Twin Cities Campus

Biochemistry B.S.

Biochemistry, Molecular Biology, & Biophysics TCBS

College of Biological Sciences

- Program Type: Baccalaureate
- Requirements for this program are current for Fall 2020
- Required credits to graduate with this degree: 120
- Required credits within the major: 71 to 86
- Degree: Bachelor of Science

Biochemists study molecules found in living organisms, particularly proteins, nucleic acids, lipids, and carbohydrates. Biochemistry majors focus their studies on the biosynthesis, metabolism, function, and regulation of these molecules of life. This information is essential to gain an understanding of many biological processes, including how diseases like cancer and diabetes develop, and to learn how genetic engineering and biotechnology can be used in ways that benefit society.

Earning a BS in biochemistry prepares majors for graduate study in biochemistry or other biological sciences, professional training programs in the health sciences, careers in teaching, and entry-level positions in industries, agencies, and universities.

Biochemistry is an experimental science, and majors, especially those planning to pursue graduate studies in the field, should become acquainted with laboratory research approaches beyond those in the formal lab courses. Research options are available through BIOC 4994 or BIOC 4794W. Students should consult early with their faculty mentor to begin planning the research component of their major.

Program Delivery

This program is available:

- via classroom (the majority of instruction is face-to-face)

Admission Requirements

A GPA above 2.0 is preferred for the following:

- 2.50 transferring from another University of Minnesota college
- 2.50 transferring from outside the University

For information about University of Minnesota admission requirements, visit the Office of Admissions website.

General Requirements

All students are required to complete general University and college requirements including writing and liberal education courses. For more information about University-wide requirements, see the liberal education requirements.Required courses for the major or minor in which a student receives a D grade (with or without plus or minus) do not count toward the major or minor (including transfer courses).

Program Requirements

At least 14 upper division credits in the major must be taken at the University of Minnesota Twin Cities campus.

Foundational Courses

Nature of Life/Nature of Science and Research

BIOL 1805 - Nature of Life: Introducing New Students to the Biological Sciences (0.5 cr)
BIOL 1806 - Nature of Life, Part Two (0.5 cr)
BIOL 2905 - Nature of Life, Part III (0.5 cr)
BIOL 2906 - Nature of Life, Part IV (0.5 cr)
or This track (BIOL 3001) is for transfer students only.
BIOL 3001 - Nature of Science and Research (1.0 cr)

Foundations of Biology

BIOL 1951 - Foundations of Biology Lecture I for Biological Sciences Majors [BIOL] (4.0 cr)
or BIOL 1951H - Foundations of Biology Lecture I for Biological Sciences Majors [BIOL] (4.0 cr)
BIOL 1961 - Foundations of Biology Lab I for Biological Sciences Majors [BIOL] (2.0 cr)
BIOL 2003 - Foundations of Biology for Biological Sciences Majors, Part II (3.0 cr)
or BIOL 2003H - Foundations of Biology for Biological Sciences Majors, Part II (3.0 cr)
BIOL 3004 - Foundations of Biology for Biological Sciences Majors, Part II Laboratory (3.0 cr)

Quantitative Requirements

MATH 1241 - Calculus and Dynamical Systems in Biology [MATH] (4.0 cr)

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or MATH 1271 - Calculus I [MATH] (4.0 cr)
or MATH 1371 - CSE Calculus I [MATH] (4.0 cr)
or MATH 1571H - Honors Calculus I [MATH] (4.0 cr)
Take 1 or more course(s) from the following:
•CSCI 1133 - Introduction to Computing and Programming Concepts (4.0 cr)
•CSCI 1133H - Honors Introduction to Computing and Programming Concepts (4.0 cr)
•CSCI 3003 - Introduction to Computing in Biology (3.0 cr)
•MATH 1272 - Calculus II (4.0 cr)
•MATH 1572H - Honors Calculus II (4.0 cr)
•MATH 2241 - Mathematical Modeling of Biological Systems (3.0 cr)
•STAT 3011 - Introduction to Statistical Analysis [MATH] (4.0 cr)
•BIOL 3272 - Applied Biostatistics (4.0 cr)
or BIOL 3272H - Applied Biostatistics (4.0 cr)
or BIOL 5272 - Applied Biostatistics (4.0 cr)

