B.S. BIOLOGICAL SCIENCES, BIOMEDICAL SCIENCES CONCENTRATION

Faculty Member(s) Responsible for Data:
Jennifer Lundmark
Juanita Barrena
Rose Leigh Vines
Brett Holland
Tom Landerholm
Christine Kirvan
Ruth Ballard
Bill Avery
Shannon Datwyler
Kelly McDonald
Adam Rechs
Rosalee Carter
Winston Lancaster
Criterion 1: Quality of Curriculum, Instructional Personnel, Curriculum Delivery

Contemporary Curriculum

The biological sciences encompass a large set of dynamic and rapidly changing disciplines, and the undergraduate programs in Biological Sciences 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. The implementation of the reconstructed degree program represents six years of curricular research and planning. Complete descriptions, including side by side comparisons of the old and new programs are available on the Academic Affairs website (December 2010): http://www.csus.edu/acaf/PDF_10_11Files/List%20of%20programs/BIO_BA%20&%20BS.pdf. In all instances, advances in scientific discovery, needs of the state and local workforce, and student interest were carefully considered in crafting curricula that will enable students to meet the demands of a rapidly changing and sophisticated STEM (Science, Technology, Engineering and Math) workforce. The BS concentration in Biomedical Sciences is a new degree track that emerged from this process.

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 and advancing 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; the ability to imagine and analyze 3-D constructs
- 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 (elucidating critical vs. irrelevant information), and case analysis
- time management and organizational skills 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 proficient 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 (large lectures) and instrumentation (particularly in laboratories)
- pedagogical advancements such as interrupted case studies and problem-based learning
- writing, library research, the use of primary literature, and making oral presentations
- 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. With regard to the Biomedical Sciences concentration, there are six full-time faculty members, all of whom have Ph.D. training in Anatomy or Physiology to support required courses and electives in the concentration and to provide academic and career advising related to the concentration.
Almost all part-time faculty members, including those who teach the concentration specific core courses, also have Ph.D. degrees in this specialty area (the few exceptions have Masters degrees in area). Graduate Teaching Assistants (GTAs), who teach some of the lower division labs (e.g., BIO 1 and BIO 2), are all pursuing their MA or MS degree in the Biological Sciences and have completed specialized training in scientific pedagogy through our BIO 207A/B courses, which are taught by a faculty member whose research specialty is Science Education. 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. The technical staff member whose primary responsibility is to support the required courses in this concentration has an MS in Physiology.

**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 a specific undergraduate program or the proportion of full-time to part-time faculty in each program. This is because, (1) there are no major courses that are exclusive to a program (i.e., a course that is required/strongly recommended in one program can be used as a required/recommended course or an elective in at least one other degree program); and (2) several major courses also serve a service function to other majors. However, we attempt here to give a “gross sense” of the full-time to part time ratio in undergraduate major programs, knowing that there is a great margin of error in the estimates provided. These estimates, using the Fall 2011 schedule were obtained as follows

1. Obtaining the total numbers of full-time and part-time wtu’s devoted to undergraduate courses. For Fall 2011, these numbers were 156.7 full-time and 175.3 part-time wtu’s for a total of 329 wtu’s.
2. Obtaining the number of full-time and part-time wtu’s devoted to courses that are either closed to Biology majors or have a substantial GE or service function. The courses included in this category were: BIO 1,7,9,10,15L,20,22,25,26,39,121,122,131,139. However, it is important to note again here that many other major courses are taken by non-majors. For Fall 2011, numbers for the listed courses were 54.9 wtu’s full-time and 122.8 wtu’s part-time for a total of 177.7 wtu’s.
3. Calculating total FTES for the courses listed in step 2, and the FTES (number and proportion) attributed to non-majors v. majors. In Fall 2011, these courses generated a total of 962.33 FTES, of which 756.07 (78.56%) were attributed to non-majors.
4. Multiplying the total full-time and part-time wtu’s in the courses listed in step 2 by the proportion of FTES generated by non-majors (i.e. 78.56%) to estimate the number of full-time and part-time wtu’s devoted to teaching non-majors. For Fall 2011, this calculation yields 43.1 full-time wtu’s and 96.47 part-time wtu’s.
5. Subtracting the values obtained in step 4 from the total number of full-time wtu’s and part-time wtu’s devoted to undergraduate instruction (obtained in step 1) to obtain an estimate of the number of full-time wtu’s and part-time wtu’s devoted to instruction of undergraduate majors in all programs. For Fall 2011, these gross estimates are 113.6 full-time wtu’s and 78.83 part-time wtu’s.

Hence, based on the methodology described above, the gross estimate of the % of instruction by full-time faculty in the undergraduate programs is 59%.

**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, and to successfully enter the growing STEM workforce. Some of the technologies incorporated in the Biomedical Sciences include:

- advanced molecular technologies, flow cytometry, real-time PCR, and bioinformatics programs
- advanced microscopy technologies (Motic images 2.1) and complex graphical analyses programs
- 3-D medical images analysis and logistics of diagnostics techniques via direct scans/patient records
- real-time digital data gathering and sharing systems, including human-based data acquisition
- wireless streaming and cyberlearning technologies (e.g. Mastering A&P), 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 complete set of seven substantially revised undergraduate degree programs and one new concentration. The implementation of these degree tracks 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. The B.S. concentration in Biomedical Sciences is the only completely new program, and is designed specifically to prepare students for health professional schools and graduate programs in the biomedical sciences. Using the “Backward Design” process, the undergraduate curricula were designed to meet an agreed upon set of learning outcomes for “key concepts” and “key skills”, which are introduced in the lower division course sequence (BIO 1 and BIO 2), reinforced and expanded in sophomore and junior level courses, and selectively emphasized in a student’s specific degree program. The learning outcomes for all undergraduate programs include the following, 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/). Furthermore, course learning outcomes include course-specific summaries of these four learning outcomes within syllabi.

