B.S. BIOLOGICAL SCIENCES, CLINICAL LABORATORY SCIENCES CONCENTRATION

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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 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 at http://www.csus.edu/acaf/policies/10-11%20Lists/10-11prgmlst4.stm#NSM. 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.

Curriculum Rigor

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

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

Because critical thinking and analysis are 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 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 standards 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 Clinical Laboratory Sciences (CLS) concentration, there are three full-time and two FERP faculty members who have Ph.D. training in disciplines that support required courses and electives in the concentration and who 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 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 Masters degrees in their area of expertise; the others all have post-baccalaureate training.

Percent of Instruction by Full-time Faculty

It is not possible at this time to provide accurate data on either total faculty wtu’s required to support 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,and 139. However, it is important to note 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 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 Clinical Laboratory Sciences concentration include:

- advanced molecular technologies, cell culture, flow cytometry, traditional and real-time PCR, and bioinformatics programs
- advanced diagnostic techniques and microscopy technologies, and complex graphical analyses programs
- real-time digital data gathering and sharing systems, including human-based data acquisition
- wireless streaming and cyberlearning technologies, such as wiki-based social learning, instant messaging, social networking and social bookmarking
Section: Clearly Developed Learning Outcomes

Criterion 2: Clearly Developed Learning Outcomes

Clearly Articulated Program Links to Campus Baccalaureate Learning Goals

In Fall 2011, the Department of Biological Sciences unveiled a 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 BS concentration in Clinical Laboratory Sciences is designed specifically to prepare students for post-baccalaureate Clinical Laboratory Sciences internship training programs. 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/](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 bridging both the structure/physiology and cell/molecular area: Factual - Recognizing the cell as the basic unit of life, as well as how the structural elements of the cell relate to the important functions performed by the cell; Conceptual - Interpreting the importance of physiological changes to the state of human health through feedback loops and homeostatic control; Procedural - Applying the biochemical, histological, and immunological tests to analyze/evaluate the results of a prescribed experiment regarding changes to human physiology during disease states; Metacognitive - Designing an experiment to test predictions regarding how different disease states (cancer vs infection) change physiological parameters in the human body and the subsequent clinical presentation of patients.

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 to 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.
Section: Clearly Developed Learning Outcomes

Although programs vary in their emphasis on field or lab methodology (this concentration primarily employs lab methodology), all programs require development of proficiency in the other noted skills necessary to generate and communicate scientific knowledge, and which also have application to other fields of study and life-long learning.

Since the BS concentration in Clinical Laboratory Sciences 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, precision, and accuracy in laboratory data acquisition and reporting, experimentation involving human and animal models, and the rising cost of medication are topics which are discussed in several of our upper division required courses.

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 (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 149B (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 CLS 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 curriculum in Clinical Laboratory Sciences meets the undergraduate coursework requirements of the State of California for eligibility to take a Clinical Laboratory Scientist (CLS) licensure examination. Eligibility to take a licensure examination also requires a one year CLS internship training program at a state-approved clinical laboratory.

\(^1\) Experimental Design Ability Test (EDAT)

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

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 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 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.

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). 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. Most students in the CLS concentration are given both academic and career advising by at least one of three full-time and two FERP faculty members in the concentration.

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 advising templates available to all faculty and students in the department. To assist with graduation petitions, a biology-specific template is available on our departmental website: [http://www.csus.edu/bios/Forms.html](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/](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 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.
Section: Advising Program and Graduation Success

- 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 Clinical Laboratory Sciences concentration graduates are very successful at gaining entry into post-graduate CLS internship training programs. There are thirteen post-graduate training programs throughout California including the three programs in Northern California where most of our students apply. Some of these training programs are independent hospital-based programs and others are affiliated with universities such as SFSU and SJSU. When students successfully complete their training, they must sit for California licensure before they can work. After licensure, graduates can either work in the geographic region when they are trained or move to another region to begin their professional careers.

