

University of Minnesota Twin Cities 2010-12 UNDERGRADUATE CATALOG



College of **BIOLOGICAL SCIENCES**

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College of BIOLOGICAL SCIENCES

General Information

The mission of the College of Biological Sciences (CBS) is to advance knowledge of the mechanisms of life through breakthrough discoveries and to prepare today's students to create the biology of tomorrow. To accomplish this mission, the college integrates a strong basic research program with traditional and innovative classroom teaching and intensive mentoring of students at all levels.

Admission

Admission to the College of Biological Sciences is competitive. Decisions are based on an overall assessment of each applicant's accomplishments and potential as presented in her or his application materials. New freshmen are admitted once a year in the fall. Internal transfer students from University of Minnesota campuses are admitted in both fall and spring semesters.

Applications for students transferring from outside of the University of Minnesota are accepted for the fall semester. Admission of transfer students is based on overall assessment of their application and usually requires satisfactory completion of prerequisite coursework and/or a record of past academic success in the sciences.

All prospective students are encouraged to visit campus and meet with admissions staff. For more information, see the Admissions and Prospective Student Services section of this catalog, or visit the Office of Admissions website at admissions.tc.umn.edu.

Admission Requirements

For Freshmen

For official and up-to-date information about the University's admissions policies, procedures, and deadlines, please see the latest edition of the *Undergraduate Application Booklet* available from the Office of Admissions or online at admissions.tc.umn.edu.

For students transferring from within the University of Minnesota

Students must be in good academic standing. Admission is based on completing 26 semester credits with a cumulative grade point average (GPA) of 2.00, and achieving a "science GPA" of 2.50 with a minimum of three courses in science that are *applicable to a CBS degree program*. If a specific course has been repeated, only the second grade is used in the "science GPA" for the purpose of admission.

The "science GPA" is calculated using grades from a minimum of three classes in science subjects such as calculus, biology, chemistry, statistics, and calculus-based physics. Relevant courses that are applicable to a CBS degree program at the Twin Cities campus include, but are not limited to:

- **Biology with lab:** BIOL 2002, 2003, 2004, or equivalent. (BIOL 2012, 2022, 2032, or equivalent would also be considered for the "science GPA")

- **Calculus:** MATH 1271, 1281, 1371, 1272, 1282, 1372, or equivalent. Note that not all CBS majors require calculus II (see major planning sheets for additional quantitative requirements).
- **Calculus-based physics:** PHYS 1201, 1202, 1301, 1302, or equivalent.
- **General chemistry with lab:** CHEM 1021, 1022, or equivalent.
- **Organic chemistry:** CHEM 2301, 2302, 2311, or equivalent.
- **Statistics:** STAT 3011 or equivalent.

The college requires two semesters of Foundations of Biology with laboratory, equivalent to Biol 2002 and 2003/2004 (10 credits total). For biology course transfer equivalency, contact CBS Student Services at 612-624-9717. Students who have completed coursework in biology from the University of Minnesota prior to Fall 2007 should consult a CBS advisor. Please check prerequisites for each course prior to registration.

For transfer students from higher education institutions other than the University of Minnesota

CBS admits qualified transfer students to all of its majors. Completion of science-related courses will be viewed as important evidence of preparation for and interest in studying biology.

Primary review factors include cumulative GPA and course grades in science-related courses, such as calculus, chemistry, and biology. Secondary review factors include grade trends, completion patterns, and biology-related lab or field research experience. High school grades, class rank, and ACT or SAT scores may also be factored into the admission decision for students who have completed fewer than 26 transferable credits. The following courses are viewed as important evidence of preparation and are required for entry.

- One semester of calculus (equivalent to MATH 1271)
- One full year of general chemistry with lab (equivalent to CHEM 1021 and 1022)

Note: Applicants with fewer than two semesters of chemistry may still be considered for admission based on the overall strength of their record. However, chemistry is a prerequisite for many biology courses. Thus, applicants who transfer before completing a year of chemistry are likely to delay their expected graduation date.

The college requires two semesters of Foundations of Biology with laboratory, equivalent to Biol 2002 and 2003/2004 (10 credits total). Students should work with the CBS transfer admissions counselor as they consider whether to complete their foundational biology sequence at their transfer institution.

Priority consideration is given to students who intend to complete a degree program in CBS. Students who have previously completed bachelor's degrees and wish to complete prerequisites for professional or graduate schools should strongly consider completing coursework as non-degree-seeking students through the College of Continuing Education.

Visit the CBS website at www.cbs.umn.edu/student-services/transfercredits.html to find specific transfer information and course equivalencies for chemistry, math, and physics, or call 612-624-9717.

Applications to the University of Minnesota, Twin Cities may be requested from the Office of Admissions (612-625-2008) or toll free in the United States (1-800-752-1000).

For more information, contact the Office of Student Services (612-624-9717).

Orientation

All students new to the University of Minnesota attend orientation before classes begin. Orientation enables students to become familiar with CBS programs, courses, and opportunities. During orientation students meet CBS advisers, get to know other incoming students, and register online for classes. Freshman students participate in **New Student Orientation, Nature of Life, and Welcome Week**.

Freshmen orientation is a two-day program that provides information for a successful beginning at the University. Nature of Life is a required two-credit course; the first part takes place during the summer at the Itasca Biological Station and Laboratories and the second part takes place on campus in the fall.

Welcome Week is a mandatory, six-day, on-campus experience prior to the start of the fall semester. During Welcome Week, students will have the opportunity to participate in College Day, which is designed to assist students with resources and connections for successful study in the biological sciences.

Transfer orientation is a one-day program, which includes an online pre-orientation component, and is designed to help transfer students make a smooth transition to campus.

For more information on these programs, see the Nature of Life, New Student Orientation, and Welcome Week sections of this catalog or contact Orientation and First-Year Programs (612-624-1979 or 1-800-234-1979); www.ofyp.umn.edu.

Advising

The CBS Office of Student Services provides advising, co-curricular learning experiences and programs, and other resources to current students. CBS academic advisers help students develop meaningful educational plans that are compatible with their long-term goals and also connect students with resources to help navigate the University. All CBS students are assigned to a professional adviser in CBS Student Services. First-year students are required to meet with their adviser during fall semester of their first year and spring semester of their sophomore year. Transfer students meet with their adviser during their first semester.

During advising appointments, advisers help students review academic progress, plan course schedules, and learn about additional college and University resources. After declaring a major, CBS students are also assigned to a faculty mentor in their particular area of interest. Students consult their faculty mentors regarding courses specific to their major, graduate study, internship planning, or to arrange directed research in laboratory and field settings.

Undergraduate Programs

Students choose CBS because it has high-quality programs taught by professors who are nationally recognized researchers and educators. As students begin planning for a specific career, they should supplement their coursework with research experiences and internships to further develop their skills and prepare for their chosen professions. Students may also explore biology career interests through the biology colloquium, BIOL 2001—Career Planning for Biologists, and the Career Center for Science and Engineering.

The CBS bachelor of science degree program is composed of four essential elements. Each helps prepare students to be leaders in their chosen professions in an increasingly complex and interdisciplinary world.

I. Liberal Education—A liberal education gives students a broad perspective that strengthens judgment and critical thinking skills. Students develop communication skills, an understanding of the ways scientists and others contribute to knowledge, historical, and philosophical perspectives on the world, and insights into life and nature provided by literature and the arts.

To help achieve these goals, the University requires all students to distribute a portion of their coursework in areas of study outside of those linked to their specialized interests in their major. See Liberal Education in the Policies section of this catalog for more information.

II. Physical Sciences and Mathematics—The biological sciences rely heavily on the tools of mathematics and physical science. Organisms consist of molecules that obey the rules of physics and chemistry; these rules are often described using mathematics. Modern biologists in the field and in the laboratory must be able to use principles of mathematics, chemistry, and physics to understand living organisms at all levels from molecules to ecosystems.

III. Biology Core Curriculum—Specialists will always be important in biology, but today there is a growing need for people whose understanding spans the disciplines of biology. CBS students are introduced to diverse aspects of biology by completing a set of core courses. Some of these introduce students to various kinds of organisms—animals, plants, and microorganisms. Biochemistry introduces students to organic compounds of importance to organisms, enzyme-catalyzed reactions, and metabolic pathways involved in the synthesis or catabolism of macromolecules. Cell biology provides an in-depth analysis of cellular structure and function. Genetics examines mechanisms of heredity, including molecular genetics and population genetics. Ecology, evolution, and behavior introduce students to populations, evolution, and the behavior of animals.

IV. Specialization in the Major—All seven major programs in CBS lead to the bachelor of science degree. Students may major in:

biology
 biochemistry
 ecology, evolution, and behavior
 genetics, cell biology, and development
 microbiology

neuroscience

plant biology

All CBS freshmen choose one of the majors listed above at the end of their first year, during which students take the foundation courses in mathematics, chemistry, and general biology that are essential for success in any of the biological sciences majors. Transfer students declare a specific major when they begin their studies in CBS. During their junior and/or senior years, most students complete a research project in their area of interest by taking Directed Research (4994 and 4794W).

Graduation Requirements

To earn a B.S. degree from CBS, students must be admitted to a CBS degree program or major and meet all University requirements outlined in the Policies section of this catalog. CBS students should also note the following requirements:

- Students must complete all campus, college and program requirements with a minimum GPA of 2.00 in the major and a cumulative GPA of 2.00 or higher in all University coursework.
- Grades of C- or better are required in the math, chemistry, physics, or biological sciences courses used to meet requirements for the major.
- S grades are not allowed in major courses unless the course is only offered S-N.