The “key concepts” identified by the Department are organized into three concept areas with which all majors engage: 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. Examples for structure/physiology (the focus of much of the Biomedical Sciences): Factual - Recognizing the cell as the basic unit of life, as well as the how the structural elements of the cell relate to the important functions performed by the cell; Conceptual - Interpreting the importance of feedback loops and homeostatic control in maintaining the internal environment; Procedural - Applying the polymerase chain reaction and analyze/evaluate the results of a prescribed experiment; Metacognitive - Designing an experiment to test predictions about cardiovascular reactions to stress.

The “key skills” that are introduced in BIO 1 and BIO 2 are: Current field methodology, current lab methodology, the scientific method, reading and writing skills, critical thinking, collaborative skills, literature review and application of concepts in biology. All of the curricula require BIO 100 (Introduction to Scientific Analysis), a course that cannot be articulated with courses at other institutions, and must be taken by both our native students and transfer students as one of the first upper division courses taken within the major and is meant to serve as a bridge course between the lower and upper division. The scientific skills presented in this course reinforce the basic skills introduced in the lower division as well as extending the basic skills to a level where students feel comfortable with generating hypotheses, interpreting results from other studies, and presenting data. Although programs vary in their emphasis on field or lab methodology (this concentration primarily employs lab...
Clearly Developed Learning Outcomes

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.

Since the BS concentration in Biomedical Sciences is designed to prepare students for health professional careers and includes required courses that have direct application to human health, the Personal and Social Responsibility baccalaureate goal also has special significance to the concentration. For example, ethical questions regarding privacy, access to treatment, experimentation involving human and animal models, and the rising cost of medication are discussed in upper division anatomy and physiology.

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

The Department has collected data on various aspects of the prior undergraduate programs that can inform our future evaluations of the new and revised programs introduced in Fall 2011. They include previous departmental assessment reports, assessment of the NSAC advising center, senior survey results, and an alumni survey. Similar strategies will be employed in assessments of the new and revised programs. In addition, for the new curricula, the Department has identified the Experimental Design Ability Test (EDAT), which will address each of the outcomes identified above (1-4) by examining student-driven experimental design. The EDAT, which will be administered for the first time in Spring 2012, assesses students’ knowledge of the basic and critical elements of a good experiment, and depending on the prompt used, the EDAT can be adapted to assess specific factual and conceptual knowledge important to different fields within the biological sciences (learning outcome 1). The EDAT will further evaluate students’ ability to generate and communicate scientific knowledge, as it requires students to design and describe their own experiment in essay format (learning outcome 2). The prompts for this instrument are generated to address authentic problems that have relevance to students’ lives. Students must understand the process and nature of science, but also have the ability synthesize information and make connections to other disciplines in order to evaluate real-world scenarios (learning outcome 3). Lastly, students must employ creativity and other higher order thinking skills, as they analyze the information provided in the prompt, evaluate the claim, and ultimately solve the problem (learning outcome 4).

The EDAT will be administered at several points within the curriculum: in BIO 1 (Introductory level), BIO 100 (Intermediate level), and BIO 131 (Advanced level). An evaluation of EDAT scores at these levels will allow an assessment of student learning throughout the curriculum. Further, this will give an indication of student learning at different levels in order to establish benchmark standards that will be used in informing departmental curricular decisions. In the first administration of the EDAT, the assignment will be a stand-alone assessment (i.e., not integrated into the curriculum). However, future assessment using the EDAT will be incorporated into the curriculum of courses involved so that an assessment of knowledge can be made in an appropriate context.

External Assessment and Accreditation Outcomes, where appropriate

We are currently in the process of Program Review. Our external evaluation is planned for April, 2012.

Additional Information

The catalog description for the Biomedical Sciences concentration provides a succinct statement designed to help students decide whether this concentration is compatible with their interests and future goals. Specifically, it states: The concentration in Biomedical Sciences is designed to prepare students for graduate study in the anatomical and physiological sciences or for health professional training (Medical, Veterinary, Physical Therapy, Nursing, Pharmacy, or other health professions). Although it is possible for students to fulfill prerequisite requirements for health professional schools, while majoring in other programs, this concentration was designed to include these prerequisites and minimize the number of additional units students would have to take.

1 Experimental Design Ability Test (EDAT)

Described in: Sirum and Humburg, Bioscene: Journal of College Biology Teaching Volume 37(1) May 2011
Criterion 3: Advising Program and Graduation Success

We are particularly proud of our efforts in advising students. Between 2006-present, 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.

