Biochemistry Program Revision Draft

Targeted for AY26-27

Goals

- Prepare for American Society of Biochemistry and Molecular Biology (ASBMB) accreditation, to be first in Illinois. This could increase recruitment and yield.
- Retain American Chemical Society approval of the chemistry specialization.
- Increase the biochemistry focus of the program, which could increase yield and retention.
- Refine specializations, their learning objectives, and assessment.
- Increase accessibility of the minor.

Timeline

- February 2026 – Obtain steering committee approval, coordinate with the biology and chemistry departments, obtain UGSC approval, and complete catalog revision.
- May 2026 – Pre-application for ACS approval + review application for ASBMB accreditation

Program Learning Objectives

Current

Students will demonstrate the ability to:
1. Analyze and respond to biochemical questions using foundational technical knowledge in relevant areas such as: a. metabolism, b. organic chemistry, c. thermodynamics, d. kinetics, e. macromolecular structure, and f. cell biology
2. Ability to demonstrate technical skills in the laboratory setting and investigate biochemical questions or problems experimentally by collecting, analyzing and interpreting quantitative data.
3. Communicate scientifically in both oral and written forms.
4. Search literature and database systems related to biochemistry.

Proposed

According to the American Society of Biochemistry and Molecular Biology (ASBMB), the core concepts of the discipline are:

a. Energy is required by and transformed in biological systems;
b. Macromolecular structure determines function and regulation;
c. Information storage and flow are dynamic and interactive; and
d. Discovery requires objective measurement, quantitative analysis, and clear communication.

Graduates of the BS in Biochemistry (all tracks) will demonstrate the ability to:

1. Analyze and respond to biochemical questions by applying the core concepts of biochemistry.
2. Explain the role of evolution and homeostasis in shaping the form and function of all biological molecules and organisms.
3. Perform reproducible experiments in a biochemistry laboratory while maintaining accurate and complete records and adhering to high safety and ethical standards. Analyze and interpret quantitative data to address biochemical questions.
4. Search, evaluate, and synthesize primary literature and database resources related to biochemistry.
5. Clearly communicate about science in both oral and written forms.
6. Effectively collaborate in teams.

Major Changes

- PLO 1 replaces the list of topics in our current learning objectives with core concepts identified by ASBMB.
- PLO 2 explicitly mentions safety and ethics, as suggested by the ASBMB.
- PLO 6 is added to boost ASBMB accreditation. In the assessment plan, PLO 5&6 will be assessed at the university level (opposed to at the program level).

Curriculum

Biochemistry Requirements		**(18)**
BCHM 301	Introductory Biochemistry	3
BCHM 438	Physical Biochemistry	3
or BCHM 410	Molecular Biophysics	
BCHM 402	Metabolic Biochemistry	3
BCHM 404	Biochemistry Laboratory	3
BCHM 412	Advanced Biochemistry	3
BCHM 456	Computational Biochemistry and Drug Design	3
or BIOL 550	Bioinformatics	
Biology Requirements		**(15)**
BIOL 107	General Biology Lectures	3
BIOL 109	General Biology Laboratory	1
BIOL 115	Human Biology	3
BIOL 117	Human Biology Laboratory	1

BIOL 214	Genetics	3
BIOL 445	Cell Biology	3
BIOL 495	Biology Colloquium	1
Chemistry Requirements		**(18)**
CHEM 124	Principles of Chemistry I with Laboratory	4
CHEM 125	Principles of Chemistry II with Laboratory	4
CHEM 237	Organic Chemistry I	4
CHEM 239	Organic Chemistry II	3
CHEM 240	Organic Chemistry Laboratory	2
CHEM 485	Chemistry Colloquium	1
Biology or Chemistry classes		**(4)**
BIOL 100 or CHEM 100	Introduction to the Profession Introduction to the Profession	2
BIOL 451 or CHEM 451	Biological Literature Undergraduate Seminar	2
Upper Division Lab Requirement		**(3)**
Select any >300 biology or chemistry lab class, or other approved lab course:		3
BIOL 431	Animal Physiology Laboratory	3
BIOL 446	Cell Biology Laboratory	3
BIOL 455	Macromolecular Techniques	3
CHEM 416	Advanced Chemistry Laboratory	3
CHEM 434	Spectroscopic Methods in Identification and Analysis	4
CHEM 461	Bioanalytical Chemistry Laboratory	3
CHEM 463	Analytical Method Development Laboratory	0 TO 3
CHEM 476	Forensic Chemistry Laboratory	0 OR 3
PHYS 300	Instrumentation Laboratory	4
BIO/CHEM/BCHM 491	Research	3
Biochemistry Technical Electives		**(9)**