Students must apply for graduation by submitting an *Application for Degree* online. CBS students may apply to clear for graduation after fall, spring, May, or summer session. There is no fee to apply for the degree. Students need apply only once and may update their application online if graduation is delayed. Students are strongly encouraged to apply a few semesters in advance of anticipated graduation. Procedures and forms for submitting applications for degree can be found at www.onestop.umn.edu/onestop/graduating.html.

Graduating With Distinction and/or Latin Honors—CBS students may graduate “with distinction,” recognition of a cumulative GPA of 3.75 or higher; or “with high distinction,” recognition of a cumulative GPA of 3.90 or higher.

Those enrolled in the University Honors Program may also earn Latin honors. For more information, see the following, and the University Honors Program section at the front of this catalog.

Honors Program

The University Honors Program (UHP) offers rigorous and interdisciplinary curricula along with other honors experiences designed for highly qualified and motivated students. Honors courses, available only to honors students, offer small class size, close interaction with world-class faculty, and an engaging learning atmosphere. The University Honors Program serves honors students in all colleges. See the University Honors Program section at the front of this catalog for more information, or visit the University Honors Program website at www.honors.umn.edu.

Students admitted to honors before fall 2008 will continue to follow the honors requirements outlined at the time they entered their college honors program. All students admitted to honors as of fall 2008 forward follow the requirements of the University Honors Program. Students admitted to a college honors program before fall 2008 and who change colleges, must apply to UHP

if they want to participate in Honors. If admitted, they will be held to the new UHP requirements. See the University Honors Program section of this catalog for further instructions on how to apply.

Special Learning Opportunities and Resources

Students are encouraged to explore the full scope of learning experiences available at the University, including those beyond the required curriculum. Many students plan projects they carry out under faculty supervision in research laboratories and at environmental field stations. Some students participate in off-campus internships in private industry, government agencies, and nonprofit organizations. Other students seek employment as undergraduate teaching and research assistants or museum tour guides. Information about BIOL 2001—Career Planning for Biologists and the CBS Mentor Program can be found in the Career Information section.

Nature of Life—Incoming freshmen are required to take a class at the Itasca Biological Station and Laboratories. At Itasca, students explore some of the major issues in biology, learn about ways of discovery in various fields of biology, and begin to see the interdisciplinary nature of the field. In addition, they get to know each other and many CBS faculty and staff, leaving Itasca with new friends and a better understanding of how to make the most of their CBS experience. Follow-up activities during fall semester continue to build a sense of community and connection among students and faculty.

Biology House—Located in Frontier Hall, Biology House combines residence hall life with social and academic opportunities for students interested in the biological sciences. Activities include social events, lab tours and field trips, study groups, on-site advising, faculty and student research presentations, and career exploration. Space in Biology House is limited to incoming freshmen and PSEO students; applicants are encouraged to apply early for admission to this living and learning community. For more information, visit the Housing and Residential Life website at www.housing.umn.edu.

New Student Reception—This annual welcome event helps new students connect with CBS departments, majors, clubs, and research opportunities.

Biology Colloquium—This unique course (BIOL 1020), organized and run by students, provides an opportunity to explore a variety of fields and careers in the biological sciences. The course offers large group seminars, featuring prominent scientists discussing their research programs, and small group tours to research facilities on and off campus, such as the Raptor Center, the International Wolf Center in Ely, or behind-the-scenes at the Minnesota Zoo.

Freshman Seminars—CBS students are offered an opportunity to explore a current topic in biology in a small group setting. Offered during both fall and spring semesters, Freshman Seminars allow students to explore topics such as energy, genomics, biotechnology, and bioart to name a few. In CBS, Freshman Seminars are considered an essential element of a first-year course schedule.

Craniofacial Research Opportunities—This unique program is offered through the U of M School of Dentistry and provides students the opportunity to work in a dental research lab.

Participating labs use the latest research techniques and state-of-the-art equipment, and conduct experiments on questions of significant scientific interest. Successful applicants have a serious interest in pursuing a research career, perhaps partnered with a career in clinical dentistry.

Senior Reception—The Senior Reception is a special event for graduating CBS seniors designed to recognize and celebrate student accomplishments and to answer questions related to this important milestone. Representatives from the Biological Sciences Alumni Society, CBS Student Services, Office of Student Finance, the Health Careers Center, and Career Center for Science and Engineering are available to answer questions about degree clearance, commencement, and life after college.

Deans' Scholars—This unique program is designed to help CBS students build their leadership skills and prepare them to be active citizens in their chosen professions and communities after graduation. The program focuses on three areas to help students increase their leadership potential: self-awareness, citizenship, and creating change. Students are offered opportunities to grow in each of these areas through a combination of coursework, seminars, service opportunities, and celebrations from their first year in CBS through graduation.

Student Excellence in Academics and Multiculturalism (SEAM)—A SEAM community consists of 15–20 first-year students who share similar interests or goals, have expressed a desire to study in a multicultural environment, and take the same two to four classes for fall semester. CBS SEAM seminars include topics such as “The Science of Sex: How Do We Know What We Know?” and “CSI Minnesota: Biologists Look at Forensic Science.”

Foundations of Biology—Our foundational biology sequence is a signature experience in the CBS undergraduate curriculum. Students engage in a two-semester biology sequence that emphasizes the relationships among biological disciplines, chemistry, and other physical sciences. These principles are framed and illustrated by examples, activities and labs that will help students apply the scientific method to real-world problems. Project teams have published scientific papers as a result of their work.

CBS Picnic—The CBS Picnic is an annual social event for students hosted by faculty and staff and held on the last day of classes to celebrate the academic year. The event provides an opportunity for continued connections among students, faculty, and staff.

Undergraduate Research—As part of a large public research university, CBS offers a wealth of opportunities for hands-on research experience. Most students complete an independent research project under the supervision of a faculty member. All students are invited to present their research at the Undergraduate Research Symposium, which is held annually in the spring. Opportunities to get involved in research include volunteer experiences, directed research for academic credit, part-time jobs, and special grants through the Undergraduate Research Opportunities Program. Information about research opportunities and resources for finding a faculty mentor are available at www.cbs.umn.edu/student-services/research.html.

Scholarships—CBS offers a variety of scholarships to new and continuing students based on academic achievement, leadership, research experience, and humanitarian service. Scholarship information, deadlines, and application materials are available at www.cbs.umn.edu/student-services/scholarships.html.

Research and Teaching Facilities

CBS has research and teaching facilities on the Minneapolis and St. Paul campuses, and operates two field stations.

Biodale, CBS's one-stop shopping center for research support services, houses \$40 million in bioscience research equipment that is available to faculty, students, and industry scientists. Facilities include the Imaging Center, which provides low-cost research poster printing. Biodale is located in Snyder Hall on the St. Paul campus. Website: www.cbs.umn.edu/biodale.

The Biological Sciences Greenhouse is part of a complex of plant growth facilities on the St. Paul campus. The CBS greenhouse is a teaching and research facility with four landscaped rooms that exhibit the flora of the tropics, subtropics, desert, and aquatic regions.

The BioTechnology Institute (BTI) in Gortner Laboratories on the St. Paul campus brings together faculty and students from CBS, the College of Science and Engineering (formerly the Institute of Technology), the Medical School and the College of Food, Agricultural and Natural Resource Sciences for interdisciplinary research and training in emerging areas of biotechnology. These include biocatalysis, renewable energy and materials, bioremediation of toxic waste, and creation of new biological agents for use in medicine and industry. BTI promotes collaboration between University researchers and industry and trains students for Minnesota's growing biotechnology industry. Visit www.bti.umn.edu.

The Cargill Building for Microbial and Plant Genomics provides a hub for researchers from several schools. Faculty conduct basic research in functional genomics of microbes and crop plants to identify innovative ways to make crops more resistant to disease and drought, clean up the environment, and improve human health.

Cedar Creek Ecosystem Science Reserve is a 5,400-acre ecological research site located 30 miles north of the Twin Cities. It represents three large North American biomes: grass prairies, evergreen forests, and deciduous forests. Discovered in 1930, it has been nationally known as an important site for ecology research since the early 1940s. Today, Cedar Creek is a living laboratory for students and faculty members including Regents Professor of Ecology David Tilman, who studies the human impact on biodiversity in global ecosystems.

Long-term experiments at Cedar Creek examine three of the most significant human alterations to the biosphere: increased carbon dioxide in the air, increased nitrogen in soil and water from fertilizers, and reduced biodiversity. All three factors affect the performance of global ecosystems. More information is available at www.lter.umn.edu.

Itasca Biological Station and Laboratories is a CBS field station within Itasca State Park, which is located at the headwaters of the Mississippi River. The most visited park in the state, Itasca offers 50 square miles of pristine ecosystems populated with Minnesota's native flora and fauna and a spectacular collection of clear lakes, peat bogs, and old-growth forests. Website: www.cbs.umn.edu/itasca.

Nature of Life, CBS's annual class for incoming freshmen, is held at Itasca every year in July and August. Several graduate programs also offer orientation sessions at Itasca. Field biology classes are offered to students from the University of Minnesota

and other schools. See www.cbs.umn.edu/itasca for a description of courses and facilities.

The Molecular and Cellular Biology Building is a state-of-the-art facility for life sciences research and education shared by the College of Biological Sciences and the University of Minnesota Medical School. The building has four floors of faculty research laboratories and two floors of biology classrooms and instructional laboratories.

