

UNIVERSITY OF ILLINOIS
AT URBANA-CHAMPAIGN

EP0505

Office of the Provost and Vice Chancellor
for Academic Affairs

Swanlund Administration Building
601 East John Street
Champaign, IL 61820



May 26, 2004

O. Vernon Burton, Chair
Senate Committee on Educational Policy
Office of the Senate
228 English Building, MC-461

Dear Professor Burton:

Enclosed are copies of a proposal from the College of Liberal Arts and Sciences to
Revise the Specialized Curriculum of the Bachelor of Science in Biochemistry.

This proposal has been approved by the Committee on Courses and Curricula, Academic
Affairs Committee, Executive Committee and the Faculty of the College of Liberal Arts
and Sciences; it now requires Senate review.

Sincerely,

Keith A. Marshall, Ph.D.
Assistant Provost

Enclosures

c: J. Gerlt
C. Livingstone
M. Michael
C. Miller
C. Wraight

PROPOSAL TO THE SENATE COMMITTEE ON EDUCATIONAL POLICY

TITLE OF THE PROPOSAL: Revision of the Bachelor of Science in Biochemistry (Specialized Curriculum) in the College of Liberal Arts and Sciences.

SPONSOR: John A Gerlt, Head, Department of Biochemistry, 244-0205.
Colin A. Wraight, Associate Head, Department of Biochemistry, 333-3245.

BRIEF DESCRIPTION:

The past two years have seen the establishment of the School of Molecular and Cellular Biology (MCB), the movement of the Department of Biochemistry from the School of Chemical Sciences to MCB, the implementation of a BSLAS Science and Letters major in MCB, and the streamlining of course offerings across MCB units. In keeping with these changes, we now propose to revise the Specialized Curriculum in Biochemistry in order to clarify the distinction between the Specialized Curriculum and the MCB Science and Letters major Area of Emphasis in Biochemistry. [Note: the phrase "MCB Area of Emphasis in Biochemistry" is being used to refer to the MCB undergraduate majors who chose to take their electives from among the Biochemistry offerings.] The overall thrust and objectives of the Biochemistry Specialized Curriculum remain the same, however, some requirements have changed in response to anticipated changes in the projected clientele.

JUSTIFICATION:

The old curriculum provided training suitable for graduates with research intentions, as well as giving an explicit "biochemistry" imprimatur for medical school applicants. Students from both groups, with genuine research plans, i.e., including potential MD/PhD candidates, have tended to do undergraduate research under BIOC 492, while the majority (including most pre-meds) has not. The new curriculum recognizes this distinction explicitly. Based on a recent report commissioned by the National Institutes of Health and the Howard Hughes Medical Institute, the American Society for Biochemistry and Molecular Biology (ASBMB) has strongly recommended that two semesters of genuine research experience be incorporated into Biochemistry curricula. This has been adopted as a required element of the new curriculum. Based on the number of students involved in undergraduate research in Biochemistry in recent years (10-20), we expect a similar number of students to opt for the new Specialized Curriculum in Biochemistry.

While cell and molecular biology, generally, has been greatly influenced by the rapid advances made in structural biology, biochemistry represents the core field that utilizes structural information for fully mechanistic, chemical interpretation. Its position at the interface between biology and chemistry places a substantial burden of fundamental knowledge on students with the desire to innovate in this field. An effective curriculum must therefore aim to provide a higher level of understanding of core chemical and physical principles, and to place these in a modern research context.

The focus of the new curriculum, therefore, is to provide training that is targeted towards students with definite research-oriented goals. It provides significantly more instruction in physico-chemical principles and in current developments in biochemistry, introduces undergraduates to the research literature, and requires a substantial research effort. The more didactic approach of the MCB Area

of Emphasis in Biochemistry will serve the majority of students whose needs are for an understanding of the role of biochemistry in biology and medicine.

Distinction between Specialized Curricula and Science and Letters Curricula in the College of Liberal Arts and Sciences.

The basic LAS degree program is the Sciences and Letters Curriculum. (Policy Statement Defining Majors and Specialized Curricula; adopted November, 1987; updated August 2001). The major constitutes that part of the student's program which is the study of a particular discipline, area or topic in some depth. In most cases, the major can be divided into those requirements in the major unit and the supporting coursework, which is outside the unit but needed to support the major. A Science and Letters curricular program should have both breadth of study and sufficient depth. Furthermore, a liberal arts and sciences program should allow sufficient "free electives" that the student has some freedom for exploration of possible majors, for additional study in depth, or for exploration of additional areas (minor or a second major). The Science and Letters major in Molecular and Cellular Biology is the pertinent example here.

