



SACRAMENTO  
STATE

# Program Proposal Form B



Academic Group ( <i>College</i> ): Natural Sciences and Mathematics	Date of Submission to College Dean: 5/7/2008
Academic Organization ( <i>Department</i> ): Chemistry	Requested Effective: Fall __, Spring <u>X</u> , 2009_.
Department Chair: Susan Crawford	Contact if not Department Chair: Linda Roberts
Title of the Program: Bachelor of Science in Biochemistry	
Type of Program Proposal:  <input type="checkbox"/> Modification in Existing Program: <input type="checkbox"/> Substantive Change <input type="checkbox"/> Non-Substantive Change <input type="checkbox"/> Deletion of Existing Program  <input checked="" type="checkbox"/> New Programs <input type="checkbox"/> Initiation (Projection) of New Program on to Master Plan <input type="checkbox"/> New Degree Programs <input type="checkbox"/> Regular Process <input checked="" type="checkbox"/> Fast Track Process <input type="checkbox"/> Pilot Process <input type="checkbox"/> New Minor, Concentration, Option, Specialization, Emphasis <input type="checkbox"/> New Certificate Program	
PLEASE NOTE: Form B is to be used only as a Cover Form. Additional information is requested for each of the above as noted in the corresponding procedure in the Policies and Procedures for Initiation, Modification, Review and Approval of Courses and Academic Programs found at <a href="http://www.csus.edu/acaf/univmanual/index.htm">http://www.csus.edu/acaf/univmanual/index.htm</a>	

**Briefly describe the program proposal (new or change) and provide a justification.**

Biochemistry is an expanding area of Chemistry both locally and nationally, the growth of which is reflected in the Sacramento region's burgeoning biotechnology industry. The Chemistry department at CSUS currently offers a BA in Chemistry with Biochemistry concentration (BA/BC). This degree was developed in the early 90's in recognition of the need to incorporate Biochemistry into the Chemistry curriculum. The BA/BC degree is popular, with 40% of Chemistry majors consistently choosing this degree option. We believe the time has come to offer a BS in Biochemistry. Due to its more rigorous content, we believe our graduates will be better prepared for post-graduate study and for industry jobs if they have BS, rather than BA, degrees. In a survey recently conducted of Chemistry and Biology students, nearly 80% of respondents would choose the BS in Biochemistry over the BA in Chemistry with Biochemistry concentration or the BS in Biology. An evaluation of programs around the CSU revealed that our current BA/BC degree is close to those offered within the CSU system for a BS in Biochemistry, and that formulating a new BS Biochemistry degree would require relatively minor changes. The hiring of 4 new biochemistry faculty in the last decade facilitates the offering of this degree. Therefore, we propose to add the BS in Biochemistry as an option for Chemistry students. The main curriculum changes involve the addition of three existing Chemistry courses: upper division organic and physical chemistry labs (CHEM 125 and CHEM 141) and one upper division Chemistry elective. We will retain the three units of upper division Biology electives and add Genetics (BIOL 184) as a required core course. The addition of BIOL 1 and BIOL 2 in place of BIOL 10 reflects changes in the introductory biology offered by the Department of Biological Sciences. The math (MATH 030 and 031) and physics (PHYS 005A and 005B) tracks for the BS Biochemistry will remain the same as those for the BA with Biochemistry concentration.

**Approvals:**

Department Chair:           *Lisa M. Campbell*           Date:           8/25/08          

College Dean:           *Laurel Jefferson*           Date:           9/3/08          

University Committee: \_\_\_\_\_ Date: \_\_\_\_\_

Associate Vice President and Dean  
for Academic Affairs: \_\_\_\_\_ Date: \_\_\_\_\_

8/27/07

# PROPOSAL FOR THE BACHELOR OF SCIENCE DEGREE IN BIOCHEMISTRY

Linda M. Roberts, PhD  
Chemistry Department  
Spring 2008

1. *Complete Form B* - see attached.
2. *State the purpose of the program.*

To provide CSUS students interested in Biochemistry with the opportunity to obtain a Bachelor of Science Degree in Biochemistry. This degree is not intended to replace the existing BA Chemistry with Biochemistry concentration degree but instead allows students to opt for the more rigorous curriculum associated with the BS degree.

