B.S. BIOLOGICAL SCIENCES, CELL AND MOLECULAR BIOLOGY CONCENTRATION

Program Name

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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 cell biology in all areas of the life sciences. To address changes in the field and the current fiscal realities, the Department of Biological Sciences launched a major restructuring of its programs, adding several new courses, restructuring the laboratory course requirements and modernizing its degree programs. The implementation of the reconstructed degree program represents six years of curricular research and planning. Complete descriptions, including comparisons of the old and new programs are at http://www.csus.edu/acaf/PDF_10_11Files/List%204%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 workforce. The concentration in Cell and Molecular Biology (CMB) is a redesigned Bachelor of Sciences degree track with a fully integrated, three-tier core curriculum, re-envisioned elective course structure and externally acquired modern physical infrastructure. The catalog description for the concentration states: The concentration in Cell and Molecular Biology is designed for students interested in advanced studies at the Masters or Ph.D. level, students pursuing career working in academic laboratories or biotechnology, or pre-health professions majors pursuing a fundamental understanding of the bimolecular basis of disease. Students completing the degree requirements for the Cell and Molecular Biology concentration also fulfill the requirements for a minor in Chemistry.

Curriculum Rigor

The biological sciences, particularly the molecular cell 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 from systems interactions to those at the cell and molecular level (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-technology instruments (more fully described below)
- problem-solving, scientific reasoning and critical thinking skills
- time management skills to complete various projects/assessments

Critical thinking and analysis is foundational to our program. Faculty members employ teaching and assessment techniques that require students to be facile with their acquired skills and to demonstrate knowledge in a variety of ways. Examples of instructional techniques and strategies include:

- inquiry-based laboratory protocols and research experiences (both within and outside of classes)
- teaching with current technology and instrumentation (in lectures and laboratory)
- evidence-based pedagogy such as case studies, problem-based and cooperative learning.
- writing, library research, and the use of primary literature and molecular databases
- 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 standards for most courses
Section: Quality of Curriculum, Instructional Personnel, and Curriculum Delivery

Faculty (and staff where appropriate) Qualifications

All full-time faculty members teaching in CMB have Ph.D. specializations aligned with their role in the Program. Most also have post-doctoral experience and professional training directly related to their area of specialization within the biological sciences. There are six full-time faculty members teaching core, required courses and providing academic and career advising related to the concentration. All of the core CMB courses also serve as core courses for other concentrations in the Department; with most serving all but a handful of our majors. Along with the six primary CMB faculty members, three additional full-time faculty members teach electives in the concentration. Again, the bulk of these electives serve multiple concentrations in Biological Sciences.

Most part-time faculty members, including those who teach the concentration specific core courses and electives, also have Ph.D. degrees in this specialty area (the few exceptions have Masters degrees in area). Graduate Teaching Assistants (GTAs) teach some of the lower division labs and 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, 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 Master’s degrees in their area of expertise; the others all have post-baccalaureate training. Staff technical support in the concentration comes from two staff members with BS degrees in Molecular and Microbiology, respectively, who support BIO2, BIO121, BIO 139, BIO 180/181, BIO184 and BIO1871 as half, or less, of their responsibilities.

Percent of Instruction by Full-time Faculty

The curricular redesign of Biological Sciences focused on developing courses and programs that overlap requirements and conserve resources. Therefore, it is not possible to provide accurate data on the faculty wtu’s required to support a specific program or the proportion of full-time to part-time faculty in each program. Based on the methodology described below, the gross estimate of the % of instruction by full-time faculty in all undergraduate programs is 59%. These estimates use the Fall 2011 schedule as follows:

1. Total wtu’s (329) devoted to undergraduate courses from full-time (156.7) and part-time (175.3).
2. Total wtu’s (177.7) devoted to courses that are closed to Biology majors or have a substantial GE or service function, from full-time (54.9) and part-time (122.8). These courses included BIO1, 7, 9, 10, 15L, 20, 22, 25, 26, 39, 121, 122, 131 and 139, however, it is important to note again here that that many other major courses are taken by non-majors.
3. Total FTES (962.33) for the listed courses listed, of which 756.07 (78.56%) were attributed to non-majors.
4. Multiplying total full-time and part-time wtu’s by the proportion of FTES generated by non-majors (i.e. 78.56%) yields 43.1 full-time wtu’s and 96.47 part-time wtu’s devoted to teaching non-majors.
Subtracting non-majors from total numbers yields gross estimates of 113.6 full-time wtu’s and 78.83 part-time wtu’s devoted to instruction of undergraduate majors in all programs.

