem II or Fund OChem with ≥ D-
Genetics	310	F	● completion of General Biology I and II, both with ≥ C ● completion of Cell Physiology with ≥ C ● completion of OChem II or Fund OChem with ≥ D-
		S	● completion of General Biology I and II, both with ≥ C ● completion of Cell Physiology with ≥ C ● concurrent enrollment in OChem II or Fund OChem or completion of OChem II Fund OChem with ≥ D-
Note: *Students enrolled in Genetics may also take on UD course (see below) with permission of the department chair; however, those repeating Genetics may not take an UD Biology course*			
UD courses (see exceptions below)			● completion of Genetics with ≥ C (and all Genetics pre-requisites as listed above) ● completion of OChem II or Fund OChem with ≥ D-
Ecology	319		● completion of Cell Physiology with ≥ C (and all Cell Physiology pre-requisites as listed above) ● Genetics can be concurrent or completed with ≥ C ● OChem II or Fund OChem can be concurrent, or completed with ≥ D-
Biology Seminar	490		● completion of Genetics with minimum grade of C (and all Genetics pre-requisites as listed above) ● completion of OChem II or Fund OChem with > D- ● Seminar should be taken in one of the last two semesters before graduation (not the semester after Genetics)
Evolution	414		● permission ofdepartment chair ● completion of Genetics with minimum grade of C (and all Genetics pre-requisites as listed above) ● completion of at least two upper division Biology electives. ● completion of OChem II or Fund OChem with > D- ● Evolution must be taken in one of the last two semesters before graduation (not the semester after Genetics)
Directed Studies	398, 498 598, 599		● Science GPA pre-requisites: 3.0 for 398 (readings), 3.2 for 498 (Research), and 3.4 for 598/599 (Honors Program)

Note: Courses required for the Biology major may not be taken more than twice to satisfy grade requirements.
Note: No more than two courses required for the Biology major can be repeated.

Appendix F. Placements of Recent Graduates - MS in Blology

- Graduate programs, either PhD (3) or JD (1)
    - University of Colorado PhD program
    - Colorado State PhD program
    - University of Virginia PhD program
    - Creighton University JD program
- Conservation, Biodiversity, Nonprofit Organizations (3)
    - Memphis Zoo
    - Conservation Geneticist, California Botanical Garden
    - Research Data Coordinator, Marine Mammal Center
- Biotechnology, either academic (2) or industry (4)
    - Quality Analysis at Ferrero
    - Copeland's Biosolutions LLC
    - Ragon Institute (Mass General Hospital/MIT/Harvard)
    - Innovative Genomics Institute, U.C. Berkeley
    - Kyverna Therapeutics
    - Vir Biotechnology, Inc
- K-12 teaching (1)
    - Middle School Science Teacher
- State Agency (1)
    - Resource Programs Technician, Sonoma County Water Agency
- Tech (1)
    - CX Lead, Betterment

Appendix G. Assessment Reports

Assessment Report for the 2020-2021 Academic Year
Biology Major (BS in Biology)

Assessment Coordinators:

- Scott Nunes (nunes@usfca.edu)
- Leslie Bach (lbach@usfca.edu)
- Louise Goupil (lgoupil@usfca.edu)
- Brian Young (byoung3@usfca.edu)

Mission Statement:

The core mission of the University of San Francisco is to educate students in the knowledge and skills required to succeed as professionals and as persons, while also teaching the sensitivity and values necessary to participate in a world shared by all people. The Department of Biology particularly emphasizes the core Jesuit value of advancing the freedom and responsibility to pursue truth and to follow evidence to its conclusion. In pursuit of these values, the faculty of the Department of Biology educates undergraduate students in current biological concepts, methodologies, and ethical practices in the laboratory and the natural environment to prepare them to succeed personally and professionally with the potential for advanced training in the sciences.

(No changes since last report)

Program Learning Outcomes:

The BS in Biology program prepares students to:

1. Demonstrate both in-depth and broad knowledge of the concepts that comprise the biological sciences.
2. Apply the scientific process, including designing and conducting experiments and testing hypotheses.
3. Perform laboratory, field, and analytical techniques.
4. Discuss and critically review scientific papers and prepare oral and written reports in a standard scientific format.
5. Demonstrate an awareness of the significance ethics plays in the biological sciences. (No changes since last report)

Curriculum Map:

See attached. (No changes since last report)

Schedule for Assessment of Program Learning Outcomes (PLOs):

- 2014-2015: PLO #5
- 2015-2016: PLO #3
- 2016-2017: PLO #4
- 2017-2018: PLO #1
- 2018-2019: PLO #2
- 2019-2020: PLO #2
- 2020-2021: Reflection based on past assessments.

Methods for 2020-2021 Assessment:

Reflection Based on Passed Assessments:

Faculty members in the Biology Department met on 6 May 2021 to discuss program learning outcomes for the Biology major and strengths and weaknesses in the Biology curriculum based on past assessments.

Results and Findings of 2020-2021 Assessment:

1) Discussion of Program Learning Outcomes:

PLO #2: The scientific process includes communicating results of scientific investigation. The department agreed that this learning outcome should include a writing component, and in particular presenting the rationale for an investigation and the outcome of the investigation in a properly written scientific format. Assessment of this learning outcome in the past has involved rating scientific reports written by students, so it would be appropriate to incorporate a writing component into this learning outcome.

PLO #4: Reading the scientific literature involves analyzing and synthesizing information. The department agreed that these and possibly other specific aspects of writing based on scientific literature be included in this learning outcome. The department agreed that "preparing oral and written reports in a scientific format" fits better in PLO #2, and that the writing component of PLO #4 should focus more on the analytical facets of reading and writing about scientific literature.

PLO #5: Faculty members suggested that "social responsibility" is broader and more general terminology than "ethics," which can have specific definitions. Because the course may emphasize socially responsible behavior, for example in the lab, but not specifically discuss ethics, it was suggested that "ethics" might be replaced with "social responsibility."

During the 2021-2022 academic year, the assessment committee for Biology will take the feedback from the Biology faculty members and use it to revise the PLOs for the Biology major, and then discuss proposed revisions with the faculty.

2) Discussion of the Biology Curriculum:

The department focused on writing as the area that should have priority for revision within the curriculum. Students take writing courses at USF, but these do not cover the specific details of scientific writing. As discussed above, the department identified two main areas of scientific writing that should be covered: 1) presenting the rationale for a scientific investigation and results of the investigation in a scientific format, and 2) presenting a cogent written analysis and synthesis of the scientific literature.

During the 2021-2022 academic year the assessment committee will take the lead on working with the Biology faculty members to create a document providing guidance on the important features of scientific writing to include in Biology courses, and presenting a plan for incorporating these features into courses so that students can build on their writing skills as they progress through the Biology major.

3) Curriculum Map

Although not discussed during the assessment meeting with the Biology faculty, the assessment committee noted that it should update the curriculum map for the Biology major as suggested in feedback from prior assessment reports. The assessment committee will update the curriculum map for the Biology major to reflect revisions to program learning outcomes and to include courses added to the curriculum since the map was last updated.

Assessment Report for the 2020-2021 Academic Year
Biology Minor

Assessment Coordinators:

- Scott Nunes (nunes@usfca.edu)
- Leslie Bach (lbach@usfca.edu)
- Louise Goupil (lgoupil@usfca.edu)
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Mission Statement:

The core mission of the University of San Francisco is to educate students in the knowledge and skills required to succeed as professionals and as persons, while also teaching the sensitivity and values necessary to participate in a world shared by all people. The Department of Biology particularly emphasizes the core Jesuit value of advancing the freedom and responsibility to pursue truth and to follow evidence to its conclusion. In pursuit of these values, the faculty of the Department of Biology educates undergraduate students in current biological concepts, methodologies, and ethical practices in the laboratory and the natural environment to prepare them to succeed personally and professionally with the potential for advanced training in the sciences.

(No changes since last report)

Program Learning Outcomes:

Prior to 2021-2022—The minor program in Biology prepares students to:

1. Demonstrate both in-depth and broad knowledge of the concepts that comprise the biological sciences.
2. Apply the scientific process, including designing and conducting experiments and testing hypotheses.
3. Perform laboratory, field, and analytical techniques.
4. Discuss and critically review scientific papers and prepare oral and written reports in a standard scientific format.
5. Demonstrate an awareness of the significance ethics plays in the biological sciences.

In effect beginning 2021-2022—The minor program in Biology prepares students to:

1. Demonstrate an understanding of the building blocks of life, fundamentals of cells and the foundational theories of biology.
2. Demonstrate an understanding of organismal form, function, and diversity.
3. Demonstrate an understanding of cellular structure and interactions necessary for the maintenance and reproduction of life.
4. Demonstrate an understanding of the principles of genetics, evolution, and ecology.
5. Discuss and critically review biological scientific papers.

Curriculum Map:

See attached. (No changes since last report)

Schedule for Assessment of Program Learning Outcomes (PLOs):

- 2014-2015: PLO #5 from PLOs prior to 2021
- 2015-2016: PLO #3 from PLOs prior to 2021
- 2016-2017: PLO #4 from PLOs prior to 2021
- 2017-2018: PLO #1 from PLOs prior to 2021
- 2018-2019: PLO #2 from PLOs prior to 2021
- 2019-2020: PLO #2 from PLOs prior to 2021
- 2020-2021: Reflection based on past assessments.

Methods for 2020-2021 Assessment:

Reflection Based on Passed Assessments:
Faculty members in the Biology Department met on 6 May 2021 to discuss the Biology minor. Discussions of the curriculum for the Biology minor in the two prior years resulted in revision of the requirements for the minor to include the upper division Biology course in ecology in place of an upper division elective chosen by the student. The rationale for this change was to ensure that all major areas of biology received adequate coverage in the curriculum. In the reflection on the Biology minor there was discussion on the curriculum for the minor, but the focus was aligning the learning outcomes for the minor with the curriculum for the minor.

Results and Findings of 2020-2021 Assessment:

1) Discussion of Program Learning Outcomes:

PLOs #1-4: These learning outcomes are related to demonstrating knowledge related to the areas of biology covered in the minor. The department agreed that these could be combined into a single outcome, or a reduced number of outcomes, related to knowledge gained in the minor. Moreover, the department agreed that the language of the outcomes should more accurately reflect the skills students develop such as conceptualizing, evaluating, analyzing, and explaining biological principles.

PLOs #5: Reading the scientific literature involves analyzing and synthesizing information. The department agreed that this learning outcome could be expanded to writing about the scientific literature, and include analyzing and synthesizing scientific information.

Additional PLOs: The scientific method is covered in all of the classes required in the Biology minor. Students learn basic laboratory techniques and develop basic scientific writing skills to report the results of work they do related to the scientific method. The department agreed that a learning outcome related to applying the scientific method should be developed, and that this outcome should include performing laboratory techniques to evaluate and explore scientific problems, and preparing written reports describing scientific investigations in a scientific format.

During the 2021-2022 academic year, the assessment committee for Biology will take the feedback from the Biology faculty members and use it to revise the PLOs for the Biology major, and then discuss proposed revisions with the faculty.