A recent review of the California Department of Public Health Laboratory Field Services personnel licensing site showed that of the 87 CLS students who graduated from our program in 2006-2011, 48 graduates were licensed as Clinical Laboratory Scientists and 11 other graduates from our program were licensed or certified in related clinical laboratory fields. Recent graduates from our program may still be in CLS internship training programs and have not taken the CLS license exam.

Success rates for our graduates who attend post-graduate CLS internship training programs and subsequently pass the CLS license exam 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. Faculty members who advise in the Clinical Laboratory Sciences concentration not only advise in the curriculum but also assist students with information about any or all of the CLS internship training programs, the application process for these programs, writing personal statements, the interview process, and state licensure requirements for professionals in the field of clinical laboratory medicine. Faculty guidance with training program applications is an important part of helping our students get accepted into training programs following graduation.

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 (UCDHS), 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. Twenty-nine of our CLS graduates have trained at the UCDHS CLS Internship Training Program and several have subsequently been hired as licensed CLS professionals in their clinical laboratory.

The combined growth in biotechnology and laboratory medicine/research in this region makes the BS concentration in Clinical Laboratory Sciences an important pipeline to meet workforce needs for health professionals and technically trained employees.
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 (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 program as a whole are mature (fun fact: we retain the only CSUS faculty member on staff when the university began), but they are continually evolving as our knowledge of the natural world expands. As a department we have readily responded to these changes with alterations in our curriculum. Thus, although a foundational program that has been in place since this institution began, Biological Sciences may also be viewed as a progressive program that is continually restructuring its offerings and focus in response to the changing demands of the field and of the scientific workforce.

Clinical Laboratory Sciences has been a concentration in the BS in Biological Sciences for many years. Very few changes in the curriculum have been made in the last thirty-five years because the requirements for preparation and acceptance into a CLS internship training program have not significantly changed during that time. Laboratory Field Services (LFS), a division of the California Department of Public Health, is the governing body that licenses and regulates all hospitals and clinics as well as the personnel who work in these facilities. LFS also approves and oversees all CLS internship training programs in California. Applicants seeking admission to a training program must qualify for a CLS Trainee license from Laboratory Field Services. To obtain a Trainee license, an individual is required to have a baccalaureate degree that includes specific courses in biological sciences, chemistry, physics and mathematics. Biological Sciences has developed the coursework in the Clinical Laboratory Sciences concentration with the California requirements addressed. The requirements of the concentration are designed so that our students will fulfill all LFS requirements and be prepared to apply for the CLS Trainee license as soon as they graduate. Students can apply for CLS internship training programs if they are in other concentrations such as microbiology and molecular biology but they must have also taken all of the LFS mandated coursework to obtain the CLS Trainee license, which permits them to train in an approved facility.

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) - was introduced, developed to align with recent advances in the life sciences. 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 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.

In addition to adapting to recent laboratory advances by updating many of our cell/molecule and genetics courses, which are important courses for clinical laboratory scientists, new courses such as Advanced Problem Solving in Physiology (BIO 131A), Molecular Ecology (BIO 178), and Advanced Problems in Immunology (BIO 149C), are all courses that serve our CLS students well and provide electives if needed. 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. If a student does not get accepted into a CLS internship training program following graduation, the variety of coursework that he/she will have taken will permit them to work in a number of other types of laboratories including biotech and research labs.

Future goals of program

Based on current knowledge of LFS regulation of laboratories and licensed personnel, we do not anticipate any major changes in LFS-mandated curriculum that will affect our CLS concentration. Faculty members in Biological Sciences will continue to follow state regulations, monitor workforce needs, and assess our students’ performance by successful acceptance into CLS internship training programs and update our curriculum to address new scientific changes in the field.
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 Clinical Laboratory Sciences 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 careers in clinical laboratory medicine.