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. Skills and concepts learned in CMB are applicable to ALL fields of Biology. CMB faculty members supply essential technical expertise to courses, students and faculty members across the biological sciences; and under many circumstances have worked to obtain the equipment themselves. Some of the advanced CMB and associated technological expertise in CMB include:

- DNA, RNA and protein technologies, flow cytometry, PCR, real-time PCR, and bioinformatic programs
- microscopy technologies (inverted, fluorescence and confocal) and digital capture and image analysis programs with real-time instructor/student data gathering and sharing capabilities
- laminar flow hoods, sterile and non-sterile culture incubators, temperature and CO2 controlled incubators
- 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 implemented 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. 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, Intellectual and practical skills

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 “Backward Design” process utilized to craft the Department curriculum student learning outcomes (SLO) led to a remarkable transformation of CMB culture and we have since designed an integrated and scaffolded set of SLO that links Introductory Level learning directly to an intermediate Expansion Level and, in turn, to a Mastery Level that allows the necessary specialization for success in a sophisticated CMB workforce. CMB concepts and skills are increasingly required of all biological disciplines, however, and these tiers affect all concentrations to varying degrees. The integrated CMB Core gives our students advanced experiential learning and state-of-the-art concept and skills training. The eight core courses will be fully implemented by Fall 2012 and development of SLO-based assessments are underway. We are currently implementing a redesigned core curriculum that is based on a fully integrated set of student learning outcomes (SLO) that spans an Introduction Level for freshmen and sophomores, an Expansion Level for sophomores and juniors, and a Mastery Level for senior students. The three-tier CMB core includes eight courses that we are developing SLO for as an integrated series. The Introduction Level exposes students to eight fundamental Key Concepts and five Key Skills determined through a Backwards Design process by the Department to be the most basic essentials of training in CMB. This Level includes our Introduction to Cells, Molecules and Genes (BIO 02). Detailed SLO for BIO 02 are under development around each Key Concept and Key Skill. The Expansion Level includes four courses that take the Key Concepts and Key Skills established earlier and delves deeper into the theoretical and factual material at their core. The detailed SLO at this level reiterate the major ideas that students encountered in BIO 02 and move on to the regulatory mechanisms of those learned concepts and application of learned skills. The core courses at this Level include Introduction to Scientific Analysis (BIO 100), Molecular Cell Biology (BIO 121), Genetics (BIO 184) and Biochemistry (CHEM 161). The Mastery Level gives our senior students advanced level instruction that includes experiential learning in scientific method and in-depth laboratory skills. The SLO at this Level focus on
experimental design and laboratory technologies necessary to generate new data in CMB. The core courses at the Mastery Level include Advanced Molecular Biology (BIO 180), Advanced Cell Biology (BIO 187) and Evolution (BIO 188).

Conceptual material changes rapidly in CMB but we emphasize fundamental Key Skills that allow students to become lifelong learners. The Key Skills of our three tier design include: 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, CMB often requires proficiency in both as samples for teaching and research may come from any source.

**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)\(^1\), 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 (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 (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 (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 (outcome 4).

The EDAT will be administered at several points within the curriculum: in BIO 1 (Introductory level), BIO 100 (Intermediate level), and BIO 188 (Advanced level). All three of these classes are required for native CMB students and BIO 100 and BIO 188 will be taken by transfer students. An evaluation of EDAT scores 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 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.

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\(^1\)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. 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.

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 reference 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 Bio 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 our 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 that take even the most introductory majors course), the graduation rates are much higher than those indicated by the Fact Book, and likely lie 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.