2) Curriculum Map

Although not discussed during the assessment meeting with the Biology faculty, the assessment committee noted that it should update the curriculum map for the Biology minor as suggested in feedback from prior assessment reports. The assessment committee will update the curriculum map for the Biology minor to reflect changes in the curriculum for the minor.

Assessment Report for the 2020-2021 Academic Year
Natural Science Minor

Assessment Coordinators:

- Scott Nunes (nunes@usfca.edu)
- Leslie Bach (lbach@usfca.edu)
- Louise Goupil (lgoupil@usfca.edu)
- Brian Young (byoung3@usfca.edu)

Mission Statement:

The core mission of the University of San Francisco is to educate students in the knowledge and skills required to succeed as professionals and as persons, while also teaching the sensitivity and values necessary to participate in a world shared by all people. The Department of Biology particularly emphasizes the core Jesuit value of advancing the freedom and responsibility to pursue truth and to follow evidence to its conclusion. In pursuit of these values, the faculty of the Department of Biology educates undergraduate students in current biological concepts, methodologies, and ethical practices in the laboratory and the natural environment to prepare them to succeed personally and professionally with the potential for advanced training in the sciences.

(No changes since last report)

Program Learning Outcomes:

The Natural Science Minor prepares students to:

1. Demonstrate broad knowledge of the concepts that comprise the natural sciences of biology, chemistry, and physics
2. Perform laboratory techniques used to evaluate and explore scientific problems 3. Apply the scientific process

Curriculum Map:

See attached. (No changes since last report)

Schedule for Assessment of Program Learning Outcomes (PLOs):

- 2018-2019: PLO #3
- 2019-2020: PLOs #1 and #3
- 2020-2021: Reflection based on past assessments.

We could not find assessment reports prior to 2018-2019, but believed we had assessed PLOs 1-3 in recent years when making plans for the 2020-2021 assessment.

Methods for 2020-2021 Assessment:

Reflection Based on Passed Assessments:
Faculty members in the Biology Department met on 6 May 2021 to discuss the Natural Science Minor.

Discussions focused on the curriculum for the minor and the Program Learning Outcomes for the minor.

Results and Findings of 2020-2021 Assessment:

Biology faculty members agreed that the curriculum in the Natural Science Minor provides a solid introduction to the sciences, and that the Program Learning Outcomes for the minor accurately reflect the curriculum. We discussed the Biology Minor in the same meeting that we discussed the Natural Science Minor, and in fact used the Natural Science Minor PLOs as a model for discussing revisions to the Biology Minor PLOs and aligning the Biology Minor PLOs with the curriculum for the Biology minor.

We did not realize that we did not have a recent record for assessment of PLO #2 for the Natural Science Minor. We will plan to assess PLO #2 in the 2021-2022 academic year.

Assessment Report for the 2020-2021 Academic Year
Masters in Biology (MS in Biology)

Assessment Coordinators:

• Naupaka Zimmerman (nzimmerman@usfca.edu

Mission Statement:

The MS graduate program in Biology offers a research-intensive experience for post–baccalaureate students in a focused field of Biology. The program seeks to prepare students for further postgraduate work or a technical research profession by developing proficiency in scientific research through critical thinking, inquiry, analysis, teaching, and communication.

No changes since last report.

Program Learning Outcomes:

The BS in Biology program prepares students to:

1. Develop scientific literacy in the areas of biology relevant to selected research interests.
2. Exhibit advanced technical, critical thinking, inquiry and analysis skills.
3. Communicate clearly and persuasively to a variety of audiences.

Curriculum Map:

See attached. (No changes since last report)

Schedule for Assessment of Program Learning Outcomes (PLOs):

- 2015-2016: PLO #4
- 2016-2017: PLO #3
- 2017-2018: PLO #2
- 2018-2019: PLO #4
- 2019-2020: Alternative assessment due to Covid
- 2020-2021: PLO #1

Methods for 2020-2021 Assessment:

All students in the MS biology program are required to take a seminar course once per year that they are in the program. In this course, students view presentations from guest speakers presenting their work and then are required to write an abstract summarizing this work using proper scientific writing form. These abstracts are then evaluated by faculty following the attached 10-point rubric. For the AY 2020-2021 evaluation period, we had 12 graduate students in the program across all cohorts. 11 of these 12 students were in seminar either in the Fall or the Spring semesters, and so their ability to Describe and synthesize concepts and techniques in the current literature within a specific research area (PLO1)

were directly assessed. Note that this evaluation does not specially address the application of concepts and techniques; this has been evaluated via other metrics for the other PLOs since the last APR.

Results and Findings of 2020-2021 Assessment:

In assessing these metrics of students' abilities to "Describe, synthesize, & apply concepts and techniques in the current literature within a specific research area (PLO1)", we found that our students are generally scoring quite high on the rubric metrics for abstract writing and organization (Figure 1), which indicate a high level of ability to interpret, synthesize, and describe modern and cutting-edge techniques within specific research areas. Despite this overall relatively high level of ability for students coming into the program and the class, there is also a significant improvement in rubric scores over the course of the semester, which provides evidence that this element of our curriculum is being effective at improving students' skills in this area.

In many cases, the areas on the rubric where the students lost points most frequently were the ability to tightly and logically structure the flow of ideas in their abstract writing and to evaluate which pieces of information from a long talk are important enough to include in a 200-300 word abstract. These are both higher-level synthesis and writing skills that we work with them to build.

Results and Findings of 2020-2021 Assessment:

These results were shared with the department and the graduate program committee, as well as the rotating set of faculty that teach the seminar course each semester. In response to this observation that the points being lost are frequently those higher-level organizational skills, we have added some additional skills-building days into the seminar course, where students are given instructions and exercises to help build their ability to organize complex information in a concise and logical way. This has anecdotally seemed to improve both student ability and student morale, and future assessments will be able to discern whether this change had a significant impact on student skill improvement over the course of a semester.

Appendix H. Rationale for Changes to Foundational Courses

General Biology I (BIO105) Rationale for Changes

Purpose: This document explains the rationale for altering topics within Bio105 (General Biology I). The main reason for changing these topics is due to a large overlap with material in Bio212 (Cell Physiology). This summary is to explain the intentions behind the new draft of the 105 syllabus. The expectations for each subject are listed below, and also included in the spreadsheet.

Summary:
General Biology I aims to give an overview of the five characteristics of living organisms: 1) all living organisms are made of cells, 2) they acquire and use energy, 3) these cells replicate, 4) they transmit and process information, and 5) populations of organisms evolve over time. This is the current flow of information through the course.

The early material of Gen Bio I (bonds, macromolecules, and cellular structures) would largely be unchanged. To reduce redundancy with Cell Physiology, we should require that students retain the information from this section. To that end, we suggest that Cell physiology presents these as a review module (perhaps on Canvas); more details can be added in Cell physiology (i.e. learning to identify specific amino acids and nucleotides), but the bulk of explanation will come from General Biology.

We propose reducing Bio105's coverage of signal transduction pathways to just the "big picture" (the idea of an amplification cascade, the role of a hormone) without major distinctions or specific proteins. Both GPCRs and RTKs are discussed in great detail in Cell Physiology.

The committee agreed that the coverage of cellular respiration was appropriately detailed for Bio105 and Cell Physiology and that, as this is a complex subject, some redundancy would not cause big problems.

For cellular division, Bio105 does most of the heavy lifting on the phases of mitosis (Cell Physiology focuses instead on mechanisms of cell cycle regulation). Cell Physiology does not cover meiosis at all (it is instead covered in Genetics).

The committee agreed that the current amount of genetics exposure (Mendelian and non-Mendelian) was suitable for Gen Bio as an overview for what will come later in Genetics.

For DNA replication and repair, we suggest removing discussions of the "classic" experiments (Avery and McLeod, Meselson and Stahl, etc.) We also suggest reducing the amount of detail/ memorization of enzymes involved in the replication fork. These details are discussed again in Cell Physiology and Genetics; it is more important that students understand the structure of the replication fork than the details of each enzymatic role.

For the central dogma, transcription, and translation, General Biology's current level seems appropriate. Students practice transcribing and translating DNA, as well as learning the major players in these processes without specifics (i.e. learning about transcription factors in general instead of TFIIB specifically, which is explained in Cell Physiology).

Gene expression is covered in much greater detail in Cell Physiology than in General Biology. While there is redundancy in discussing the *lac* operon, this is a challenging idea for many students, so we believe that this redundancy is acceptable. Also, Cell Physiology adds in additional details for other operons (specifically the *trp* operon). For eukaryotic gene expression, Cell Physiology builds on the General Biology foundation, and overlap is not currently a big problem here.

We propose a reduction in the analyzing/engineering genes lecture, as the current textbook has far too much detail and because students do not get enough lab time to explore all of these techniques. We instead propose focusing on PCR, DNA fingerprinting, and sequencing, as well as exposing students to the ideas of CRISPR and cloning/recombinant DNA, but not with specific detailed mechanisms.

The animal development lecture has been removed and relocated to Bio106, where animal reproduction is discussed in more detail. The principles of development will still be fully discussed, especially its relationship with gene expression.

Many faculty suggested that there was a deficient amount of evolution/ecology in Bio105 currently. Our proposal is that by reducing the overlaps with Cell Physiology, more time will remain to cover these topics. This will allow for time for big picture concepts to "sink in" and provide the opportunity for more depth in certain areas. We propose the addition of a discussion on human evolution (increased depth in evolution by providing a specific example that is interesting/ relevant to the students), and a discussion of climate change (increased ecological depth).

Expectations for each subject:

A. Energy and bonds
- Students should fully understand covalent bonds
  - Cell physiology can focus more on non-covalent interactions

B. Macromolecules
- Keep current level of macromolecules for 105
  - Cell physiology can treat these as a review module (slims down from 4+ lectures to 1)

C. Cellular structures (organelles)
- 105 just does the major functions, endomembrane system, a little bit of vesicular transport
  - This will be review in cell physiology

D. Cell interactions (specifically signal transduction)
- Signal transduction pathways: reduce in 105
  - The committee agreed that the "big picture" was important (the idea of an amplification cascade, the role of a hormone) without major distinctions
  - GPCR vs. RTK pathways are discussed in detail in cell physiology

E. Cellular respiration
- The committee agreed that the current level of discussion on this topic both in Gen Bio and Cell Phys was appropriate. This level consists of:
  - 105: Overall equation, conditions (why does fermentation happen vs. cellular respiration)?, what's happening and why it's happening, what are the requirements, the connection between photosynthesis and cellular respiration
    - When do we use ATP and when do we get it out

        - Emphasize a few enzymes to talk about regulation
        - Students can be shown detailed cycles/reactions, but to illustrate changes, not as major steps to know/understand in detail
    - 212: All the steps of glycolysis, understanding of what goes in/out of the Krebs cycle (understand thoroughly glycolysis steps, describe big ideas of Krebs - maybe not memorize because there's overlap in biochemistry)
        - Know what major molecules look like

F. Mitosis
- Gen Bio should emphasize division of DNA, nomenclature, relationship to cancer
- In cell physiology, this is mostly a recap (more emphasis is placed on activities during the cell cycle)
- Genetics also covers mitosis, but more emphasis is placed on how kinetochores attach to microtubules, mechanisms for separation of chromosomes

G. Genetics (Mendelian and non-Mendelian)
- All these general things are important and more details come later - it's worth introducing the nomenclature, sex-linked vs. not, passing on disorders, and pedigrees, and talk about genetic testing

H. DNA replication/repair
- Remove the classic experiments because they're presented later, and students can't fully understand their relevance in Gen Bio
- The actual mechanics of the replication fork are presented in Gen Bio, Cell Phys, and Genetics. The idea was presented to emphasize the reason the replication fork looks the way it does (why is it synthesized 5' to 3', why a leading and lagging strand exists)
    - Proteins involved should be mentioned (i.e. major roles), but not a huge focus; Cell physiology and genetics can spend more time on the actual mechanisms of how these enzymes interact with DNA
- For repair, major methods are mentioned (DNA proofreading, NER), but not analyzed mechanistically. Cell physiology will cover these in detail, including NHEJ and homologous recombination

I. Central Dogma Basics
- Remove the discussion of Beadle and Tatum ("one-gene, one protein") as it is presented in detail in Genetics
- The current level of this discussion (mRNA, tRNA, genetic codons, etc.) is appropriate

J. Transcription
- Basic discussion of transcription of DNA to RNA
- Mention the big picture of transcription without the details (i.e. mention transcription factors, but not specific ones; show the spliceosome in general, but not specific parts).
- RNA processing is mentioned in the context of alternative products and the importance to the organism/disease

K. Translation
- Basic discussion of how to use a codon chart to make proteins from RNA
- The general structure of the ribosome and translational steps are discussed; in cell physiology, the role/structure of tRNA synthetase is discussed specifically and does not need to be mentioned in 105.