Chemistry

Track 1: Preferred CBS Chemistry Sequence
CHEM 1081 - Chemistry for the Life Sciences I [PHYS] (3.0 cr)
CHEM 1065 - Chemical Principles I Laboratory [PHYS] (1.0 cr)
CHEM 1082 - Chemistry for the Life Sciences II (3.0 cr)
CHEM 1086 - Chemistry for the Life Sciences II Laboratory (1.0 cr)
CHEM 2081 - Chemistry for the Life Sciences III (3.0 cr)
CHEM 2085 - Chemistry for the Life Sciences III Laboratory (2.0 cr)
or **Track 2**
This track is allowable for students entering CBS with previous chemistry credit, or for whom space is not available in the preferred track. Students should speak with a CBS academic advisor to determine eligibility for this track.
CHEM 1061 - Chemical Principles I [PHYS] (3.0 cr)
CHEM 1065 - Chemical Principles I Laboratory [PHYS] (1.0 cr)
CHEM 1062 - Chemical Principles II [PHYS] (3.0 cr)
CHEM 1066 - Chemical Principles II Laboratory [PHYS] (1.0 cr)
CHEM 2301 - Organic Chemistry I (3.0 cr)
CHEM 2302 - Organic Chemistry II (3.0 cr)
or **Track 2 (Honors Option)**
This track is allowable for CBS honors students.
CHEM 1071H - Honors Chemistry I [PHYS] (3.0 cr)
CHEM 1075H - Honors Chemistry I Laboratory [PHYS] (1.0 cr)
CHEM 1072H - Honors Chemistry II [PHYS] (3.0 cr)
CHEM 1076H - Honors Chemistry II Laboratory [PHYS] (1.0 cr)
CHEM 2331H - Honors Elementary Organic Chemistry I (3.0 cr)
CHEM 2332H - Honors Elementary Organic Chemistry II (3.0 cr)

Physics
PHYS 1201W *{Inactive}*[PHYS, WI] (5.0 cr)
or PHYS 1221 - Introductory Physics for Life Science Majors I [PHYS] (4.0 cr)
or PHYS 1301W - Introductory Physics for Science and Engineering I [PHYS, WI] (4.0 cr)
or PHYS 1401V - Honors Physics I [PHYS, WI] (4.0 cr)
PHYS 1202W *{Inactive}*[PHYS, WI] (5.0 cr)
or PHYS 1222 - Introductory Physics for Life Science Majors II [PHYS] (4.0 cr)
or PHYS 1302W - Introductory Physics for Science and Engineering II [PHYS, WI] (4.0 cr)
or PHYS 1402V - Honors Physics II [PHYS, WI] (4.0 cr)

Molecular and Cellular Biology

Molecular Biology
BIOL 3015 - Molecular Biology (2.0 cr)
or BIOL 3025 - Molecular Biology and Society [TS] (3.0 cr)
BIOC 4331 - Biochemistry I: Structure, Catalysis, and Metabolism in Biological Systems (4.0 cr)
BIOL 4003 - Genetics (3.0 cr)

Ecology, Evolution, and Biodiversity
Take 1 or more course(s) from the following:
•EEB 3807 - Ecology (4.0 cr)
•EEB 3407 - Ecology (3.0 cr)
•EEB 3408W - Ecology [WI] (4.0 cr)
•MICB 3301 - Biology of Microorganisms (5.0 cr)
•EEB 3409 - Evolution (3.0 cr)
or EEB 5409 - Evolution (3.0 cr)

Biochemistry Major-specific Courses

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Biochemistry Core

BIOC 4332 - Biochemistry II: Molecular Mechanisms of Signal Transduction and Gene Expression (4.0 cr)
BIOC 4025W - Laboratory in Biochemistry [WI] (2.0 cr)
BIOC 4521 - Introduction to Physical Biochemistry (3.0 cr)
or CHEM 4501 - Introduction to Thermodynamics, Kinetics, and Statistical Mechanics (3.0 cr)
CHEM 4502 - Introduction to Quantum Mechanics and Spectroscopy (3.0 cr)