University Enterprise Laboratories (UEL) is a nonprofit entity that provides lab space for biotech start-up companies. UEL is located in the heart of the St. Paul Bioscience Zone, an area that provides tax advantages and resources that encourage bioscience companies to innovate, grow, and prosper. Sponsors include Xcel Energy, 3M, Allina, Medtronic, Boston Scientific, Dorsey and Whitney, Ecolab, Guidant Corporation, and Surmodics. Visit www.uelmn.org.

International Programs

CBS encourages all students to consider an international experience as part of their undergraduate program. Many unique opportunities allow students to study abroad in the biological sciences. These international experiences can help students gain field experience in different ecosystems, learn international perspectives in biology, develop laboratory research skills in an academic setting, enhance communication and problem-solving skills, and prepare for a career in the ever-expanding global market.

Internships, volunteer experiences, and academic programs are available to help students prepare for careers in health care, academia, industry, or the public sector. Study abroad can also help students learn a language or make progress toward liberal education or major requirements.

For more information, contact the Learning Abroad Center at 612-626-9000 or visit www.UMabroad.umn.edu.

Graduate Programs

Graduate study at the University is coordinated and administered by the University of Minnesota Graduate School. Undergraduates who are interested in continuing on to graduate study and who have questions about how their undergraduate work can prepare them for specific graduate bioscience programs should contact the director of graduate studies in the appropriate program area. For a listing of CBS graduate programs and their directors, visit www.cbs.umn.edu/studentervices/prospective/graduate.html.

Career Information

CBS students have access to a rich and varied array of services to meet their career planning needs. These include career centers, career planning courses, a mentor program, internships and campus-wide career fairs.

The Career Center for Science and Engineering (CCSE)—50 Lind Hall (612-624-4090), provides comprehensive career services to students and alumni from the College of Biological Sciences. CCSE assists students in exploring majors and careers best suited to their skills, interests, and values. CCSE also provides resources and programs aimed at assisting students with their search for part-time, internship, and co-op positions, as well as permanent jobs following graduation. The services provided by

CCSE include on-campus interviewing, job postings, workshops on many job search-related topics, and individual assistance with any career issue.

Health Career Center—At this center, students will find a variety of valuable resources, including courses, workshops, online tools, and knowledgeable staff who can provide guidance about careers in the ever-expanding health care field. For more information, call 612-624-6767 or visit 2-565 Moos Tower or the website, www.healthcareers.umn.edu.

Biology 2001: Career Planning for Biologists—provides students with an opportunity to take an in-depth look at themselves (strengths, interests, needs) in the context of careers, future trends, and preparation for life beyond college. Topics in the class cover decision-making, goal setting, the role of planned happenstance, U of M Student Development Outcomes, informational interviewing, and career research. Students also learn about campus and community resources, and work on honing their career-readiness skill set.

The College of Biological Sciences Alumni/Student Mentor Program—This program provides an opportunity for CBS students to connect one-to-one with an alumnus or friend of the college for career exploration, planning, and networking. Mentors advise student mentees about career-related issues such as career options, the value of networking and gaining work experience, resumé writing, and interviewing skills. Mentors also provide feedback and support to help students succeed in their chosen fields. The program begins early fall semester and students meet with their mentors over a four-month period.

Internships for credit—Students can earn internship credit by registering for BIOL 3610—Internship: Professional Experience in Biological Science. Recent student internships have included:

- Developing plastics from renewable resources at a biotech company
- Assisting with dolphin care and training at a local aquarium
- Researching new forensic science techniques in a criminal identification lab
- Organizing volunteers for tissue donor programs
- Assisting high school biology teachers
- Helping develop a groundwater monitoring program
- Researching the needs of people with neurological injuries

Student Organizations

CBS is committed to building an inclusive community and providing resources and support to help students learn, develop and grow in their pursuits outside of the classroom. Toward that end, the college supports a wide variety of student organizations and clubs. For contact information or details on any of the groups below, visit www.cbs.umn.edu/studentervices/involvement.html.

AED—Alpha Epsilon Delta, the Pre-Med Honor Society, is for anyone who aspires to be a physician. Members meet other pre-med students and learn about how to prepare for a career in medicine.

AMSA Premed—The American Medical Student Association is a national pre-med student group that helps students who share interests in the health sciences connect and prepare for medical school and the MCAT.

Biological Science Journal Club—The purpose of the Biological Science Journal Club is to help students interpret scientific journal articles. Members read and discuss journal articles, and give informal presentations.

Biology Without Borders—BWB provides students with global opportunities to volunteer and gain experience in health sciences and other fields.

CBS Ambassadors—Members gain valuable communication and leadership skills while sharing their experience at the University of Minnesota and the College of Biological Sciences with others.

CBS Student Board—The Student Board works with administration, departments, and student organizations to build community among CBS students and to represent students to the CBS administration. The board holds social events, workshops, and other events that foster academic and career development.

A club for every field and career interest

Numerous CBS clubs represent fields of biology and career paths. They offer guest speakers, field trips, tours of labs, connections for research experience, meetings with potential employers, and social and volunteer opportunities. For details, visit www.cbs.umn.edu/student-services/involvement.html.

Biochemistry Club

Forensic Science Club

Genetics, Cell Biology, and Development Club

Headwaters Ecology Club

Minority Association of Pre-Medical Students

Microbiology Club

Neuroscience Club

Pre-Dental Club

Pre-Optometry Club

Pre-Pharmacy Club

Pre-Physician Assistant Club

Student Society of Stem-Cell Research Club

Directory

Office of the Dean

Dean: Robert Elde
123 Snyder Hall
1475 Gortner Avenue
St. Paul, MN 55108
612-624-2244
elde@umn.edu

Student Services

Advising and Registration

229 Snyder Hall (St. Paul), 612-624-9717

Career Center for Science and Engineering

50 Lind Hall (Mpls.), 612-624-4090
ccse@umn.edu

Dean's Scholars Program

229 Snyder Hall (St. Paul), 612-624-9717

Nature of Life Program

229 Snyder Hall (St. Paul), 612-624-9717
nol@umn.edu

University Honors Program (UHP)

20 Nicholson (Mpls.), 612-624-5522

Directors of Undergraduate Studies

Biochemistry

158 Gortner Laboratory of Biochemistry (St. Paul), 612-625-4928

Biology

3-104 Molecular and Cellular Biology Building (Mpls.),
612-625-4718

Ecology, Evolution, and Behavior

412 Ecology Building (St. Paul), 612-625-5296

Genetics, Cell Biology, and Development

204 Biological Sciences Center (St. Paul), 612-624-5354

Microbiology

1435 Mayo Memorial Building (Mpls.), 612-624-9933

Neuroscience

6-145 Jackson Hall (Mpls.), 612-625-7961

Plant Biology

768 Biological Sciences Center (St. Paul), 612-625-2761

Departments, Institutes, and Programs

Alumni Relations

123 Snyder Hall (St. Paul), 612-624-4770

Biochemistry, Molecular Biology, and Biophysics

140 Gortner Laboratory of Biochemistry (St. Paul), 612-624-7755
6-155 Jackson Hall (Mpls.), 612-625-6100

Master of Biological Sciences

123 Snyder Hall (St. Paul), 612-625-3133

BioTechnology Institute

140 Gortner Laboratory of Biochemistry (St. Paul), 612-624-6774

CBS Computing Services

247 Gortner Laboratory of Biochemistry (St. Paul), 612-625-9284

Cedar Creek Ecosystem Science Reserve

509 Ecology Building (St. Paul), 612-625-5740
Cedar Creek area, 763-434-5131

Developmental Biology Center

4-122 Moos Tower (Mpls.), 612-625-0642

Ecology, Evolution, and Behavior

100 Ecology Building (St. Paul), 612-625-5700

Biology Program

3-104 Molecular and Cellular Biology (Mpls.), 612-625-6636

Genetics, Cell Biology, and Development

250 Biological Sciences Center (St. Paul), 612-624-3003
6-160 Jackson Hall (Mpls.), 612-624-3110
gcd@umn.edu

Imaging Center

35 Snyder Hall, (St. Paul), 612-624-3231

Institute of Human Genetics

4-122 Moos Tower (Mpls.), 612-625-1609

Instructional Computing Center

406 Biological Sciences Center and 170 Ecology (St. Paul)
2-585 Moos Tower (Mpls.), 612-624-2789

Instructional Labs

123 Biological Sciences Center (St. Paul), 612-624-2789

Itasca Biology Program

720 Biological Sciences Center (St. Paul), 612-624-6743

Microbiology (Medical School)

1460 Mayo Memorial Building (Mpls.), 612-624-6190

Neuroscience

6-145 Jackson Hall (Mpls.), 612-626-6800

Plant Biology

250 Biological Sciences Center (St. Paul), 612-625-1234

Microbial and Plant Genomics Institute

122 Cargill Building for Microbial and Plant Genomics
(St. Paul), 612-624-6269

College of BIOLOGICAL SCIENCES

Degree Programs and Minors

Biochemistry B.S.

Biochemistry, Molecular Biology, and Biophysics TCBS

- Required credits to graduate with this degree: 120.
- Required credits within the major: 73 to 80.

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 B.S. 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 industry, 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.

Admission Requirements

Freshmen students are usually admitted to pre-major status before admission to this major.

A GPA above 2.00 is preferred for the following:

- 2.50 for students transferring from another University of Minnesota college.
- 2.50 for students transferring from outside the University.

For information about University of Minnesota admission requirements, visit the [Office of Admissions website](#).