Graduation Rate

According to the 2011 Fact Book, the 5-year graduation rate for freshmen entering in Fall, 2005 is 23% (6-yr rate = 40%). While we understand that these numbers are indicative of student flow through the University, we have data that show they are highly inaccurate with regard to the graduation rate of our “real” majors, in part because a substantial number of students declare biology without taking, or even intending to take, any actual course work in the degree (e.g. we investigated 40 “declared” biology majors taking a non-majors service course this semester; only 2 intended to complete a Biology degree, the rest were taking pre-nursing course work, with no courses that could apply to the Biological Sciences degree). Biological Sciences attracts individuals interested in health professions (which represent the great majority of incoming freshmen at our orientations); thus, many students declare Biology when they really are interested in Kinesiology, pre-Nursing, or Health Science, and the flow out of the major is large. Additionally, students often declare Biology midway through their academic careers and come to us as juniors or seniors (e.g. in BIO 1, the first majors course, 26% of enrolled students were Jr/Sr Biology majors in Fall 2010); because our course work is specific and sequential, flow into the major includes many students who then take 7 years (or more) to graduate. The take-home message is that institutional statistics are clouded by variables we cannot control. Using SacVault, we have taken 'snapshots' of students at different levels of our program to obtain a more accurate view of the graduation rates of “real” biology majors.

Analysis using BIO 1, first introductory required course (this course has no pre-requisites): 47%* of freshmen taking this course in Fall 2006 (first offering) or Spring 2007, had graduated or were set to graduate by Spring 2011 (5 year mark); 69%* are on track to graduate by Spring 2012 (6 year mark). [*students individually tracked]

Analysis using BIO 184, a mid-level required course: Majors who began here in 2004 (similar data pool to Fact Book) took Genetics around Fall 2007/Spring 2008. Data indicate that in fact, 83% of biology majors taking Genetics during those semesters have graduated, the majority of them (83%) by Spring 2009, the 5-yr mark for the 2004 entering freshmen class. While we are aware it is difficult to separate out transfers from freshmen in this analysis, we note that the Fact Book reports only a 27% 3-yr graduation rate for transfers entering Fall 2007.

Conclusion: It is clear that for “real” biology majors (those who take even the most introductory majors course), the graduation rates are much higher than those indicated by the Fact Book, and are likely between 50-60%.

Regardless, we do note that lower graduation rates tend to be the norm in areas that have difficult lower division requirements (CSU 5-yr graduation rate in STEM disciplines = 34.7%). To that end, we have invested a great deal of faculty energy and resources into the care of our introductory students. Full-time faculty (including our Science Education expert) teach the majority of our lower division core, and these courses are structured to assist students with different learning styles and study skills become as successful as possible. Our new PASS grant (shared with faculty from Chemistry and Physics) is designed to increase student success in gateway courses throughout the College, and we have intrusive advising for all freshmen and transfers. Programs in the College that assist students traditionally at-risk, such as the Science Educational Equity program and the Louis Stokes Alliance for Minority Participation program, have their roots in our department, as our faculty have in large part developed or obtained funding for these programs.
Distribution of Advising Responsibilities Among Faculty Members

Demographic and technological changes have radically changed the way advising is done within the department. In 2006, the department had approximately 916 majors and 26 Full Time Faculty (35:1), where as now we have more than doubled to 1550 majors and 18 FTF* (86:1) [*plus 3 FERP faculty]. The total number of majors greatly exceeds the number of full-time faculty available to advise. Previous attempts at mandatory advising were ineffective due to the high student/faculty ratio, so we amended it to focus on the most at-risk students (freshmen and first-semester transfers); other students are strongly encouraged to see their advisor. Incoming students are required to see an advisor in our advising center (Natural Sciences Advising Center, NSAC); advisors there refer students to a faculty member in their area of interest. All full-time faculty share advising responsibilities, and NSAC provides all students with career advising information. We note that Biomedical Sciences faculty members are primarily responsible for the time-consuming task of advising pre-health students (including several from other majors across campus).

Proactive Advising Contact with Students to Assure Progress to Degree

NSAC was piloted in 2009 to provide more comprehensive advising to incoming students, and has been largely staffed by our invaluable retired faculty who maintain diligent logs about which students visit and why. Using Sign-In software and an Exit Survey designed by Biology faculty, they have compiled information on the 1300+ students that are served by NSAC every semester. Students came for a variety of reasons:

- 86% come seeking advice on course selection
- Many are interested in career advising (75%) or internship opportunities (63%) – NOTE: to address this interest, we now have our Career Center liaison, Shannon Wells, holding office hours in NSAC
- Students come in for help with departmental/university forms (53%), to find a faculty career advisor (51%), or are interested in interpreting transfer credit (44%)
- Academic issues: seeking study tips (37%), looking for study groups (29%) or workshops on study skills or time management (40%) NOTE: to address these concerns, an NSF grant has funded a new staff position to assist with student success in gateway science courses. This new staff member specializes in Early Intervention with at-risk students in our gateway courses. She is housed in NSAC, and her position is funded by the PASS grant, a joint project led by faculty in Biology, Chemistry, and Physics.