Upper Division Biochemistry Electives

Take 1 or more course(s) from the following:
•BIOC 4351 - Protein Engineering (3.0 cr)
•BIOC 5213 *{Inactive}*(3.0 cr)
•BIOC 5216 - Current Topics in Signal Transduction (2.0 cr)
•BIOC 5309 - Biocatalysis and Biodegradation (3.0 cr)
•BIOC 5352 - Biotechnology and Bioengineering for Biochemists (3.0 cr)
•BIOC 5361 - Microbial Genomics and Bioinformatics (3.0 cr)
•BIOC 5444 - Muscle (3.0 cr)
•BIOC 5528 - Spectroscopy and Kinetics (4.0 cr)
•BIOC 5535 - Introduction to Modern Structural Biology -- Diffraction (2.0 cr)
•BIOC 5536 - Introduction to Modern Structural Biology - Nuclear Magnetic Resonance (2.0 cr)
•MPHY 5040 - Introduction to Medical Physics (3.0 cr)
•MPHY 5160 - Advanced Radiation Physics and Dosimetry (3.0 cr)

Upper Division Lab

Take 1 or more course(s) from the following:
•BIOC 4125 - Laboratory in Molecular Biology and Biotechnology (3.0 cr)
•BIOC 4225 - Laboratory in NMR Techniques (1.0 cr)
•BIOC 4325 - Laboratory in Mass Spectrometry (1.0 cr)
•CHEM 4423W - Foundations of Chemical Biology Laboratory [WI] (2.0 cr)
•GCD 4025 - Cell Biology, Development & Regeneration Laboratory (3.0 cr)
•GCD 5005 - Computer Programming for Biology (3.0 cr)
•MICB 4215 - Advanced Laboratory: Microbial Physiology and Diversity (3.0 cr)
•MICB 4225W - Advanced Laboratory: Microbial Genetics [WI] (3.0 cr)
•MICB 4235 - Advanced Laboratory: Virology, Immunology, and Microbial Genetics (3.0 cr)
•Students may use a maximum of 7 credits of directed research toward a CBS degree. A minimum of two credits of research must be taken to count for the requirement.

Take 2 or more credit(s) from the following:
•BIOC 4794W - Directed Research: Writing Intensive [WI] (3.0 - 5.0 cr)
•BIOC 4994 - Directed Research (1.0 - 7.0 cr)
•BIOL 4794W - Directed Research: Writing Intensive [WI] (3.0 - 5.0 cr)
•BIOL 4994 - Directed Research (1.0 - 7.0 cr)
•COP 4794W - Writing Intensive Directed Research [WI] (1.0 - 7.0 cr)
•COP 4994 - Directed Research (1.0 - 7.0 cr)
•EEB 4794W - Directed Research: Writing Intensive [WI] (3.0 - 5.0 cr)
•EEB 4994 - Directed Research (1.0 - 6.0 cr)
•GCD 4794W - Directed Research: Writing Intensive [WI] (3.0 - 5.0 cr)
•GCD 4994 - Directed Research (1.0 - 7.0 cr)
•MICB 4794W - Directed Research: Writing Intensive [WI] (3.0 - 5.0 cr)
•MICB 4994 - Directed Research (1.0 - 7.0 cr)
•NSCI 4794W - Directed Research: Writing Intensive [WI] (3.0 - 5.0 cr)
•NSCI 4994 - Directed Research (1.0 - 6.0 cr)
•PMB 4794W - Directed Research: Writing Intensive [WI] (3.0 - 5.0 cr)
•PMB 4994 - Directed Research (1.0 - 7.0 cr)

