MINOR in BIOLOGICAL SCIENCES

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Criterion 1: Quality of Curriculum, Instructional Personnel, and Curriculum Delivery

Contemporary Curriculum

The biological sciences encompass a large set of dynamic and rapidly changing disciplines, and the minor program in Biological Sciences, like the major, must be responsive to current research and discovery in order to provide students with the most relevant academic knowledge and laboratory skills. Importantly, major advances in scientific research have revealed the essential role of molecular biology in all areas of the life sciences. To address changes in the field, the Department of Biological Sciences launched a major restructuring of its programs, adding several new courses and modernizing its degree programs, including the minor. The implementation of the reconstructed degree program represents six years of curricular research and planning, and in the case of the minor, accounted for both flexibility and historical data on which majors tended to select the Biological Sciences minor. In all instances, advances in scientific discovery, needs of the state and local workforce, and student interest were carefully considered in crafting a minor that supports a variety of majors.

Curriculum Rigor

The biological sciences have inherent rigor in both the subject matter and the skills needed to learn and integrate ideas from rapidly changing fields. Understanding biological complexity (e.g. the organization and activity of biological molecules, the transmission and evolution of genomes, the organization, interaction and health of Earth’s biome, and the application of these fields to humans and other organisms) requires:

• detailed learning and integration of ideas from multiple courses (including application of principles from the fields of chemistry, physics, and mathematics)
• the capacity to understand, generate and communicate information using complex technology
• the ability to conduct both laboratory and library-based (primary literature) research, analyze data, and draw evidence-based conclusions
• critical thinking, writing, and oral communication skills that break down complicated theories and data
• accurate use of high-level data acquisition instruments (microscopes, pipettes, spectrometers, etc.)
• problem-solving, scientific reasoning and critical thinking skills
• time management to complete various projects/assessments

Because critical thinking and analysis is so foundational to our program, faculty employ teaching and assessment techniques that require students to be facile with their acquired skills and to demonstrate knowledge in a variety of ways. Our classes employ:

• inquiry-based laboratory protocols and research experiences within classes
• teaching with current technology and instrumentation (particularly in laboratories)
• pedagogical advancements such as interrupted case studies and problem-based learning
• writing, library research, and the use of primary literature
• when possible (even in lectures of 70+), essay exams with questions that require data analysis
• assessment of student skill with regard to experimental design and data portrayal (graphs, figures)
• rigorous pre-requisite courses and minimum math/chemistry knowledge for most courses

Faculty (and staff where appropriate) Qualifications

All full-time faculty members in the department have Ph.D. specializations aligned with their role in the department. Most also have post-doctoral experience and professional training directly related to their area of specialization within the biological sciences. Since the minor has been redesigned to provide students the opportunity to select a set of courses that best support their major and/or career goals, all full-time faculty are engaged to a greater or lesser extent in teaching courses taken by students pursuing the minor. Almost all part-time faculty members also have Ph.D. degrees in the appropriate specialty areas (the few exceptions have Masters degrees in area). Graduate Teaching Assistants (GTAs), who some of the labs for courses often taken by students
in the minor (e.g., BIO 1, BIO 2, BIO 25, and BIO 26) are all pursuing their MA or MS degree in the Biological Sciences and have completed specialized training in scientific pedagogy through our BIO 297A/B courses. While they do not teach, the majority of our technical staff (57%) also have Masters degrees in their area of expertise; the others all have post-baccalaureate training.

**Percent of Instruction by Full-time Faculty**

It is not possible at this time to provide accurate data on either total faculty wtu’s required to support the minor program or the proportion of full-time to part-time faculty in the minor program. This is because there are no courses that are exclusive to the minor. However, we attempt here to give a “gross sense” of the full-time to part-time ratio in all undergraduate programs, knowing that there is a great margin of error in the estimates provided. These estimates, using the Fall 2011 schedule were 156.7 full-time and 175.3 part-time wtu’s for a total of 329 wtu’s. Thus, a gross estimate of the % of instruction by full-time faculty in the undergraduate courses that serve the minor is 47.6%.

**Use of Technology, as appropriate for discipline**

Technology is at the very core of the biological sciences and its use is essential to prepare students to acquire scientific data in today’s high-technology setting. Most courses in Biological Sciences include a laboratory component and the minor requires that at least one of the upper division courses taken for the minor include a laboratory component. Some of the technologies incorporated in course taken for the major and minor include:

- advanced molecular technologies flow cytometry, real-time PCR, and bioinformatic programs
- advanced microscopy technologies and complex graphical analyses programs
- 3-D medical images analysis and logistic of diagnostics techniques
- real-time digital data gathering and sharing systems, including human-based data acquisition
- wireless streaming and cyberlearning technologies, such as wiki-based social learning, instant messaging, social networking and social bookmarking.
Section: Clearly Developed Learning Outcomes

Criterion 2: Clearly Developed Learning Outcomes

Clearly Articulated Program Links to Campus Baccalaureate Learning Goals

In Fall 2011, the Department of Biological Sciences unveiled a completely new curriculum that included a number of new or revised courses that serve students that serve both majors and minors in the Biological Sciences. Since the minor requires both lower and upper division course work in the Biological Sciences, one can assume that the curricular scaffolding present in the major also affects those pursuing the minor.