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 Clinical Laboratory Sciences concentration has many of its upper division course requirements from the Cellular and Molecular Biology 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 (the CLS concentration places emphasis on lab methodology), all programs require development of proficiency in the other noted skills necessary to generate and communicate scientific knowledge, and which also have application to other fields of study and life-long learning. Since the BS with a concentration in Clinical Laboratory Sciences is designed to prepare students for a health professional career 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

The Clinical Laboratory Sciences concentration has been one of the strongest academic pathways toward CLS licensure in the entire state for many years. Our concentration has remained viable and graduated students during a time of budgetary constraints while other campuses in the CSU and UC have stopped offering some of the courses required for licensure preparation. One of these courses is Clinical Hematology (BIO 124), which is required for all students obtaining a CLS Trainee License and entering a postgraduate CLS internship training program. Lack of availability of this course has been a major roadblock for students applying for CLS programs.
Section: Impact, Justification and Centrality to University Mission

contributing to a major decrease in the number of CLS licensed personnel in California over the last fifteen to twenty years. Approximately ten years ago, the faculty member in the CLS concentration who teaches BIO 124 was approached by CSU, Stanislaus regarding the possibility of teaching Clinical Hematology to their students. They wanted to develop a CLS concentration but had no faculty member to teach the course, similar to many other CSU and UC campuses. Since that time, the Biological Sciences CLS faculty member has worked with faculty, staff and students from multiple California CSU and UC campuses and adapted the course to serve external students. Undergraduate and graduate students from 15 different California campuses and postgraduate students who had previously completed their degrees have taken the course. Our course has served approximately 400 non-CSUS students in addition to over 300 Sac State students since it began in the current format ten years ago. Lectures are delivered to students through synchronous and asynchronous video streaming technology from a studio classroom on the Sac State campus and other course materials are posted in SacCT. Students attend two weekend laboratory days during the semester. Faculty and staff colleagues from other CSU campuses assist students with registration through the CSU Concurrent Enrollment process as well as proctor exams on their campuses as part of the multi-campus effort. Fees for the course remain with the home CSU campus and FTES for the course belong to the Sac State campus. Students from UC campuses and other postgraduate students enroll in the course through the College of Continuing Education. What began 10 years ago as a pilot effort is now a pedagogically successful, ongoing practice that serves students statewide and has contributed to the number of students who are academically prepared in clinical hematology to enter CLS internship training programs. No other program in the CSU or UC provides access to the numbers of students seeking a course in hematology as successfully as our CLS program does on this campus. In fact, we are the only program to deliver the course statewide with a lecture-lab format.

With the success of the BIO 124 effort, the Department has recently approved the offering of a new course in the curriculum (BIO 140) to meet the needs of a population of students who are unable to enroll in a medical microbiology course that is also required for state licensure and is difficult to obtain. Pathogenic Bacteriology (BIO 144) is the advanced microbiology course that our CLS majors take but it is impacted and students from off-campus rarely are permitted to enroll. Our new BIO 140 course, Medical Microbiology and Emerging Infectious Diseases, will permit these off-campus students to enroll in the course and fulfill the requirement for a medical microbiology course so that they can apply for trainee licensure and CLS training programs.

Providing accessibility to state-mandated requirements for students in hematology and medical microbiology continues to support the excellent reputation of our CLS concentration, which is known statewide as one of, if not, the best CLS undergraduate preparatory program for postgraduate CLS internship training programs in California.
Criterion 7: External Demand for the Program

Community Engagement

Since 2006:

- 1,044 students in in our Genetics course have volunteered with organizations that serve developmentally-disabled adults (who may have the genetic abnormalities they are studying). Project Ride (which uses horse therapy) and the Orange Grove Adult Day School are among the projects that have benefitted
- Over 50 students have participated in teaching internships in local K-12 schools
- 160 students have joined our new student-faculty volunteer club, BioCorps, in which students donate at least 100 hours of service to the community in various projects such as Special Olympics, Bone Marrow Drives, Remote Area Medical care, 4-H’s On the Wild Side, and tutoring of local K-12 students.
- 30-35 students/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 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.
- Many faculty and staff also give several workshops annually in the Expanding Your Horizons program for young women in the community.
- Most of the faculty members who teach in the CLS concentration area have given multiple presentations to CLS students and working community Clinical Laboratory Scientists at professional meetings statewide, nationally and internationally.