Sometimes, however, a specific educational purpose leads to the design of a program that cannot be accommodated within the guidelines for the Sciences and Letters Curriculum. Such a program is called a Specialized Curriculum. The requirements of a specialized curriculum are typically more constraining than those of Science and Letters majors. There are various reasons for the establishment of specialized curricula. For example, the demands of an outside accrediting agency may be such that the program cannot be established within the structure of a Science and Letters major. Another need might be for a program with very few electives. The Specialized Curriculum in Biochemistry clearly meets these criteria.

Because of the sheer number of hours required of specialized curricula, and because of the lack of flexibility that characterizes curricula that are built upon clearly defined sequences of coursework in technical fields, the College of Liberal Arts and Sciences allows these specialized curricula to follow the campus pattern of General Education coursework rather than the distributional model of General Education that characterizes the Science and Letters majors within LAS.

Biochemistry as a Specialized Curriculum

The preferred advising route for the Specialized Curriculum in Biochemistry (course sequences indicated by asterisks in Table 1) comprises 127 hours, as proposed. In contrast to the MCB Area of Emphasis in Biochemistry, the Specialized Curriculum is more technical in nature, and targets students with well defined career goals in biochemistry laboratory research. Therefore, the logic and necessity behind the two curricula are also distinct.

BIOC 460 is required for the Specialized Curriculum, and will fulfill the campus Advanced Composition requirement. It is also an advanced course that specifically introduces undergraduates to the primary research literature and requires written analyses of current research. Instruction will be given on the writing of scientific papers, and this will also serve as a guide for the students' own senior theses. All written work will be reviewed, critiqued and re-written. This course will address the ASBMB recommendation to train students in the "ability to assess primary papers critically".

The ability to take courses outside MCB/Biochemistry, at this point, is in accord with the ASBMB recommendations for students to take advanced offerings, broadly, in science and engineering. An approved list of current courses is attached and will be up-dated each year, as many new courses are appearing across campus. All 400-level MCB courses are acceptable. The faculty revision of this list of approved courses will occur in January/February for the coming year.

The Specialized Curriculum will also require a "capstone" course (Current Topics in Biochemistry), offered in spring semester of the senior year. This is a new course (BIOC 445) that will cover four selected areas of current research activity, each presented by one faculty member. Each year, one or two of the topics will change to involve all the faculty over a period of a few years and to allow for material changes to keep abreast of rapidly developing areas. The course will be presented in a lecture format, but based on readings from the primary literature (students will have already gained experience with the primary literature in BIOC 460, the previous semester). Students in the capstone course will also attend a few selected research seminars (related to the class topics) presented in the departmental seminar series, and an important goal of the lectures will be to bring the students to a level of understanding sufficient for them to follow these research seminars with ease. With the new mode of charging tuition (fixed fee for 4 years), it is more important than ever to respect the feasibility of graduating within the nominal 4 year period. To do this, we wish to ensure that the total number of hours required is kept under 130. Following the campus rather than College-specific general education guidelines will greatly facilitate this.

Minimum Grade Point Average Requirement

A critical component of this Specialized Curriculum is a meaningful research experience, with the goal of training future generations of innovators at the interface between biology and chemistry. At the present time, research credit is an elective in the Specialized Curriculum, but it has a *strongly recommended* minimum GPA of 3.0. Furthermore, the general experience of faculty throughout MCB is that students with a curriculum GPA that is much lower than this are simply not able to perform adequately in this endeavor. For the new Specialized Curriculum in Biochemistry, which is specifically targeted towards students with genuine career goals in research, it is proposed that all students in the specialized curriculum maintain a minimum GPA of 2.5 in their curriculum courses. This is a compromise that safeguards both the students and the faculty in the Department of Biochemistry, who will be obligated to provide an appropriate, two semester research environment for all majors in the Specialized Curriculum. The Biochemistry Department Office of Student Affairs will be responsible for monitoring the new 2.5 GPA requirement.

It is important to note that this does not shut the door on the occasional student with a deficient GPA who has genuine interest and aptitude for research. If a faculty member is willing, such students can obtain research experiences in the Science and Letters MCB major, where research remains an elective and the GPA is considered only as a guideline.