The implementation of the new major tracks and courses represents six years of curricular research, planning, and the intensive crafting of learning outcomes such that students are able to progress through a set of modern foundational courses with the option to specialize in a sub-area of the biological sciences. While the minor itself does not have specific learning outcomes, the courses within the Department of Biological Sciences have a coherent set that infuse the entire curriculum; therefore, one can assume that the following learning outcomes (developed for all programs within the department) apply, and are directly linked to the baccalaureate learning goals as described below:

1) Students will develop a base of factual and conceptual knowledge of basic and applied biological processes.
   **Baccalaureate learning goals addressed:** Competence in the discipline, Knowledge of human cultures and the physical and natural world, Intellectual and practical skills

2) Students will be able to generate and communicate scientific knowledge.
   **Baccalaureate learning goals:** Competence in the discipline, Intellectual and Practical Skills, Personal and social responsibility, Integrative learning

3) Students will develop and appreciate the importance of connections between other academic disciplines and the biological sciences and the social relevance of biology.
   **Baccalaureate learning goals:** Competence in the discipline, Knowledge of human cultures and the physical and natural world, Integrative learning

4) Students will be able to implement the skills needed to be life-long learners in any field of study.
   **Baccalaureate learning goals:** Competence in the discipline, Knowledge of human cultures and the physical and natural world, Intellectual and Practical Skills, Personal and social responsibility, Integrative learning

To clarify these expectations to students, the Department of Biological Sciences posts these learning outcomes on its website home page ([http://www.csus.edu/bios/](http://www.csus.edu/bios/)). Furthermore, for minors who may not receive this information through the website or advising, course learning outcomes include course-specific summaries of these four learning outcomes within syllabi.

In addition, the intended purpose of the minor is clearly stated in the catalog as follows:

*The minor in Biological Sciences is designed to provide students in other majors with the opportunity to broaden their exposure to and understanding of the biological sciences. The minor complements several majors that require course work in Biological Sciences, including Chemistry, Nursing, Environmental Studies, Health Science, Kinesiology, and Family and Consumer Sciences.*

The “key concepts” identified by the Department pervade the curriculum, and thus affect the minor as well as majors in the department. These concepts are organized into three main areas: Cellular and Molecular Biology, Ecology and Biodiversity, and Structure and Physiology of Living Organisms. Within each of these areas, specific learning outcomes have been identified at factual, conceptual, procedural, and metacognitive levels. As an example, in reference to structural/functional relationships, outcomes include:

- **Factual Knowledge:** Students should recognize and recall examples of the relationship between the structure and functional processes. Examples of this level of understanding include, but are not limited to:
  - Recognizing the cell as the basic unit of life, as well as how the structural elements of the cell relate to the important functions performed by the cell
  - Recognizing that biological communities are composed of different trophic levels that interact to produce complex ecosystems
Section: Clearly Developed Learning Outcomes

- Conceptual Knowledge: Students should have a conceptual understanding of the structure/function relationship. Examples of this level of understanding would include, but are not limited to:
  - Interpreting the importance of feedback loops and homeostatic control in maintaining the internal environment
  - Explaining how the structure of nucleic acids leads to self-replication
  - Differentiating between the fundamentally different processes that control growth and development in plants and animals

- Procedural Knowledge: Students should have an understanding the range of scientific approaches taken to structure/function relationships. Ex. of this level of understanding would include, but are not limited to:
  - Applying the polymerase chain reaction and analyze/evaluate the results of a prescribed experiment
  - Applying the Lotka-Volterra model to analyze data on changes in pop. size within a community

- Metacognitive Knowledge: Students should have the ability to appropriately contextualize and develop strategies to further understanding about the structure/function relationship. Examples of this level of understanding would include, but are not limited to:
  - Designing an experiment to test predictions about biochemical differences between two cell lines
  - Use knowledge of nutrient cycling to develop and test predictions about the influence of human actions on the environment

Updated Plan that Clearly Identifies Program Learning Goals, Assessment Strategies, and Processes by Which Data Inform Program Curriculum Decisions

This portion of the criterion does not apply to the minor.

External Assessment and Accreditation Outcomes, where appropriate

We are currently in the process of Program Review. Our external evaluation is planned for April, 2012.
Criterion 3: Advising Program and Graduation Success

We are particularly proud of our efforts in advising students. Since 2006, the Department:

- implemented a new advising center to provide comprehensive attention to incoming students
- developed and implemented sophisticated online advising tools
- structured our gateway courses to be more inclusive of diverse student learning styles
- began efforts to intrusively advise students at risk of failing introductory gateway courses, recently obtaining (in cooperation with other faculty in our College) a $2 million National Science Foundation (NSF) grant (Project PASS) to support student success in introductory science.

All of these interventions, while targeting majors and those enrolled in service courses within the department, also serve students pursuing the minor. The Natural Sciences Advising Center (NSAC) in particular is a drop-in center for all students, where minors can receive one-on-one advising and advice regarding courses and graduation.