Program Requirements

Chemistry

CHEM 1021—Chemical Principles I (4 cr)
CHEM 1022—Chemical Principles II (4 cr)
CHEM 2301—Organic Chemistry I (3 cr)
CHEM 2302—Organic Chemistry II (3 cr)
CHEM 2311—Organic Lab (4 cr)
BIOC 4521—Introduction to Physical Biochemistry (3 cr)
or CHEM 3501—Introduction to Thermodynamics, Kinetics, and Statistical Mechanics (3 cr)
and CHEM 3502—Introduction to Quantum Mechanics and Spectroscopy (3 cr)

Mathematics

MATH 1271—Calculus I (4 cr)
MATH 1272—Calculus II (4 cr)

Physics

PHYS 1201W—Introductory Physics for Biology and Pre-medicine I, PHYS, WI (5 cr)
or PHYS 1301W—Introductory Physics for Science and Engineering I, PHYS, WI (4 cr)
PHYS 1202W—Introductory Physics for Biology and Pre-medicine II, PHYS, WI (5 cr)
or PHYS 1302W—Introductory Physics for Science and Engineering II, PHYS, WI (4 cr)

General Biology

BIOL 2002—Foundations of Biology for Biological Sciences Majors, Part I, BIOL (5 cr)
or BIOL 2002H—Foundations of Biology for Biological Sciences Majors, Part I, BIOL, H (5 cr)
BIOL 2003—Foundations of Biology for Biological Sciences Majors, Part II (3 cr)
or BIOL 2003H—Foundations of Biology for Biological Sciences Majors, Part II, H (3 cr)
BIOL 2004—Foundations of Biology for Biological Sciences Majors, Part II Laboratory (2 cr)
or BIOL 2004H—Foundations of Biology for Biological Sciences Majors, Part II Laboratory, H (2 cr)

Biology Core

BIOL 4003—Genetics (3 cr)
BIOL 4004—Cell Biology (3 cr)
Take one course or course pair.
Take 1 or more course(s) from the following:
MICB 3301—Biology of Microorganisms (5 cr)
BIOL 3407—Ecology (3 cr)
BIOL 3408W—Ecology, WI (3 cr)
BIOL 3807—Ecology (4 cr)
BIOL 3409—Evolution (3 cr)
BIOL 3411—Introduction to Animal Behavior (3 cr)
BIOL 3811—Introduction to Animal Behavior (4 cr)
BIOL 3007W—Plant, Algal, and Fungal Diversity and Adaptation, WI (4 cr)
BIOL 3211—Animal Physiology (3 cr)
and BIOL 2005—Animal Diversity Laboratory (1 cr)
PHSL 3051—Human Physiology (4 cr)
and BIOL 2005—Animal Diversity Laboratory (1 cr)
PHSL 3061—Principles of Physiology (4 cr)
and BIOL 2005—Animal Diversity Laboratory (1 cr)
BIOL 3002—Plant Biology: Function (2 cr)
and BIOL 3005W—Plant Function Laboratory, WI (2 cr)

Biochemistry Core

BIOC 3960—Research Topics in Biochemistry (1 cr)
BIOC 4025—Laboratory in Biochemistry (2 cr)
BIOC 4331—Biochemistry I: Structure, Catalysis, and Metabolism in Biological Systems (4 cr)
BIOC 4332—Biochemistry II: Molecular Mechanisms of Signal Transduction and Gene Expression (4 cr)

Biochemistry Major Electives

Must include one lab/field course from the approved list. Directed Research (4994/4794W) must be completed for at least 2 credits to count as a lab/field course. Courses used in electives cannot also fulfill other areas in the major. Upper division (38xx, 48xx or 58xx) BIOL, EEB, or PBIO courses taken at the Itasca Biological Station also count toward the lab/field requirement.

Take 6 or more credit(s) from the following:

Laboratory and Field Courses

Take 1 or more course(s) from the following:
BIOC 4125—Laboratory in Molecular Biology and Biotechnology (3 cr)
BIOC 4794W—Directed Research: Writing Intensive, WI (1–6 cr)

BIOC 4994—Directed Research (1–6 cr)
 BIOL 3007W—Plant, Algal, and Fungal Diversity and Adaptation, WI (4 cr)
 EEB 4014—Ecology of Vegetation (3 cr)
 EEB 4016W—Ecological Biogeography, WI (3 cr)
 EEB 4129—Mammalogy (4 cr)
 EEB 4134—Introduction to Ornithology (4 cr)
 EEB 5605—Limnology Laboratory (2 cr)
 EEB 4607—Plankton Ecology (4 cr)
 EEB 4794W—Directed Research: Writing Intensive, WI (1–6 cr)
 EEB 4994—Directed Research (1–6 cr)
 GCD 4025—Cell Biology Laboratory (2 cr)
 GCD 4111—Histology: Cell and Tissue Organization (4 cr)
 GCD 4794W—Directed Research: Writing Intensive, WI (1–6 cr)
 GCD 4994—Directed Research (1–6 cr)
 MICB 3301—Biology of Microorganisms (5 cr)
 MICB 4215—Advanced Laboratory: Microbial Physiology and Diversity (3 cr)
 MICB 4235—Advanced Laboratory: Virology, Immunology, and Microbial Genetics (3 cr)
 MICB 4794W—Directed Research: Writing Intensive, WI (1–7 cr)
 MICB 4994—Directed Research (1–7 cr)
 NSCI 4794W—Directed Research: Writing Intensive, WI (1–6 cr)
 NSCI 4994—Directed Research (1–6 cr)
 PBIO 4321—Minnesota Flora (3 cr)
 PBIO 4511—Flowering Plant Diversity (3 cr)
 PBIO 4794W—Directed Research: Writing Intensive, WI (1–6 cr)
 PBIO 4994—Directed Research (1–6 cr)
 BIOL 4794W—Directed Research, WI (1–6 cr)
 BIOL 4994—Directed Research (1–6 cr)
 BIOC 4325—Laboratory in Mass Spectrometry (1 cr)
 FW 4136—Ichthyology (4 cr)
 BIOL 3002—Plant Biology: Function (2 cr)
 and BIOL 3005W—Plant Function Laboratory, WI (2 cr)
 BIOL 2005—Animal Diversity Laboratory (1 cr)
 and BIOL 3211—Animal Physiology (3 cr)
 BIOL 2005—Animal Diversity Laboratory (1 cr)
 and PHSL 3051—Human Physiology (4 cr)
 BIOL 2005—Animal Diversity Laboratory (1 cr)
 and PHSL 3061—Principles of Physiology (4 cr)

Biochemistry Electives

Take 0–5 credit(s) from the following:

BIOC 4xxx, 5xxx
 BIOL 3xxx, 4xxx, 5xxx
 EEB 3603—Science, Protection, and Management of Aquatic Environments (3 cr)
 EEB 3963—Modeling Nature and the Nature of Modeling (3 cr)
 EEB 4xxx, 5xxx
 GCD 4xxx, 5xxx
 MICB 3303—Biology of Microorganisms (3 cr)
 MICB 4xxx, 5xxx
 NSCI 3xxx, 4xxx
 NSC 5xxx
 PBIO 4xxx, 5xxx
 CHEM 3xxx, 4xxx
 CSCI 3xxx, 4xxx
 MATH 3283W—Sequences, Series, and Foundations: Writing Intensive, WI (4 cr)
 MATH 4xxx, 5xxx
 PHYS 3xxx, 4xxx, 5xxx
 STAT 3xxx, 4xxx, 5xxx
 ANAT 3xxx

Program Sub-plans

A sub-plan is not required for this program.

Honors (UHP) Sub-plan

Students admitted to the University Honors Program (UHP) must fulfill UHP requirements in addition to degree program requirements. Honors courses used to fulfill degree program requirements will also fulfill UHP requirements. Current departmental honors course offerings are listed at www.honors.umn.edu/academics/curriculum/dept_courses_current.html.

Honors students complete an honors thesis project in the final year, most often in conjunction with an honors thesis course, or with an honors directed studies or honors directed research course. Students select honors courses and plan for a thesis project in consultation with their UHP adviser and their departmental faculty adviser.

BIOL 2960H and 3960H are strongly recommended for CBS sophomores and juniors, respectively. Directed Research is the basis for an honors thesis completed in conjunction with BIOL 4960H.

Biochemistry Minor

Biochemistry, Molecular Biology, and Biophysics TCBS

- Required credits in this minor: 10.

Biochemists study molecules found in living organisms, particularly proteins, nucleic acids, lipids, and carbohydrates. Biochemistry minors 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 how genetic engineering and biotechnology can be used in ways that benefit society.

Minor Requirements

Students who wish to declare a minor in biochemistry can do so online at the College of Biological Sciences website.

Minor Courses

BIOC 4331—Biochemistry I: Structure, Catalysis, and Metabolism in Biological Systems (4 cr)
 BIOC 4332—Biochemistry II: Molecular Mechanisms of Signal Transduction and Gene Expression (4 cr)
 BIOC 4025—Laboratory in Biochemistry (2 cr)

Biology B.S.

College of Biological Sciences

- Required credits to graduate with this degree: 120.
- Required credits within the major: 69 to 75.

Students majoring in biology gain a broad understanding of the fundamental nature and characteristics of living things and the ways in which they interact. Their studies cover the full range of life sciences, from cancer genes to acid rain, from lichens to marine mammals.

The biology B.S. program prepares students for study in a broad spectrum of biological sciences; for professional training programs in the health sciences; careers in teaching; and entry-level scientist positions in industry, government agencies, and universities.

Admission Requirements

Freshmen students are usually admitted to pre-major status before admission to this major.

A GPA above 2.00 is preferred for the following:

- 2.50 for students transferring from another University of Minnesota college.
- 2.50 for students transferring from outside the University.

For information about University of Minnesota admission requirements, visit the [Office of Admissions website](#).