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%)
- A growing number are coming for assistance with academic issues, seeking study tips (37%), looking for study groups (29%) or seeking 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 began this semester, and will focus her efforts on 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 offerings 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 advising templates available to all faculty and students within the department. To assist with graduation petitions, a biology-specific template is available on our departmental website: http://www.csus.edu/bios/Forms.html

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/), 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 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; 13 of 19 faculty responded) indicated the following success rates:

- Graduate programs in science: 114 applicants, 76 matriculants = 67% success rate
- 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
- Teaching credential programs: 11 applicants, 10 matriculants = 91% success rate

[Note: These statistics are conservative. Data are only from instances where we know the fate of the applicant.]

Sacramento ranks 22nd among metropolitan areas with the largest employment levels in research, testing and medical laboratories, with a work force of 5,101 in 2008 (Sacramento Business Journal, 2010). The University of California at Davis Health System is centered 2 miles from campus. Its "economic impact...is close to $3.5 billion...and more than 20,000 jobs (Ryan Sharp, director of the 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 ten years ($200 million in 2011), according to the [UCD news room].

The combined growth in biotechnology and medical research in this region makes the concentration in CMB an important pipeline to meet workforce needs and to technically train employees for a vast number of careers spanning the biological sciences and other disciplines. We realize that our success rates are quite high, something we attribute to intrusive, purposeful, and honest advising. The CMB faculty work to advise students with a diverse range of academic and career goals related to graduate school, the biotechnology industry, academic and government laboratory positions, and health professional school. Students benefit from the fact that faculty in this concentration have strong relationships with regional employers, as the majority have either worked previously for other academic, government or biotechnology employers in the area or have been engaged in long-term collaborations with scientists in these private and public sectors. These strong external relationships facilitate the placement of students in internships, advanced degree programs and employment following graduation. Furthermore, one CMB faculty member coordinates and teaches a course (BIO 186A: Cell and Molecular Bio Seminar) that brings in guest speakers of regional partners, in order to introduce students to career opportunities and facilitate internships and employment. Other CMB faculty members also contribute to this course.
Section: Strength of Teaching Performance

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 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 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 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.
Criterion 5: Program History and Development Status

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

The Biological Sciences program as a whole is mature. However, since our understanding of the natural world is increasing at a very rapid pace, we are continuously modifying and, in some cases, adding entirely new areas of emphasis to keep pace with these changes. At many institutions the growth and impact of the biological sciences has led to the creation of many separate academic departments that fall under the umbrella of the biological sciences. For example, at UC Davis the College of Biological Sciences includes five major departments while numerous other departments within the University also study some component of biology, including many in the College of Agricultural and Environmental Sciences and in the Medical and Veterinary Schools. In our program we have attempted to address this growth in the biological sciences by focusing our students into concentrations. While cell biology has been a foundation of the biological sciences for over one hundred years, our ability to understand cell biology and biology in general was revolutionized by the development of molecular biology.

The Department responded to the revolution of molecular biology by, at first, developing single courses in this area and then eventually adding a concentration in molecular biology. This concentration successfully prepared many students for careers and continued study in this area. In examining our entire curriculum we chose to integrate cellular and molecular biology into our new curriculum that is being implemented now. Therefore, the Cell and Molecular Biology (CMB) concentration is new; however, it builds upon mature components of our curriculum, infusing these pieces with new approaches and a fresh look at these rapidly growing segments of biology.

Ability of program to adapt to current demands

Our new curriculum, especially the curriculum of the CMB concentration, represents the culmination of a major effort to adapt to current demands. The new curriculum will not be static, though. Throughout our courses we have embedded inquiry-based labs and teaching approaches that facilitate the incorporation of new approaches, techniques and ideas as they develop. As part of the Department's revision of its entire curriculum we introduced a new introductory series comprised of BIO 1 (Biodiversity, Evolution and Ecology) and BIO 2 (Cells, Molecules and Genes). BIO 2 greatly expanded our early students' exposure to cell and molecular biology. Since a major driving force behind our revision of the department's curriculum was the recognition of the importance of keeping pace with the rapid advances across cell and molecular biology, much of the curricular revision occurred within this area. Our new upper division core was modified to include 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.