Graduation Rate

This portion of the criterion does not apply to the minor.

Distribution of Advising Responsibilities Among Faculty Members

Students interested in pursuing the minor may visit any of our full-time faculty for assistance. Generally their choice depends on their area of interest (i.e. allied health students would likely choose differently from those interested in environmental issues). In addition, all students are eligible to see an advisor in our advising center (Natural Sciences Advising Center, NSAC); advisors there then refer students to a faculty member in their area of interest, or, if appropriate, handle all of their questions directly. NSAC also provides all students with career advising information.

Proactive Advising Contact with Students to Assure Progress to Degree

This portion of the criterion does not apply to the minor.

Program Roadmap to Curriculum Completion and Graduation Success

The “Roadmap” for minors can vary greatly depending on the types of courses they are interested in pursuing. In some cases of other majors, all or most of the “roadmap” is built into pre-requisites or co-requisites to the major. For example, the B.S. in Environmental Science requires: BIO 1, 2, 160, and 3 additional upper division BIO courses from a specified list. These requirements constitute the minor. Similarly, the BS Biochemistry concentration requires BIO 1, 2, 184 and one additional course from a specified list (which is total different from the Env. Sci list). Although this does not complete a minor, only one additional upper division course is required.

Another important example is Nursing, where pre-requisite course include: BIO 10 or 20, a course in Anatomy, a course in Physiology, and a course in Microbiology. Again, while does not complete the minor, which requires a total of 20 units, 10 at the upper division level, only 1-2 more course would be required to complete the minor.

Use of Technology to Supplement and Strengthen Program Advising Effort

The Department has created and maintains interconnected websites and online tools that allow us to disseminate advising information among faculty as well as direct students to information.

- NSAC – The Natural Sciences Advising Center makes use of online appointments (http://saweb.csus.edu/students/aascheduler/), and maintains a website and Facebook page (http://www.facebook.com/pages/Hot-Stuff-at-NSAC/199202573428705) with current meetings, internships, job opportunities, etc. All websites and appointment and exit survey software were developed or adapted by a Bio Sci faculty member.
- Pre-Health website (http://www.csus.edu/prehealth/): this site is intended for bio majors/minors and other CSUS students interested in a professional health-care related degree program following graduation. The
site consists of approximately 17 web pages of information (and dozens of links) which contain extensive information regarding dozens of health professions, links to on-campus pre-health advisors by major and profession, prerequisite comparison for five of the most common pre-health professional degree programs, links to local health organizations' volunteer contact information, links to campus pre-health student organizations, dozens of links to external programs and ancillary sites, links to other campus advising sites, including: Departmental NSAC, Career Center, and detailed FAQ.

- Department of Biological Sciences website [http://www.csus.edu/bios/](http://www.csus.edu/bios/): this site contains approximately two dozen web pages, most of which are devoted to advising and otherwise empowering students by providing them with tools to find information and help from faculty and staff. It contains 13 pages of advising sheets, links to online syllabi, advisors by specialty, scholarships, employment, internships, seminars, faculty research, student associations, SEE, MOSS, science educational sites, GE courses, and the BIO sections of the catalog.
- Sacsend to inform all minors of upcoming study skills workshops, etc.

**Post-degree Success, Graduate Impact on Community, etc.**

This portion of the criterion does not apply to the minor.
Criterion 4: Strength of Teaching Performance

Note: Faculty teaching in all programs in the Department of Biological Sciences are held to the same standards with regard to teaching performance. Therefore, responses relating to this criterion apply to all Biology programs. The Department of Biological Sciences is committed to quality teaching, and takes pride in the fact that five of its faculty have received the College Outstanding Teaching Award (with more nominated).

Articulated Program Statements regarding Quality of Teaching

Examples of documents that include articulated statements regarding this commitment and selected excerpts from these documents are provided below.

1. Department RTP Policy: Current Department RTP Policy includes the following statements:

   *The Department of Biological Sciences places primary emphasis on Teaching Performance and shall weight performance in this category no less than 55% in the evaluation of candidates for retention, tenure, and promotion. In addition, competent teaching performance shall be the primary and essential criterion for retention, tenure, or promotion.* (note: in practice, the normal weight assigned to teaching performance under current policy is 80%, a weight that is proposed to be reduced to 60% in reviews/evaluations beyond the first couple of years in residence, though still maintaining the eminence of the category).

   *The Department of Biological Sciences is strongly committed to advancing the teaching mission of the University through classroom instruction and non-classroom activities that foster the intellectual and personal development of students.*

2. Department Hiring Policies: When hiring a new full-time tenure-track faculty member, evidence of potential for teaching effectiveness and commitment to teaching is the first consideration brought to bear by the faculty on the Search Committee, and is required by policy set forth in the Department’s Governance model. The job announcement is crafted in such a way as to attract teacher/scholars. A statement such as “teaching experience at the college level is required” is included and applications must include statements of both teaching and research interests. In paper screening selection of candidates for interview, ~40% of the weight is accorded specifically to evidence of potential for teaching effectiveness in assigned courses, including evidence of: breadth of coursework and/or experience in biology, potential for teaching lower division biology for majors, and non-majors, potential for teaching effectiveness in area of specialization, and experience with diverse student groups. During the interview candidates are asked to present a teaching seminar in addition to showcasing currency in the discipline and their scholarly work. As in the case of paper screening, at least 40% of the weight in making a hiring recommendation from among the candidates interviewed is accorded specifically to potential for teaching effectiveness.

