

**The University Senate of Michigan Technological University**

**PROPOSAL 12-06**

(Voting Units: Academic Departments)

**BIOCHEMISTRY AND MOLECULAR BIOLOGY, B.S.**

with concentrations in  
Chemistry and Biological Sciences

**1. Program Description**

The proposed Biochemistry and Molecular Biology B.S. degree will be offered through a collaboration of the departments of Chemistry and Biological Sciences. This new degree will be jointly administered by the two departments and combines the strengths of the existing biochemistry/molecular biology concentrations in each. The proposed program meets the guidelines set by the BIO2010 report (National Research Council of the National Academies, 2003) and the American Society for Biochemistry and Molecular Biology (ASBMB) in having a strong basis in quantitative and physical sciences. Graduates will be prepared for technical and research positions in industry, particularly biomedical, pharmaceutical and agricultural sciences, and for advanced study in biochemistry, molecular biology, or health sciences.

This B.S. program recognizes that biochemistry and molecular biology represent a melding of basic biology and chemistry concepts that truly integrates the topics. The subject can be studied from the perspective of molecular concepts that are applied to biological systems, or from a cellular biochemical process perspective progressing down to the molecular scale. Students will choose one of these two complementary approaches by selecting a concentration in Chemistry or a concentration in Biological Sciences. All students in this B.S. program take a common set of core courses in chemistry, biology, mathematics, and physics and an additional concentration in Chemistry or Biological Sciences. This degree is jointly administered by the departments of Chemistry and Biological Sciences through a committee composed of the two department chairs, and two faculty members from each department.

**2. Rationale**

Expanding career opportunities in biomedical and biotechnical fields will be available to graduates with a practical and in-depth understanding of biochemistry and molecular biology. These skills cannot be conveniently acquired through traditional biology or chemistry degree programs. The joint program takes advantage of faculty expertise in both departments and offers students the choice of focusing on chemistry or biological processes in their advanced courses.

During the past decade, the interrelationships between the disciplines of biochemistry and molecular biology have grown so numerous and complex that the previously distinct boundary between these two disciplines has essentially vanished and a program with the combined name of Biochemistry and Molecular Biology is appropriate. In addition to traditional areas of research specialization, new areas such as Metabolomics, Bioinformatics, Genomics and Proteomics have appeared at the interfaces of biology and chemistry. Irrespective of the model system being studied (plants, bacteria, yeasts, animal cells), investigators now utilize an array of sophisticated techniques and approaches to address complex cellular problems. Application of these techniques, and development of improved ones, requires a thorough theoretical understanding of their underlying mechanisms. In recognition of the increased use of molecular tools and approaches in biochemistry, the premier society for biochemistry, The American Society for Biochemistry (ASB), was renamed to reflect this change; it is now the American Society for Biochemistry and Molecular Biology (ASBMB).

The collaboration of the two departments provides disciplinary strength as well as diversity to this B.S. program. This program will provide the State of Michigan with graduates educated to actively engage in life science, biotechnology and pharmaceutical research and industrial productivity. Graduates will be prepared to join a workforce that increasingly demands interdisciplinary and technologically savvy employees in the biochemical, biomedical and molecular biology fields. This program draws on the strength of the existing degree concentrations in Biochemistry and Molecular Biology in both the Biological Sciences and Chemistry departments and complements other recent B.S. degree programs in Pharmaceutical Chemistry, Cheminformatics, and in Bioinformatics at Michigan Tech. The curricular model for this degree is based directly upon the recommendations forwarded by the ASBMB.

**3. Related Programs**

The following related programs exist at MTU.

- B.S. in Biological Sciences, Molecular Biology and Biochemistry concentration
- B.S. in Chemistry with Biochemistry concentration (ACS approved)
- B.S. in Bioinformatics
- B.S. in Cheminformatics

- B.S. in Pharmaceutical Chemistry
- The following related minors are also available
  - Biochemistry (Biological Sciences)
  - Bioprocess Engineering (offered jointly by Chemical Engineering and Biological Sciences)
  - Plant Biotechnology (offered jointly by Department of Biological Sciences and the School of Forest Resources and Environmental Science)

Related Bachelor of Science Degrees at other State of Michigan Universities

**Central Michigan University**

B.S. in Biochemistry Department of Chemistry

**Eastern Michigan Univ.**

B.S. in General Biochemistry Department of Chemistry  
 B.S. in Professional Biochemistry Curriculum Department of Chemistry  
 B.S. in Biochemistry/Toxicology Program Department of Chemistry  
 B.S. in Biology (Cell and Molecular Biology) Department of Biology