Local Trends in Enrollment

Since 2006, undergraduate enrollment in the Biological Sciences major has increased 69%, from 916 to 1550. We present the following data as a reflection of the enrollment trend in the CLS concentration: Spring 2008 data show 86 CLS majors out of a total of 948 majors in the Department at that time; Spring 2012 data show 101 CLS majors out of a total enrollment in Biological Sciences of 1539. The enrollment in the CLS concentration is remaining steady with no major increase or decrease in numbers of students.

Demand from Employers

The U.S. Bureau of Labor and Statistics (BLS) reported in the 2010-2011 edition of the Occupational Outlook Handbook section on the “Clinical Laboratory Technologists and Technicians, also known as Clinical Laboratory Scientists occupational category (http://www.bls.gov/oco/pdf/ocos096.pdf) that: employment of clinical laboratory scientists is expected to grow 14 percent over the 2008-18 decade, much faster than the average for all occupations. The volume of laboratory tests continues to increase with both population growth and the development of new types of tests. Technological advances will continue to have opposing effects on employment. On the one hand, new, increasingly powerful diagnostic tests and advances in genomics—the study of the genetic information of a cell or organism—will encourage additional testing and spur employment. On the other hand, research and development efforts targeted at simplifying and automating routine testing procedures may enhance the ability of non-laboratory personnel—physicians and patients in particular—to perform tests now conducted in laboratories. Although hospitals are expected to continue to be the major employer of clinical laboratory workers, employment is expected also to grow rapidly in medical and diagnostic laboratories, offices of physicians, and all other ambulatory health care services. Job opportunities are expected to be excellent because the number of job openings is expected to continue to exceed the number of jobseekers. Although significant, job growth will not be the only source of opportunities. As in most occupations, many additional openings will result from the need to replace workers who transfer to other occupations, retire, or stop working for some other reason. Willingness to relocate will further enhance job prospects.
Criterion 8: Program Size, Scope

Breadth of Coverage

Like all BA/BS programs in Biological Sciences, the BS concentration in Clinical Laboratory 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 B.S. with a Clinical Laboratory Sciences concentration take Molecular Cell Biology (BIO 121), Clinical Hematology (BIO 124), Systemic Physiology (BIO 131), General Microbiology (BIO 139), Pathogenic Bacteriology (BIO 144), Immunology (BIO 149), Immunology and Serology Laboratory (BIO 149B), Human Parasitology (BIO 152), General Biochemistry (CHEM 161) and General Biochemistry Laboratory (CHEM 162).

Degrees and Certificates Awarded

The Clinical Laboratory Sciences concentration in the B.S. is an established degree that has been offered by the Department for many years. Current enrollment in this concentration equals 6.6% of the total number of majors. Recent data from SacVault indicates that during the last two years, the average number of degrees awarded annually to students graduating with a CLS concentration is 16.

Program Enrollment

Spring 2012 data show 101 CLS majors out of a total enrollment in Biological Sciences of 1539. FTES for the Department is 1529.60 for 2011-2012. Thus, we can estimate that 6.6%, or 101 FTES are associated with the concentration in Clinical Laboratory 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 5 faculty members with Ph.D. training in disciplines related to the clinical laboratory sciences. These faculty members support required courses/electives in the Clinical Laboratory Sciences concentration and provide academic and career advising to the students in the curriculum. One of the faculty members who teaches courses in the CLS concentration is a licensed Medical Technologist (former professional name for a Clinical Laboratory Scientist).
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 members with primary responsibility for advising and teaching required courses in the Clinical Laboratory Science concentration also teach the following Service/GE courses: BIO 39,139 (service) and BIO 10, 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, Env 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>Env 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><strong>351.14</strong></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></td>
<td></td>
<td><strong>417.07</strong></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, including the autoclave, a large sterilization unit that processes materials for all of NSM, and the human cadaver facility, which serves programs in HHS, including the graduate program in Physical Therapy. Faculty from our department obtained the original funding and continued support for 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

Faculty productivity in non-teaching areas

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.).