   In part-time hiring, candidates are required to provide a statement of qualifications for the teaching assignment, and prior teaching performance evaluations are given substantial weight in rankings.

Ongoing, Meaningful Assessment of Teaching Performance of Faculty, Post-Tenure

Post-tenure, the importance of teaching performance (which is given significant weight in RTP, see above) is given the same weight in promotion from Associate to full Professor as in the earlier RTP cycle. The Department encourages continued excellence in Teaching Performance through a 5-year review process, governed by its Policy on “Evaluation of Tenured Faculty not subject to RTP Review.”

Part-time faculty members are evaluated on an annual basis by the Department’s Executive Committee, which is summarized in a letter to each individual. They are also invited to meet with the Committee to discuss any aspects of their evaluation, and are referred to the Center for Teaching and Learning if they are interested in working on specific aspects of their teaching.
Multiple Measures of Teaching Performance of Full-time and Part-time Faculty Members

Multiple measures include:

- **Student Evaluations:** The Department takes great care to solicit information from students regarding the quality of our teaching in an ongoing fashion. All pre-tenure full-time faculty members and all part-time faculty members (regardless of experience) are required to have all classes evaluated by students every semester. These evaluations are thoroughly reviewed in RTP considerations. Our RTP policy specifies that: while no minimum instructor performance rating is specified as a condition for retention, tenure or promotions, faculty being evaluated should be advised that an average instructor performance rating below 7.5 (on a 10 point scale) across all courses taught will necessitate explanation and substantial evidence of teaching effectiveness from other sources. Faculty members being evaluated are also advised that high instructor performance ratings in student evaluations are not in themselves sufficient to demonstrate teaching effectiveness. Faculty members who have completed the promotional cycle (Full Professors) are also required to have their classes evaluated (at least two courses per year, although most continue to have every course evaluated every semester). Part-time faculty members are required to have student evaluations for all courses taught, and these are carefully considered and heavily weighted by the Department’s Executive Committee in its annual evaluation of Part-time Faculty and by area committees in their review of applications for reappointment.

- **Additional Measures of Teaching Performance:** In all RTP Periodic Evaluations and Performance reviews, candidates must provide a) a reflective statement on teaching (“Overview of Teaching Effectiveness”), and b) Course syllabi and samples of course materials produced by the candidate for courses taught during the semester preceding the evaluation/review. In addition, after the first two years in residence, full-time faculty must provide evidence additional contribution to the teaching mission of the Institution, which extends beyond their effectiveness in classroom teaching. Examples include: evidence of a positive impact upon the lives and achievements of students, evidence of extra assistance for student learning such as preparation of study guides, revisions of laboratory exercises, preparation of audio-visual aids, preparation of tutorial materials, conducting review sessions or open laboratories, providing adjunct courses, and working with study groups, evidence of supervision of students engaged in special activities such as graduate research, undergraduate research, service learning, internships, volunteer work, laboratory preparation, and independent study, and evidence of receiving teaching awards or honors, or other noted contributions to the curriculum. Although multiple measures of effective teaching performance are clearly delineated for full-time faculty, the Department Executive Committee is in the process of considering a request for more detailed information from part-time faculty members as part of their yearly evaluation process. This would include sample exams, class assignments, etc. All tenure-track faculty members are required to participate in reviewing and ranking part-time applications, with priority given to applicants with demonstrated teaching effectiveness. Transcripts, current CVs, a statement of interest and teaching philosophy are required of all applicants and are rigorously assessed during the hiring process.

**Systematic Program Attention to Problematic Individual Teaching Performance**

Full-time faculty members are addressed primarily through the RTP process, where a letter is generated in which each candidate’s strengths and possible areas of improvement are articulated. This feedback allows the candidate to see where Teaching Performance needs improvement. In addition, the Department's RTP policy requires that the Professional Development Committee (consisting of the RTP Committee Chair, Department Chair, and another senior faculty member) follow up with the candidate in a meeting at the completion of each evaluation cycle. As noted above, part-time faculty are invited to meet with the Committee to discuss any aspects of their evaluation, and are referred to the Center for Teaching and Learning if they are interested in working on specific aspects of their teaching. Perhaps, most importantly, the Department adheres to the view that problematic teaching performance can be avoided by its systematic engagement of faculty in activities and discussions with the specific intention of improving curriculum design and improving teaching performance.
Section: Program History and Development Status

Criterion 5: Program History and Development Status

The foundations of the Biological Sciences program as a whole are mature (fun fact: we retain the only CSUS faculty member on staff when the university began), but they are continually evolving as our knowledge of the natural world expands. As a department we have readily responded to these changes with alterations in our curriculum. Thus, although a foundational program that has been in place since this institution began, Biological Sciences – including the minor - may also be viewed as a progressive program that is continually restructuring its offerings and focus in response to the changing demands of the field and of the scientific workforce.

