

# Biochemistry Major

University of Michigan - Department of Chemistry

Biochemistry is the chemistry of life. Biochemists seek to understand the chemical principles that underpin all living organisms. Biochemistry is central to medical science as almost all diseases and drugs act to change the body's chemistry. Advances in biochemistry directly affect the fields of biotechnology, pharmaceutical science, agriculture, and environmental science, among many others. The Biochemistry major is for those interested in learning about life from a chemical perspective. Students will be well-equipped for graduate studies in biochemistry, chemical biology, and many other fields of inquiry in the life sciences. The major will also provide excellent preparation for students intending to pursue professional careers in industry and medicine.

## Prerequisites:

- AP credit for Physics (125/127 or 139) & (126/128 or 239) will fulfill the Physics requirement.
- AP credit for Math (120 & 121) will fulfill the Math requirement.
- AP credit for Biology (195) will fulfill the Biology 171 & 172 requirements.

| Course #                     | Course Description                                                   | Typically Offered | Credits |
|------------------------------|----------------------------------------------------------------------|-------------------|---------|
| *CHEM 125/126                | General Chemistry Laboratory I and II                                | F, W, Su          | 2       |
| *CHEM 130                    | General Chemistry: Macroscopic Investigation and Reaction Principles | F, W, Su          | 3       |
| CHEM 210                     | Structure and Reactivity I                                           | F, W, Sp          | 3       |
| CHEM 211                     | Investigations in Chemistry: Laboratory                              | F, W, Sp          | 2       |
| CHEM 215                     | Structure and Reactivity II                                          | F, W, Sp          | 3       |
| BIO 171                      | Introductory Biology: Ecology and Evolution                          | F, W, Sp, Su      | 4       |
| BIO 172                      | Introductory Biology: Molecular Cellular and Developmental           | F, W, Sp          | 4       |
| MATH 115                     | Calculus I                                                           | F, W, Sp, Su      | 4       |
| MATH 116                     | Calculus II                                                          | F, W, Sp, Su      | 4       |
| <b>One of the following:</b> |                                                                      |                   |         |
| CHEM 262<br>OR<br>MATH 215   | Mathematical Methods for Chemists                                    | F, W              | 4       |
|                              | Calculus III                                                         | F, W, Sp, Su      | 4       |

|                                                         |                                                   |                   |         |
|---------------------------------------------------------|---------------------------------------------------|-------------------|---------|
| Prerequisite Courses: continue from page 1.             |                                                   | Typically Offered | Credits |
| <b>One of the following groups; 150/151 or 140/141:</b> |                                                   |                   |         |
| PHYS 150/151<br>OR<br>PHYS 140/141                      | Fundamental Physics for the Life Sciences I/ Lab  | F, W, Sp          | 4/1     |
|                                                         | General Physics I/Elementary Laboratory I         | F, W, Sp          | 4/1     |
| <b>One of the following groups; 250/251 or 240/241:</b> |                                                   |                   |         |
| PHYS 250/251<br>OR<br>PHYS 240/241                      | Fundamental Physics for the Life Sciences II/ Lab | F, W, Sp          | 4/1     |
|                                                         | General Physics II/ Elementary Laboratory II      | F, W, Sp          | 4/1     |

**The Biochemistry Program must include the following:**

**Core courses: minimum 37 credits.**

| Course #                                            | Course Description                                                                        | Typically Offered | Credits |
|-----------------------------------------------------|-------------------------------------------------------------------------------------------|-------------------|---------|
| CHEM 260<br>OR<br>CHEM 230 & 261                    | Chemical Principles                                                                       | F, W              | 3       |
|                                                     | Physical Chemical Principles and Applications AND Introduction to Quantum Chemistry       | F, W              | 3/1     |
| ** CHEM 351                                         | Fundamentals of Biochemistry                                                              | F, W              | 4       |
| CHEM 352<br>OR<br>CHEM 353                          | Introduction to Biochemical Research Techniques: Laboratory                               | F, W              | 2       |
|                                                     | Introduction to Biochemical Research Techniques and Scientific Writing: Laboratory (ULWR) | F, W              | 3       |
| CHEM 451                                            | Advanced Biochemistry I Macromolecular Structure and Function                             | F, W              | 4       |
| CHEM 452                                            | Advanced Biochemistry II Cellular Processes                                               | W                 | 4       |
| CHEM 453                                            | Biophysical Chemistry                                                                     | F                 | 3       |
| BIO 305                                             | Genetics                                                                                  | F, W, Su          | 4       |
| <b>One of the following; 241, 245, 302, OR 303:</b> |                                                                                           |                   |         |
| CHEM 241                                            | Chemical Analysis                                                                         | F, W              | 2       |
| CHEM 245                                            | Biomedical Analytical Chemistry                                                           | F, W              | 2       |
| CHEM 302                                            | Inorganic Chemistry                                                                       | W                 | 3       |
| CHEM 303                                            | Introductory Bioinorganic Chemistry: the Role of Metals in Life                           | F                 | 3       |
| <b>One of the following; 216, 242, OR 246/247:</b>  |                                                                                           |                   |         |
| CHEM 216                                            | Structure and Reactivity II: Laboratory                                                   | F, W, Sp          | 2       |
| CHEM 242                                            | Chemical Analysis: Laboratory                                                             | F, W              | 2       |
| CHEM 246/247                                        | Biomedical Analytical Chemistry Laboratory I and II                                       | F, W              | 2       |

**Elective Courses:** at least 6 credit hours from the courses listed below. Electives should be selected in consultation with a departmental advisor.