Upper Division Life Sciences Electives

Take 6 or more credit(s) from the following:
•BIOC 4351 - Protein Engineering (3.0 cr)
•BIOC 5213 *{Inactive}*(3.0 cr)
•BIOC 5216 - Current Topics in Signal Transduction (2.0 cr)
•BIOC 5309 - Biocatalysis and Biodegradation (3.0 cr)
•BIOC 5352 - Biotechnology and Bioengineering for Biochemists (3.0 cr)
•BIOC 5361 - Microbial Genomics and Bioinformatics (3.0 cr)
•BIOC 5444 - Muscle (3.0 cr)
•BIOC 5528 - Spectroscopy and Kinetics (4.0 cr)
•BIOC 5535 - Introduction to Modern Structural Biology -- Diffraction (2.0 cr)
•BIOC 5536 - Introduction to Modern Structural Biology - Nuclear Magnetic Resonance (2.0 cr)
•BIOL 3211 - Physiology of Humans and Other Animals (3.0 cr)
•BIOL 3696 - Internship: Professional Experience in Biological Sciences (1.0 - 3.0 cr)
•BIOL 4004 - Cell Biology (3.0 cr)
•BIOL 5309 - Molecular Ecology And Ecological Genomics (3.0 cr)

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- CHEM 2311 - Organic Lab (4.0 cr)
- CHEM 4001 - Chemistry of Biomass and Biomass Conversion to Fuels and Products [ENV] (4.0 cr)
- CHEM 4412 - Chemical Biology of Enzymes (3.0 cr)
- CHEM 4423W - Foundations of Chemical Biology Laboratory [WI] (2.0 cr)
- CSCI 3003 - Introduction to Computing in Biology (3.0 cr)
- EEB 3407 - Ecology (3.0 cr)
- EEB 3408W - Ecology [WI] (4.0 cr)
- EEB 3807 - Ecology (4.0 cr)
- EEB 5221 *{Inactive}*(3.0 cr)
- GCD 4034 - Molecular Genetics and Genomics (3.0 cr)
- GCD 4143 - Human Genetics and Genomics (3.0 cr)
- GCD 4151 - Molecular Biology of Cancer (3.0 cr)
- GCD 4161 - Developmental Biology (3.0 cr)
- GCD 4171 - Stem Cells in Biology and Medicine (3.0 cr)
- GCD 5036 - Molecular Cell Biology (3.0 cr)
- MATH 5445 - Mathematical Analysis of Biological Networks (4.0 cr)
- MICB 4131 - Immunology (3.0 cr)
- MICB 4151 - Molecular and Genetic Bases for Microbial Diseases (3.0 cr)
- MICB 4161W - Eukaryotic Microbiology [WI] (3.0 cr)
- MICB 4171 - Biology, Genetics, and Pathogenesis of Viruses (3.0 cr)
- MICE 5035 - Personal Microbiome Analysis (3.0 cr)
- MPHY 5040 - Introduction to Medical Physics (3.0 cr)
- MPHY 5160 - Advanced Radiation Physics and Dosimetry (3.0 cr)
- NSCI 3101 - Neurobiology I: Molecules, Cells, and Systems (3.0 cr)
- NSCI 3102W - Neurobiology II: Perception and Behavior [WI] (3.0 cr)
- PMB 4111 - Microbial Physiology and Diversity (3.0 cr)
- PMB 4121 - Microbial Ecology and Applied Microbiology (3.0 cr)
- PMB 4131 - Prokaryotic Genetics (3.0 cr)
- STAT 3021 - Introduction to Probability and Statistics (3.0 cr)
- STAT 3022 - Data Analysis (4.0 cr)
- STAT 4101 - Theory of Statistics I (4.0 cr)
- STAT 4102 - Theory of Statistics II (4.0 cr)
- EEB 3409 - Evolution (3.0 cr)
  or EEB 5409 - Evolution (3.0 cr)
- BIOC 5960 - Biophysical Spectroscopy (2.0 cr)
  or BIOC 4960 - Special Topics in Biochemistry (3.0 cr)
- Take 0 - 1 course(s) from the following:
  - GCC 3xxx
  - GCC 5xxx

Upper Division Writing Intensive within the Major

Students are required to take one upper division writing intensive course within the major. If that requirement has not been satisfied within the core major requirements, students must choose one course from the following list. Some of these courses may also fulfill other major requirements.