L. Gene Expression (Prokaryotes)
- Discussion of the nomenclature of an operon (promoter, operator, repressor, activator, etc.)
- Discussion of the features and control of the *lac* operon in detail, as well the the big picture of when regulation occurs.
    - Cell physiology does cover the *lac* operon, but additionally has the *trp* operon. Genetics adds the *gal* operon as well - each class with increasing complexity

M. Gene Expression (Eukaryotes)
- Current level is appropriate with general ideas of gene silencing, chromatin condensation affects on gene expression. Cell physiology is much more detailed and builds on these ideas.

N. Analyzing/ Engineering Genes
- We propose keeping PCR, DNA fingerprinting, and sequencing (with a tie in of biotechnology, i.e. "what do companies like 23andMe actually do?)
- Some details about CRISPR should be mentioned
- We propose removing the details of generating recombinant DNA. The overall idea should be discussed (i.e. what is recombinant DNA, how do we generally make it) without emphasis on all the steps. This is mostly because the students do not get a chance to manipulate DNA like this in lab, and it is challenging for them to understand the steps given that they don't have the chance to employ them.

O. Development
- The current lecture of principles of development is appropriate, and should focus on the overall ideas of how gene expression impacts development
    - Mention *Hox* genes specifically
- The committee agreed that the animal development lecture would be better suited to Bio106 than Bio105 as it would allow for a full discussion from gametogenesis through organogenesis in one course.

P. Evolution
- Level of depth is acceptable; time on this subject should be expanded
    - If time permits, specific examples of human evolution can be presented to students as an application of the principles learned in this unit
- Level of depth is acceptable; time on this subject should be expanded
    - Current lectures include evolution by natural selection, evolutionary processes, and speciation

Q. Ecosystems and ecology
- Level of depth is acceptable; time on this subject should be expanded
    - If time permits, specific examples of climate change can be presented to students as an application of the principles learned in this unit
- Current lectures include ecosystems, community ecology, population ecology, and organismal/ behavioral ecology

General Biology II (BIO106) Rationale for Changes

Purpose: This document explains the rationale for altering topics within Bio106 (General Biology II). The main reason for changing these topics is to more thoroughly integrate organismal taxonomy with relevant anatomy/physiology or organisms. This summary is to explain the intentions behind the new draft of the 106 syllabus. The expectations for each subject are listed below, and also included in the spreadsheet.

Summary:
General Biology II aims to discuss the diversity of life ranging from prokaryotes to protozoans, plants, fungi, and animals. General Biology II also specifically discusses the anatomy and physiology of plants and animals.

We propose the addition of a lecture on evolution to start the course. This will help unite the General Biology series and highlight the importance of evolution throughout the Biology major. This should be a very brief discussion of evolution to set up several themes throughout the course: diversity of life, traits derived from common ancestry, and adaptations found in major taxa with emphasis on adaptations for terrestrial life.

We also propose moving Animal Development from General Biology I to General Biology II. As General Biology II spends time discussing reproduction of animals, we feel that this topic fits best in Bio106. This will include discussing fertilization, cleavage, and gastrulation in slightly more detail than it is currently presented.

In order to add in these topics, we propose reducing several smaller areas throughout the course. First, we propose a reduction in the number of taxa presented in the Protist lecture. Students will still be required to learn about the seven lineages of Eukarya and several important examples of protists, but we wish to reduce memorization of groups for memorization's sake. Instead, emphasis will be placed on the evolutionary and ecological importance of these groups.

Second, we propose shifting parts of plant form and function and animal form and function to laboratory exercises. The major functions of tissues in plants and animals will still be discussed in lecture, but a laboratory exercise will help reinforce these ideas more fully and take advantage of the many excellent samples that we already have but underutilize.

Third, we will reduce the discussion of plant nutrition. Great emphasis is already placed on water and sugar transport in plants, and although certainly some information should be given about other nutrients for plants, the current textbook focuses quite a bit on soil composition and chemistry. While important, this has more of an earth-science focus, and instead we can minimize this to focus more on plant interactions with bacteria, or other evolutionary mechanisms to supplement nutrition (carnivory, parasitism, etc.)

Finally, we propose removing the detailed mechanism of actin-myosin contractions in muscle cells. This is explicitly discussed in detail in Cell Physiology (and again in upper division physiology courses).

Expectations for each subject:

A. <u>Evolution Review</u>

- We propose the addition of a basic lecture on evolution. Bio106 relies on the understanding of organisms sharing common ancestry and diverging through time. We suggest opening the course with this concept explicitly. This will be some review for students who have just taken Bio105, and help set up new students to the biology series for success. Also, it will provide a better tie-in of evolution from General Biology up through the Evolution capstone course.

B. Phylogenies
- Students will learn how to read and create basic phylogenetic trees (topic unchanged)

C. Prokaryotes
- Students will learn basic features of prokaryotes as well as the major taxa/classification methods that exist (topic unchanged)

D. Protists
- We suggest a reduction in the current amount of protist coverage. Currently, students learn about the 7 major lineages of Eukarya, their evolutionary paths, and associated synapomorphies. We recommend keeping this level of detail.
  - The book goes into much greater detail of groups within the lineages and the distinguishing traits. We propose cutting these back to 1-2 major examples per lineage to serve as examples of the major roles protists play in ecosystems and related to humans.
- Students will learn basic features of protists as well as the major taxa/classification methods that exist.

E. Green Plants
- This lecture will tie in the evolutionary perspective of traits plants need to survive on land and the four major plant types (nonvascular, seedless vascular, gymnosperms, and angiosperms).
  - Students will learn the major phyla within these groups and distinguishing characteristics

F. Plant form and function
- We suggest a reduction in this lecture by shifting the bulk of exploration of plant tissues/ modifications into a laboratory exercise. The general functions of tissues will be discussed in lecture, but they will be viewed more closely in the lab.
  - We also suggest discussing plant modifications in depth in the lab (i.e. organisms with modified stems, leaves, etc.)

G. Plant reproduction
- This lecture focuses on alternation of generations (first touched upon briefly in the protist lecture) and specifically the reproduction of angiosperms in detail

H. Plant Water and Sugar transport
- This lecture should discuss osmosis in detail - it is presented in Gen Bio I, but not all students will take the series in order, and this is a critical concept through the semester (it is necessary later for animal water balance)
- Discussion of water movement and sugar loading (topic unchanged)

I. Plant nutrition
- We suggest a reduction in this lecture to focus on the very basics: plants get additional nutrients from soil, occasionally aided by nitrogen-fixing bacteria, and sometimes alternative methods (carnivory, parasitism, etc.)

- Much of the current lecture focuses on soil chemistry/ion absorption, which, while important, has more of an earth-science focus.

J. Plant Sensory systems
- This lecture should discuss phototropism (including roles of blue light and red light), and a brief discussion of thigmotropism and gravitropism. Plant hormones can be discussed briefly/ adaptations to predation if time allows.

K. Fungi
- Students will learn basic features of fungi as well as major taxa/classification methods and life cycles that exist (topic unchanged)

L. Introduction to animals
- This lecture will tie in the evolutionary perspective of adaptations possessed by animals (multicellularity, tissues, coelom, etc.)
  - Taxa discussed: Porifera, Cnidarians
- Traits needed for life on land discussed
  - Protostome and deuterostome development discussed

M. Animal Form and Function
- Like the Plant Form and Function lecture, we suggest a reduction could be possible by shifting the bulk of exploration of animal tissues/ modifications into a laboratory exercise. The general functions of tissues will be discussed in lecture, but they will be viewed more closely in the lab.
- The bulk of the lecture should be spent on homeostasis. A preview of major body systems is suggested to prime students to look out for differences between organisms (comparative physiology)

N. Protostomes and Deuterostomes
- These are two large lectures that go through the major taxa of animals. Strong attention should be paid to evolutionary adaptations in each phylum/class, especially in regards to terrestrial life
  - While these lectures do cover a wide range of taxa, we believe it is important to cover these as 1) students will apply the knowledge from these lectures during the anatomy/physiology portion of the course, and 2) students will encounter these examples again in future courses.

O. Animal anatomy and physiology
- Most of these lectures will go unchanged except for the removal of the specific details of muscle contraction. These are covered in detail in cellular physiology and in upper division physiology courses as well.
- We also propose incorporation of animal development into animal reproduction. This was formally in General Biology I, but should instead be covered in General Biology II.
- Although there is overlap between Gen Bio II and Cell Physiology regarding electrical signals/ action potentials, we feel that this topic is both very important and quite challenging for students. We believe this redundancy is acceptable between the two courses.
- Systems include: digestion, gas and circulation, reproduction, nervous (sensory and motor), endocrine, water/electrolyte balance, and immune
  - Throughout each lecture, there should be comparisons between selected taxa from the earlier lectures.

Cell Physiology (BIO212) Rationale for Changes

Purpose: This document explains the rationale for altering topics within Bio212 (Cell Physiology). The main reason for altering the syllabus is due to a large overlap with material in Bio105 (General Biology I). This summary explains the intention behind the new draft of the 212 syllabus. The expectations for each subject are listed below, and also included in the spreadsheet.

Summary:
Cell Physiology aims to describe cellular activities, including structure-function relationships on a molecular and cellular level. This includes a discussion of the major macromolecules in cells and their applications to gene expression, cell metabolism, membrane transport, cell division, and interactions between cells and tissues. Much of the material in this course builds on the fundamentals presented in the General Biology series, specifically Biology 105 (General Biology I).