Program Roadmap to Curriculum Completion and Graduation Success

We have long published “ideal” schedules for students within the major, for both 4-year and 5-year plans. We regularly publish schedules for courses that are not regularly offered (e.g. odd springs or fall only). Faculty members consult the published multi-year schedule when advising students, and we have created advising templates for all Biology programs. To assist with graduation petitions, a Biomedical Sciences-specific template is available on our website. [http://www.csus.edu/bios/Forms/Grad_AppBiomed.pdf](http://www.csus.edu/bios/Forms/Grad_AppBiomed.pdf)

Use of Technology to Supplement and Strengthen Program Advising Effort

The Department has created and maintains interconnected websites and online tools that have partially offset the impact of the tremendous change in student:faculty ratios, allowing 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/](http://saweb.csus.edu/students/aascheduler/)), and maintains a website and Facebook page ([http://www.facebook.com/pages/Hot-Stuff-at-NSAC/199202573428705](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/](http://www.csus.edu/prehealth/)): this site is intended for bio majors 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
Section: Advising Program and Graduation Success

- 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/): 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 majors of upcoming advising holds, study skills workshops, etc.

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

Our 2009 Alumni Survey (187 respondents, 75% of whom had graduated in the past 3 years) indicated that the largest subset of our graduates had found work in the health care arena (27%), with others working in clinical or research labs (20%) or for the government in some capacity (16%). 20% were in graduate or professional school; all others were employed, with only 2% working in a field unrelated to biology. Perhaps even more telling, 86% of respondents indicated that their employer considered it important that their degree be in the biological sciences.

Our graduates are very successful at gaining entry to graduate and professional programs. A recent survey of faculty (who provided information on all applicants seeking letters of recommendation between 2006-2011; all but two faculty responded) indicated the following: (data www.csus.edu/bios/temp/quartile_1290847qwel;rj.html)

- Medical school: 66 applicants, 41 matriculants = 62% success rate [National avg = 43.5%]
- Dental school: 34 applicants, 19 matriculants = 56% success rate
- Pharmacy school: 39 applicants, 25 matriculants = 64% success rate
- Nursing/Nurse Practitioner: 15 applicants, 12 matriculants = 80% success rate
- Other health care fields (e.g. MPH, vet): 20 applicants, 17 matriculants = 85% success rate
- Graduate programs in science: 114 applicants, 76 matriculants = 67% success rate
- Teaching credential programs: 11 applicants, 10 matriculants = 91% success rate

[Note: These statistics are conservative estimates. Instances where we did not know the fate of the applicant were counted as unsuccessful]

Our success rates are quite high, something we attribute to intrusive, purposeful, and honest advising. If a student is not likely to meet with success when pursuing a particular career, we gently steer them elsewhere so they will reach their professional goals. The concentration in Biomedical Sciences was specifically designed to enhance this process by providing a mechanism for identifying students with health professional school ambitions and has the added benefit of cohorting students through the curriculum, which improves academic success. In the past, most pre-health professional students have been scattered about, primarily in the General BA or General BS, which required that students seek advising for both major requirements and pre-health professional school prerequisites. Students who elect the new Biomedical Sciences concentration will have access to one-stop advising.

Sacramento ranks 22nd among metropolitan areas with the largest employment levels in research, testing and medical laboratories (a work force of 5,101 in 2008; Sacramento Business Journal, 2010). The University of California, Davis Health System, has an "economic impact...close to $3.5 billion...and more than 20,000 jobs” (Center for Strategic Economic Research). The rate of growth of the UCD Health System is substantially greater than other segments of the regional economy. For example, total NIH funding for the School of Medicine has more than tripled in the past 10 years ($200 million in 2011; UCD news room).

The combined growth in biotechnology and medical research in this region makes the concentration in Biomedical Sciences an important pipeline to meet workforce needs for health professionals and technically trained employees. Again the largest subset of graduates had found work in the health care arena (27%). In the same survey, 90% said they were satisfied/very satisfied with the quality of instruction provided by our program, and 62% indicated that their course work with us prepared them very well for graduate/professional school.
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 members 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 (with selected excerpts) 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 Professor to 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 members 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. Professors who have completed the promotional cycle 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 members must provide evidence of 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 members in activities and discussions with the specific intention of improving curriculum design and improving teaching performance.
Criterion 5: Program History and Development Status

Level of program development (e.g. young, growing, mature)

The foundations of the Biological Sciences programs, 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 and methods of studying the natural world expands. As a department we respond to these changes with on-going review and revision of our curricula. Thus, although the foundations of all programs have been in place since this institution began, each program may also be viewed as a work in progress, which responds to changing demands of the field and of the scientific workforce.

Although the concentration is Biomedical Sciences is technically a “new” program (implemented in Fall 2011), and is specifically designed for students interested in pursuing health professional schools, the undergraduate programs in Biological Sciences have always served as the programs that most pre-health professional students pursue. Although it remains possible for students to fulfill pre-requisite requirements for health professional schools while majoring in other undergraduate programs, this concentration was designed to include these prerequisites and minimize the number of additional units students would have to take. In addition, while in the past most pre-health professional students have been scattered about, primarily in the General BA or General BS, requiring two types of advising to ensure satisfaction of both major requirements and pre-health professional school pre-requisites, students who elect this concentration will have access to one-stop advising.