In its curricular revision the department introduced entirely new courses and revised others. Within the CMB concentration, new courses include Histology (BIO 130), Forensic Biology (BIO 150) and Advanced Laboratory Techniques in Forensic Biology (BIO 151), Advanced Problems in Immunology (Bio 149C), Molecular Ecology (BIO 178), and Advanced Cell and Molecular Biology (BIO 187). In some instances, the revisions were major while the course number remained the same. This was the case for Bio 121, which was entirely revised and renamed Cell and Molecular Biology (formerly Cell Physiology). BIO 181 was also entirely revised and renamed Advanced Molecular Biology (formerly Molecular Biology Lecture). Our extensive revision demonstrates that the Department is ready and willing to adapt its programs as needed to meet demands of the developing science. The department has also been very creative in its offerings in meeting the demands of decreased funding and increasing student demand. Extensive use of shared resources across labs greatly reduces overall cost. In addition, in training our students we have them prepare and maintain materials as part of the learning process that otherwise would be too expensive for course use. In the process, we dramatically reduce costs, increase relevant hands-on training, and increase our ability to offer state-of-the art labs without increasing staff lab preparation loads. As noted above our lecture and lab designs also are very adaptable, and this allows faculty and staff to readily incorporate new techniques and approaches continuously.
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. Since much of our curriculum in this concentration was just revised, our immediate focus will be on assessing its success in preparing students for careers and future study in this area.
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 Cell and Molecular Biology (CMB) advances the University’s mission through its disciplinary focus on the preparation of students for entry into the workforce and for continued growth in the field as lifelong learners. Graduates of the program are prepared to address scientific issues affecting the region, the state, the nation and the world as a result of a pedagogical emphasis on the development of intellectual and practical skill sets (e.g., inquiry and analysis), which are broadly applicable.

Alignment with the University’s Baccalaureate Learning Goals:
Like all programs offered by the Department of Biological Sciences, the CMB concentration is 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 CMB concentration emphasizes an approach that builds an understanding of biological function by directly examining genes and their products and testing how these function at the subcellular and cellular level to build an understanding of whole organism function. Many of the tools used by molecular and cellular biologists have important applications throughout the biological sciences, therefore students from other concentrations and majors such as Chemistry (especially in the Biochemistry concentration) and Environmental Studies gain broad integrative training through courses that are part of this program. Like students in all of our programs, the students in CMB are expected to develop intellectual and practical skills in: field and lab methodology, the scientific method, reading and writing, critical thinking, collaboration, literature review and the 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 the 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 for life-long learning. The CMB concentration is designed to prepare students for a broad range of careers in the laboratory sciences, along with an understanding of the application of the tools of molecular and cellular biology in field studies. Since many of these areas (such as genetic testing, stem cell research, and the genetic modification of organisms) carry with them significant ethical considerations, ethical discussions and activities are integrated throughout the curriculum, in order to address the Personal and Social Responsibility baccalaureate goal.
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 few 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 in Criterions 2 and 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 several areas that overlap the CMB concentration offered at CSUS, including Biochemistry and Molecular and Cell Biology. Both of these BS degrees share much in common with our CMB curriculum. The dramatic difference is that the upper division courses in our curriculum typically include labs, while many fewer upper division courses at UCD include labs (see table below). The labs associated with our courses incorporate key skills and state of the art techniques that prepare our students to step right into jobs and graduate research settings that use these skills. It is the laboratory “know how” that makes our students competitive for jobs and for acceptance into graduate programs and professional schools that recognize the importance of this training.