Take 0 - 1 course(s) from the following:

- BIOC 4025W - Laboratory in Biochemistry [WI] (2.0 cr)
- BIOC 4793W - Directed Studies: Writing Intensive [WI] (1.0 - 7.0 cr)
- BIOC 4794W - Directed Research: Writing Intensive [WI] (3.0 - 5.0 cr)
- BIOL 4321W - Deconstructing Research: Writing about Biological Research for Non-scientists [WI] (2.0 cr)
- BIOL 4793W - Directed Studies: Writing Intensive [WI] (1.0 - 7.0 cr)
- BIOL 4794W - Directed Research: Writing Intensive [WI] (3.0 - 5.0 cr)
- COP 4793W - Writing Intensive Directed Studies [WI] (1.0 - 7.0 cr)
- COP 4794W - Writing Intensive Directed Research [WI] (1.0 - 7.0 cr)
- EEB 3408W - Ecology [WI] (4.0 cr)
- EEB 3412W - Introduction to Animal Behavior, Writing Intensive [WI] (4.0 cr)
- EEB 3811W - Animal Behavior in the Field [WI] (4.0 cr)
- EEB 4330W - Animal Communication [WI] (3.0 cr)
- EEB 4609W - Ecosystem Ecology [ENV, WI] (3.0 cr)
- EEB 4793W - Directed Studies: Writing Intensive [WI] (1.0 - 7.0 cr)
- EEB 4794W - Directed Research: Writing Intensive [WI] (3.0 - 5.0 cr)
- GCD 4005W - Cell Biology-Writing Intensive [WI] (4.0 cr)
- GCD 4793W - Directed Studies: Writing Intensive [WI] (1.0 - 7.0 cr)
- GCD 4794W - Directed Research: Writing Intensive [WI] (3.0 - 5.0 cr)
- MICB 4161W - Eukaryotic Microbiology [WI] (3.0 cr)
- MICB 4225W - Advanced Laboratory: Microbial Genetics [WI] (3.0 cr)
- MICB 4793W - Directed Studies: Writing Intensive [WI] (1.0 - 7.0 cr)

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- MICB 4794W - Directed Research: Writing Intensive [WI] (3.0 - 5.0 cr)
- NSCI 3001W - Neuroscience and Society [CIV, WI] (4.0 cr)
- NSCI 3102W - Neurobiology II: Perception and Behavior [WI] (3.0 cr)
- NSCI 4793W - Directed Studies: Writing Intensive [WI] (1.0 - 6.0 cr)
- NSCI 4794W - Directed Research: Writing Intensive [WI] (3.0 - 5.0 cr)
- PMB 3005W - Plant Function Laboratory [WI] (2.0 cr)
- PMB 3007W - Plant, Algal, and Fungal Diversity and Adaptation [WI] (4.0 cr)
- PMB 4516W - Plant Cell Biology: Writing Intensive [WI] (3.0 cr)
- PMB 4793W - Directed Studies: Writing Intensive [WI] (1.0 - 7.0 cr)
- PMB 4794W - Directed Research: Writing Intensive [WI] (3.0 - 5.0 cr)

Program Sub-plans

A sub-plan is not required for this program.

Integrated BS/MPH-Environmental Health

The College of Biological Sciences (CBS) and the School of Public Health (SPH) offer an early-admission opportunity for eligible CBS students interested in pursuing the Environmental Health MPH degree.

The MPH program in the Division of Environmental Health Sciences emphasizes the scientific, technological, policy, and management skills required to address environmental health concerns. These concerns include investigating health hazards in our environment, protecting worker health, and establishing the basis for public health policy. The Division of Environmental Health is committed to graduating professionals with interdisciplinary training, which includes practicing innovative problem solving, and gaining experience with a diversity of approaches and applications.

To be eligible for this program, applicants must be admitted undergraduate students in the College of Biological Sciences, have completed at least 60+ credits, and have a GPA of a least 3.25.

Students admitted to the Integrated BS/MPH-Environmental Health program take 12 MPH credits during their senior year, and complete the MPH by taking remaining credits as a full-time graduate student in the summer and academic year after completing their undergraduate degree.

Graduate courses cannot be applied toward both BS and MPH credit and degree requirements. Admitted students must maintain timely degree progress to ensure that the BS degree is awarded no later than the end of the senior year.

The application deadline for the Integrated BS/MPH-Environmental Health opportunity is the spring of the applicant's junior year. Interested students should consult with their CBS academic advisor or School of Public Health for application instructions.

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