The major change we propose in the Cell Physiology syllabus is to reduce the overlap of instruction of basic macromolecules and general chemistry that has already been presented in General Biology I. We would require students to retain this information from their previous courses, although we suggest that the use of review activities (i.e. a module on Canvas, quizzes, etc.) be employed in case students are struggling. Instead, course time will be focused on new, more specific and targeted material. This will allow instructors to begin teaching more complex and in-depth material earlier in the semester, and more time can be devoted to analyzing scientific literature.

The current level of most of the subjects that share overlap with Bio105 (cellular respiration, DNA replication, gene expression, etc.) are much more expanded in Cell Physiology. In the current revamp model, most of the material in Cell Physiology will be new or much more detail-oriented than Bio105.

We propose keeping in many of the "classic" experiment stories removed from General Biology I, as we believe that 1) students will be more prepared to understand these concepts and 2) it will prepare students to think about experimental design and data analysis.

Expectations for each subject:

A. <u>Basics of cells</u>
- The differences between prokaryotes and eukaryotes can be a very brief review activity, as can be the subcellular components of cells. This lecture can instead focus on tools used to view cells and model organisms discussed during the course.

B. <u>Chemical components of cells</u>
- This chapter can largely be reduced to discussing non-covalent interactions
  - Bio105 will discuss covalent, ionic, and hydrogen bonds, as well as properties of water. It can be required that students have retained this material from Bio105.

C. <u>Energy, Catalysis, and Synthesis</u>
- This chapter can be combined with the "chemical components" lecture. A review of basic thermodynamics, redox reactions, electron carriers, and enzyme activation energy can be discussed as a review to help set up for future lectures on cell metabolism.

D. <u>Protein Structure and function</u>
  - Students will have already learned basic amino acid structure and protein levels in Bio105. Cell Physiology will still require students to learn the precise structures of all 20 amino acids.

- Methods to study proteins (chromatography, MS, NMR, etc.) will be discussed, as well as regulation of enzymes (both by chemical modifications and binding of small molecules).

E. DNA structure and function
   - "Classic" experiments can be visited here. Complementary base pairing and nucleotide structure should include examining the precise structures of nitrogenous bases.
   - More attention can be paid to overall chromatin structure and methods to modify chromatin condensation

F. DNA replication and repair
   - The replication fork and the precise mechanisms of enzymes involved can be discussed in detail
   - NHEJ and homologous recombination will be new repair mechanisms for students (not discussed in 105)

G. Gene expression
   - Students will have had practice transcribing and translating sequences before. More specifics of mechanisms (especially transcription and RNA processing details) can be worked in.
   - Students will have covered the *lac* operon in Bio105, but revisiting it closely is recommended as it is challenging for many students. The *trp* operon should also be discussed.
   - Eukaryotic transcriptional control is briefly discussed in 105; Cell Physiology should cover more specifics of transcription factors as well as inheritance of gene expression

H. Genome evolution
   - This is an entirely new subject for students that is not covered in Bio105. The textbook has good information on this subject, and it will help students prepare for some aspects of Bio310 (Genetics)

I. Analyzing and Engineering genes
   - Students will have been exposed to PCR and DNA amplification before, but new techniques can be added to this discussion

J. Membrane structure and transport
   - A brief reminder of diffusion/osmosis might be necessary, but most attention should be paid to the makeup of the bilayer and transportation methods (channels and pumps)

K. Cellular Respiration and Photosynthesis
   - This was covered in 105, but are both challenging topics. Cell Physiology should go into much more detail (specific enzymes, learning of structures, etc.)

L. Intracellular compartments and transport
   - This is a fairly new concept for most students; signal sequences are not discussed in 105

M. Cellular communication
   - Students should have learned about hormones in Bio106 and the purpose of signaling pathways in 105, but will not know details. Cell Physiology should include examples of pathways and their roles and regulations in cells

N. Cytoskeleton
   - Students will learn the basic cytoskeletal filaments in Bio105, but no details. Also, we propose removing the details of muscle contraction from 106, so it will be important that these details are covered in Cell Physiology

O. Cellular division

- The phases of mitosis will be reviewed for students. The lecture should be focused on regulation of the cell cycle (Cdks, anaphase-promoting complex, microtubules, etc.) and apoptosis

P. Cellular Communities: tissues, stem cells, and cancer
- This lecture is the culmination of the course, and as such should be given plenty of time for discussion. This lecture will tie in the final three topics specifically (cellular communication, cytoskeleton, cellular division) as well as weave in other aspects of cell physiology covered (gene expression, metabolism, etc.)

Q. Paper discussions
- By reducing the amount of overlap with Bio105, this will allow instructors more time to dedicate to paper discussions, allowing students to have more experience reading, analyzing, and discussing scientific literature.

Appendix I. Modifications to General Biology I Assignments

To improve the quality of student work in designing experiments and writing a lab report, the following changes were implemented in the General Biology I laboratory beginning Fall 2020:

- Citations tutorial and exercise – in partnership with the USF Gleeson library, a tutorial on APA formatting was produced to guide students through proper formatting of citations.
- Mile marker exercises – three short assignments encouraged students to work on their full lab report on their photosynthesis experiment over the course of several weeks. In addition, students were asked to submit portions of the report for review and comments by their lab instructors before finalizing their full reports. The mile marker exercises included:
    - Mile marker 1 – hypotheses and experimental designs; students were asked to design their own experiment to test the effect of light intensity, wavelength, or temperature on oxygen production using an online simulator. Before starting their experiment, students were required to submit two hypotheses and experimental designs, including specifying their independent variable, dependent variable(s), and controlled variables.
    - Mile marker 2 – identify appropriate references for their report and provide complete citations.
    - Mile marker 3 – report the data collected, including a table, graph, and a paragraph appropriate for the Results section of a complete lab report for each experiment.

The addition of these small, interim assignments improved the scores on full lab reports by 4.08 points (6.8%) compared to the semesters prior to Fall 2020 (Table 1, Figure 1).

Table 1. Comparison of student performance on full lab reports before and after implementing mile marker exercises. Student data from five terms (Fall 2017, Summer 2018, Fall 2018, Summer 2019, and Fall 2019) are included for “no mile markers”, while data from three terms (Fall 2020, Spring 2021, and Summer 2021) are included for “with mile markers”.

	Number of Students	**Average Lab Report Score**	**Standard Deviation**	**N earning max score (60 pts)**
No Mile Markers	870	47.93 (79.9%)	7.81	18 (2.1%)
With Mile Markers	259	52.01 (86.7%)	8.17	29 (11.2%)

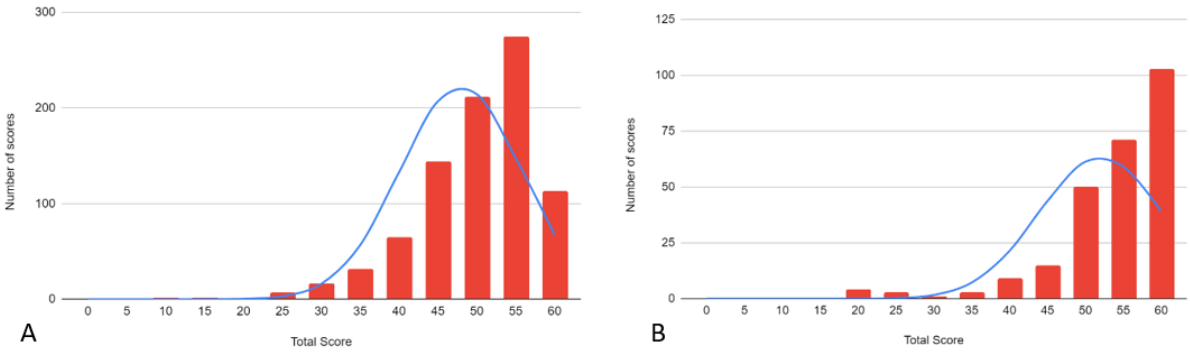

Figure 1. Comparison of total lab report scores pre- and post-implementation of mile marker assignments. **A**. Distribution of scores prior to assigning mile marker assignments. **B**. Distribution of scores after assigning mile marker assignments.

History of Core Assessment Effort

The Core Assessment Working Group (CAWG) is a committee formed in 2015 by the Core Advisory Committee (CAC), a committee made up of department chairs who represent each Core area, faculty representatives from the School of Management and the School of Nursing and Health Professions, as well as the Associate Dean of Academic Effectiveness, with the support of the College Council, in response to College of Arts and Sciences Dean Marcelo Camperi's call for an assessment of the Core Curriculum. That call was issued as a result of faculty concerns surrounding the growth and coherence of the Core, and from the Western Association of Schools and Colleges (WASC) requirement that colleges and universities engage in regular curricular assessment in order to retain their academic accreditation. The USF Core Curriculum had not been assessed since its inception in 2002. In the spring of 2015 the CAC, with the guidance of Associate Dean for Academic Effectiveness June Madsen Clausen, asked that a committee be created to investigate procedures, design materials, and develop and establish a timeline for assessing the Core. CAWG was then constituted by Dean Camperi, with a representative from each area of the College's Core Curriculum. Its initial membership was Tracy Benning (Sciences), Christine Young (Arts), Yaniv Stopnitzky (Social Sciences), and Ronald Sundstrom (Humanities, CAWG Chair). In the spring of 2017, Joshua Gamson replaced Prof. Stopnitzky; in the fall of 2017, Ryan Van Meter replaced Prof. Sundstrom. In spring 2018, Eve-Anne Doohan replaced Prof. Joshua Gamson. Thus the current membership of the committee is Tracy Benning (Sciences, CAWG Chair), Christine Young (Arts), Ryan Van Meter (Humanities) and Eve-Anne Doohan (Social Sciences).

CAWG, with Associate Dean Clausen, created a timeline for assessing the Core (see Appendix A for Core Area Assessment Master Timeline; See Appendix B for D1 and B2 Assessment Process Timeline), and concurrently began to investigate and design materials to support an assessment of the Core. The group conferred with a consultant, Carol Gittens (Associate Dean, Santa Clara University). Based on Gitten's recommendation, CAWG consolidated the 48 learning outcomes from the 11 Core areas (A1 through F) into a simplified and more measurable set of Higher Order Learning Goals (HOLGs) corresponding to each Core area (see Appendix C). The HOLGs were then used to design a draft rubric for each Core area, with the goal of developing rubrics specific enough to offer a meaningful measure of student learning in relation to Core learning outcomes and general enough that they could be applied to student work products from a variety of courses and disciplines within a Core area.

The Core areas were divided into five sets of 2-3 Core areas, with each set due to be assessed once during a five-year period. This assessment process is broken into five phases, with staggered start dates for the different Core area sets. 1) faculty in a Core area are asked to align their Core courses with the respective Core learning outcomes; 2) rubrics for each area are developed with input from faculty teaching in the relevant Core area, and assessable student work products are identified; 3) workshops are conducted both to inform faculty about the assessment process and to recruit faculty raters; 4) student work products are gathered and rated by paid faculty raters; 5) the results are interpreted by CAWG and shared with faculty and administration (see Appendix D for Core Assessment Reporting Protocol).