Select 12 credit hours from >300 biology or chemistry or		11
BIOL 210	Microbiology	3
BIOL 225	Microbiology Laboratory	2
BME 418	Reaction Kinetics for BME	3
CHEM 247	Analytical Chemistry	3
CS 330	Discrete Structures	4
CS 331	Data Structures and Algorithms	3
CS 422	Data Mining	3
CS 484	Introduction to Machine Learning	3
MATH 230	Introduction to Discrete Math	3
MATH 251	Multivariate and Vector Calculus	4
MATH 252	Introduction to Differential Equations	4
FDSN 401	Nutrition, Metabolism, and Health	3
PHYS 410	Molecular Biophysics	3
Any 300+ level BIOL or CHEM course		3
Free Electives		**(3)**
Physics Requirements		**(8)**
PHYS 123	General Physics I: Mechanics	4
PHYS 221	General Physics II	4
or PHYS 223	General Physics III	
Mathematics Requirements		**(13)**
MATH 151	Calculus I	5
MATH 152	Calculus II	5
MATH 425	Statistical Methods	3
Computer Science Requirement		**(2)**
Any CS core class		2
Interprofessional Projects (IPRO)		**(6)**
See Illinois Tech Core Curriculum, section E		6
Humanities and Social Science Requirements		**(21)**
See Illinois Tech Core Curriculum, sections B and C		21

Total Credit Hours	**120**

Major Changes

- The program is more deeply focused on Biochemistry
  - BCHM 410/438, 412, 456 are moved from electives to required
  - MATH 251 and CHEM 343 are moved from requirements to electives
- BCHM courses are existing courses in BIOL and CHEM that would be cross-listed.
  - BCHM 301 is currently BIOL 401
  - BCHM 412 is currently BIOL 512 and will be cross-listed as an UG class
- Research is added as fulfilling an upper-division lab requirement

Specializations

Current Learning Objectives

- Pre-health: Students will demonstrate an understanding of the role and impact of biochemical systems in health and medicine.
- Advanced biochemistry: Students will demonstrate an understanding of biochemical molecules and systems beyond that required for the non-specialized program
- Chemistry: Students will demonstrate the ability to apply quantitative analytical chemistry methods to biochemical systems.
- Computational biochemistry: Students will demonstrate the ability to apply computational tools to the study of biochemical macromolecules and systems
- Biophysics: Students will demonstrate an understanding of the physical basis of the structure and function of biochemical macromolecules and systems, and methods of studying this physical basis.

Proposed Learning Objectives

Graduates of the BS in Biochemistry in specialized tracks will demonstrate the ability to:

- Pre-health: Students will demonstrate an understanding of the role and impact of biochemical systems in health and medicine.
- Chemistry: Students will demonstrate the ability to apply quantitative analytical chemistry methods.
- Computation: Students will demonstrate the ability to apply computational tools to the study of biochemical macromolecules and systems
- Biophysics: Students will demonstrate an understanding of the physical basis of the structure and function of biochemical macromolecules and systems, and methods of studying this physical basis.

Curriculum

Pre-Health	
Choose 3 courses from the below	9

BIOL 210	Microbiology	3
BIOL 327	Introduction to Immunology	3
BIOL 410	Medical Microbiology	3
BIOL 415	Advanced Human Genetics	3
BIOL 440	Neurobiology	3
BIOL 470	Systems and Behavioral Neuroscience	3
BIOL 475	Health and Disease in Modern Society	3
FDSN 401	Nutrition, Metabolism, and Health	3
PSYC 414	Neural and Biological Bases of Behavior	3
Chemistry		13 OR 14
CHEM 247	Analytical Chemistry	3
CHEM 321 or BIOL 455	Instrumental Analysis * Macromolecular Techniques	3 OR 4
CHEM 415	Inorganic Chemistry	3
CHEM 434	Spectroscopic Methods in Identification and Analysis	4
Computation		11 or 12
CS 116	Object-Oriented Programming II	2
CS 331	Data Structures and Algorithms*	3
CS 422	Data Mining	3
or CS 484	Introduction to Machine Learning	
MATH 251 or MATH 252 Or MATH 230 CS 330	Multivariate and Vector Calculus Introduction to Differential Equations Introduction to Discrete Math Discrete Structures	3 or 4
Biophysics		9
PHYS 223/224	General Physics III / General Physics III for Engineers	3 or 4
PHYS 410	Molecular Biophysics	3
BIOL 455	Macromolecular Techniques*	3
Or BIOL 555	Macromolecular Structure	