- If the term column is not listed with a term, please check the course guide. These courses are not consistently offered during the same term each year.

| Course #     | Course Description                      | Typically Offered | Credits |
|--------------|-----------------------------------------|-------------------|---------|
| CHEM 417     | Dynamic Biophysics                      | W                 | 3       |
| CHEM 419     | Intermediate Physical Organic Chemistry | F                 | 3       |
| CHEM 420     | Intermediate Organic Chemistry          | W                 | 3       |
| CHEM 421     | Organic Chemistry of Drug Design        | F                 | 3       |
| CHEM 440     | Biophysics of Disease                   | F                 | 3       |
| CHEM 447     | Physical Methods of Analysis            | W                 | 3       |
| CHEM 455     | Special Topics in Biochemistry          | F                 | 3       |
| CHEM 461     | Physical Chemistry I                    | F                 | 3       |
| CHEM 474     | Environmental Chemistry                 | F                 | 3       |
| CHEM 520     | Methods of Biophysical Chemistry        | F                 | 3       |
| CHEM 521     | Biophysical Chemistry II                | W                 | 3       |
| MCDB 408     | Genomic Biology                         | W                 | 3       |
| MCDB 411     | Protein Biochemistry                    | F, W              | 3       |
| MCDB 417     | Chromosome Structure and Function       |                   | 3       |
| MCDB 420     | Struct Bio: Arc Life                    | W                 | 3       |
| MCDB 422     | Brain Development                       | W                 | 3       |
| MCDB 427     | Molecular Biology                       | F                 | 4       |
| MCDB 428     | Cell Biology                            | W                 | 4       |
| MCDB 430     | Molec Bio of Plants                     |                   | 3       |
| MCDB 434     | Protein Misfold Dis                     |                   | 3       |
| MCDB 440     | Cell Cyc Ctrl & Canc                    |                   | 3       |
| MCDB 441     | Cell Biology of Disease                 |                   | 3       |
| MCDB 448     | Telomerase Function                     | F                 | 2       |
| MCDB 462     | Epigenetics                             | F                 | 3       |
| MCDB 472     | Bld a Synthetic Cell                    |                   | 3       |
| BIOPHYS 420  | Structural Biology I                    | W                 | 3       |
| BIOPHYS 421  | Struct Bio: Biop Con                    | F                 | 3       |
| BIOPHYS 430  | Medical Physics                         | W                 | 3       |
| BIOPHYS 433  | Biocomplexity                           |                   | 3       |
| MICRBIOL 405 | Med Microbio & ID                       | F, W              | 3       |
| MICRBIOL 440 | Human Immunology                        | W                 | 3       |
| PHRMACOL310  | Pharmacol & Therapeut                   | F                 | 4       |
| PHRMACOL425  | New Medications                         | W                 | 3       |
| PHYSIOL 502  | Human Physiology                        | F                 | 4       |
| MEDCHEM 532  | Chemical Biology in Drug Discovery      | F                 | 3       |

An advanced laboratory or undergraduate research course, one of the following:

| Course #     | Course Description                                             | Term Typically Offered | Credits |
|--------------|----------------------------------------------------------------|------------------------|---------|
| CHEM 482     | Synthesis and Characterization- <i>ULWR</i>                    | <i>F</i>               | 3       |
| CHEM 483     | Physical and Instrumental Chemistry                            | <i>W</i>               | 3       |
| BIOPHYS 450  | Laboratory Techniques in Biophysics                            | <i>F,W</i>             | 3       |
| MCDB 429     | Laboratory in Cell and Molecular Biology                       | <i>F,W</i>             | 3       |
| CHEM 398     | Undergraduate Research in Biochemistry- taken over 2 semesters | <i>F, W, Sp, Su</i>    | 4       |
| BIOLCHEM 398 | Undergraduate Research in Biochemistry- taken over 2 semesters | <i>F, W, Sp, Su</i>    | 4       |

### Biochemistry honors:

Students who have a major GPA of 3.4 and an overall GPA of 3.4 are eligible to declare an honors major in Biochemistry. They are required to complete four credits of research by enrolling in CHEM 398 over at least two semesters and writing a thesis based on their undergraduate research. Students must register for one credit of CHEM 498 during their final semester when they submit their thesis.

**Exclusions:** *Students who elect a major in Biochemistry may not elect the following majors: Biomolecular Science, Chemistry, Interdisciplinary Chemical Sciences, Biology; General Biology; Molecular, Cellular, and Developmental Biology (formerly known as Cell and Molecular Biology, or CMB); Cellular and Molecular Biomedical Science Major (formerly known as Cellular and Molecular Biology and Biomedical Engineering, or CMB:BME); Ecology and Evolutionary Biology; Microbiology; or Neuroscience. They may also not elect a minor in Biology, or any of the Chemistry minors.*

### Chemistry GPA requirement:

A student must earn a cumulative grade point average (GPA) of at least 2.0 in all courses required for the Biochemistry major including prerequisites. Transfer courses are not calculated into the GPA.

#### NOTES:

\* Students with AP credit may waive the General Chemistry prerequisites

\*\* Students are strongly encouraged to take CHEM 351 but could substitute this course requirement with MCDB 310 or BIOLCHEM 415.