Ability of program to adapt to current demands

In 2006, a new introductory biology sequence – BIO 1 (Biodiversity, Evolution and Ecology) and BIO 2 (Cells, Molecules and Genes) - developed to align with recent advances in the life sciences, was introduced for all undergraduate programs. This was followed by a reexamination of the rest of the curriculum, with the ultimate goal of creating a structure that allows students to specialize within the biological sciences to meet the demands of a rapidly changing and sophisticated STEM workforce. We introduced a new “mid-level” core for all programs consisting of Genetics – BIO 184 (expanded to four units, to include more problem-solving and application of ideas) and a new course, 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. BIO 100 is also the “equalizer” course that combines our native students and transfer students, ensuring that all who pass to the upper division are competent in these vital skills. Removing courses from the core also allowed students to have more specialization in their area of interest. For the BS in Biomedical Sciences, the core for all students includes Introductory Anatomy (BIO 22), General Microbiology (BIO 139), Molecular Cell Biology (BIO 121), Systemic Physiology (BIO 131), General Biochemistry (CHEM 161), and the extended series of Organic Chemistry (CHEM 24, 124, 25), which is required by health professional programs. At least three additional units from the Structure-Function category and three units from the Ecology-Biodiversity category are also required. New Structure-Function electives which will directly benefit this group of students include: Histology (BIO 130), Advanced Problem Solving in Physiology (BIO 131A), Plant Anatomy & Physiology (BIO 128), Cardiovascular, Respiratory, Renal Physiology (BIO 133), Comparative Vertebrate Morphology (BIO 126), Medical Microbiology and Emerging Infectious Diseases (BIO 140), and Adv. Problems in Immunology (Bio 149C).

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. As this “new” program was just introduced in Fall 2011, our immediate focus will be on assessing its success in preparing students academically and through advisement for advancement to health professional schools and advancement to graduate programs in the biomedical sciences.
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 BS concentration 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. In particular, this concentration is designed to prepare students for health professional careers and research in the biomedical sciences.

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 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.

Although students in all programs are expected to develop a base of knowledge in each of three concept areas (Cellular and Molecular Biology, Ecology and Biodiversity, and Structure and Physiology of Living Organisms), the Biomedical Sciences concentration emphasizes the Structure and Physiology area. Similarly, students in all programs 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 programs vary in their emphasis on field or lab methodology (this program places emphasis on lab methodology), all programs require development of proficiency in the other skills necessary to generate and communicate scientific knowledge, and which also have application to other fields of study and life-long learning. Since the BS concentration in Biomedical Sciences is designed to prepare students for health professional careers and includes required courses that have direct application to human health, the Personal and Social Responsibility baccalaureate goal also has special significance to the concentration.

Unique Program Characteristics/Adding Distinctiveness to our Campus

Although BA/BS degree programs in Biological Sciences and/or its subfields are offered in most, if not all, four-year universities, it is likely that 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 and explained in greater detail under question 8.

As should be expected, the nearest 4-year university offering baccalaureate degrees in the biological sciences is UC Davis. All of the UCD programs, most of which are housed in their College of Biological Sciences, are designated as BS programs. UCD offers a general BS in Biological Sciences and BS degrees in specific
subfields, most of which are represented in the concentrations offered at Sacramento State. The UCD program that is most similar to the CSUS Biomedical Sciences concentration is the BS major in Neurobiology, Physiology and Behavior. Sacramento State’s programs can be distinguished from the UCD programs in two very important ways. First, Sacramento State’s programs (including concentrations) require upper division coursework in each of three designated concept areas. This greater breadth at the undergraduate level provides students a wider range of employment opportunities, as well as the ability to more readily change areas of specialization. Second, the BA/BS programs at Sacramento State have a much stronger laboratory/field component. Unlike the programs at UCD, where most labs are offered as separate and optional courses (and taught by graduate students), most labs at Sacramento State are embedded with the lecture component of the course (and most are taught by faculty), providing opportunity for one-one attention and engagement of active learning and the “doing of science.” And, it is the laboratory “know how” that makes our students competitive for jobs and for acceptance into graduate programs and health professional schools.

Although we are proud of the distinctive qualities noted above, it is equally important to note that the Biomedical concentration also includes similar courses and experiences. We show these similarities in the table below.