SUMMARY:

These changes in the Biochemistry Specialized Curriculum are intended to target the curriculum towards students with definite expectations of a research-oriented career. It is therefore expected that the size of the specialized curriculum will decrease, especially due to loss of most pre-med students, except those with joint M.D./Ph.D. aspirations, to the MCB major. The revised

curriculum is compared to the current one in Table 2. The proposal is for a tightly constructed major that adopts as much as possible of the new course structure in MCB, thereby allowing facile transfer of students between the Specialized Curriculum in Biochemistry and the Science and Letters MCB major, at almost any time in the four year period. The distinctions between the Biochemistry Specialized Curriculum and the MCB Emphasis in Biochemistry are tabulated in Table 1. The main differences are: at least 1 extra semester of calculus, a second semester of organic chemistry, a second semester of physical chemistry, a specialized Comp II course based on advanced biochemistry topics, an advanced Current Topics lecture course, and a significant (10 hours) required research component. In addition, majors in the Specialized Curriculum will be strongly advised to take physics with calculus, PHYS 211-214, and, where possible, to take the accelerated chemistry sequence, CHEM 202-205. For the preferred advising route, the Specialized Curriculum requires 25 hours more work in the major than does the MCB Area of Emphasis in Biochemistry (the minimum extra is 18 hours).

BUDGETARY AND STAFF IMPLICATIONS:

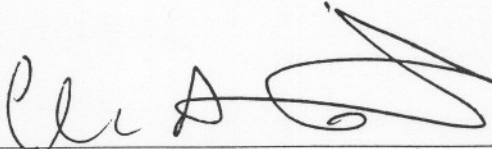
There are no budgetary implications and few, if any, staff implications. For the last 5 years, 10-20 Biochemistry undergraduates, each year, have been involved in elective, senior research projects (BIOC 492). A similar number of students are expected to opt for the new Specialized Curriculum in Biochemistry, which will mandate two semesters (10 hours) of research. Every Biochemistry faculty member will take a minimum of 1 student/year, which will allow us to guarantee spots for all eligible students. The Biochemistry faculty have fully agreed to accommodate Biochemistry majors in their laboratories for senior research. Based on recent experience, there is no expectation that there will be any restriction on the number of students that can be accepted into the major. Furthermore, as is currently the case for elective research, students in the Specialized Curriculum will have the flexibility to conduct their research in laboratories of any faculty member in MCB, on projects of an essentially biochemical nature, with approval from the Department. The faculty in all Departments of MCB have been apprised of the fact that research is now a requirement of the Specialized Curriculum. The procedure for handling cross-departmental research will require the student to enroll under a Biochemistry sponsoring faculty member's call #, with the thesis being read by both faculty, and the final grade being submitted to the sponsor by the research advisor. The large majority of students in the current curriculum, who do not carry out research, will be well served by the MCB Area of Emphasis in Biochemistry. The Biochemistry Department guarantees that all majors will have access to research projects. Students who are able to enroll in recognized, intensive research experiences, such as summer research at Woods Hole, N.I.H., etc., may substitute such activities for the research requirement, with prior departmental approval.

GUIDELINES FOR UNDERGRADUATE EDUCATION:

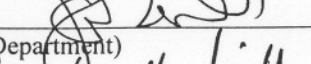
All campus General Education guidelines will be followed.

PROPOSED EFFECTIVE DATE: Fall 2005

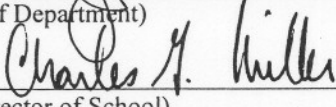
CLEARANCES:

Sponsor approval 
(Colin A. Wright, Assoc. Head of Department)

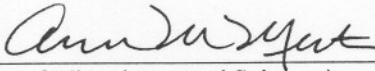
Date 10 March 04

Department approval 
(John A. Gerlt, Head of Department)

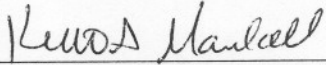
Date 3/15/04

School approval 
(Charles G. Miller, Director of School)

Date 3/10/04


(College of Liberal Arts and Sciences)

Date 5/17/04


(Office of the Provost)

Date 5-26-04

STATEMENT FOR PROGRAMS OF STUDY CATALOG:

MAJOR IN SPECIALIZED CURRICULUM IN BIOCHEMISTRY

A total of at least 123-128 semester hours of course work as outlined below, with a minimum 2.0 academic grade-point average required for graduation. In addition, in order to graduate, students must attain a 2.5 average in the chemistry, biochemistry, biology, mathematics, physics, and advanced electives in Science/Engineering courses specified in this curriculum. All proposals for course substitutions must be approved by the faculty adviser. This curriculum is intended for those students who desire a rigorous education in chemistry, biochemistry, and biology, who have definite research-oriented goals, and whose career objectives include graduate school, MD/PhD programs, or industry.