3. *How does the proposed program fit into the mission of the University and the program responsibility of the College and the academic unit that will offer the program?*

The BS Biochemistry degree offers excellent preparation for students entering professional programs, particularly pharmacy and medical school. It also offers excellent preparation for post-graduate study in a multitude of disciplines having Biochemistry as their foundation (biochemistry, biophysics, molecular biology, cell biology, bacteriology, virology, pharmaceutical science, etc.). Finally, it provides excellent preparation for students entering the biotechnology workforce, since students become proficient in their comprehension and handling of all classes of biological molecules. Currently, CSUS does not offer this degree. The Chemistry department does offer a BA Chemistry with Biochemistry concentration (BA/BC). Implementation of the BS Biochemistry degree fulfills both the university's mission and the goals of Destination 2010 because it offers students more rigorous and comprehensive preparation for careers in local industry as well as post-graduate study.

4. *Describe the need for the program with respect to student interest, interest in the community and the demand within our service area for graduates of the program.*

#### **a. Student interest**

A survey was conducted in Spring 2003 of Chemistry and Biology undergraduate and graduate students in nine different courses. (This survey also included questions regarding a proposed Master's in Chemistry with Biochemistry Concentration, which was approved and implemented in 2004). The courses surveyed included the following (\*indicates graduate course):

Biol 121 (Cell Physiology)  
Biol 181 (Molecular Biology Lab)  
Biol 223\* (Human Molecular Genetics)  
Chem 124 (Organic Chemistry Lecture, second semester)  
Chem 140B (Physical Chemistry Lecture, second semester, taken by BS Chem majors)  
Chem 161 (General Biochemistry Lecture, taken by Biology majors)  
Chem 164 (Advanced Biochemistry Laboratory, capstone course for BA/BC majors)

Chem 231\* (Chemical Separations Laboratory)  
Chem 260\* (Protein Biochemistry)

A total of 156 students responded. 80% of the students surveyed were undergraduates and 20% were graduates in Chemistry or Biology (about 50% from each department). The students were asked the following:

*If given the choice, would you opt or would you have opted for the BA/BC or the BS Biochemistry degree?*

78% of students answered yes to this question, 17% answered no. This response verifies our perception of a strong desire among students to pursue a BS in Biochemistry. To gauge the level of interest of Chemistry versus Biology students, we asked:

*If you are a Biology major, would you have majored in Chemistry if the BS Biochemistry degree had been available?*

67% of the respondents said no, 28% said yes and 5% said maybe. While the majority of Biology majors indicated they would not opt for the degree, as many as 33% may have chosen this degree option if had been available.

Since the survey was conducted, interest in the degree has remained very high. Due to the very strong interest in this degree, a number of students have been approaching the Chemistry department for approval to fulfill the curriculum of the proposed degree through the Special Major.

**b. Community interest and demand.**

In spite of the current economy, Biotechnology is booming in the greater Sacramento area as well as the Bay area with established companies such as Genentech expanding operations closer to Sacramento while new companies are being formed at a fast rate. It is critical that we provide our students with high-level, comprehensive, rigorous academic programs in order to increase their competitiveness in securing jobs in this area. Furthermore, a number of government laboratories are located in the Sacramento region, many of them concerned with environmental testing. CSUS is already a recognized leader by these laboratories due to our ability to provide significantly more hands-on laboratory training than our major competitor, UC Davis. The proposed BS Biochemistry curriculum better prepares students for jobs in both areas because it strengthens the Biochemistry core curriculum while increasing and broadening participation in upper division laboratory course work.