Ability of program to adapt to current demands

As minors can take a variety of different courses within the department, the curricular changes since 2006 affect all students pursuing the minor. These changes, to both lower and upper division courses, were introduced to align with recent advances in the life sciences. One of our new courses, Introduction to Scientific Analysis - BIO 100, which focuses on intermediate skills such as graphic analysis, reading and writing scientific papers, and interpretation of tables and figures, is particularly relevant to students who may be majoring in another field but wish to extend their expertise into the biological sciences.

Courses implemented since 2006 include: Histology (BIO 130), Advanced Problem Solving in Physiology (BIO 131A), Plant Anatomy and Physiology (BIO 128), Cardiovascular/Respiratory/Renal Physiology (BIO 133), Evolution and Speciation in Flowering Plants (BIO 113), Comparative Vertebrate Morphology (BIO 126), Molecular Ecology (BIO 178), Evolution (BIO 188), Medical Microbiology and Emerging Infectious Diseases (BIO 140), Advanced Problems in Immunology (Bio 149C), Cell and Molecular Biology (BIO 121), which was reintroduced as a mid-level course; Advanced Cell and Molecular Biology (BIO 187), BIO 150 (Forensic Biology) and BIO 151 (Advanced Laboratory Techniques in Forensic Biology).

In all instances, advances in scientific discovery, needs of the state and local workforce, and student interest were carefully considered when crafting the course offerings.

Future goals of program

Although cutting-edge topics and techniques have been introduced into our curriculum, the biological sciences are changing so rapidly that we anticipate further restructuring in the future; however, we feel more than adequately prepared to address these needs, as our faculty are now well-versed in the process of Backwards Design and scaffolded curriculum.
Section: Impact, Justification and Centrality to University Mission

Criterion 6: Impact, Justification and Centrality to University Mission

Centrality to the University’s Mission:

Like all programs offered by the Department of Biological Sciences, the minor in Biomedical Sciences program advances the University’s mission through its disciplinary focus on preparation of the workforce needed to address scientific issues affecting the region and the state and its pedagogical emphasis on the development of intellectual and practical skill sets (e.g., inquiry and analysis), which are broadly applicable to understanding and addressing issues beyond the realm of science.

Alignment with the University’s Baccalaureate Learning Goals:

The BA/BS programs are closely aligned with the Baccalaureate Learning Goals. Specifically

- Competence in the Discipline is met through a modern curriculum driven by a well-defined set of learning outcomes that are current, focused and flexible enough to accommodate changes in the field.

- Knowledge of Human Cultures and the Physical and Natural World: The biological sciences focus on the study of the living world, and because scientific understanding is pursued on some level by all human cultures, science is a global endeavor. At all levels of study within our department, contributions of various cultures to the study of science are highlighted and given appropriate focus.

- Intellectual and Practical Skills are developed at all levels of our “three-tier” curricular design (introductory, intermediate, advanced). By its very nature, science involves critical thinking, analysis, quantitative and technological literacy, and problem-solving (both individually and in groups). Students work with lab/activity partners in all introductory and intermediate courses, as well as most advanced classes. Expectations of student lab performance, data analysis, and experimental design scale upward (i.e., are scaffolded) as the student progresses through the curriculum.

- Personal and Social Responsibility are highlighted in all applications of science. As science progresses, especially in its applications to human health, ethical, legal, and societal questions multiply.

- Integrative Learning: As a science, biology has its foundations in the disciplines of mathematics, physics, and chemistry; as such, it is really an applied science that integrates these “basic” sciences along with many other fields that affect its application to our society.

Students in all programs within the Biological Sciences are expected to develop the following intellectual and practical skills: field and lab methodology, the scientific method, reading and writing skills, critical thinking, collaborative skills, literature review and application of concepts in biology. Although courses vary in their emphasis on field or lab methodology, all programs require development of proficiency in the other noted skills necessary to generate and communicate scientific knowledge, and which also have application to other fields of study and life-long learning.

Unique Program Characteristics/Adding Distinctiveness to our Campus

Although minor degree programs in Biological Sciences and/or its subfields are offered in most, if not all, four-year universities, it is likely that there are few that were developed using “Backward Design” and employ the scaffolded learning outcomes design described above under the “Intellectual and Practical Skills” Baccalaureate Goal.
Criterion 7: External Demand for the Program

Community Engagement

Students in the minor program participate in many of our courses, and as such have certainly contributed to the data provided below. As the number of minors in the department (56) represents just 3.5% of our students, this contribution is likely small; nevertheless, we consider it important Since 2006:

- 1,044 students in in our Genetics course have volunteered with organizations that serve developmentally-disabled adults (who may have the genetic abnormalities they are studying). Project Ride (which uses horse therapy) and the Orange Grove Adult Day School are among the projects that have benefitted
- Over 50 students have participated in teaching internships in local K-12 schools
- 160 students have joined our new student-faculty volunteer club, BioCorps, in which students donate at least 100 hours of service to the community in various projects such as Special Olympics, Bone Marrow Drives, Remote Area Medical care, 4-H’s On the Wild Side, and tutoring of local K-12 students.
- 30-35 students/yr (mostly Bio majors) from the Science Educational Equity Program have participated in outreach activities to local K-12 schools, to encourage underrepresented students to matriculate to college

Demand for the Program’s Resources and Expertise

- Our Faculty provide workshops and field experiences in support of academic programs for area high school and middle school students such as the Science Olympiad and the Academic Talent Search.
- Many faculty and staff also give several workshops annually in the Expanding Your Horizons program for young women in the community.
- To serve local K-12 schools, and to make them aware of the diversity of the animal and plant collections in Biological Sciences, staff provide tours through the vertebrate museum and the greenhouses. Since 2006, over 40 tours to 1240+ students in the region from 15 different schools, centers and programs.

Local Trends in Enrollment

We do not have data that demonstrate changes in minor enrollment.

Demand from Employers

Although we do not track data on employer demand for minors, we assume that the inclusion of all or most of the requirements in other degree programs indicates that it provides graduate students in those majors the knowledge and skills necessary to be successful in those fields.
Criterion 8: Program Size, Scope

The minor in Biological Sciences is designed to provide students in other majors with the opportunity to broaden their exposure to and understanding of the biological sciences. It has purposefully been given an open design in order to serve a number of different non-biology majors, which draw on different specialization areas of the Biological Sciences. Specifically, The minor requires a total of 20 units, of which at least 10 must be upper division, and at least one upper division course must include a laboratory component.

The minor complements several majors that require course work in Biological Sciences, including Chemistry, Nursing, Environmental Studies, Health Science, Kinesiology, and Family and Consumer Sciences. In fact, in these majors, most or all of the minor is specified by the major. For example, the B.S. in Environmental Science requires: BIO 1, 2, 160, and 3 additional upper division BIO courses from a specified list. These requirements constitute the minor. Similarly, the BS Biochemistry concentration requires BIO 1,2, 184 and one additional course from a specified list (which is total different from the Env. Sci list). Although this does not complete a minor, only one additional upper division course is required. Another important example is Nursing, where pre-requisite course include: BIO 10 or 20, a course in Anatomy, a course in Physiology, and a course in Microbiology. Again, while does not complete the minor, which requires a total of 20 units, 10 at the upper division level, only 1-2 more course would be required to complete the minor.

Degrees and Certificates Awarded

Using data from SacVault, we were able to determine that on average 24.5 students with minors in the Biological Sciences graduate every year (data averaged from four semesters, Fall 2010-Spring 2011).

Program Enrollment

We do not have a mechanism for tracking the minor. However, there are presently 56 students who have declared a minor in Biological Sciences. We note that because most students do not declare a minor until they are near graduation, this most certainly underestimates the number of students who plan to declare the minor. This is further reflected by the number of students who graduate with this degree every year (24.5). Because the minor may be obtained by any combination of courses within the biological sciences (including GE and service courses), it is impossible to determine the FTES associated with this degree.

Program Resources and Faculty Expertise

Since the minor has been designed to provide students the opportunity to select a set of courses that best support their major and/or career goals, all full-time faculty are engaged to a greater or lesser extent in teaching courses taken by students pursuing the minor. In addition, since the number of minors is small (56 in 2012) in comparison to the large numbers of undergraduate majors in Biological Sciences (currently 1,550), and since there are no minor-specific courses, the minor imposes no significant additional demand on the department.
Criterion 9: Internal, Non-major Demand for the Program

Demand for the Program’s Courses from other Programs

Courses that can be applied to the minor include the full range of upper division major courses and a number of GE/Service courses. The major courses that are most frequently drawn courses or applied to the minor are listed below, along with the majors that they primarily serve: (note, we do not include here the GE courses that serve minors, but cannot be applied to the major—e.g., BIO 10 and BIO 20)

Principal GE/Service/Minor courses (accompanying AY FTES)

