

# Biochemistry and Molecular Biology, B.S.

with concentrations in  
Chemistry and Biological Sciences

*(Adapted for web site distribution 2/3/06)*

## 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)

### **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>	credits	
<b>Orientation</b>		
BL/CH 1800 Biochemistry Orientation	1	1
<b>Biological Sciences</b>		
BL 1040 Principles of Biology	4	
BL 2200 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	24
<b>Physics</b>		
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>Concentration Prerequisite</b> Select one of the following: *		
BL 2100 Principles of Biochemistry	3	
OR		
CH 4710 Biomolecular Chemistry I	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 I	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 by selecting one of these courses will meet the prerequisites for their chosen concentration upper division courses.

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:

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.

15. Accreditation Requirements          None required

## 16. Internal Status of Proposal

Approved by the University Senate 2-2-06. Remaining approvals: Board of Control and the State of Michigan.

## 17. Planned Implementation Date

Fall Semester, 2006