**5. Indicate the anticipated student demand for the program. Upon what basis were these estimates derived?**

According to our survey from 2003 (interest has since grown even higher since the survey was conducted), 80% of current BA/BC (~9 graduate per year) and 25% of BS Biology (including only concentrations in Molecular and Microbiology) majors (~25 graduate per year) would opt for the BS Biochemistry degree, giving a projection of 13-14 students in year one. Given the

current rate of increase in graduation from existing programs (~20%), the three and five year projections are 16-17 and 19-20 students, respectively. In terms of overall enrollment in the degree, about 32% of all chemistry majors are expected to enroll (80% of existing BA/BC which currently constitute 40% of the 140-150 students enrolled in Chemistry), giving about 50 students at any time enrolled in the program. Students opting for the BS Chemistry versus the BS Biology degree could increase this enrollment quite significantly.

**6. Describe the general scope and content of the proposed program.**

The BS Biochemistry expands upon the existing BA/BC degree by strengthening and broadening the curriculum to include genetics (offered by the Department of Biological Sciences), two additional upper division Chemistry laboratories (organic and physical chemistry) and one additional upper division Chemistry elective. The existing Biochemistry core for the BA/BC degree, which includes one year of Biochemistry lecture and one year of Biochemistry lab, is retained in the BS Biochemistry degree. The math and physics tracks are the same as those for the BA/BC degree. The proposed curriculum is listed below:

NOTES:

- **No new courses are required for this degree**
- These units also fulfill the 12 units of AREA B General Education requirement, bringing the program total to 118-122. Virtually all students opt for the two semester physics sequence (5A and 5B) versus the three semester sequence (11 A, B, C), giving a total of 118 units, which falls within the 120 unit limit for new programs.

***Required Lower Division Courses (46-50 units)***

- (5) CHEM 001A\* General Chemistry I (High school algebra [two years] and high school chemistry or equivalent)
- (5) CHEM 00B General Chemistry II (CHEM 001A with a passing grade of "C" or better)
- (3) CHEM 024 Organic Chemistry Lecture I (CHEM 001B)
- (3) CHEM 025 Organic Chemistry Lab I (CHEM 24, CHEM 124 may be taken concurrently)
- (4) CHEM 031 Quantitative Analysis (CHEM 001B)
- (5) BIO 001 Biodiversity, Evolution and Ecology
- (5) BIO 002 Cells, Molecules and Genes (BIO 001, CHEM 001A)
- (4) MATH 030 Calculus I (MATH 029 or four years of high school mathematics which includes two years of algebra, one year of geometry, and one year of mathematical analysis; completion of ELM requirement and Pre-Calculus diagnostic tests)
- (4) MATH 031 Calculus II (MATH 030 or appropriate high school based AP credit)
- (8-12) PHYS 005A General Physics: Mechanics, Heat, Sound (Recently completed three years of high school algebra and geometry; and a college course in algebra and trigonometry) **AND**  
PHYS 005B General Physics: Light, Electricity, and Magnetism, Modern Physics (PHYS 005A or instructor permission) **OR**

- PHYS 011A General Physics: Mechanics (MATH 030, MATH 031; or equivalent certificated high school courses. MATH 031 may be taken concurrently)  
**AND**  
 PHYS 011B General Physics: Heat, Light, Sound (MATH 031, PHYS 011A) **AND**  
 PHYS 011C General Physics: Electricity and Magnetism, Modern Physics (MATH 031, PHYS 011A)

\*Passing a placement exam or obtaining a passing grade of "C" or better in CHEM 004 is required to enroll in CHEM 001A.

***Required Upper Division Courses (27 units)***

- (3) CHEM 124 Organic Chemistry Lecture II (CHEM 024, or instructor permission; concurrent enrollment in CHEM 025 recommended)  
 (3) CHEM 125 Organic Chemistry Laboratory II (CHEM 025, CHEM 124, ENGL 020 or an equivalent second semester composition course)  
 (3) CHEM 142 Introduction to Physical Chemistry (CHEM 001B, CHEM 024, PHYS 005A, PHYS 005B, MATH 031)  
 (3) CHEM 141 Physical Chemistry Laboratory (CHEM 142, ENGL 020 or an equivalent second semester composition course)  
 (3) CHEM 160A Structure and Function of Biological Molecules (CHEM 124; MATH 026A or MATH 030 is recommended)  
 (3) CHEM 160B Metabolism and Regulation of Biological Systems (CHEM 160A)  
 (3) CHEM 162 General Biochemistry Laboratory (CHEM 031; CHEM 160A or CHEM 161, either may be taken concurrently), ENGL 020 or an equivalent second semester composition course)  
 (3) CHEM 164 Macromolecular Laboratory Techniques (CHEM 162 or equivalent, ENGL 020 or an equivalent second semester composition course)  
 (3) BIOL 184 Genetics (BIO 002)