Although we are proud of the distinctive qualities noted above, it is equally important to note that the CMB 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>BS Major in Cell Biology</td>
<td>BS in Biological Sciences, Concentration in Cell and Molecular Biology</td>
</tr>
<tr>
<td></td>
<td>During freshman and sophomore years, the program requires foundational courses in math (including statistics), chemistry, physics and general biology.</td>
</tr>
<tr>
<td></td>
<td>As majors in Biological Sciences, students in the concentration take a common upper division curriculum, which includes Genetics (BIO 184) and Introduction to Scientific Analysis (BIO 100). In addition, students in this concentration take the following courses.</td>
</tr>
<tr>
<td>Upper Division</td>
<td>Upper Division:</td>
</tr>
<tr>
<td></td>
<td>• BIO 121, Molecular Cell Biology</td>
</tr>
<tr>
<td></td>
<td>• BIO 180, Advanced Molecular Biology (w/ lab)</td>
</tr>
<tr>
<td></td>
<td>• BIO 187, Advanced Cell Biology (w/ lab)</td>
</tr>
<tr>
<td></td>
<td>• BIO 188, Evolution</td>
</tr>
<tr>
<td></td>
<td>• CHEM 20L, Intro Organic Chem Lab</td>
</tr>
<tr>
<td></td>
<td>• CHEM 31 Quantitative Analysis</td>
</tr>
<tr>
<td></td>
<td>• CHEM 161 Biochemistry</td>
</tr>
<tr>
<td></td>
<td>• CHEM 162 Biochem Lab</td>
</tr>
<tr>
<td></td>
<td>Most of the required courses in this concentration include a laboratory component, including BIO 1, BIO 2, BIO 100, BIO 139, BIO 121, BIO 180, BIO 184, BIO 187, CHEM 20L and CHEM 162.</td>
</tr>
<tr>
<td></td>
<td>• To gain additional breadth and depth, students in this concentration also take ten units of electives.</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, and tutoring of local K-12 students.
- 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.

CMB faculty members coordinate two of the department’s Service Learning experiences that are run through the Community Engagement Center on campus – Project Ride (mentioned above), and a stand-alone Teaching Experience (BIO 195T) that places biology majors, interested in teaching, in high school science classrooms.

Demand for the Program’s Resources and Expertise

CMB faculty members:

- 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.
- Design and teach workshops annually in the Expanding Your Horizons program for young women in the community, as well as intensive summer laboratory-based workshops for high school students.
- Conduct professional development workshops such as Science in the River City, Sacramento Area Science Project and Closing the Achievement Gap in Math and Sciences.
- Serve on external academic advisory boards for regional high schools and community colleges and participate in local collaborative efforts, such as Biotech SYSTEM (UC Davis).
- Serve as science consultants or experts to local public and private organizations.

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 CMB 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 93 majors in Molecular Biology concentration (which is a closely related program), and that by February 2012, data from the same source indicate that there are now 102 declared majors in the Cell and Molecular Biology concentration.

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) 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
Section: External Demand for the Program

the 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.
Criterion 8: Program Size, Scope

Breadth of Coverage

The BS concentration in Cell and Molecular Biology 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 that students are exposed to in 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 upper division level, students are provided advanced instruction that includes experiential learning in the scientific method and in-depth laboratory skills. All students in the BS in Cell and Molecular Biology take BIO 121, Molecular Cell Biology, BIO 180, Advanced Molecular Biology (w/ lab), BIO 187, Advanced Cell Biology (w/ lab), BIO 188, Evolution, CHEM 20L, Intro Organic Chem Lab, CHEM 31 Quantitative Analysis, CHEM 161 Biochemistry, and CHEM 162 Biochem Lab. To gain additional breadth and depth students are also required to take ten units of electives including one course from the following group: BIO 126 (Comparative Vertebrate Morphology), BIO 127 (Developmental Biology), BIO 128 (Plant Anatomy and Physiology); 3 units in List 2 (Ecology, Evolution, and Biodiversity); and additional units chosen in consultation with an advisor to total 10 units.

Degrees and Certificates Awarded

The BS concentration in Cell and Molecular Biology is a new degree designation and, as such, has only had its first few students graduate. We anticipate that graduation from this concentration will reflect the proportion of graduates from our department that are enrolled in this concentration. We've averaged 139 graduates per year from 2005-2010 (University Factbook, 2010) and, therefore, since 6.7% of our majors currently are in this concentration, we anticipate approximately 8 graduates in this concentration each year. However, as noted below, we anticipate that this concentration will grow as our overall number of majors has over the last ten years.