Degree title: Bachelor of Science in Biochemistry

General education: All campus general education requirements must be satisfied.

Minimum hours required for graduation: 123-128 hours

Students earning the Biochemistry major automatically complete the Chemistry minor. Students earning a degree in the Specialized Curriculum in Biochemistry may not earn a second degree in the Science and Letters Curriculum in Molecular and Cellular Biology.

Departmental distinction: In addition to meeting the above requirements, a student seeking distinction must satisfy the following:

- a. Complete 10 hours of BIOC 492.
- b. Earn at least a 3.0 grade-point average.
- c. Present a senior thesis for deposit in the College of Liberal Arts and Sciences.

HOURS	REQUIREMENTS ^{1,2}
8-9	General chemistry, select from: CHEM 202—Accelerated Chemistry I; CHEM 203—Accelerated Chemistry Lab I; CHEM 204—Accelerated Chemistry II; and CHEM 205—Accelerated Chemistry Lab II or CHEM 102—General Chemistry I, CHEM 103—General Chemistry Lab I, CHEM 104—General Chemistry II, CHEM 105—General Chemistry Lab II
8-9	Organic chemistry, select from: CHEM 236—Fundamental Organic Chem I; CHEM 237—Structure and Synthesis; CHEM 436—Fundamental Organic Chem II or CHEM 232—Elementary Organic Chemistry I; CHEM 233—Elementary Organic Chem Lab I; CHEM 332—Organic Chem II
7-8	Physical chemistry: select from: CHEM 440-B—Physical Chemistry Principles (Biological Perspective Section) and BIOC 446—Physical Biochemistry or CHEM 442—Physical Chemistry I and CHEM 444—Physical Chemistry II
11	Mathematics: MATH 220—Calculus I; MATH 230—Calculus II; and MATH 242—Calculus of Several Variables
10-12	Physics, select from: ³ PHYS 211—Univ Physics, Mechanics, PHYS 212—Univ Physics, Elec & Mag, PHYS 213—Univ Physics, Thermal Physics, and PHYS 214—Univ Physics, Quantum Physics or PHYS 101—College Physics, Mech & Heat, and PHYS 102—College Physics, E&M & Modern Physics, or equivalent as approved by academic adviser
17	Molecular and Cellular Biology: MCB 150—Molec & Cellular Basis of Life, MCB 250—Molecular Genetics, MCB 251—Exp Techniqs in Molecular Biol, MCB 252—Cells, Tissues & Development, MCB 253—Exp Techniqs in Cellular Biol and MCB 354—Biochem & Phys Basis of Life, or equivalent as approved by academic adviser
23	Biochemistry: BIOC 455—Technqs Biochem & Biotech BIOC 406—Gene Expression BIOC 460—Biochemistry Senior Seminar (satisfies Advanced Composition requirement) BIOC 445—Current Topics in Biochemistry BIOC 492—Senior Thesis
6	Advanced Science/Engineering: select from approved list. ⁴
variable	Non-technical Requirements: ⁵ General education: <ul style="list-style-type: none"> • Foreign language—three semesters of college study (or three years of high school study) in a single foreign language to satisfy the campus foreign language requirement • Composition I writing requirement (to satisfy the campus Composition I requirement) • Advanced Composition writing requirement (BIOC 460 is required) • Humanities/Arts to satisfy the campus general education requirements • Social/Behavioral sciences to satisfy the campus general education requirements • Cultural Studies to satisfy the campus general education requirement⁶

variable Electives (not including any credit in satisfaction of the above requirements)

¹Transfer credit must be approved by an adviser in biochemistry in order to be used to satisfy degree requirements.

²A more detailed description of the requirements is listed in the *Biochemistry Curriculum Brochure*, available in room 420A of Roger Adams Laboratory.

³PHYS 213 is not required if CHEM 442/444 sequence is taken.

⁴An approved list of current courses will be up-dated annually in January/February for the coming year.

⁵The requirements for the Campus General Education categories Natural Sciences and Technology and Quantitative Reasoning I are fulfilled through required course work in the curriculum.

⁶The courses taken to satisfy Western and/or Non-Western Civilization requirements may also be used to satisfy non-technical and/or free elective categories.