**Ferris State University**

B.A. in Biochemistry Department of Physical Sciences  
 B.S. in Biotechnology Department of Biological Sciences

**Grand Valley State Univ.**

B.S. in Cell and Molecular Biology Interdisciplinary Program (Chemistry, Biology, & Biological Health)  
 B.S. in Biology (Genetics and Cell/Molecular Biology) Department of Biology  
 B.S. in Chemistry (Biochem. and Biotechnology Emphasis) Department of Chemistry

**Michigan State Univ.**

B.S. in Biochemistry and Molecular Biology Department of Biochemistry and Molecular Biology  
 B.S. in Biochemistry and Molecular Biology/Biotechnology Department of Biochemistry and Molecular Biology

**Northern Michigan University**

B.S. in Biochemistry Department of Chemistry

**Oakland University**

B.S. in Biochemistry Interdisciplinary major (Biology & Chemistry)  
 B.S. in Biology (Cell and Molecular Biology) Department of Biology

**Saginaw Valley State University**

B.S. in Biochemistry Interdisciplinary major

**University of Michigan, Ann Arbor**

B.S. in Biochemistry, Cellular and Molecular Biology Interdisciplinary major (Department of Molecular, Cellular and Developmental Biology)  
 B.S./M.S. 5 year program in Cellular and Molecular Biology and Biomedical Engineering Department of Molecular, Cellular and Developmental Biology (with Biomedical Engineering)

**University of Michigan, Dearborn**

B.S. in Biochemistry Department of Natural Sciences

### Univ. of Michigan, Flint

B.S. in Molecular Biology and Biotechnology

B.S. in Chemistry (Biochemistry Option)

Department of Biology

Department of Chemistry

### Wayne State University

B.S. in Biological Sciences (Biotechnology Track)

B.S. in Chemistry (Biochemistry Concentration)

Department of Biological Sciences

Department of Chemistry

### Western Michigan University

B.S. in Biochemistry

Department of Chemistry

## 4. Projected Enrollment

The current graduates in the biochemistry options between the two departments are 5-7 per year (2003-2004 data). Our goal is to double this graduation rate within a few years. Inquiries from prospective students indicate that the program will attract additional students to Michigan Tech.

## 5. Scheduling Plans

This Biochemistry and Molecular Biology B.S. will be a regular on-campus program offering. The anticipated commencement date is Fall semester 2006.

## 6. Curriculum Design

All students in Biochemistry and Molecular Biology take a common set of core courses. Additional courses are determined by the choice of concentration: Biological Sciences or Chemistry. This degree is jointly administered by the Departments of Biological Sciences and Chemistry. Advising is based on concentration interest.

<u>Core Courses</u>	<u>Credits</u>
<b>Orientation</b>	1
BL/CH 1800 Biochemistry Orientation	3
Select one of the following:*	
BL 2100 Principles of Biochemistry	
OR	
CH 4710 Biomolecular Chemistry I	
	4
<b>Biological Sciences</b>	
BL 1040 Principles of Biology	4
BL 2220 Genetics	3
BL 3210 Microbiology	4
BL 3300 Introduction to Genomics	3
BL 4030 Molecular Biology	3
BL 4820 Biochemical Laboratory Techniques	2
BL 4840 Molecular Biology Techniques	3
	22
<b>Chemistry</b>	
CH 1110 University Chemistry I	4
CH 1111 University Chemistry Lab I	1
CH 1120 University Chemistry II	4
CH 2410 Organic Chemistry I	3
CH 2411 Organic Chemistry Lab I	1
CH 2420 Organic Chemistry II	3
CH 2421 Organic Chemistry Lab II	2
CH 3510 Physical Chemistry I	3
CH 3540 Biophysical Chemistry	3

<b>Physics</b>		24
PH 1100 Introductory Physics Lab I	1	
PH 1200 Introductory Physics Lab II	1	
PH 2100 University Physics I - Mechanics	3	
PH 2200 University Physics II - E&M	3	
		8
<b>Mathematics</b>		
MA 1150/51 or 1160/61 Calculus I	4	
MA 2150 or 2160 Calculus II	4	
		8
<b>Computer Science</b>		
CS 1121 Intro to Computer Science	3	
		3
<b>General Education and Distribution</b>		
UN 1001 Perspectives	3	
UN 1002 World Cultures	4	
UN 2001 Revisions	3	
UN 2002 Institutions	3	
General Education and Distribution Courses	15	
		28
<b>Total core credits</b>		<b>97</b>