**Scholarly and Creative Activity:** The five faculty members who assume primary teaching and advising assignments in the Clinical Laboratory Sciences concentration are active in the scholarship of teaching and the scholarship of integration of university and community activities, or service. Since 2006, faculty members in this area have published 7 scholarly articles in refereed journals such as the *Journal of Immunology, Journal of Neuroimmunology, and Autoimmunity*. One of the faculty members has also published “A Practical Method for Rapid Assessment of the Bacterial Quality of Water – A Field-Based Guide” for the United Nations based on his work in the discipline of microbiology. All five faculty members in the CLS area are also very active in presenting seminars and workshops at professional meetings. They have delivered 33 oral presentations and presented 3 posters to professionals at several meetings including the California Association for Medical Laboratory Technology, UC Davis M.I.N.D. Institute, 9th International Conference on Neuroimmunology, American Society of Microbiology, American Phytopathological Society, International Water Association’s World Water Congress, American Water Works Association, World Conference on Educational Multimedia, Hypermedia and Telecommunications, and the MERLOT International Conference. Many of these meetings have been held nationally and internationally and provide an important avenue for dissemination of information about our campus and our CLS program.

In addition, faculty members in the CLS area have submitted several grant applications in their areas of expertise to support research and teaching activities. Twelve grant applications have been submitted since 2006 (8 funded). Eight of the grants submitted were to external sources and 4 of the applications were to sources of funding internal to the campus that included University Enterprises, Inc. and Goethe Project Funding. One of the awardees is a faculty member who teaches courses in the CLS concentration and also serves as the Director of the Science Educational Equity Program in the College of Natural Sciences and Mathematics. She was awarded $160,000 by the California Wellness Foundation (2011-2014) for the proposal *Preparation of Pre-Health Professional Students: The Source for Diversity in the Health Professions*.

Clinical Laboratory Sciences faculty members are also well-represented as members in professional societies and serving in leadership roles such as: Co-chair of the Fall 2010 Northern California Society of Microbiology *Molecular Diagnostics Symposium*, Member of the German Fulbright Commission, Member of the California Public Health Laboratory Director Training Steering Committee, Co-chair of Workshops at both the 2007 and 2011 Annual Meetings of the California Association for Medical Laboratory Technology (CAMLT), Member of CAMLT Education and Research Foundation Board of Trustees, Co-chair of the CAMLT Council for

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Section: Quality of Program and Resource Utilization

Coordinating Education Activities, Member of the University of California, Davis Health Services Advisory Board for the CLS Training Program in Sacramento, and External Reviewer for the CSU, Dominquez Hills Clinical Laboratory Sciences Program.

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. One of the faculty members in the Clinical Laboratory Sciences area has served as Department Chair and the Director of Distance and Distributed Education for the campus.

Working with other programs

Our faculty members are highly collaborative, working with others across campus on several different projects. 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. A faculty member in the CLS concentration will serve as the Director of the Summer Academy for CCE as well as participate in the 3-wk CCE course for visiting German students who will be studying U.S. Healthcare Management. As previously mentioned one of our faculty members is currently serving as the Director of the Science Educational Equity program in the College and is working with other university colleagues on the Graduation Initiative and with NSM colleagues on the Student Academic Success Working Group. Other programs in which our faculty members collaborate are Nursing, Chemistry, Geology, Environmental Studies, Office of Global Education and the Center for Teaching and Learning.

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.