Program Enrollment

As noted above, the concentration in Cell and Molecular Biology is a new degree designation, but is a revision that builds the Molecular Biology concentration that it replaced. We expect this new concentration to grow as it now is likely to attract students who would have chosen the Molecular Biology concentration along with additional students interested in the expanded breadth of the new concentration. Currently there are 102 students declared as majors in the program. If each of these students attends full-time this accounts for 6.7% of the Department's 1529.60 for 2011-2012.

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 included in all BA/BS curricula.
Criterion 9: Internal, Non-major Demand for the Program

The Biological Sciences provides courses used to meet the requirement for General Education in Areas B2 and B3, and also provides service courses for other majors focused on allied health (e.g. Kinesiology, Health Science, Nursing, RPTA) and other areas of science (e.g. Chemistry, Environmental Sciences). Faculty members in all areas of the department contribute to GE/Service courses. Full-time faculty with primary responsibility for advising and teaching required courses in the Cell and Molecular Biology concentration also teach the following GE/Service courses: BIO 121, 127, 128, 143, 149A, 150, 151, 180, 183, 185, and 186A and 1 and 2 (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, 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>
</tbody>
</table>

**TOTAL NON-MAJOR FTES** | 351.14 |

*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>
</tbody>
</table>

**TOTAL NON-MAJOR FTES** | 417.07 |

** This course is required for all Biological Sciences majors

Research resources

The Biological Sciences department houses many resources that serve other programs, including the autoclave (a large sterilization unit that processes materials for all of NSM). Faculty from our program obtained the original funding for (and continue to obtain resources to support) the CIMERA interdisciplinary research facility, which serves as a collaborative research hub for the cellular and molecular sciences, and involves faculty from Chemistry.
Section: Quality of Program and Resource Utilization

Criterion 10: Quality of Program and Resource Utilization

The Department embraces a broad definition of scholarship, similar to that initially described by Ernest Boyer\textsuperscript{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, including those who teach in the CMB curriculum, obtained $14.67 million in grant funding (source: Research and Contract Administration). In addition, they secured over $1 million in donated equipment and supplies (e.g. cell culture hoods, incubators, analysis kits, a mass spectrometer, etc.). Finally, some members of the CMB group participate in traditional bench/field research, supervising both undergraduate and graduate students in science and science education research.

Scholarly and Creative Activity: Since 2006, faculty members who teach in the CMB curriculum:

- Have published six refereed articles or other types of professional manuscripts (e.g., text chapters).
- Have made 39 poster or oral presentations at professional meetings.
- Have secured $3.275 million in grant funding (source: Research and Contract Administration). In addition, these faculty members secured over $1 million in donated equipment and supplies (e.g. cell culture hoods, incubators, analysis kits, a mass spectrometer, etc.).

Service: Faculty members in CMB are highly active in the area of service to the institution and community, demonstrating strong dedication to outreach activities that benefit students and programs within the CSU System, the K-12 system and the Sacramento region as a whole. Faculty members in this concentration serve as faculty advisors to student clubs, organizations and programs within the department (e.g., SEE, Pre-Dental Club and BioCorps) as well as at the university level (e.g., mentor for Guardian Scholar’s Program, which serves CSU students that have been wards of the state). Our faculty members are also dedicated to pre-college student education and teacher training, serving on high school advisory boards (as mentioned in the list above), the Scientific Review Committee for the Sacramento Regional Science and Engineering Fair, and the Sheldon Biotechnology Academy mentoring program, to name a few. Collectively, we review for peer-reviewed Science and Science Education publications (e.g., Journal of College Science Teaching, BioScene: Journal of College Biology) and have edited textbooks and other published curriculum in the areas of Cell and Molecular Biology, Cancer Biology, Biotechnology and Human Anatomy and Physiology. We are further dedicated to teacher professional development and routinely teach workshops for programs such as Expanding Your Horizons, Science in the River City, Sacramento Area Science Project, and Closing the Achievement Gap in Math and Sciences. In addition, the CMB faculty are highly motivated to serve the community at-large in order to advance science and technology in the region and science literacy as a whole. Our CMB faculty members serve on the Sacramento Area Regional Technology Alliance (SARTA) Stem Cell Devices Subcommittee, on the Board of Directors, American River Watershed, and have engaged in activities to educate our state legislators on topics related to California’s Biotechnology Industry.