Process and Methodology for Core Area Assessments - Set 1

Core Areas D1 (Philosophy) and B2 (Natural or Laboratory Science) were selected as the first set to be assessed based on the assumption that CAWG members representing Humanities and Sciences believed their Core area syllabi were already quite well aligned with their Core learning outcomes. This allowed

CAWG to begin work without the semester long syllabi alignment process. As a result, rubric development started immediately. All full-time and part-time faculty teaching D1 and B2 classes were invited to attend rubric feedback sessions in their Core area, to ensure that rubrics remained true to the intentions of the existing Core learning outcomes, would make sense to raters, would reflect the language and practices of the Core area, and when applied to student work products would provide an accurate measure of whether and to what degree the learning outcomes were achieved. The rubrics were each reviewed by faculty teaching in the Core area during two rubric feedback sessions, before their final approval by the CAC in March 2017 (see Appendix E for the Rating Rubrics). In consultation with Core area faculty, CAWG reviewed D1 and B2 syllabi to determine what type of student work products would be available and useful for assessment. For D1, final papers from all D1 courses were collected; for B2, both an exam and lab report were collected. Student work products were then randomly sampled using a stratified approach based on overall course enrollments. However, we were not able to reach our target numbers for every course because many of the work products submitted had to be eliminated from rating for various reasons, such as being incomplete or illegible or not having a corresponding key (See Appendix F for details on the numbers of courses, student work products, and sampled student work products).

Rating workshops, in which the assessment goals and rating methodology were reviewed, were held in April 2017. All D1 and B2 faculty were invited to apply to serve as faculty raters in a daylong assessment of student work products in their Core area, for which they received a $250 honorarium. Six D1 faculty and four B2 faculty participated in rating sessions on May 30, 2017 (D1) and June 6, 2017 (B2) (see Appendix B for a list of participants). Rating was preceded by a calibration process, in which participants rated the same student work products and discussed any discrepancies in their application of the rubric. A portion of the work products was also rated by a second faculty rater to check inter-rater reliability (this procedure is explained later in this report). In total, raters assessed about 25% of the submitted D1 work products and about 16% of the submitted B2 work products.

Assessment Results - Set 1

B2 Natural or Laboratory Science

Results shown in Figures 6-8 reveal that overall, a high percentage of Core Area B2 students are able to explain scientific concepts and principles and conduct investigative analyses using scientific principles. In

addition, almost two-thirds of students are able to apply scientific content to self or the world, considering multiple perspectives and why they matter. Student performance is strongest on Criteria 1 and 2, and moderate in Criterion 3, but overall the results indicate fairly strong performance in this core area. Specifically:

- *Criterion 1: Explains scientific concepts and principles.* More than 80% of the students were rated to be meeting or exceeding expectations in this area, and the remaining 20% were below expectations. About 2% failed to meet expectations altogether.

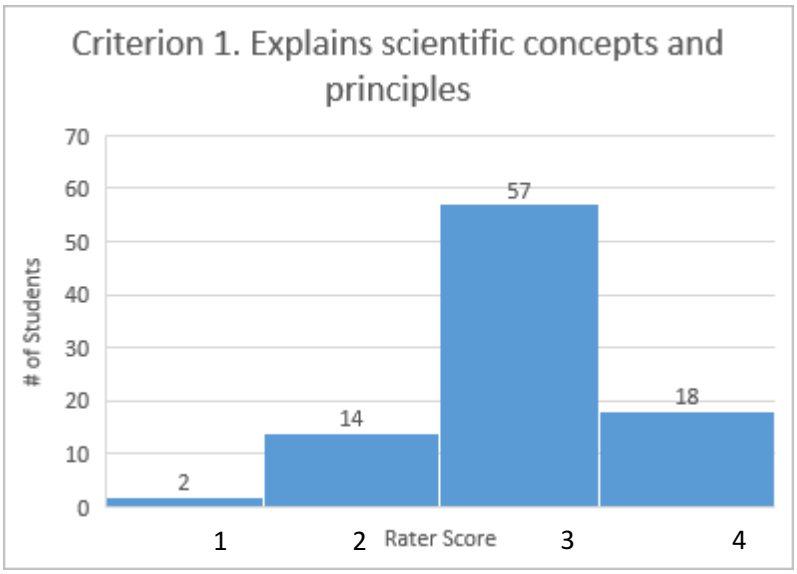

Figure 6. Rating score distribution for sampled B1 work products. A score of 3 or higher indicates that a student has met Criterion 1 competency expectations.

- *Criterion 2: Conducts an investigative analysis using scientific methodology.* Nearly 75% of students were rated to be meeting or exceeding expectations in this area, with 24% failing to meet expectations. In addition, almost 17% of the students sampled failed to demonstrate competency for this criterion. Several raters noted in some cases that products scoring a "1" were the result of not having a "conventional" laboratory product to assess, such as a lab report or lab worksheet reflective of an investigative analysis. If the product did not demonstrate use of investigative analysis techniques such as the application of scientific method/methodology or parts of scientific method/methodology to address a science topic/issue or problem, a rating of 1 was given. This may explain the higher failure rate for this criterion.

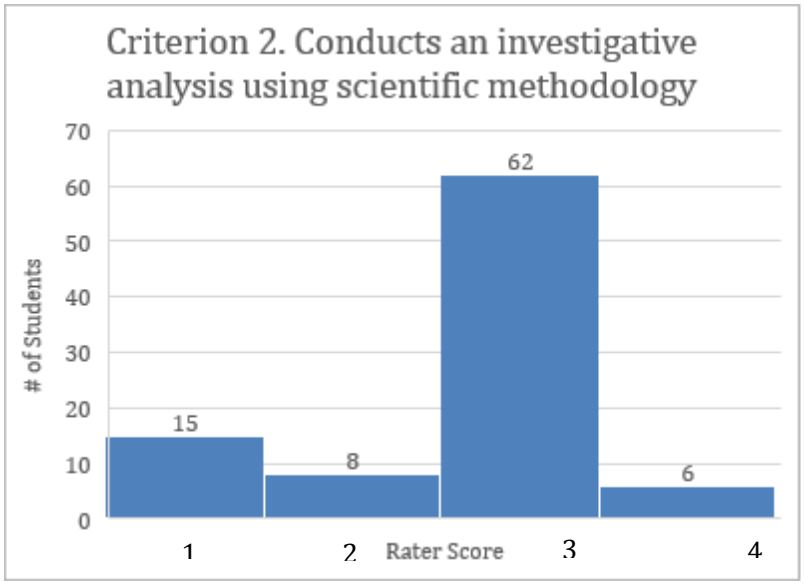

Figure 7. Rating score distribution for sampled B2 work products. A score of 3 or higher indicates that a student has met Criterion 2 competency expectations.

- *Criterion 3: Applies content to self or the world, considering multiple perspectives (e.g., comparative, historical, methodological) and why they matter.* About two-thirds of students were rated to be meeting or exceeding expectations in this area, with about one-third below expectations. About 5% of student work products sampled failed to meet expectations all together. Raters discussed the interpretation of this criterion at length during the calibration process. While there is some ambiguity in how some specific work products demonstrate competency, raters agreed to a broad interpretation of how this criterion would be applied.

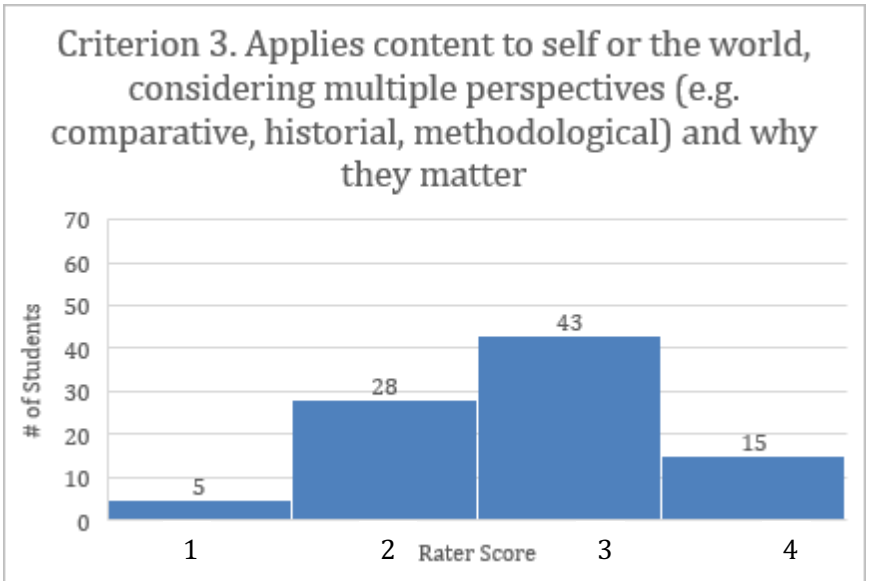

Figure 8. Rating score distribution for sampled B2 work products. A score of 3 or higher indicates that a student has met Criterion 3 competency expectations.

Criteria	Percentage of Students Scoring 3 or Above for B2 Criteria
1	82.4
2	74.7
3	63.7

Table 2. Percentage of students meeting expectations on assessed work. The percentage is based on the number of work products with a rating score of 3 or higher divided by the total number of rated products overall.

Reflections on Assessment Results - Set 1

Reflections on Assessment Results - Set 1

B2 Natural or Laboratory Science

The Core B2 curriculum and instruction as assessed is highly successful in teaching students scientific concepts and principles and teaching aspects of investigative analysis using scientific methodology. In many ways, the assessment of these two criteria is very straightforward and consistent because the HOLGs closely mirror the original Core Learning Outcomes (CLOs). Thus as was assumed at the beginning of our work, results confirm that most B2 core courses were very well-aligned to CLOs and subsequent HOLGs. However, it is problematic that Criterion 2 also had the highest number of work products that did not meet expectations. This was an unexpected result given the nature of Core B2 courses. The laboratory component of B2 courses should be a point of emphasis with work products that clearly demonstrate the use of scientific methodology in an investigative nature. The laboratory portion of these courses should at a minimum provide an authentic laboratory and/or field experience with an appropriate product. Criterion 3 is also an area of concern because it had the lowest competency rate overall. Clearly, this criterion is easier to address in some scientific disciplines. However, raters used very broad interpretations of how this criterion could be met, yet the results were not to the level we would expect. Departments should reexamine how to address this criterion better or whether it should be modified in future assessments.

Inter-Rater Reliability Analysis for Set 1 Raters

Inter-rater reliability is a numerical estimate that measures the degree of agreement among raters when assessing the same work product. Inter-rater reliability was examined to ensure that the assessment process was both accurate and consistent. We used a basic two rater model to calculate percent agreement with both exact and adjacent ratings scored as agreement. Out of the 134 work products rated for D1, a sample of 26 work products (or 19.4 %) was rated twice; out of 91 total work products rated for B2, a sample of 13 work products (or 14. 3%) was rated twice.

Rule of thumb benchmarks for rater data containing 4 or fewer categories (as in the case of both the D1 and B2 datasets) is that a percent agreement of 90% (or higher) constitutes a high agreement, and 75%

is considered minimal agreement. Using these benchmarks, rater agreement on all D1 criteria surpassed the minimal standard, with Criterion 2 having the highest percent agreement at 92% (Table 3).

Criteria	D1 Rater Percent Agreement
1	88.0
2	92.0
3	77.0
4	88.0
5	81.0

Table 3. Inter-rater reliability for D1 criteria based on a two rater method of agreement.