<table>
<thead>
<tr>
<th>UC Davis</th>
<th>Sacramento State</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>BS Major in Neurobiology, Physiology</strong></td>
<td><strong>BS in Biological Sciences,</strong></td>
</tr>
<tr>
<td>and Behavior</td>
<td>Concentration in Biomedical Sciences</td>
</tr>
<tr>
<td>The major requires strong foundations</td>
<td>During freshman and sophomore years, the program</td>
</tr>
<tr>
<td>in the quantitative disciplines of math,</td>
<td>requires the following foundational courses in math,</td>
</tr>
<tr>
<td>chemistry and physics. During the</td>
<td>chemistry, physics and general biology:</td>
</tr>
<tr>
<td>freshman and sophomore years, students</td>
<td>BIO 1 and BIO 2; CHEM 1A, 1B, 24, 25 and 124; PHYS 5A</td>
</tr>
<tr>
<td>take courses in math, chemistry, physics</td>
<td>and 5B; Math 26A or Math 30; and STAT 1.</td>
</tr>
<tr>
<td>and general biology.</td>
<td></td>
</tr>
<tr>
<td>As a part of the College of Biological</td>
<td>As majors in Biological Sciences, students in the</td>
</tr>
<tr>
<td>Sciences, students then take a common</td>
<td>concentration take a common upper division curriculum,</td>
</tr>
<tr>
<td>upper division curriculum in genetics,</td>
<td>which includes Genetics (BIO 184) and Introduction to</td>
</tr>
<tr>
<td>biochemistry, and cell biology, disciplines</td>
<td>Scientific Analysis (BIO 100). In addition,</td>
</tr>
<tr>
<td>essential for all students studying any</td>
<td>students in this concentration take upper division</td>
</tr>
<tr>
<td>area within modern biology.</td>
<td>courses in Biochemistry (Bio 161) and Molecular Cell</td>
</tr>
<tr>
<td>As NPB majors, students take an</td>
<td>Biology (BIO 121).</td>
</tr>
<tr>
<td>additional course in cellular</td>
<td></td>
</tr>
<tr>
<td>neurobiology, a course in systemic</td>
<td>For the specialization in Biomedical Sciences,</td>
</tr>
<tr>
<td>physiology, and a course in behavior.</td>
<td>students are required to take a course in systemic</td>
</tr>
<tr>
<td>Since biology is an experimental</td>
<td>Physiology (BIO 131), a course in Human Anatomy (BIO 22), and a course in Microbiology (BIO 139).</td>
</tr>
<tr>
<td>science, the laboratory experience is</td>
<td></td>
</tr>
<tr>
<td>essential. Students are required to</td>
<td>Most of the required courses in this concentration</td>
</tr>
<tr>
<td>take three laboratory courses, one in</td>
<td>include a laboratory component, including BIO 1, BIO 2,</td>
</tr>
<tr>
<td>systemic physiology, another in cell</td>
<td>BIO 100, BIO 184, BIO 22, BIO 131, and BIO 139.</td>
</tr>
<tr>
<td>physiology and neurobiology, and an</td>
<td>To gain additional breadth and depth, students in</td>
</tr>
<tr>
<td>advanced laboratory.</td>
<td>this concentration also take:</td>
</tr>
<tr>
<td>After completing these required courses,</td>
<td>• 3 units from Elective List 1 (Structure and Function</td>
</tr>
<tr>
<td>students gain additional breadth and</td>
<td>electives).</td>
</tr>
<tr>
<td>depth by taking elective courses in</td>
<td>• 3 units from Elective List 2 (Ecology, Evolution,</td>
</tr>
<tr>
<td>physiology, neurobiology, or behavior.</td>
<td>and Biodiversity electives).</td>
</tr>
<tr>
<td></td>
<td>• Additional elective selected in consultation with</td>
</tr>
<tr>
<td></td>
<td>an advisor to total 13 upper division elective units.</td>
</tr>
</tbody>
</table>
**Criterion 7: External Demand for the Program**

**Community Engagement**

Since 2006:
- 1,044 students 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, tutoring of local K-12 students, etc.
- 30-35 students/year (mostly Bio majors) from the Science Educational Equity Program have participated in outreach activities to local K-12 schools, to encourage underrepresented students to go 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.
- Laboratories, technical staff, and faculty in Anatomy and Physiology, which constitute the concentration specific core in the BS in Biomedical Sciences are often engaged in providing K-12 enrichment activities (e.g., heart dissections, lab-based case studies, human performance labs) for K-12 students.

**Local Trends in Enrollment**

Since 2006, undergraduate enrollment in the Biological Sciences major has increased 69%, from 916 to 1550. Since all of the undergraduate degree programs in Biological Sciences in their current configuration have only been in existence since Fall 2011, trend data by program are either not available or must be based on data for the most closely related program (by title or sub-discipline area). Hence such data should not be viewed as reliable predictors of future program enrollments. In the case of the Biomedical Sciences concentration, which is a new degree designation, there are no trend data. However, it is noteworthy that in November, 2011, data obtained from SacVault indicated that there were 53 majors in this concentration, and that by February 2012, data from the same source indicates that are now 100 declared majors in the concentration (an 88% increase in 3 months!)

**Demand from Employers**

The U.S. Bureau of Labor Statistics (BLS) reported in the 2010-2011 edition of the *Occupational Outlook Handbook* section on the “Biological Scientist” occupational category ([http://www.bls.gov/oco/ocos047.htm](http://www.bls.gov/oco/ocos047.htm)) that: employment of biological scientists is projected to grow 21 percent over the 2008-18 decade, much faster than the average for all occupations; people with bachelor's and master's degrees are expected to have more opportunities in nonscientist jobs related to biology, in fields like sales, marketing, publishing, and research management; and biological scientists are less likely to lose their jobs during recessions than those in other occupations, because many are employed on long-term research projects. The “biological scientist” category is only one of many occupational categories that require a BA/BS degree in Biological Sciences (e.g., “science technician”, “conservation scientist”) or require a post-baccalaureate degree, certificate or license for which the BA/BS degree in Biological Sciences provides the required undergraduate preparation. Although all of the BA/BS programs in Biological Sciences can serve as preparation for most of these occupational categories, the BS in Biomedical Sciences is specifically designed as preparation for advancement to health professional schools leading to careers in the BLS category referred to as “health diagnosing and treating practitioners” and to graduate programs leading to careers as Ph.D. trained “Medical Scientists”, occupational categories for which demand is expected to grow at rates much higher than most occupational categories. Further, we note that 86% of the 187 respondents to our 2009 Alumni Survey indicated that their employer considered it important that their degree be in biology.
Criterion 8: Program Size, Scope

Breadth of Coverage

Like all BA/BS programs in Biological Sciences, the BS concentration in Biomedical Sciences includes a two semester (10 units) introductory sequence, redesigned in 2006, which provides introductory exposure to key concepts, methods, and skills, determined through a “Backwards Design” process by the Department to be the most basic essentials of training in the Biological Sciences. The scope of content of the lower division courses is reflected in their titles: BIO 1: Biodiversity, Evolution and Ecology, and BIO 2: Cells, Molecules and Genes. The lower division core includes co-requisite courses in Chemistry, Physics, and Mathematics.