Section: Quality of Program and Resource Utilization

Our faculty members are also well-represented in regional and national professional organizations, serving such roles as:

- President of the Biology Council for the CSU
- CSU System-wide Coordinator of CSU/CC Lower Division Transfer Pattern in the Biological Sciences;
- Member, Faculty Consensus Group CSUPERB (California State University Program for Education and Research in Biotechnology)
- Member, CSU GE Area B Course Review Committee
- Member, CSUS/UCD Cancer Center Partnership Board and Steering Committee for CSU Fresno/Burnham Institute NIH Grant
- Co-Chair for the Cancer Biology section of the Annual Biomedical Research conference for Minority Students sponsored by the National Institute of General Medical Sciences (NIGMS)
- Member of several national collaboratives to improve undergraduate biology education (NSF Introductory Biology Project and Society for the Advancement of Biology Education Research)

Service in University Governance
Faculty members who teach in the CMB curriculum are well represented on committees at the College and University levels, and currently or have recently served on/as the following: CTL Advisory Board, Animal Care and Use Committee, the NSM and Senate Curriculum Committees, Faculty Policy Committee, NSM Student Academic Success Committee, and (2006-07) as Department Chair.

Working with other programs
Our CMB faculty members are highly collaborative, working with others within NSM and across campus. CMB faculty were involved in the design, opening, expansion and leadership (serving as officers) of CIMERA, an NSM College level Center. At least four have served as its Director or Associate Director. Furthermore, CIMERA has been used for SEE’s summer Science Training Program (STP) and for a public Science Open House during River City Days. One faculty member also served as the Faculty Director of the Science, Technology, Engineering and Mathematics (STEM) Initiative. CMB members recently submitted a CSUPERB grant and are writing an NSF-TUES grant in collaboration with Information Research Technology to create a model for faculty and student learning that integrates high-technology laboratory instruments and advanced computer networking and sharing with the development of inquiry-based curriculum that can be applied across a broad range of scientific disciplines. Other projects involve an intra-campus service learning research collaboration with faculty from FACs and Sociology and development of the first Summer Academy for high school students (focus on biotechnology) with the College of Continuing Education. A CMB faculty member also serves as a Co-PI with Teacher Education faculty to provide scholarships for future science teachers (NSF Noyce Grant).

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 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. The CSI-TRU facility is run by one of our CMB faculty and provides an excellent resource for projects requiring specialized equipment for advanced DNA work such as DNA sequencing.
Criterion 11: Revenue and Other Resources Generated by Program

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).

Research grants, in-kind equipment donations, fundraising

The CMB teaching faculty has contributed to a dramatic expansion of our research capacity in CMB. This has primarily been through external grants and in-kind donations that have modernized our infrastructure at every level. CMB faculty members were principally responsible for obtaining nearly $1 million in in-kind donations of equipment, both large and small, and consumable resources that have elevated our capacity for research and teaching tremendously. These materials are being used in various research laboratories, our cell and molecular teaching laboratories and the College Center for Interdisciplinary Molecular Biology: Education, Research and Advancement (CIMERA). In addition, concentration faculty have also been instrumental in obtaining $350K to build an Advanced Cell Analysis Laboratory that allows our researchers and classroom students the ability to collect data and train at the cutting-edge of cell biology. Concentration faculty members were also principally responsible for obtaining a $755K National Science Foundation grant to remodel the CIMERA Facility into a modern and highly effective cell and molecular research facility. In addition, a California Institute for Regenerative Medicine grant and two approximately $15K California State University Program in Education and Research in Biotechnology (CSUPERB) grants provide significant funding for small equipment purchased for our graduate CMB methods course that which are available for Department researchers and others to borrow.

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, which is used to support laboratories throughout the dept