Concentration courses

**Chemistry Concentration**

CH 3511 Physical Chemistry Lab	2
CH 3541 Bio Physical Chem Lab	2
CH 4222 Intro to Quant. and Instrumental Analysis	5
CH 4720 Biomolecular Chemistry II	3
CH 4910 Senior Seminar II	1
CH 4995 Research in Biochemistry	6
MA 2321 Elementary Linear Algebra	2
MA 3521 Elementary Differential Equations	2
Concentration Credits	23

**Biological Sciences Concentration**

BL 3240 Cell Biology	3
Select one of the following:	3
BL 3640 Immunology	
BL 4140 Plant Physiology	
BL 4350 Developmental Biology	
BL 4010 Biochemistry I	3
BL 4020 Biochemistry II	3
BL 4510 Senior Essay	2
BL 4995 Research in Biochemistry	3-6
Concentration Credits	17-20

Electives

8

Electives

11-14

**TOTAL credits required 128** (Core, Concentration, Elective)

\*Students will select one of these courses based on their chosen concentration.

GPA calculation:

Students will select a concentration initially to determine advising and GPA determination.

The departmental GPA will be calculated for all students in each concentration using grades from:

A. The core courses in Biological Sciences and Chemistry

AND

B. The cognate courses in the concentration (i.e. all the chemistry (CH) courses in the Chemistry concentration

OR

all the biology (BL) courses in the Biological Sciences concentration).

Since this degree is cross-departmental, students will select a concentration, which will determine their department for advising and determination of GPA beyond the core courses.

**7. New Course Descriptions**

Four new courses were submitted through the course change process and approved, BL/CH 1800, CH 3540, CH 3541, and BL 4995.

**8. Library and Other Learning Resources**

The support from the library for the existing degrees and their biochemistry concentrations is sufficient at present.

**9. Computing Access Fee**

Students selecting their concentration (in Biological Sciences or in Chemistry within this B.S. Biochemistry and Molecular Biology) will be designated to that home department. Basic computer access fees will be as designated for the home department.

## 10. Faculty Curriculum Vitae

Biochemistry associated faculty from the departments of Biological Sciences and Chemistry:

John Adler, Ph.D., Professor  
Sterol and ecdysteroid biochemistry  
Shiyue Fang, Ph.D., Assistant Professor  
Synthesis of bioactive natural products and oligonucleotide analogs  
Michael Gretz, Ph.D., Professor  
Carbohydrate biochemistry  
Donald Lueking, Ph.D., Associate Professor  
Microbial biochemistry and polycyclic aromatic hydrocarbon metabolism  
Pushpalatha Murthy, Ph.D., Professor  
Phospholipid and Phosphoinositide metabolism and biochemistry  
Martin Thompson, Ph.D., Assistant Professor  
DNA-Protein interactions  
Ramakrishna Wusirika, Ph.D., Assistant Professor  
Comparative and functional genomics, molecular analysis of disease resistance  
Heather Youngs, Ph.D., Assistant Professor  
Enzyme structure/function analysis, plant and fungal biochemistry

Faculty resumes for Biological Sciences are posted online: <http://www.bio.mtu.edu/faculty/index.htm>

Faculty resumes for Chemistry are posted online: <http://www.chemistry.mtu.edu/pages/faculty/index.php>

## 11. Available/Needed Equipment

All equipment required exists within the respective department laboratories.

## 12. Program Costs: Years 1, 2, and 3

Since the new degree program is based upon existing concentrations, no new costs are expected. Programmatic advertising costs will be borne by the respective departments.

## 13. Space

No new laboratory or faculty space is required.

14. **Policies, Regulations and Rules** None required

15. **Accreditation Requirements** None required

## 16. Internal Status of Proposal

Department of Biological Sciences,	11-11-05	, Date Approved
Department of Chemistry,	11-11-05	, Date Approved
Dean of Sciences and Arts,	11-14-05	, Date Approved
Vice Provost for Instruction,		, Date Approved
Provost,		, Date Approved
University Support Units,		, Date Approved
University Senate,		, Date Approved
Academic Affairs Officers,		, Date Approved
Board of Control,		, Date Approved

## 17. Planned Implementation Date

Fall Semester, 2006.

**Introduced in Senate: 18 January 2006**

**Adopted by Senate: 1 February 2006**

**Approved by Administration: 6 February 2006**

**Approved by BOC: 28 April 2006**