***Upper Division Elective Courses (6 units)***

3 Units of Chemistry Elective (must be from the approved list)

- (3) CHEM 110 Inorganic Chemistry Lecture (CHEM 125, CHEM 140B, or CHEM 142 with instructor permission; CHEM 140B may be taken concurrentl  
 (3) CHEM 133 Chemical Instrumentation (CHEM 031, CHEM 140B or CHEM 142 with instructor permission; ENGL 020 or an equivalent second semester composition course)  
 (3) CHEM 126 Physical Organic Chemistry Lecture (CHEM 124, CHEM 140B; CHEM 140B may be taken concurrently. Fall only.)  
 (3) CHEM 128 Organic Synthesis (CHEM 124. Spring only.)  
 (3) CHEM 198 Senior Research. (One upper division CHEM lab, ENGL 020 or equivalent second semester composition course, and instructor and department chair permission)  
 (3) CHEM 250 Selected Topics in Chemistry (Enrollment in MS Chemistry graduate program or instructor permission)  
 (3) CHEM 260 Protein Biochemistry (One semester of biochemistry)

- (3) CHEM 261 Nucleic acid chemistry (Undergraduate course in biochemistry)

3 Units of Biological Sciences Elective (must be from the approved list):

- (3) BIO 121 Cell Physiology (BIO 001 and 002; CHEM 161)  
(4) BIO 139 Microbiology (BIO 010 or BIO 020 or BIO 001 and BIO 002; CHEM 020 or CHEM 024)  
(4) BIO 144 Pathogenic Bacteriology (BIO 139)  
(3) BIO 149A Immunology Lecture (BIO 139, CHEM 161)  
(1) BIO 149B Immunology Lab (BIO 139, BIO 149A)  
(2) BIO 180 Molecular Biology Lecture (BIO 184. Fall only.)  
(2) BIO 181 Molecular Biology Laboratory (BIO139, BIO 184; BIO 180 recommended. Spring only.)  
(2) BIO 220 Research Methods in Biological Sciences (Spring only)  
(3) BIO 222 Molecular Biology (BIO 184, CHEM 161)

7. *Estimate the resources (existing and new) required to operate the proposed program.*

***Existing Support Resources for the Proposed Degree Major Program:***

**a. Faculty**

See attached table. The addition of four new Biochemistry faculty since 1995, as well as new hires in the Organic and Physical areas facilitates the offering of the degree.

**b. Space and facilities**

The Dept. of Chemistry is located in Sequoia Hall. Depending on course size, lecture courses in Chemistry are currently taught in several buildings around campus. Chemistry labs are all taught on the fourth floor of Sequoia Hall. The required Biology courses will be taught primarily in Sequoia or Humboldt Halls.

**c. Library resources**

The library has a reasonable collection of Biochemistry and related books. In addition, the library has on-line access to the major journals students would need for writing reports in the required classes (e.g. *J. of American Chemistry, Biochemistry, Journal of Biological Chemistry*). The library also has a large computer lab for student use.

**d. Equipment and other specialized materials currently available.**

The Dept. of Chemistry has extensive instrumentation available including a Hewlett- Packard 5890 Series II GC-Mass spectrometer; a Bruker Avance-300 nmr; a Bruker MSL 300MHz wide bore nmr; a Perkin-Elmer 2000 FTIR; a Shimadzu UV-2401 PC spectrometer; an HP 8452A UV-VIS Diode array spectrometer; a Shimadzu, RF-5301PC spectrofluorophotometer; a Beckman L2-50 ultracentrifuge; several Agilent/HPLC systems; an epr spectrometer; a Beckman