*Will satisfy the upper division lab requirement

Major Changes

- The specialization in Advanced Biochemistry is being eliminated
- The specialization in Computational Biochemistry is being renamed to Computation. BCHM 456 is removed (now a program requirement) and math and machine learning classes are added.
- MATH 252 is being removed from specializations because MATH 251 is no longer required in the degree
- In pre-health, PSYC 411 Medical Aspects of Disabling Conditions is being removed.

Minors

We would also like to update the minor so that it is accessible for students from mathematics- and computing-related disciplines. According to the catalog, "A minor consists of at least five courses (minimum of 15 credit hours), of which at least four courses (minimum 12 credit hours) are not required for a degree program." Currently, the biochemistry minor requirements are,

Biochemistry (Current)

BIOL 214	Genetics	3
BIOL 401	Introductory Biochemistry	3
BIOL 402	Metabolic Biochemistry	3
BIOL 404	Biochemistry Laboratory	3
BIOL 445	Cell Biology	3
Total Credit Hours		**15**

Beyond the minor requirements themselves, the courses in the minor require students to take out-of-minor prerequisites – CHEM 124 (4), CHEM 125 (4), CHEM 237 (4), CHEM 239 (3), and BIOL 107 or BIOL 115 (3) – which add up to 18 credits. Due to these prerequisites, the minor is prohibitive to students who are not already taking the prerequisites as part of their major. To address this issue, we propose making CHEM 237 and BIOL 107 or BIOL 115 part of the minor. Moreover, advanced course options will be expanded.

Biochemistry and Molecular Biophysics (Proposed)

CHEM 237	Organic Chemistry I	4
BIOL 107 or BIOL 115	General Biology Lectures/Human Biology	3
BCHM 301 or BCHM 403	Introductory Biochemistry/Biochemistry	3/4
Select at least two of the following:		

BCHM 438	Physical Biochemistry	3
BCHM 410	Molecular Biophysics	3
BCHM 402	Metabolic Biochemistry	3
BCHM 404	Biochemistry Laboratory	3
BCHM 412	Advanced Biochemistry	3
BCHM 455	Macromolecular Techniques	3
BCHM 456	Computational Biochemistry and Drug Design	3
BIOL 445	Cell Biology	3
BIOL 550	Bioinformatics	3
BCHM 555	Macromolecular Structure	3

With this revised minor, the only outside-minor prerequisites are general chemistry, CHEM 124 (4) and CHEM 125 (4). This allows the minor to work feasibly with mathematics and computing majors, including,

- **Artificial Intelligence (BS)** – If students use BIOL 107 or BIOL 115 as part of the Science Requirements for the major, they will need to take four other courses from the minor and general chemistry (8 out-of-minor credits).
- **Applied Mathematics (BS)** – If students take general chemistry (8 out-of-minor credits) to fulfill the required Science Electives (6 credits), they can use the minor to full the Minor requirement (15 credits).
- **Computer Science (BS)** – If students take general chemistry (8 out-of-minor credits) to fulfill the required Science Electives (6 credits), they are prepared to take the minor.

The minor could also work with natural science majors including,

- **Biology (BS)** – Students already need to take the outside-of-minor prerequisites, required courses from the minor, and several other classes in the minor. They could still complete the minor with four courses from BCHM 438, 410, 412, and 456, and BIOL 550 and 555. If BCHM 404 and 455 are not used for the major, they could be used for the minor.
- **Chemistry (BS)** – Students already need to take the outside-of-minor prerequisites, required courses from the minor, and several other classes in the minor. The minor could be completed with four 400-level courses from the minor, none of which are not required for the major.
- **Physics (BS)** students already need to take general chemistry, so no extra credits outside the minor are needed. None of the minor classes are required for the major.

Another major that may have students interested in the minor is **Psychological Science (BS),** where a minor could help prepare for a career in psychiatry. Students can take general chemistry and BIOL 107 or 115 to fulfill the natural science requirement (10-11 credits) and complete the minor with four additional courses.

Other

An Assessment Plan and Curriculum Map has been prepared. ASBMB Learning Objectives have been allocated to key classes, with Course Outlines that demonstrate their feasibility.