Percent rater agreement for B2 criteria ranged from 92 to 100%, resulting in a high agreement for all criteria (Table 4). For both of the assessed areas, we concluded the calibration process was sufficient to train the raters and that results presented fall within an acceptable reliability range.

Criteria	B2 Rater Percent Agreement
1	100.0
2	100.0
3	92.0

Table 4. Inter-rater reliability for B2 criteria based on a two rater method of agreement.

Next Steps for Core Assessment Reports- Set 1

Following the release of the Core assessment report and any department-specific data, departments and programs will be required to offer their interpretations of the results and to specifically evaluate the Core Learning Outcomes (CLOs) as they apply to courses they teach. Departments and programs will be required to provide feedback on the current set of CLOs for their Core Area and comment on both strategies to address deficiencies that were identified in the assessment process and whether CLOs should be modified as a result of the assessment. Potential outcomes at the department or program level include but are not limited to reporting: 1) modification of current CLOs are necessary, 2) identification of more appropriate student work products for the assessment process, 3) suggesting modifications to the rubric used for the assessment and finally, 4) identifying changes to specific Core courses to better align with CLOs. This information will be collected in a simple Google form designed to capture faculty sentiment at the department or program level after discussion of the assessment results. Once submitted, this form will be sent to the relevant Core Area Chair, the Core Advisory Committee (CAC) co-chairs and the Associate Dean of Academic Effectiveness. A timeline for reporting feedback will be established to align with other required assessment activities and reports for the College. Information from these reports will be used to inform Core Area Chairs and the CAC on the state of Core curriculum and should provide the data necessary to guide any subsequent changes to the Core curriculum.

Appendix K. Faculty Biographies

Leslie Bach, Assistant Professor (Term), received her B.S. in Animal Science from Michigan State University in 2004. She earned her Ph.D. in Genetics from the University of California Davis in 2010 where she studied the causative mutations of long hair in the domestic cat and developed a radiation hybrid panel for the assembly of the cat genome. After completing her doctorate, she began teaching courses in biology, anatomy, physiology, and biotechnology at Gavilan College, College of Alameda, and Holy Names University. In 2017, she joined the biology department at University of San Francisco, where she now teaches courses in General Biology, Human Anatomy, and Human Physiology.

Jennifer Dever, Professor, received her Ph.D. in Zoology from Texas Tech University. She conducted post-doctoral research at the Savannah River Ecology Lab. Her past research area was in the population genetics of threatened and/or endangered populations of vertebrates, including the California native, Federally threatened, foothill yellow-legged frogs. She employed molecular markers to assess the genetic structure with the goal of species conservation. More recently she has been working on the identification of cryptic frog species from south-east Asia. As a research associate at the California Academy of Sciences, she has been collaborating with several scientists on the identification of species new to science using phylogenetic methods.

Louise Goupil, Assistant Professor (term faculty), earned her B.S. degree at the University of California, Berkeley, and her Ph.D in Chemical Biology at the University of California, San Francisco. Her graduate research focused on the role of cysteine proteases in the free-living flatworm Schmidtea mediterranea as a model system for parasitic flatworms. She currently teaches General Biology I (BIOL 105), General Biology II (BIOL 106), Cell Physiology (BIOL212), General Parasitology (BIOL 385/386), and Molecular Biology (BIOL 420). She has also previously taught non-majors courses such as The Science of Life (BIOL 100) and Freshman Year Seminar: Good Germs, Bad Germs (BIOL 195).

Deneb Karentz (MS Oregon State University, PhD University of Rhode Island) came to USF in 1992 and has a joint faculty appointment in Environmental Science. She is a marine biologist with expertise in plankton ecology and ultraviolet photobiology. Her post-doctoral training was at the University of California San Francisco working on the molecular genetics of inherited human disorders related to defects in DNA repair. Her primary area of research has been the biological effects of Antarctic ozone depletion, and she has also continued research collaborations in mammalian DNA repair with UCSF. She provides undergraduate students with research opportunities including participating in field work in Antarctica, studying plankton in San Francisco Bay, and working with colleagues at UCSF. Deneb has taught introductory (majors and non-majors), upper division and graduate courses in USF programs of Biology, Environmental Science and Environmental Management. She is responsible for Biology part-time faculty, facilitating the staffing of 40-50 laboratory and lecture sections each semester.
Deneb has been a rotator at the NSF Office of Polar Programs, and is currently involved in the coordination of international polar research as the US delegate to the Scientific Committee on Antarctic Research (SCAR) and as the SCAR Vice President for Science. In this capacity she is involved in a number of international committees and groups. Deneb serves as a science advisor to the US Department of

State delegation to the Antarctic Treaty System, contributing to the development of environmental management and conservation policies for Antarctica and the Southern Ocean. She is also the co-director for an NSF-funded program that supports the field training of international PhD students and postdocs who are interested in developing careers in polar science.

Sangman Kim, Assistant Professor, received his B.S. in Biological Sciences from UC Davis in 2006. After working as a Chemist at Celera until 2008, he pursued graduate studies at Seoul National University, receiving an M.S. in Biology in 2010 in the laboratory of Dr. Chin Ha Chung. He earned a Ph.D. in Immunology at the University of Chicago in 2018 in the laboratory of Dr. Bana Jabri. His dissertation research focused on developing and characterizing the first pathophysiologically relevant preclinical mouse model of Celiac disease. In addition to his work on Celiac disease he contributed to projects focusing on mucosal immunology and the characterization and treatment of diverse immune-related disorders, such as inflammatory bowel disease, sepsis, and leukemia. In 2019, Prof. Kim joined the faculty at the University of San Francisco, where he runs a research lab that studies a family of receptors that are used by our immune cells to recognize and differentiate between different microbes. Prof. Kim routinely teaches courses in Microbiology, Cell Physiology, and General Biology.

Leslie King, Instructor (term), earned a B.S. in Zoology from U.C. Davis in 1989 and an M.A. in Physiology and Behavior from San Francisco State University in 1993. Her graduate research focused on adult and fetal hemoglobin-oxygen affinities in the oviparous shark *Cephaloscyllium ventriosum*. In 1993 she was hired at U.S.F. as a full-time faculty member where she taught until 2000, at which point she left to teach high school for a semester and then subsequently worked as a bioinformatics technician in the laboratory of Patricia Babbitt at UCSF through 2001. Leslie returned to U.S.F. as a full-time faculty member in 2002 and teaches courses in General Biology, Comparative Animal Physiology, and Human Physiology.

Cary Lai, Associate Professor, majored in Biology and Chemistry at M.I.T. As a Ph.D. student at the U.C. Berkeley, he performed a biochemical and structural analysis of the enzyme telomerase and as a postdoctoral fellow at M.I.T., he studied DNA replication in Drosophila. After transitioning to industry, he worked in early-stage research at Genentech and in commercial operations at LakePharma. Prof. Lai came to USF in 2012, recruited in to help teach in and develop the newly launched Professional Science Master's (PSM) in Biotechnology program. Since 2012, he has taught many of the lecture and lab-based classes in the Biotechnology program as well as undergraduate classes such as General Biology, Cell Physiology, and Molecular Biology. He has also served as Program Director and Associate Director of the PSM in Biotechnology program.

Mary Jane Niles, Professor, received her Diploma in Nursing in 1978 from Binghamton General Hospital School of Nursing and worked as an R.N. until 1986. During that time she completed a B.S. in Cell and Molecular Biology at San Francisco State University (1985). She then went on to the University of California at Berkeley, where, in 1992, she completed her Ph.D. in Immunology. During the subsequent 30 years as a faculty member at U.S.F. Mary Jane has served as a research advisor to ten Masters students and numerous undergraduates; Her research addresses IgM synthesis and assembly in

terminally differentiated B cells, or plasma cells. In particular, she has worked toward the identification and characterization of a rough endoplasmic reticulum (RER)-associated enzyme, which is thought to catalyze the formation of IgM-IgM and J chain-IgM disulfide bridges. Her course repertoire includes Virology, Molecular Biology, Immunology with lab, and Molecular Genetics and Biotechnology with lab (upper-division), and Cell Physiology (lower-division). Mary Jane has contributed chapters on immunology to several textbooks: Campbell's Biology (editions four through seven), Human Physiology by Germann and Stanfield (First edition), The World of the Cell by Becker, Reece and Peonie (Third edition), and Microbiology: A Photographic Atlas for the Laboratory by Alexander and Strete (First edition). In addition, she co-authored Laboratory Exercises in Organismal and Molecular Microbiology by Alexander, Strete, and Niles (McGraw-Hill, 2003, first edition). She served 20 years as an officer of the USF Faculty Association, and during that time she also served as USF's pre-health advisor. Professor Niles continues to serve as advisor to the U.S.F. Chapter of Beta Beta Beta Biological Honor Society, which she has done since 1995.

Scott Nunes, Professor, earned his BA in Biology from the University of California at Santa Cruz and PhD in Zoology from Michigan State University. He did postdoctoral work at Michigan State University and the University of Nebraska at Omaha. He began at USF in 2000, and recent teaching has included General Biology II, Human Anatomy, Comparative Anatomy, and Neurobiology. His research focus is behavioral ecology, with current work examining adaptive benefits of play behavior in young animals. He has studied a population of ground squirrels in the Sierra Nevada off and on since 1993, collecting data during the summer with the help of student field research assistants. He has recently done collaborative work with a research group at UC Berkeley examining neural and endocrine substrates of social behavior in ground squirrels.

John R. Paul, Associate Professor, received a B.S. from The Evergreen State College, a Masters In Zoology from the University of Florida, and a Ph.D. in Biology from the University of Pittsburgh (2008). Focusing on the ecology and evolution of plants, much of his graduate research focused on tropical diversity, conducting extensive field work in Uganda and Costa Rica. John joined USF in 2013 and his lab's research has focused on understanding rarity in plants, with an emphasis on how plant species respond to changing climate. His Masters in Biology students have won numerous competitive grants and scholarships to support their research in plant communities across California and Hawaii. He teaches General Biology II, Molecular Ecology, Field Botany, Ornithology and Evolution. He served as Director of the Biology Masters in Science Graduate Program from 2018 to 2020.

James Sikes, Associate Professor, majored in Biology at Furman University in Greenville, South Carolina. Following five years as secondary education teacher where he taught courses in biology, marine science, and environmental science, he pursued graduate studies at the University of Maryland, College Park. He earned a Ph.D. in Behavior, Ecology, Evolution, and Systematics in 2009 after researching the evolution of asexual reproduction and regeneration in marine flatworms. After completing his doctorate, he completed a postdoctoral fellowship at the Howard Hughes Medical Institute and University of Illinois, Urbana-Champaign studying the molecular and genetic events that have led to reduction or loss of regenerative abilities in certain flatworm lineages. Research in Professor Sikes's laboratory at the

University of San Francisco continues to focus on the evolution and diversification of asexual reproduction and regeneration in both marine and freshwater flatworms. At the University of San Francisco, he routinely teaches courses in Developmental Biology, Invertebrate Zoology, and Evolution. He served as Director of the Biology Masters in Science Graduate Program from 2013-2017 and has served as Department Chair since 2021.