<table>
<thead>
<tr>
<th>Service Course</th>
<th>Other majors served</th>
<th>% non-majors</th>
<th>FTES total</th>
<th>FTES non-majors</th>
</tr>
</thead>
<tbody>
<tr>
<td>BIO 1** (Biodiversity, Ecology, Evolution)</td>
<td>Chem, Envt. Stud.</td>
<td>52%</td>
<td>160.33</td>
<td>83.0</td>
</tr>
<tr>
<td>BIO 22 (Anatomy)*</td>
<td>Chem, Nursing, Kins, Health Sci, FACS, “pre-med”</td>
<td>86%</td>
<td>96.0</td>
<td>82.40</td>
</tr>
<tr>
<td>BIO 25 (Anatomy/Physiology I)</td>
<td>Same as above</td>
<td>93%</td>
<td>101.33</td>
<td>94.67</td>
</tr>
<tr>
<td>BIO 26 (Anatomy/Physiology II)</td>
<td>Same as above</td>
<td>95%</td>
<td>66.13</td>
<td>62.67</td>
</tr>
<tr>
<td>BIO 39 (Micro -Allied Health)</td>
<td>Chem, FACS, Nursing, CHDV</td>
<td>98%</td>
<td>13.6</td>
<td>13.33</td>
</tr>
<tr>
<td>BIO 121 (Cell Physiology) *</td>
<td>Chem, Envt Stud, FACS, Nursing, Psych, Business</td>
<td>10%</td>
<td>35.40</td>
<td>3.40</td>
</tr>
<tr>
<td>BIO 122 (Advanced Anatomy)*</td>
<td>Chemistry, Kins</td>
<td>85%</td>
<td>9.07</td>
<td>7.73</td>
</tr>
<tr>
<td>BIO 131 (Systemic Physiology)*</td>
<td>Same as for BIO 22</td>
<td>59%</td>
<td>78.13</td>
<td>45.87</td>
</tr>
<tr>
<td>BIO 139 (General Microbio) *</td>
<td>Same as for 39</td>
<td>44%</td>
<td>68.27</td>
<td>29.87</td>
</tr>
<tr>
<td>BIO 160*</td>
<td>Envt Stud, others</td>
<td>22%</td>
<td>51.00</td>
<td>11.20</td>
</tr>
<tr>
<td><strong>TOTAL NON-MAJOR FTES</strong></td>
<td><strong>424.14</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

*also fulfills major or elective requirements in several programs within Biological Sciences
Section: Quality of Program and Resource Utilization

Criterion 10: Quality of Program and Resource Utilization

Faculty productivity in non-teaching areas

Scholarly and Creative Activity: The Department embraces a broad definition of scholarship, similar to that initially described by Ernest Boyer to include the scholarship of discovery, the scholarship of integration; the scholarship of application; and the scholarship of teaching. Each faculty member is expected to pursue a program of scholarship that is reflected by accomplishments that: 1) contribute to the development or creation of new knowledge, OR 2) contribute to the critical analysis and review of knowledge within disciplines or the creative synthesis of insights contained in different disciplines or fields of study, OR 3) apply findings generated through the above to solve real problems in professions, industry, government, the university, and/or the community, OR 4) contribute to the development of critically reflective knowledge about teaching and learning. This enables the Department to contribute to the University’s multi-faceted mission by encouraging faculty to apply their varied talents, interests, and capabilities in ways that ensure that all facets of this mission receive substantial attention.

Since 2006, faculty members in the department of Biological Sciences (all of whom serve the minor) obtained $14.67 million in grant funding (source: Research and Contract Administration). In addition, faculty members secured over $1 million in donated equipment and supplies (e.g. cell culture hoods, incubators, analysis kits, a mass spectrometer, etc.). Faculty members in this area are also active in research on science education, and collectively have made 127 oral and poster presentations to more than 40 different recognized, national professional organizations (e.g. American Physiological Society, Society for the Study of Evolution, California Association of Medical Laboratory Technology, Human Anatomy and Physiology Society (HAPS), California Wellness Foundation, CSU Academic Council, National Association of Science Teachers, American Educational Research Association, California Science Teachers Association). Finally, many faculty members participate in traditional bench/field research and have published forty-one articles in refereed journals since 2006. (raw data included on departmental website for this process: http://www.csus.edu/bios/temp/quartile_1290847qwel;rj.html)

The Biological Sciences faculty are also well-represented in professional societies, serving leadership roles such as: Reviewers for the National Science Foundation (several faculty), Editorial Board member, Advances in Physiological Education; Chair, American Physiological Society Awards Committee; Program Leader, 4-H “On the Wild Side” program; Team Leader, Sacramento Wildlife Count; President, CSU Biology Council; Faculty Liaison and Steering Committee member, HAPS Institute for graduate study; Co-PI/ Lead Project Director for the state-wide CSU-LSAMP project which engages 22 CSU campuses in effort to broaden participation in STEM; Officer (including President) of the national NIH-NIGMS Bridges to the Baccalaureate Directors Association.

The following programs have been established and supported by the scholarly work of our faculty:

1) Peer-Assisted Student Success (PASS) Program, funded by the National Science Foundation (NSF) ($2,000,000/5 years); collaborative effort with faculty from Chemistry and Physics/Astronomy. This project aims to increase the academic success of students in science gateway courses through early intervention, peer-assisted learning, and study programs;

2) The CSUS (campus –based) Louis Stokes Alliance for Minority Participation Program, serving both NSM and engineering students ($60,000/yr for 5 years) aims to increase the number of students from underrepresented groups graduating from CSUS in the STEM disciplines.

3) Preparation of Pre-Health Professional Students: The Source for Diversity in the Health Professions, funded by the California Wellness Foundation ($160,000 /3 years), supports efforts to increase the number underrepresented students entering health professional schools.