Program Requirements

Chemistry

CHEM 1021—Chemical Principles I (4 cr)
 CHEM 1022—Chemical Principles II (4 cr)
 CHEM 2301—Organic Chemistry I (3 cr)
 CHEM 2302—Organic Chemistry II (3 cr)
 CHEM 2311—Organic Lab (4 cr)

Quantitative Requirement

MATH 1271—Calculus I (4 cr)
Take exactly 1 course(s) from the following:
 MATH 1272—Calculus II (4 cr)
 STAT 3011—Introduction to Statistical Analysis, MATH (4 cr)
 CSCI 1901—Structure of Computer Programming I (4 cr)
 CSCI 3003—Introduction to Computing in Biology (3 cr)

Physics

PHYS 1201W—Introductory Physics for Biology and Pre-medicine I, PHYS, WI (5 cr)
or PHYS 1301W—Introductory Physics for Science and Engineering I, PHYS, WI (4 cr)
and PHYS 1202W—Introductory Physics for Biology and Pre-medicine II, PHYS, WI (5 cr)
or PHYS 1302W—Introductory Physics for Science and Engineering II, PHYS, WI (4 cr)

General Biology

BIOL 2002—Foundations of Biology for Biological Sciences Majors, Part I, BIOL (5 cr)
or BIOL 2002H—Foundations of Biology for Biological Sciences Majors, Part I, BIOL, H (5 cr)
 BIOL 2003—Foundations of Biology for Biological Sciences Majors, Part II (3 cr)
or BIOL 2003H—Foundations of Biology for Biological Sciences Majors, Part II, H (3 cr)
 BIOL 2004—Foundations of Biology for Biological Sciences Majors, Part II Laboratory (2 cr)
or BIOL 2004H—Foundations of Biology for Biological Sciences Majors, Part II Laboratory, H (2 cr)

Organismal Biology

Take 1 or more course(s) from the following:

Animal Biology

BIOL 2012—General Zoology (4 cr)
or BIOL 3211—Animal Physiology (3 cr)
and BIOL 2005—Animal Diversity Laboratory (1 cr)
or PHSL 3051—Human Physiology (4 cr)
and BIOL 2005—Animal Diversity Laboratory (1 cr)
or PHSL 3061—Principles of Physiology (4 cr)
and BIOL 2005—Animal Diversity Laboratory (1 cr)

Plant Biology

BIOL 2022—General Botany (3 cr)
or BIOL 3007W—Plant, Algal, and Fungal Diversity and Adaptation, WI (4 cr)
or BIOL 3002—Plant Biology: Function (2 cr)
and BIOL 3005W—Plant Function Laboratory, WI (2 cr)

Microbiology

VBS 2032—General Microbiology With Laboratory (4 cr)
or MICB 3301—Biology of Microorganisms (5 cr)

Biology Core

BIOC 3021—Biochemistry (3 cr)
or BIOC 4331—Biochemistry I: Structure, Catalysis, and Metabolism in Biological Systems (4 cr)

Take 1 or more course(s) from the following:

BIOL 3407—Ecology (3 cr)
 BIOL 3408W—Ecology, WI (3 cr)
 BIOL 3807—Ecology (4 cr)
 BIOL 3409—Evolution (3 cr)
 BIOL 3411—Introduction to Animal Behavior (3 cr)
 BIOL 3811—Introduction to Animal Behavior (4 cr)
 BIOL 4003—Genetics (3 cr)
 BIOL 4004—Cell Biology (3 cr)

Biology Major Electives

Electives must include 2 laboratory or field courses from the approved list. To count as a lab/field course, directed research must be completed for a minimum of 3 credits; credits can be split over multiple terms using 4994, 4794W, or a combination of the two. Directed research can only be used for one laboratory or field requirement.

Take 11 or more credit(s) from the following:

Laboratory and Field Courses

Take 2 or more course(s) from the following:

BIOC 4025—Laboratory in Biochemistry (2 cr)
 BIOL 4125—Laboratory in Molecular Biology and Biotechnology (3 cr)
 BIOL 4794W—Directed Research: Writing Intensive, WI (1–6 cr)
 BIOL 4994—Directed Research (1–6 cr)
 BIOL 3007W—Plant, Algal, and Fungal Diversity and Adaptation, WI (4 cr)
 BIOL 3807—Ecology (4 cr)
 BIOL 3811—Introduction to Animal Behavior (4 cr)
 BIOL 3820—Aquatic Toxicology (2 cr)
 BIOL 3825—Ecological Genetics (2 cr)
 BIOL 4035—Mississippi Metgenomics Laboratory (3 cr)
 BIOL 4794W—Directed Research, WI (1–6 cr)
 BIOL 4862—Biological Photography and Digital Imaging Techniques (3 cr)
 BIOL 4894—Directed Research at Itasca (1–7 cr)
 BIOL 4994—Directed Research (1–6 cr)
 EEB 4014—Ecology of Vegetation (3 cr)
 EEB 4016W—Ecological Biogeography, WI (3 cr)
 EEB 4129—Mammalogy (4 cr)
 EEB 4134—Introduction to Ornithology (4 cr)
 EEB 4607—Plankton Ecology (4 cr)
 EEB 4794W—Directed Research: Writing Intensive, WI (1–6 cr)
 EEB 4801—Field Limnology (4 cr)
 EEB 4809—Field Ecosystem Ecology (3 cr)
 EEB 4814—Plant Community Ecology (4 cr)
 EEB 4817—Vertebrate Ecology (4 cr)
 EEB 4825—Telemetry and Animal Behavior (2 cr)
 EEB 4839—Field Studies in Mammalogy (4 cr)
 EEB 4842—Arctic Field Ecology (4 cr)
 EEB 4844—Field Ornithology (4 cr)
 EEB 4994—Directed Research (1–6 cr)
 EEB 5605—Limnology Laboratory (2 cr)
 ENT 4861—Aquatic Insects (3 cr)
 FW 4136—Ichthyology (4 cr)
 GCD 3485—Bioinformatic Analysis: Introduction to the Computational Characterization of Genes and Proteins (3 cr)
 GCD 4025—Cell Biology Laboratory (2 cr)
 GCD 4111—Histology: Cell and Tissue Organization (4 cr)
 GCD 4794W—Directed Research: Writing Intensive, WI (1–6 cr)
 GCD 4994—Directed Research (1–6 cr)
 MICB 3301—Biology of Microorganisms (5 cr)
 MICB 4215—Advanced Laboratory: Microbial Physiology and Diversity (3 cr)
 MICB 4225—Advanced Laboratory: Microbial Genetics (3 cr)

MICB 4235—Advanced Laboratory: Virology, Immunology, and Microbial Genetics (3 cr)
 MICB 4794W—Directed Research: Writing Intensive, WI (1–7 cr)
 MICB 4994—Directed Research (1–7 cr)
 NSCI 4794W—Directed Research: Writing Intensive, WI (1–6 cr)
 NSCI 4994—Directed Research (1–6 cr)
 PBIO 4321—Minnesota Flora (3 cr)
 PBIO 4511—Flowering Plant Diversity (3 cr)
 PBIO 4794W—Directed Research: Writing Intensive, WI (1–6 cr)
 PBIO 4994—Directed Research (1–6 cr)
 PBIO 5416—Plant Morphology, Development, and Evolution (4 cr)
 BIOL 3002—Plant Biology: Function (2 cr)
and BIOL 3005W—Plant Function Laboratory, WI (2 cr)
 BIOL 3211—Animal Physiology (3 cr)
and BIOL 2005—Animal Diversity Laboratory (1 cr)
 PHSL 3051—Human Physiology (4 cr)
and BIOL 2005—Animal Diversity Laboratory (1 cr)
 PHSL 3061—Principles of Physiology (4 cr)
and BIOL 2005—Animal Diversity Laboratory (1 cr)

Additional Electives

Take 0–8 credit(s) from the following:

BIOC 3960—Research Topics in Biochemistry (1 cr)
 EEB 3603—Science, Protection, and Management of Aquatic Environments (3 cr)
 EEB 3963—Modeling Nature and the Nature of Modeling (3 cr)
 GCD 3485—Bioinformatic Analysis: Introduction to the Computational Characterization of Genes and Proteins (3 cr)
 MATH 3283W—Sequences, Series, and Foundations: Writing Intensive, WI (4 cr)
 PHCL 4001—Mechanisms of Drug Action (2 cr)
 VPM 4131—Immunology (3 cr)
 ANAT 3xxx
 BIOC 4xxx, 5xxx
 BIOL 3xxx, 4xxx, 5xxx
 CHEM 3xxx, 4xxx
 CSCI 3xxx, 4xxx
 EEB 4xxx, 5xxx
 GCD 4xxx, 5xxx
 MATH 4xxx, 5xxx
 MICB 3303—Biology of Microorganisms (3 cr)
 MICB 4xxx, 5xxx
 NSC 5xxx
 NSCI 3xxx, 4xxx
 PBIO 4xxx, 5xxx
 PHYS 3xxx, 4xxx, 5xxx
 STAT 3xxx, 4xxx, 5xxx
 EEB 3002—Sex, Evolution, and Behavior: Examining Human Evolutionary Biology (4 cr)
or ANTH 3002—Sex, Evolution, and Behavior: Examining Human Evolutionary Biology (4 cr)

Program Sub-plans

A sub-plan is not required for this program.

Honors (UHP) Sub-plan

Students admitted to the University Honors Program (UHP) must fulfill UHP requirements in addition to degree program requirements. Honors courses used to fulfill degree program requirements will also fulfill UHP requirements. Current departmental honors course offerings are listed at www.honors.umn.edu/academics/curriculum/dept_courses_current.html.