John Sullivan, Professor, graduated from Dartmouth College with a biology degree in 1968. His graduate education at the University of Hawaii, under the direction of the parasitologist Thomas C. Cheng, was interrupted by military service, and he completed his Ph.D. in 1976 in Dr. Cheng's lab at Lehigh University. Prior to joining USF as the Fletcher Jones Chair, Dr. Sullivan worked in a variety of research and teaching positions (UCSF's International Center for Medical Research in Kuala Lumpur, Malaysia, Downstate Medical Center, The National Institutes of Health, The Medical University of South Carolina, Lamar University, and the University of the Incarnate Word). He has also taught both non majors and majors biology summer courses at Stanford University, and parasitology at San Francisco State University and UC Berkeley. At USF, he has taught General Biology I and II, General Parasitology, Histology, and Animal Toxicology. His research is directed at the role of the molluscan immune system in responding to parasitic infection, mainly at the organismal and histological levels, and his studies have been supported by grants from WHO, DOE, NIH, NSF, and other agencies.

Sevan Suni, Assistant Professor, majored in Biology at Colorado College in Colorado Springs, Colorado. She earned her Ph.D. in Biology from Stanford University where she studied the evolution and population genetics of harvester ants. Following her doctorate, she was an NIH Postdoctoral Fellow at the University of Arizona, where she used population genetics to study how bees respond to land use changes. She was then the Darwin Postdoctoral Fellow at the University of Massachusetts Amherst, where she taught courses on scientific writing and conducted research on effects of commercial bees on wild bees. She then became a postdoc in the Organismic and Evolutionary Biology Department at Harvard University, where she studied how drought affects plant trait that mediate the interaction with pollinators. In 2018, Prof. Suni joined the faculty at the University of San Francisco, where she runs a research lab that investigates how human-induced biotic and abiotic changes affect plant-pollinator interactions. She teaches the department's capstone course on Evolution, Insect Biology, and she developed new community engaged learning field courses on Pollination Biology and Plant Biology.

Nicole Thometz, Assistant Professor, majored in Biology at the University of Portland in Portland, Oregon. She earned her Ph.D. in Ecology and Evolutionary Biology from the University of California Santa Cruz in 2014 where she studied the physiological development and behavior of southern sea otters. Following her doctorate, she was a postdoctoral researcher for Dr. Terrie Williams at UC Santa Cruz examining diving physiology in Hawaiian monk seals and reproductive physiology in southern sea otters. In addition, she was a postdoctoral researcher for Dr. Colleen Reichmuth at UC Santa Cruz studying the unique physiology of ice dependent Arctic seals. In 2017, Prof. Thometz joined the faculty at the University of San Francisco, where she continues to run an active research lab and teach several courses in the Biology department. Research in the Thometz Lab focuses on the physiology, ecology, and

behavior of marine mammals. In addition, Prof. Thometz teaches courses in Animal Physiology, Ecology, and Marine Mammalogy, among others.

Brian Thornton, Professor (Term), received his B.S. in Genetics from UC Davis in 1994. He then worked at the University of Washington and the Fred Hutchinson Cancer Research Center as a Research Technician in the laboratories of Dr. Leland Hartwell and Dr. Stephen Friend until 1998. In 1998 he began his Ph.D. in Genetics in the PIBS Tetrad program at UC San Francisco, where he studied the control of cell division in the budding yeast Saccharomyces cerevisiae in the lab of Dr. David Toczyski. He briefly joined the lab of Dr. Denise Monack at Stanford University as a postdoctoral fellow in 2005, but left to pursue teaching full time in 2006. He began teaching part-time at the University of San Francisco in 2008, and was hired as a full-time member of the Department of Biology in 2009, where he now teaches courses in Microbiology, Genetics, Cell Physiology and General Biology.

Christina Tzagarakis-Foster, Professor, majored in Biology at the University of San Francisco, San Francisco, CA. She earned her Ph.D. in Microbiology from the University of California, Davis in 2019 where she studied the v-erb gene of Avian Erythroblastosis Virus (AEV) that codes for avian Thyroid Hormone Receptor. Following her doctorate, she was a postdoctoral researcher for Dr. Dale Leitman at the University of California, San Francisco where she examined the differential gene expression of Estrogen Receptor (ER) alpha and ER beta in human breast cancer. She also investigated protein partners of ER alpha and ER beta in human breast tissue as well as testes. During her tenure as a postdoctoral researcher, she also served as an adjunct professor at Dominican University in San Rafael, where she taught Cell Biology, Microbiology and a non-majors “Science and Society” course. In 2005, Prof. Tzagarakis-Foster joined the faculty at the University of San Francisco. The focus of her research extends from her work as a postdoctoral researcher and explores the role of the orphan receptor, DAX-1, and its role in regulating cancer growth as well as steroidogenesis in the adrenal gland. Prof. Tzagarakis-Foster teaches courses in Endocrinology, Cell Physiology, General Biology and Biology of Cancer. In addition, she has also been closely involved in supporting the Professional Science Master’s (PSM) in Biotechnology and will serve as the Program Director in 2022.

Nico Wagner, Assistant Professor (Term), received his B.S. in Astrophysics, Physics, and Cellular & Molecular Biology from the University of Michigan in 2014. He began his Ph.D. in Biology at Harvard University, where he studied the interplay of RNA structure and translational recoding of the VEGF-A gene in the lab of Prof. Victoria D’Souza. Nico started teaching during his PhD work and switched to full-time teaching upon graduating in 2019. After 2 more years of teaching at Harvard, he began teaching part time at the University of San Francisco in 2021. In 2022, he was hired as a full-time member of the Department of Biology, where he now teaches courses in General Biology, Molecular Biology, and Interdisciplinary Biology lab.

Brian Young, Assistant Professor (term faculty) earned his bachelor’s degree from Western Washington University. He received his Ph.D. from the University of California at San Francisco for his studies on the structural biology of transcription initiation. He performed post-doctoral work at Rockefeller University in DNA replication and at UC Berkeley in cytokinesis. From 2009 to 2011, he worked at Sutro Biopharma, a

biotechnological start-up. In 2012, he shifted to teaching, as an adjunct instructor at UC Berkeley, Skyline College and College of Alameda. He was hired at USF in 2015 to join the growing biotechnology division. He teaches a variety of graduate and undergraduate courses including Molecular Medicine; Molecular Genetics and Biotechnology; and Disease Physiology and Immunology.

Naupaka Zimmerman, Assistant Professor, majored in Environmental Science and Public Policy & Cultural Anthropology (joint major) at Harvard University, graduating with a BA in 2005. After working as a lab technician in a geochemical oceanography lab at Harvard and teaching for a year abroad in Seoul, South Korea, he pursued graduate studies at Stanford. He earned a Ph.D. in Biological Sciences (Ecology and Evolutionary Biology track) in 2013 based on dissertation research in microbial ecology, focused specifically on fungi that live asymptomatically in plant tissues. After completing his doctorate, he completed a postdoctoral fellowship at the University of Arizona in Tucson, AZ, as a Gordon and Betty Moore Fellow of the Life Science Research Foundation. His postdoctoral work expanded the dissertation to focus on mechanisms of interaction between plant and microbes in host leaf tissues using high throughput gene expression assays using RNA-Seq. Current research in Professor Zimmerman's laboratory at the University of San Francisco continues to focus on the ecology of plant-associated microbes, in natural, urban, and agricultural systems. At the University of San Francisco, he routinely teaches courses in Bioinformatics, Ecology, Urban Ecology, and Microbiology. He has served as Director of the Master's of Science in Biology Graduate Program since 2020.

Appendix L. Externally Funded Grants (2014-2022)

Status	Dates	Agency	PI	Grant Title	Award
Closed	2013	NSF	Deneb Karentz	Collaborative Research - supplement for travel funds	$3,600
Closed	2014-2019	NIH	Juliet Spencer	Modification of Host Chemokine Responses by Human Cytomegalovirus	$424,783
Closed	2014-2016	Avon Foundation	Juliet Spencer	Acon Viral IL-10 in Cancer Study	$300,000
No cost extension	2015-2022	NSF	Deneb Karentz	Biological Adaptations to Environmental Change in Antarctica	$215,343
Closed	2017-2018	NSF	Deneb Karentz	Group Travel Award: XIIth SCAR International Biology Symposium	$50,000
No cost extension	2017-2022	NIH	James Sikes	Modifying heads & midlines: Mechanisms of axial polarity modification during development	$423,649
Closed	2017-2020	Henry Luce Foundation	Christina Tzagarakis-Foster	Support of Four CBL Undergraduate Scholarships	$278,080
Closed	2018-2019	NSF	Deneb Karentz	Group Travel Award: XXXVth SCAR Biennial Meetings	$71,000
Active	2018-2023	NSF	MS student	NSF Graduate Research Fellowship Program	$138,000
Active	2019-2022	NOAA	Nicole Thometz	Physiological capacities and constraints of ice-dependent Alaskan seals	$60,426

Closed	2019-2020	NSF	Deneb Karentz	Group Travel Award: SCAR XIII International Symposium on Antarctic Earth Sciences	$35,000
Active	2020	Sea Otter Foundation	Nicole Thometz	Investigating Southern Sea Otter Foraging Ecology at the Northern Range Extent	$4,940
Active	2020-2025	NSF	Deneb Karentz	Support of US Participation in the Scientific Committee for Antarctic Research (SCAR)	$1,178,625
Active	2020-2023	NSF	Naupaka Zimmerman	Development and Validation of a Continuous Soil Respiration Product at Core Terrestrial NEON Sites	$199,106
Active	2022-2025	NSF	Naupaka Zimmerman	Data4Ecology.org: A Learning, Resource, and Community Platform for Computational and Data-Centric Ecology Courses	$79,514

Appendix M. Biology Department Bylaws

Approved and adopted by the faculty by unanimous vote on October 29, 2020.

Preamble

The faculty of the Biology Department has drafted and adopted these Bylaws in order to define a set of principles, organizational structures, and procedures that will enable the smooth and effective operation of the department in furtherance of its mission.

The department bylaws adhere to and are consistent with policies found in the USFFA Collective Bargaining Agreement.

Each faculty member has an equal responsibility in furthering the academic goals and in maintaining the academic excellence of our department. This will be achieved in an atmosphere of collegiality and constructive cooperation.

Voting Membership

Those eligible to vote are all full-time faculty in the Biology Department.

Faculty Meetings and Voting

The purpose of the meetings shall be to disseminate information and to consider matters pertaining to the curriculum, policies, or personnel of the department. Faculty meetings are typically scheduled by the department chair, a minimum of one time per month during the Fall and Spring semesters—but may also be called by petition to the department chair of four voting members. All full-time faculty members of the department are required to attend unless on Sabbatical or otherwise occupied with formal university obligations (e.g. teaching). Exceptions made for professional commitments and personal scheduling conflicts.

Minutes will be kept and shall be made available to members. At the request of any voting member, *Robert's Rules of Order* shall be invoked.

An agenda will be prepared by the party or parties calling the meeting and will be distributed at least one day in advance of the meeting

Attendance at department meetings shall be restricted to the full-time Biology Department Faculty and invited guests.