At the sophomore/junior level, the curriculum includes courses that take the key concepts and skills established earlier and delve deeper into the theoretical and factual material at their core. The student learning outcomes at this level enhance skill development and reiterate the major concepts from the introductory BIO 1/BIO 2 series. The common courses at this level include Introduction to Scientific Analysis (BIO 100) and Genetics (BIO 184). Core concepts requiring more in-depth study are embedded in designated courses within each program. These core concepts fall into three areas: 1. Cell and Molecular Biology, 2. Ecology and Biodiversity, and 3. Structure and Function Relationships in Living Organisms. At the senior level, students are provided advanced level instruction that includes experiential learning in the scientific method and in-depth laboratory skills. All students in the BS in Biomedical Sciences take Intro Human Anatomy (BIO 22), Systemic Physiology (BIO 131), Biochemistry (Bio 161), Molecular Cell Biology (BIO 121) and General Microbiology (BIO 139). To gain additional breadth and depth, Biomed students also take: 3 units of Structure and Function electives; 3 units of Ecology, Evolution, and Biodiversity electives and additional electives to total 13 upper division elective units.

Degrees and Certificates Awarded

The BS concentration in Biomedical Sciences is a new degree designation, with no specific counterpart in years prior to 2011-2012. Therefore, no degrees have yet been awarded to date. However, in light data obtained from SacVault showing a rapid increase in number of students electing to pursue this program (i.e., 0 in Spring 2011, 53 in November 2011, and 100 in February 2012), this concentration is likely to yield a substantial and increasing share of BA/BS degrees awarded each year. However, rather than adding to the total number of BA/BS degrees, the number of degrees awarded in other programs, most especially the BA and BS degrees in General Biology, are likely to decrease since, in the past, many students interested in meeting requirements for health professional schools elected these programs. Current enrollment in this concentration equals approximately 6.5% of the total number of majors. Therefore, if the proportion remained at this level and it can be assumed that the proportion of students earning BA/BS degrees would be the same as the proportion of enrollment, then at least 9 degrees would be awarded annually (.065 x the annual average of 140 BA/BS degrees awarded annually in BIO SCI programs).

Program Enrollment

As noted above, the BS concentration in Biomedical Sciences is a new degree program designation. However, it is important to emphasize that there are already 100 students declared as majors in the program (6.5% of dept). FTES for the Department is 1529.60 for 2011-2012. Thus, we can estimate that 6.5%, or 99.42, are associated with the concentration in Biomedical Sciences.

Program Resources and Faculty Expertise

In these challenging economic times, creating a curriculum in the biological sciences that prepares students with up-to-date concepts and skills has required tremendous creativity from the Department’s faculty. In part, these challenges have been addressed through faculty grant activity and finding nonconventional or unique partnerships and opportunities to enhance our capacity (e.g., donations of supplies and equipment from industry). Although additional faculty positions are desperately needed to meet the Department’s enrollment demands, there are 3-6 tenured/tenure-track faculty members with Ph.D. training in each of core concept fields that comprise the BA/BS curricula, including six faculty members with Ph.D. training in Anatomy or Physiology to support required courses/electives in the Biomedical Sciences concentration and to provide academic/career advising there.
Criterion 9: Internal, Non-major Demand for the Program

Courses in Biological Sciences are used to meet the requirement for General Education in Areas B2 and B3, and provide service for other majors focused on allied health (e.g. Kinesiology, Health Science, Nursing, RPTA) or other areas of science (e.g. Chemistry, Environmental Sciences). GE/service constitutes 50.2% of total departmental FTES. Faculty members across the department contribute to GE/Service courses. Full-time faculty with primary responsibility for advising and teaching required courses in the Biomedical Sciences concentration also teach the following GE/Service courses: BIO 22, 25, 26, 122, and 131 (service) and 7, 10, and 15L (GE).

Service 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 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, Envst, 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>Envst 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></td>
<td></td>
<td>351.14</td>
<td></td>
</tr>
</tbody>
</table>

*also fulfills major or elective requirements in several programs within Biological Sciences

GE courses (accompanying AY FTES)

<table>
<thead>
<tr>
<th>GE Course</th>
<th>FTES total</th>
<th>% non-majors</th>
<th>FTES non-majors</th>
</tr>
</thead>
<tbody>
<tr>
<td>BIO 1** (Biodiversity, Ecology, Evolution)</td>
<td>160.33**</td>
<td>52%</td>
<td>83.00</td>
</tr>
<tr>
<td>BIO 7 (Introduction to the Science of Biology)</td>
<td>40.27</td>
<td>100%</td>
<td>40.27</td>
</tr>
<tr>
<td>BIO 9 (Our Living World)</td>
<td>24.4</td>
<td>100%</td>
<td>24.4</td>
</tr>
<tr>
<td>BIO 10 (Basic Biological Concepts)</td>
<td>121.20</td>
<td>100%</td>
<td>121.20</td>
</tr>
<tr>
<td>BIO 15L (Lab Investigations in Biology)</td>
<td>12.6</td>
<td>100%</td>
<td>12.6</td>
</tr>
<tr>
<td>BIO 20 (Biology: A Human Perspective)</td>
<td>135.60</td>
<td>100%</td>
<td>135.60</td>
</tr>
<tr>
<td><strong>TOTAL NON-MAJOR FTES</strong></td>
<td>417.07</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