Honors students complete an honors thesis project in the final year, most often in conjunction with an honors thesis course, or with an honors directed studies or honors directed research course. Students select honors courses and plan for a thesis project in consultation with their UHP adviser and their departmental faculty adviser.

BIOL 2960H and 3960H are strongly recommended for CBS sophomores and juniors, respectively. Directed Research is the basis for an honors thesis completed in conjunction with BIOL 4960H.

Health Sciences Track (Sub-plan)

This track is designed for CBS students who enter health-related professional schools such as dentistry, pharmacy, or veterinary medicine to earn their B.S. degree by allowing the use of biological science related credits earned at an accredited professional school to fulfill CBS degree requirements.

Students may transfer up to 30 credits of accredited, health-related professional school courses towards their bachelor of science degree (e.g., credits from courses in biologically related topics such as anatomy, physiology, biochemistry, cell biology, neuroscience, genetics, organismal biology [plant, animal, and microbiology], and ecology). Clinical courses are not acceptable substitutions.

Students, assisted by a CBS academic adviser, prepare a petition for submission to the CBS Scholastics Committee. The committee conducts a holistic review of all coursework ensuring that the intention and logic of CBS requirements have been met by the additional coursework.

The CBS Scholastics Committee uses the following criteria to guide its deliberations.

Students are eligible for a degree if they have:

- completed the University CLE requirements
- completed the non-biology requirements (e.g., chemistry, physics, mathematics) for the degree
- earned at least 90 credits as undergraduates (including PSEO, AP, and related credits)

Biology Minor

College of Biological Sciences - Adm

- Required credits in this minor: 20.

Biology minors gain a broad understanding of the fundamental nature and characteristics of living things and the ways in which they interact. Their studies cover the full range of life sciences, from cancer genes to acid rain, from lichens to marine mammals.

Note: This program is not appropriate as a primary plan for CBS students.

Admission Requirements

Students interested in declaring a biology minor can do so online at the College of Biological Sciences website.

For information about University of Minnesota admission requirements, visit the [Office of Admissions website](#).

Minor Requirements

All courses must be taken A-F with a grade of C- or better.

Minor Courses

BIOL 1001—Introductory Biology I: Evolutionary and Ecological Perspectives, BIOL SCI/L, ENVT (4 cr)
or BIOL 1009—General Biology, BIOL SCI/L (4 cr)
or BIOL 2022—General Botany (3 cr)
 CHEM 1021—Chemical Principles I, ENVT, PHYS SCI/L (4 cr)

Electives

All courses for the minor must have a CBS designator (BIOL, BIOC, GCD, EEB, MICB, NSCI, PBIO) or be cross listed with CBS designators.

Take 12 or more credit(s) from the following:

Take 0–9 credit(s) from the following:

BIOC 2xxx
BIOL 2xxx
EEB 2xxx
GCD 2xxx
MICB 2xxx
NSCI 2xxx
PBIO 2xxx

Take 3 or more credit(s) from the following:

BIOC 3xxx, 4xxx, 5xxx
BIOL 3xxx, 4xxx, 5xxx
EEB 3xxx, 4xxx, 5xxx
GCD 3xxx, 4xxx, 5xxx
MICB 3xxx, 4xxx, 5xxx
NSCI 3xxx, 4xxx, 5xxx
PBIO 3xxx, 4xxx, 5xxx

Ecology, Evolution, and Behavior B.S.

Ecology, Evolution and Behavior

- Required credits to graduate with this degree: 120.
- Required credits within the major: 75 to 82.

Students majoring in ecology, evolution, and behavior (EEB) focus on three related areas of biology. Ecology examines the growth and maintenance of populations and their interactions in communities, and relationships among organisms and physical events in terrestrial and aquatic ecosystems. Evolution investigates the origin and change of biological diversity by studying evolutionary patterns and processes at various temporal and spatial scales. Behavioral biology explores behavioral adaptations to the environment, mechanisms of behavior, and the evolution of social systems.

A B.S. in EEB prepares students for graduate study in integrative biology and related biological sciences; careers in teaching; and entry-level scientist positions in industry, government agencies, nonprofit agencies, and universities.

Admission Requirements

Freshmen students are usually admitted to pre-major status before admission to this major.

A GPA above 2.00 is preferred for the following:

- 2.50 for students transferring from another University of Minnesota college.
- 2.50 for students transferring from outside the University.

For information about University of Minnesota admission requirements, visit the [Office of Admissions website](#).

Program Requirements

Quantitative Requirement

MATH 1271—Calculus I (4 cr)

Take exactly 1 from the following.

MATH 1272—Calculus II (4 cr)
STAT 3011—Introduction to Statistical Analysis, MATH (4 cr)
CSCI 1901—Structure of Computer Programming I (4 cr)
CSCI 3003—Introduction to Computing in Biology (3 cr)

Chemistry

CHEM 1021—Chemical Principles I (4 cr)

CHEM 1022—Chemical Principles II (4 cr)

CHEM 2301—Organic Chemistry I (3 cr)

and CHEM 2302—Organic Chemistry II (3 cr)

or EEB 4611—Biogeochemical Processes (3 cr)

Physics

PHYS 1201W—Introductory Physics for Biology and Pre-medicine I, PHYS, WI (5 cr)

or PHYS 1301W—Introductory Physics for Science and Engineering I, PHYS, WI (4 cr)

and PHYS 1202W—Introductory Physics for Biology and Pre-medicine II, PHYS, WI (5 cr)

or PHYS 1302W—Introductory Physics for Science and Engineering II, PHYS, WI (4 cr)

General Biology

BIOL 2002—Foundations of Biology for Biological Sciences Majors, Part I, BIOL (5 cr)

or BIOL 2002H—Foundations of Biology for Biological Sciences Majors, Part I, BIOL, H (5 cr)

BIOL 2003—Foundations of Biology for Biological Sciences Majors, Part II (3 cr)

or BIOL 2003H—Foundations of Biology for Biological Sciences Majors, Part II, H (3 cr)

BIOL 2004—Foundations of Biology for Biological Sciences Majors, Part II Laboratory (2 cr)

or BIOL 2004H—Foundations of Biology for Biological Sciences Majors, Part II Laboratory, H (2 cr)

Organismal Biology

Courses or course pairs must be from two different groups

Take 2 or more course(s) from the following:

Animal Biology

BIOL 2012—General Zoology (4 cr)

or BIOL 3211—Animal Physiology (3 cr)

and BIOL 2005—Animal Diversity Laboratory (1 cr)

or PHSL 3051—Human Physiology (4 cr)

and BIOL 2005—Animal Diversity Laboratory (1 cr)

or PHSL 3061—Principles of Physiology (4 cr)

and BIOL 2005—Animal Diversity Laboratory (1 cr)

Plant Biology

BIOL 2022—General Botany (3 cr)

or BIOL 3007W—Plant, Algal, and Fungal Diversity and Adaptation, WI (4 cr)

or BIOL 3002—Plant Biology: Function (2 cr)

and BIOL 3005W—Plant Function Laboratory, WI (2 cr)

Microbiology

VBS 2032—General Microbiology With Laboratory (4 cr)

or MICB 3301—Biology of Microorganisms (5 cr)

Biology Core

BIOL 3807 and 3811 are summer courses offered at the Itasca Biological Station which can count toward the biology core and the field/lab experience.

BIOC 3021—Biochemistry (3 cr)

or BIOC 4331—Biochemistry I: Structure, Catalysis, and Metabolism in Biological Systems (4 cr)

BIOL 4003—Genetics (3 cr)

Take 2 or more course(s) from the following:

BIOL 3409—Evolution (3 cr)

BIOL 3407—Ecology (3 cr)

or BIOL 3408W—Ecology, WI (3 cr)

or BIOL 3807—Ecology (4 cr)

BIOL 3411—Introduction to Animal Behavior (3 cr)

or BIOL 3811—Introduction to Animal Behavior (4 cr)

EEB Major Electives

The 13 credits include the field/lab experience, upper division EEB requirement, and additional electives as needed. Field/lab experience courses can count in other areas of the major. Directed research must be completed for a minimum of

4 credits to count for the field/lab experience; credits can be split over multiple terms using 4994, 4794W, or a combination of the two. Contact the EEB director of undergraduate studies to discuss alternative options for the field/lab experience.