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Section: Quality of Program and Resource Utilization

Service: Faculty in the Biological Sciences engage in serving students in undergraduate programs via:

1) Science Educational Equity (SEE) Program: a comprehensive academic support program for students who face social, economic, and educational barriers to careers in the health professions, science research, and science teaching. Faculty members from our program have directed its activities since its inception; 2) The Health Professions Pipeline Partnership Project (HP^4), funded at different times by the Office of State-wide Health Planning and Development and The California Wellness Foundation ($10,000-15,000 annually), a partnership with local schools which provides science enrichment activities for K-12 students; 3) The Sacramento College Coalition for Future Scientists (aka the CSUS-Los Rios Science Transfer Project), funded from NIH-NIGMS (~1,000,000 over 5 years) aims to increase the number of students from underrepresented groups who transfer from the Los Rios CC District to CSUS to complete baccalaureate degrees in majors related to careers in biomedical research; 4) The California State University-Louis Stokes Alliance for Minority Participation, funded by NSF ($4,000,000/5 yrs). A faculty member from Biological Sciences serves as Lead Project Director for this CSU-wide project; engages 22 CSU campuses in efforts to broaden participation in STEM disciplines.

Service in University Governance

Faculty members from Biological Sciences are well represented on committees at the College and University levels. In the current year, examples include: CTL Advisory Board, Graduation Initiative Steering Committee, Faculty Senate Executive Committee, Academic Information Technology, CSUS Student Research Competition, Animal Care and Use, Program Review Oversight Committee, University Grade Appeal Committee, as well as every College-level committee. Faculty members from our department have also chaired or served on search committees for numerous administration positions and directorships across campus.

Working with other programs

Our faculty are highly collaborative, working with others across campus on projects described above (CSU-LSAMP, PASS, SEE, Noyce) as well as an intra-campus service learning research program with faculty from FACS and Sociology. Three Biological Sciences faculty members are working with the College of Continuing Education on the development of the first Summer Academy for high school students (focus on biotechnology and healthcare career opportunities), and others have written collaborative grants with Teacher Education to provide scholarships for future science teachers. Our faculty have taught in First Year Seminar, which requires a great deal of work across campus lines, and two are also mentors for the Guardian Scholar Program.

Effective sharing of resources

Faculty share resources for both research and teaching. Most faculty share office space (55% of full-time and 100% of part-time), and most research faculty members share lab space and equipment. The CIMERA facility supports integrated research activities by faculty from both Biological Sciences and Chemistry. Faculty in teaching laboratories share equipment (e.g. microscopes, models, centrifuges, incubators and safety hoods). Students from at least five different courses - Clinical Hematology, Parasitology, Developmental Biology, Histology and Neuroanatomy – use the microscope laboratory (which houses our best scopes). This sharing of results in heavy use of this expensive equipment, which is damaging and potentially problematic, as service contracts are not always affordable. One of the most effective examples of collaboration is the Natural Sciences Advising Center (NSAC) in which retired faculty from Biological Sciences and Chemistry as well as current Biology faculty provide academic advising to students in NSM. NSAC is less than three years old but has already provided thousands of students with academic advising and information on how to succeed in the classroom. Finally, the curricula at both the undergraduate and graduate levels are structured to be efficient such that no course “stands alone.” That is, all courses may be used in more than one program. Courses required in a specific concentration are also co-listed as core concept groupings to be used as electives in other programs.
Criterion 11: Revenue and Other Resources Generated by Program

Enrollment-based budgetary support from University

There is no separate enrollment-based budget for the minor. Instead, the Department of Biological Sciences receives budgetary support for all of its programs from the College based on FTEF (for office and facilities expenses) and based on FTES (for instructionally-related expenses). Unfortunately, for the past several years, this allocation has fallen very short of what we need to provide appropriate materials for students in our classes (in 2006-07, our $$/FTES ratio was $69.63/FTES; by 2011-12, the ratio had fallen 29% to $49.70/FTES). To maintain the quality of our program, we have resorted to charging students laboratory and field trip fees for almost every course. While in some ways this may seem like an equitable way to share the cost, we are highly disappointed that students in our program are absorbing the budgetary shortfall.

Research grants, in-kind equipment donations, fundraising

Similarly, since all full-time faculty contribute to the minor and since grants and donations that support research and the instructional program impact both major and minor students, no distinction is made. However, we think it noteworthy to report that, since 2006, faculty members in our Department have obtained $14.67 million in state and federal funding (source: Research and Contract Administration). In addition, faculty members secured over $1 million in donated equipment and supplies (e.g. cell culture hoods, incubators, analysis kits, a mass spectrometer, etc.). This has enabled us to create state-of-the-art laboratory experiences for our students even as the technology rapidly advances and our budget has dwindled. We would be remiss if we did not mention the fact that without these donations, we would be unable to adequately prepare our students for an increasingly complex scientific job market. We feel extraordinarily fortunate to have acquired this equipment.

Value of other services and resources provided

The department also generates at least $5000/AY from students who enroll in our courses through Open University/College of Continuing Education. However, we have no way of knowing at this time, how much of this is generated by minors. This money is used to support teaching labs throughout the department.