** This course is required for all Biological Sciences majors

Research resources

The Biological Sciences department houses many resources that serve other programs. For the Biomedical Sciences area, these include: the human cadaver facility and prospected specimens, which serve programs in HHS, including the graduate program in Physical Therapy; histology collections and instruments for preparation of histological sections (e.g., ultramicrotome, cytome, and histotome for macroscopic tissue 4”x6” sections) used by PSYC 115; advanced intracranial implant equipment, used by courses in Physical Therapy; and real-time digital data gathering and sharing systems, including human-based data acquisition, used by faculty from other departments (Geology, Teacher Education) during summer work that engages K-12 teachers in research projects.
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\(^2\) 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 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 who assume primary teaching and advising assignments in the Biomedical Sciences are highly active in the scholarship of teaching and the scholarship of integration of university and community activities, or service. Since 2006, this scholarship has manifested in $6.86 million worth of grant funding awarded to the six faculty in this area, with funded projects that include increased support of underrepresented transfer students, support of future health professional students and science teachers, and academic support of all student in science and math gateway courses. Faculty members in this area are also active in research on science education, and collectively have made 25 oral and poster presentations to 10 different recognized, national professional organizations (e.g. American Physiological Society, 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). One member of this group participates in international field research on bat morphology and has published several abstracts (in the proceedings of the North American Symposium on Bat Research) and two peer-reviewed papers since 2006; another’s recent article on neurological detection of amino acids appeared in the prestigious journal Neuroscience.

These Biomedical Sciences faculty are also well-represented in professional societies, serving leadership roles such as: Editorial Board member, Advances in Physiological Education; Chair, American Physiological Society Awards Committee; 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

Scholarly activities entirely funded by members of this group serve students from many departments in NSM and ECS: 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 of underrepresented students entering health professional schools.

Service: Faculty in the biomedical sciences area engage in serving students in undergraduate programs: 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. A faculty member from our program has directed its activities since its inception; 2) The Health Professions Pipeline Partnership Project (HP^2), 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, Academic Information Technology, CSUS Student Research Competition, Animal Care and Use, Program Review Oversight 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. Within the Biomedical Sciences, service includes Department Chair (we note that 3/6 faculty in this area have served in this position), Faculty Senate Executive Committee, Faculty Policies Committee, Graduation Initiative Steering Committee, University Grade Appeal Committee, International Studies Program, and in the Academic Advising Center.

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. In the Biomedical Sciences, most grant projects have been highly collaborative, involving faculty from Chemistry, Physics and Astronomy, and Teacher Education as co-PIs. In addition, much of the scholarly dissemination has been shared with faculty from these departments. We also collaborate a great deal with EOP, the Faculty Student Mentor Program, and Academic Advising (for both our own advising center and as part of our PASS grant). Two faculty have taught in First Year Seminar, which requires a great deal of work across campus lines.

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. Our Human Anatomy instructor works directly with the Physical Therapy program (whose elevation to the doctoral level has required significant work). Our Natural Sciences Advising Center includes faculty from Biological Sciences and Chemistry, who provide academic advising to thousands of students in NSM. 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

This section has been written for the department as a whole, as budgetary issues are handled on a departmental level.

Enrollment-based budgetary support from University

For our program, we receive budgetary support 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

Since 2006, faculty members in our program 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.

Potential revenue (gifts, alumni support)

Former faculty members have been generous in their support of our facilities and students.

- Dr. Marda West, Professor of Biological Sciences from 1966-2001, generously endowed her entire estate (over $750,000) to the Department of Biological Sciences, to be used primarily for student scholarships. Every year, at least $21,000 in student scholarships are awarded to deserving Biological Sciences majors. Marda also donated her SUV to the department for collection trips and field trips. This past year, when it needed repairs in excess of its worth, Marda’s fund allowed us to replace it (total cost = $22,413).
- Dr. Albert Delisle, Professor of Biological Sciences from 1956-1977, provided an endowment (currently valued at $300,000) whose interest provides yearly student scholarships ($2000 each, with at least two awards/year) and support for student research within the department that is open to all faculty members.
- Dr. David Vanicek, Professor of Biological Sciences from 1967-2000, used excess research funds to found a Biological Conservation scholarship (yearly award of $500)
- Dr. Carl Ludwig, Professor of Biological Sciences from 1949-1980, established an endowment that funds a yearly $700 scholarship to support outstanding teaching assistants
- Dr. Miklos Udvardy, Professor of Biological Sciences from 1966-1984, provides a yearly $500 scholarship to graduate students to support their research projects

Other scholarships available to students have come from alumni and other local donors:

- McDougal-Robinson ($1000) (shared with Nursing, awarded every other year)
- Josephine Van Ess scholarship - $2000/year
- Von Saltza - $2000/yr (this award, shared with English, is awarded every other year)
- Sutter Hospital scholarship for Clinical Lab Scientists: 2 @ $1000/year

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. This money is used to support teaching labs throughout the department.