Take 13 or more credit(s) from the following:

Field/Lab Experience

Take 4 or more credit(s) from the following:

- BIOL 3807—Ecology (4 cr)
- BIOL 3811—Introduction to Animal Behavior (4 cr)
- BIOL 3820—Aquatic Toxicology (2 cr)
- BIOL 3825—Ecological Genetics (2 cr)
- BIOL 4035—Mississippi Metagenomics Laboratory (3 cr)
- BIOL 4862—Biological Photography and Digital Imaging Techniques (3 cr)
- EEB 4794W—Directed Research: Writing Intensive, WI (1–6 cr)
- EEB 4994—Directed Research (1–6 cr)
- EEB 4801—Field Limnology (4 cr)
- EEB 4809—Field Ecosystem Ecology (3 cr)
- EEB 4814—Plant Community Ecology (4 cr)
- EEB 4817—Vertebrate Ecology (4 cr)
- EEB 4825—Telemetry and Animal Behavior (2 cr)
- EEB 4839—Field Studies in Mammalogy (4 cr)
- EEB 4842—Arctic Field Ecology (4 cr)
- EEB 4844—Field Ornithology (4 cr)
- BIOL 4850—Special Topics in Biology (1–5 cr)
- BIOL 4894—Directed Research at Itasca (1–7 cr)

Upper Division EEB

Take 7 or more credit(s) from the following:

- EEB 3603—Science, Protection, and Management of Aquatic Environments (3 cr)
- EEB 4014—Ecology of Vegetation (3 cr)
- EEB 4016W—Ecological Biogeography, WI (3 cr)
- EEB 4068—Plant Physiological Ecology (3 cr)
- EEB 4129—Mammalogy (4 cr)
- EEB 4134—Introduction to Ornithology (4 cr)
- EEB 4329—Primate Ecology and Social Behavior (3 cr)
- EEB 4607—Plankton Ecology (4 cr)
- EEB 4611—Biogeochemical Processes (3 cr)
- EEB 4631—Global Ecology (4 cr)
- EEB 4793W—Directed Studies: Writing Intensive, WI (1–7 cr)
- EEB 4794W—Directed Research: Writing Intensive, WI (1–6 cr)
- EEB 4801—Field Limnology (4 cr)
- EEB 4809—Field Ecosystem Ecology (3 cr)
- EEB 4814—Plant Community Ecology (4 cr)
- EEB 4817—Vertebrate Ecology (4 cr)
- EEB 4825—Telemetry and Animal Behavior (2 cr)
- EEB 4839—Field Studies in Mammalogy (4 cr)
- EEB 4842—Arctic Field Ecology (4 cr)
- EEB 4844—Field Ornithology (4 cr)
- EEB 4993—Directed Studies (1–7 cr)
- EEB 4994—Directed Research (1–6 cr)
- EEB 5001—Spatiotemporal Dynamics of Plant Communities (3 cr)
- EEB 5008—Forest Response to Quaternary Climate Change (2 cr)
- EEB 5009—Quaternary Vegetation History and Climate (3 cr)
- EEB 5011—Pollen Morphology (2 cr)
- EEB 5013—Quaternary Plant Macrofossils (2 cr)
- EEB 5033—Population and Quantitative Genetics (4 cr)
- EEB 5042—Quantitative Genetics (3 cr)
- EEB 5051—Analysis of Populations (3 cr)
- EEB 5053—Ecology: Theory and Concepts (4 cr)
- EEB 5068—Plant Physiological Ecology (3 cr)
- EEB 5122W—Plant Interactions with Animals and Microbes, WI (3 cr)
- EEB 5146—Science and Policy of Global Environmental Change (3 cr)
- EEB 5221—Molecular and Genomic Evolution (3 cr)
- EEB 5321—Evolution of Social Behavior (3 cr)
- EEB 5322—Evolution and Animal Cognition (3 cr)

- EEB 5323—Neural and Endocrine Mechanisms Underlying Vertebrate Behavior (2 cr)
- EEB 5327—Behavioral Ecology (3 cr)
- EEB 5361—Visions of Nature: The Natural World and Political Thought (4 cr)
- EEB 5371—Principles of Systematics (3 cr)
- EEB 5601—Limnology (3 cr)
- EEB 5605—Limnology Laboratory (2 cr)
- EEB 3963—Modeling Nature and the Nature of Modeling (3 cr)
- or EEB 5963—Modeling Nature and the Nature of Modeling (3 cr)
- EEB 4609W—Ecosystem Ecology, WI (3 cr)
- or EEB 5609—Ecosystem Ecology (3 cr)
- EEB 3002—Sex, Evolution, and Behavior: Examining Human Evolutionary Biology (4 cr)
- or ANTH 3002—Sex, Evolution, and Behavior: Examining Human Evolutionary Biology (4 cr)

Additional Electives

Take 0–6 credit(s) from the following:

- BIOC 3960—Research Topics in Biochemistry (1 cr)
- BIOC 4xxx, 5xxx
- BIOL 3xxx, 4xxx, 5xxx
- GCD 4xxx, 5xxx
- MICB 3303—Biology of Microorganisms (3 cr)
- MICB 4xxx, 5xxx
- NSCI 3xxx, 4xxx
- NSC 5xxx
- PBIO 4xxx, 5xxx
- CHEM 3xxx, 4xxx
- CSCI 3xxx, 4xxx
- MATH 3283W—Sequences, Series, and Foundations: Writing Intensive, WI (4 cr)
- MATH 4xxx, 5xxx
- PHYS 3xxx, 4xxx, 5xxx
- STAT 3xxx, 4xxx, 5xxx
- ANAT 3xxx
- GCD 3485—Bioinformatic Analysis: Introduction to the Computational Characterization of Genes and Proteins (3 cr)
- VPM 4131—Immunology (3 cr)
- FW 4136—Ichthyology (4 cr)

Program Sub-plans

A sub-plan is not required for this program.

Honors (UHP) Sub-plan

Students admitted to the University Honors Program (UHP) must fulfill UHP requirements in addition to degree program requirements. Honors courses used to fulfill degree program requirements will also fulfill UHP requirements. Current departmental honors course offerings are listed at www.honors.umn.edu/academics/curriculum/dept_courses_current.html.

Honors students complete an honors thesis project in the final year, most often in conjunction with an honors thesis course, or with an honors directed studies or honors directed research course. Students select honors courses and plan for a thesis project in consultation with their UHP adviser and their departmental faculty adviser.

BIOL 2960H and 3960H are strongly recommended for CBS sophomores and juniors, respectively. Directed Research is the basis for an honors thesis completed in conjunction with BIOL 4960H.

Genetics, Cell Biology, and Development B.S.

Genetics, Cell Biology, and Development TCBS

- Required credits to graduate with this degree: 120.
- Required credits within the major: 77 to 82.

Genetics, cell biology, and development (GCD) students focus their studies on the mechanisms by which genetic information is used to specify cell structure and function, and how that information drives cellular interactions that convert a single cell to develop into a complete organism. GCD students learn about advances in the field by studying model organisms like plants, fruit flies, zebrafish, and mice.

A B.S. in GCD prepares students for graduate study in molecular biology or related biological sciences; for professional training programs in health sciences; careers in teaching; and entry-level positions in industry, government agencies, or universities.

Admission Requirements

Freshmen students are usually admitted to pre-major status before admission to this major.

A GPA above 2.00 is preferred for the following:

- 2.50 for students transferring from another University of Minnesota college.
- 2.50 for students transferring from outside the University.

For information about University of Minnesota admission requirements, visit the [Office of Admissions website](#).

Program Requirements

Chemistry

CHEM 1021—Chemical Principles I (4 cr)
 CHEM 1022—Chemical Principles II (4 cr)
 CHEM 2301—Organic Chemistry I (3 cr)
 CHEM 2302—Organic Chemistry II (3 cr)
 CHEM 2311—Organic Lab (4 cr)

Quantitative Requirement

MATH 1271—Calculus I (4 cr)
 MATH 1272—Calculus II (4 cr)

Physics

PHYS 1201W—Introductory Physics for Biology and Pre-medicine I, PHYS, WI (5 cr)
or PHYS 1301W—Introductory Physics for Science and Engineering I, PHYS, WI (4 cr)
 PHYS 1202W—Introductory Physics for Biology and Pre-medicine II, PHYS, WI (5 cr)
or PHYS 1302W—Introductory Physics for Science and Engineering II, PHYS, WI (4 cr)

General Biology

BIOL 2002—Foundations of Biology for Biological Sciences Majors, Part I, BIOL (5 cr)
or BIOL 2002H—Foundations of Biology for Biological Sciences Majors, Part I, BIOL, H (5 cr)
 BIOL 2003—Foundations of Biology for Biological Sciences Majors, Part II (3 cr)
or BIOL 2003H—Foundations of Biology for Biological Sciences Majors, Part II, H (3 cr)
 BIOL 2004—Foundations of Biology for Biological Sciences Majors, Part II Laboratory (2 cr)
or BIOL 2004H—Foundations of Biology for Biological Sciences Majors, Part II Laboratory, H (2 cr)

Organismal Biology

Take 1 or more course(s) from the following:

Animal Biology

BIOL 2012—General Zoology (4 cr)
or BIOL 3211—Animal Physiology (3 cr)
and BIOL 2005—Animal Diversity Laboratory (1 cr)
or PHSL 3051—Human Physiology (4 cr)
and BIOL 2005—Animal Diversity Laboratory (1 cr)
or PHSL 3061—Principles of Physiology (4 cr)
and BIOL 2005—Animal Diversity Laboratory (1 cr)

Plant Biology

BIOL 2022—General Botany (3 cr)
or BIOL 3007W—Plant, Algal, and Fungal Diversity and Adaptation, WI (4 cr)
or BIOL 3002—Plant Biology: Function (2 cr)
and BIOL 3005W—Plant Function Laboratory, WI (2 cr)

Microbiology

VBS 2032—General Microbiology With Laboratory (4 cr)
or MICB 3301—Biology of Microorganisms (5 cr)

Biology Core

BIOL 3407—Ecology (3 cr)
or BIOL 3408W—Ecology, WI (3 cr)
or BIOL 3807—Ecology (4 cr)
or BIOL 3409—Evolution (3 cr)
or BIOL 3411—Introduction to Animal Behavior (3 cr)
or BIOL 3811—Introduction to Animal Behavior (4 cr)
 BIOC 3021—Biochemistry (3 cr)
or BIOC 4331—Biochemistry I: Structure, Catalysis, and Metabolism in Biological Systems (4 cr)
 BIOL 4003—Genetics (3 cr)
 BIOL 4004—Cell Biology (3 cr)

GCD Major Electives

Total of three courses are required from at least two of the following areas: genetics, cell biology, developmental biology. GCD 4151, 4161, and PBIO 5514 cannot count in more than one area. To count as an elective lab, directed research must be completed for a minimum of 3 credits; credits can be split over multiple terms using 4994, 4794W, or a combination of the two. A maximum of 7 credits of directed research can count for major electives.