Votes held outside of department meetings may be taken via an online survey (including electronic mail) when submitted to the Biology Faculty by the department chair or from the chair of any standing departmental committee. Within seven days of the initiation of voting, the Biology Faculty shall communicate their votes to the department chair or the committee chair. The department chair or the committee chair will record the votes and report the results to the Biology Faculty.

Except where these Bylaws specify a different procedure, decisions made by the faculty will be by a vote conducted at a faculty meeting, by letter ballot, or by online ballot. For a faculty meeting, one half of the Voting Membership that are eligible to vote on the measure under consideration constitutes a quorum, and passage of a measure requires a majority of the Voting Membership that is present and eligible to vote on the

measure. Passage of a letter or online ballot requires a majority of the Voting Membership that is eligible to vote on the measure. Except where these Bylaws specify differently, all the Voting Membership is eligible to vote. In addition to whatever other matters are proposed for vote at a faculty meeting, the following matters shall be subject to approval by vote of the faculty as described:

Curricular changes involving creation, deletion, and modifications of requirements for majors, certificate programs, and degree programs. The entire Voting Membership is eligible to vote on these issues. Prior to sending the Dean of the College a recommendation for an offer of new employment in a full time faculty position, the department chair will conduct a poll of the Voting Membership.

Department Chair

The department chair compensation, accountability, and election procedure is stated in the USFFA CBA, Article 25. The Biology Department chair position is a three-year term appointment. The department chair will ensure that all department members are informed on matters of policy.

The Department Chair has the following responsibilities:

1. Administer and manage a departmental budget throughout the academic year.
2. Prepare a proposed schedule of classes for approval by the Dean.
3. Maintain a two-year running tentative schedule of teaching assignments.
4. Prepare proposed curriculum changes for approval by the Dean.
5. Initiate faculty personnel requisitions and, after approval by management, supervise the selection process.
6. Arrange for the advising of students with majors in the department.
7. Serve as chairperson for department meetings.
8. Serve as liaison with the Dean and Associate Dean on departmental matters.
9. Supervise curriculum changes approved by the department in the University Catalog.
10. Approve directed readings and directed research courses.
11. Represent the department at College Council and COSEC and report meeting discussions and outcomes to the faculty.
12. Facilitate discussion between members of the Department Faculty when conflicts arise.

Department Committees

Permanent standing and *ad hoc* committees may be created at faculty meetings, as necessary.

These Bylaws establish and define the responsibilities of permanent committees. These committees are elected by the faculty of the department. In addition to these committees, the department chair may create and appoint additional *ad hoc* committees for specific purposes. Except as specified otherwise in these Bylaws, committee members will come from the Voting Membership of the department.

Awards Committee

1. The Department of Biology Chair shall appoint an Award Committee of three biology faculty members, including at least one full professor. This committee shall:
    a. appoint an Awards Committee Chair
    b. coordinate the distribution of applications

c. review and evaluate the application files to validate the academic record, achievements, curricular and extracurricular activities and letters of support, if applicable; and
d. determine finalists to be presented to the department, in rank order. There shall be no more than three finalists for the Kessel Award and no more than six finalists for the Chihara Semester Awards.

2. The Department shall vote on the recommended applicants for the Chihara Semester Awards and for the Kessel Award. With respect to the latter, the recommended applicant receiving positive votes from more than 50% of the faculty will be granted the Award.
3. The awardee(s) and finalists shall be informed by the Department Chair.
4. The Department will plan an award ceremony or determine an appropriate venue for presentation of the award(s).

Assessment Committee

The Biology Assessment Committee consists of an assessment coordinator and 1-3 additional committee members. The committee is responsible for annual assessment of the Biology major, Biology minor, and Natural Science minor.

- The assessment coordinator prepares and submits annual assessment reports. · The assessment coordinator and other committee members
  - o prepare annual and long-term assessment plans,
  - o collect and rate student work,
  - o review and revise the annual assessment reports prepared by the assessment coordinator,
  - o periodically review and update program learning outcomes, with feedback from Biology faculty members, and
  - o periodically review and update curriculum maps for the Biology major and minor and Natural Science minor.

Exceptions Committee

The Exceptions Committee will consist of two faculty members plus the chair. This committee will review all student requests for exceptions to curriculum requirements. The student's advisor and the Biology department chair will be copied on all correspondence. These exemptions will then be shared with the department so that everyone is aware of the decision and reasons for it.

MS Graduate Program Committee

The MS Graduate Committee will consist of at least two department faculty members plus the director. This committee will deliberate on the requirements for and logistics related to running the MS Biology program, including but not limited to admissions decisions. The committee will make admissions decisions following each admissions cycle in consultation with the faculty wishing to accept applicants in that cycle.

Honors Committee

The Biology Honors Committee is composed of three members. Members volunteer to be on the Committee and are approved by a vote of the faculty. Upper Division Biology majors interested in pursuing an Honors Thesis submit an Honors proposal to the Honors Committee (details of Honors proposal, and requirements to be an Honors students are outlined here: https://myusf.usfca.edu/sites/default/files/cas-biology-honors-description.pdf). All three members of the Honors Committee read over the proposal and approve or disapprove of the proposal. If a proposal is rejected

the Committee provides guidance on how to improve the proposal to be accepted. The Honors Committee also makes sure the student meets all of qualifications (GPA, credit hours) and signs off on a document approving substituting Honor Thesis credit for one Upper Division Biology laboratory or lecture course, contingent on completing the Honors Thesis and completing a total of 4 credits of BIOL 598/599.

Fletcher Jones Endowed Chair

The Fletcher Jones Endowed Chair in Biology was funded by a grant of 1.5 million dollars from the Fletcher Jones Foundation to USF in 1993 for the specific purpose of funding an endowed chair in the Department of Biology. The USF Proposal to the Fletcher Jones Foundation and the Award Letter from the foundation are appended. The chair was envisioned by USF to serve first and foremost as "a "great teacher" for our students. The University proposed to "seek a professor who is passionately committed to the learning experiences of our students and who will have an immediate, positive impact on our curriculum. We want a teacher/scholar who will inspire, challenge, nurture, and lead." Moreover, "Although research will not be the primary focus of the chair holder, the University anticipates that the holder of the endowed chair will be an asset in attracting additional research funds to the University…"

Key terms of the award from the Foundation stipulated that the income generated by the endowment be used by USF "to attract to it a person who is not presently on its faculty, who is recognized as a leader in the field and who will actively teach at the undergraduate level." The grant was expected to "support the Chair in perpetuity." The Foundation intended "that only one person shall occupy the Chair at any one time," and "that the endowment will be invested in such a manner as to provide (1) a competitive attractive salary to the holder of the Chair (2) reasonable support for such of his or her research, writing and laboratory activities as are approved in advance by him or her and (3) growth in the endowment itself…The income which is not paid to or for the holder will be added to and become part of the principal of the endowment." The endowment is not to be used to pay the cost of "locating or obtaining the occupant of the Chair."

When a vacancy for the Chair becomes available, the Biology Department is committed to carefully adhering to the spirit of both the University's grant proposal and the Foundation's grant award, and to hiring a faculty member who (1) fulfills the goals of the University and Foundation and who (2) will become an integral and active member of the Department.

PSM in Biotechnology Director The role of the PSM in Biotechnology Graduate Program Director (GPD) will be served by a faculty member that is part of the Biology program. Responsibilities of the PSM in Biotechnology Director include oversight of the admissions process, scholarship allocation, marketing and communications, budget oversight and management, preparation and submission of annual assessment report, course scheduling, curriculum development, communication with Academic Advisory Board members and handling of student conduct issues. The Director will be selected by an initial discussion with PSM in Biotechnology faculty, followed by a vote by full time faculty members in the Biology department.

Bylaws Revision and Reaffirmation Process

The department bylaws adhere to and are consistent with University policies found in the USFFA Collective Bargaining agreement. This document can be amended by a two-thirds majority of the Voting Membership of the department. Ballots for modification to this document shall be by anonymous online ballot with at least two weeks allowed for response.

Appendix N. Inventory of Biology Teaching and Research Spaces

Inventory of Laboratory Classrooms Used for Biology Laboratory Courses

Room	Lab Courses
Harney 230	BIOL 135-Microbiology (Fall & Spring; Multiple Sections)
Harney 243	BIOL 323-Ornithology (Fall) BIOL 327-Field Botany (Spring) BIOL 332-Herpetology (Spring) BIOL 336-Pollination Biology (Spring) BIOL 380-Conservation Biology (Fall) BIOL 384-Biology of Insects (Fall) BIOL 393-Oceanography (Fall)
Harney 249	BIOL 114-Human Anatomy (Fall & Spring; Multiple Sections) BIOL 116-Human Physiology (Fall & Spring; Multiple Sections) BIOL 353-Comparative Anatomy (Fall) BIOL 363-Histology (Spring)
Harney 264	BIOL 106L-General Biology II (Fall & Spring; Multiple Sections in Spring) BIOL 100L-Science of Life (Fall) BIOL 103L-Human Biology (Fall) BIOL 109-Biology of Human Aging (Every Other Fall) BIOL 311-Genetics (Fall) BIOL 386-Parasitology (Fall)
Lo Schiavo G04	BIOL 316-Biology of Marine Mammals (Spring) BIOL 325-Molecular Ecology (Fall) BIOL 329-Invertebrate Zoology (Spring) BIOL 347-General Microbiology (Fall & Spring) BIOL 356-Developmental Biology (Fall) BIOL 425-Urban Ecology (Spring) BTEC 686-Molecular Genetics and Biotechnology (Spring; Section 2) BTEC 689-Advanced Research Methods in Biotech (Fall; Section 2)
Lo Schiavo 205	BIOL 334-Endocrinology (Spring) BIOL 351-Comparative Animal Physiology (Fall & Spring) BIOL 423-Bioinformatics (Fall) BIOL 444-Immunology (Fall) BIOL 486-Molecular Genetics and Biotechnology (Spring) BTEC 686-Molecular Genetics and Biotechnology (Spring; Section 1) BTEC 689-Advanced Research Methods in Biotech (Fall; Section 1)
Lo Schiavo 208	BIOL 105L-General Biology I (Fall & Spring; Multiple Sections in Fall) BIOL 100L-Science of Life (Spring) BIOL 103L-Human Biology (Spring) BIOL 311-Genetics (Spring; Multiple Sections)

Inventory of Research Space Used by Biology Department

Room	**Research Use**
Harney 213	Faculty research lab: Sevan Suni, Nicole Thometz, and Naupaka Zimmerman.
Harney 220	Faculty research lab: Sangman Kim and John Sullivan.
Harney 224	Shared instrumentation room.
Harney 225	Faculty research lab: James Sikes.
Harney 229	Faculty research lab: Christina Tzagarakis-Foster.
Harney 238	Faculty research lab: Scott Nunes.
Harney 239	Faculty research lab: Jennifer Dever.
Harney 252	Kai Tong Chong Cell Culture Facility; shared teaching and research space.
Harney 254	Faculty research lab: John Paul.
Harney 272	Biology computation room; shared research space.
Harney 314	Freezer room; shared research space.
Harney 323	Interdisciplinary lab; shared teaching and research space.
Harney 446-448	Faculty research lab and darkroom: Deneb Karentz.
Greenhouse	Shared teaching and research space.