Take 18 or more credit(s) from the following:

Elective Labs

Take 1 or more course(s) from the following:

BIOC 4025—Laboratory in Biochemistry (2 cr)
 BIOC 4125—Laboratory in Molecular Biology and Biotechnology (3 cr)
 BIOL 4035—Mississippi Metagenomics Laboratory (3 cr)
 GCD 3485—Bioinformatic Analysis: Introduction to the Computational Characterization of Genes and Proteins (3 cr)
 GCD 4025—Cell Biology Laboratory (2 cr)
 GCD 4994—Directed Research (1–6 cr)
 GCD 4794W—Directed Research: Writing Intensive, WI (1–6 cr)
 MICB 4225—Advanced Laboratory: Microbial Genetics (3 cr)
 MICB 4235—Advanced Laboratory: Virology, Immunology, and Microbial Genetics (3 cr)

Genetics

Take 0–3 course(s) from the following:

EEB 5042—Quantitative Genetics (3 cr)
 GCD 4034—Molecular Genetics (3 cr)
 GCD 4143—Human Genetics (3 cr)
 GCD 4151—Molecular Biology of Cancer (3 cr)
 GCD 4161—Developmental Biology (3 cr)
 PBIO 5514—Plant Molecular Genetics and Development (3 cr)

Cell Biology

Take 0–3 course(s) from the following:

GCD 4111—Histology: Cell and Tissue Organization (4 cr)

GCD 4134—Endocrinology (3 cr)

GCD 5036—Molecular Cell Biology (3 cr)

NSCI 3101—Introduction to Neuroscience I: From Molecules to Madness (3 cr)

VPM 4131—Immunology (3 cr)

PBIO 4516W—Plant Cell Biology: Writing Intensive, WI (3 cr)

or PBIO 5516—Plant Cell Biology (3 cr)

Developmental Biology

Take 0–3 course(s) from the following:

GCD 4151—Molecular Biology of Cancer (3 cr)

GCD 4161—Developmental Biology (3 cr)

PBIO 5514—Plant Molecular Genetics and Development (3 cr)

PBIO 5416—Plant Morphology, Development, and Evolution (4 cr)

Additional Electives

Take 0–7 credit(s) from the following:

BIOC 3960—Research Topics in Biochemistry (1 cr)

BIOC 4xxx, 5xxx

BIOL 3xxx, 4xxx, 5xxx

EEB 3603—Science, Protection, and Management of Aquatic Environments (3 cr)

EEB 3963—Modeling Nature and the Nature of Modeling (3 cr)

EEB 4xxx, 5xxx

GCD 4xxx, 5xxx

MICB 3301—Biology of Microorganisms (5 cr)

MICB 3303—Biology of Microorganisms (3 cr)

MICB 4xxx, 5xxx

NSCI 3xxx, 4xxx

NSC 5xxx

PBIO 4xxx, 5xxx

CHEM 3xxx, 4xxx

CSCI 3xxx, 4xxx

MATH 3283W—Sequences, Series, and Foundations: Writing Intensive, WI (4 cr)

MATH 4xxx, 5xxx

PHYS 3xxx, 4xxx, 5xxx

STAT 3xxx, 4xxx, 5xxx

ANAT 3xxx

PHCL 4001—Mechanisms of Drug Action (2 cr)

FW 4136—Ichthyology (4 cr)

EEB 3002—Sex, Evolution, and Behavior: Examining Human Evolutionary Biology (4 cr)

or ANTH 3002—Sex, Evolution, and Behavior: Examining Human Evolutionary Biology (4 cr)

Program Sub-plans

A sub-plan is not required for this program.

Honors (UHP) Sub-plan

Students admitted to the University Honors Program (UHP) must fulfill UHP requirements in addition to degree program requirements. Honors courses used to fulfill degree program requirements will also fulfill UHP requirements. Current departmental honors course offerings are listed at www.honors.umn.edu/academics/curriculum/dept_courses_current.html.

Honors students complete an honors thesis project in the final year, most often in conjunction with an honors thesis course, or with an honors directed studies or honors directed research course. Students select honors courses and plan for a thesis project in consultation with their UHP adviser and their departmental faculty adviser.

BIOL 2960H and 3960H are strongly recommended for CBS sophomores and juniors, respectively. Directed Research is the basis for an honors thesis completed in conjunction with BIOL 4960H.

Microbiology B.S.**Microbiology**

- Required credits to graduate with this degree: 120.
- Required credits within the major: 73 to 80.

Microbiologists study the structure, function, and interaction of microbes, which make up 60 percent of the earth's biomass. Regarded by many as the foundation of the biosphere, microbes were likely the first form of life on earth, predating plants and animals by more than three billion years. Microbiologists study the role of microbes, such as bacteria, fungi, and viruses, in our world. A key goal of microbiologists today is to find new ways to use microbes to our advantage, such as engineering bacteria to synthesize cancer drugs or clean up toxic waste sites.

The microbiology major prepares students for advanced work in graduate programs in microbiology and related fields, and serves as preparation for careers in the health sciences. Microbiologists find employment in a variety of governmental, industrial, and pharmaceutical fields.

Admission Requirements

Freshmen students are usually admitted to pre-major status before admission to this major.

A GPA above 2.00 is preferred for the following:

- 2.50 for students transferring from another University of Minnesota college.
- 2.50 for students transferring from outside the University.

For information about University of Minnesota admission requirements, visit the [Office of Admissions website](#).

Program Requirements**Chemistry**

CHEM 1021—Chemical Principles I (4 cr)

CHEM 1022—Chemical Principles II (4 cr)

CHEM 2301—Organic Chemistry I (3 cr)

CHEM 2302—Organic Chemistry II (3 cr)

CHEM 2311—Organic Lab (4 cr)

Quantitative Requirement

MATH 1271—Calculus I (4 cr)

Take exactly 1 course(s) from the following:

MATH 1272—Calculus II (4 cr)

STAT 3011—Introduction to Statistical Analysis, MATH (4 cr)

Physics

PHYS 1201W—Introductory Physics for Biology and Pre-medicine I, PHYS, WI (5 cr)

or PHYS 1301W—Introductory Physics for Science and Engineering I, PHYS, WI (4 cr)

PHYS 1202W—Introductory Physics for Biology and Pre-medicine II, PHYS, WI (5 cr)

or PHYS 1302W—Introductory Physics for Science and Engineering II, PHYS, WI (4 cr)

General Biology

BIOL 2002—Foundations of Biology for Biological Sciences Majors, Part I, BIOL (5 cr)

or BIOL 2002H—Foundations of Biology for Biological Sciences Majors, Part I, BIOL, H (5 cr)

- BIOL 2003—Foundations of Biology for Biological Sciences Majors, Part II (3 cr)
or BIOL 2003H—Foundations of Biology for Biological Sciences Majors, Part II, H (3 cr)
- BIOL 2004—Foundations of Biology for Biological Sciences Majors, Part II Laboratory (2 cr)
or BIOL 2004H—Foundations of Biology for Biological Sciences Majors, Part II Laboratory, H (2 cr)

Biology Core

- MICB 3301—Biology of Microorganisms (5 cr)
 BIOC 3021—Biochemistry (3 cr)
or BIOC 4331—Biochemistry I: Structure, Catalysis, and Metabolism in Biological Systems (4 cr)
 BIOL 4003—Genetics (3 cr)

Microbiology Major Electives

Take exactly 4 course(s) from the following:

- MICB 4111—Microbial Physiology and Diversity (3 cr)
 MICB 4121—Microbial Ecology and Applied Microbiology (3 cr)
 MICB 4131—Immunology (3 cr)
 MICB 4151—Molecular and Genetic Bases for Microbial Diseases (3 cr)
 MICB 4161—Eukaryotic Microbiology (3 cr)
 BIOC 5352—Biotechnology and Bioengineering for Biochemists (3 cr)
 BIOC 5353—Microbial Biochemistry and Biotechnology: Small Molecules (3 cr)
 BIOC 5361—Microbial Genomics and Bioinformatics (3 cr)
 MICB 4141W—Biology, Genetics, and Pathogenesis of Viruses: Writing Intensive, WI (4 cr)
or MICB 4171—Biology, Genetics, and Pathogenesis of Viruses (3 cr)

Elective Labs

If directed research is selected to fulfill one of the two required labs, at least 6 credits of MICB 4994 and/or 4794W must be completed over the course of two or more semesters. Students double majoring with genetics, cell biology, and development can take either MICB 4225 or GCD 4015.

Take 2 or more course(s) from the following:

- MICB 4215—Advanced Laboratory: Microbial Physiology and Diversity (3 cr)
 MICB 4225—Advanced Laboratory: Microbial Genetics (3 cr)
 MICB 4235—Advanced Laboratory: Virology, Immunology, and Microbial Genetics (3 cr)
 MICB 4994—Directed Research (1–7 cr)
 MICB 4794W—Directed Research: Writing Intensive, WI (1–7 cr)

Program Sub-plans

A sub-plan is not required for this program.

Honors (UHP) Sub-plan

Students admitted to the University Honors Program (UHP) must fulfill UHP requirements in addition to degree program requirements. Honors courses used to fulfill degree program requirements will also fulfill UHP requirements. Current departmental honors course offerings are listed at www.honors.umn.edu/academics/curriculum/dept_courses_current.html.

Honors students complete an honors thesis project in the final year, most often in conjunction with an honors thesis course, or with an honors directed studies or honors directed research course. Students select honors courses and plan for a thesis project in consultation with their UHP adviser and their departmental faculty adviser.

BIOL 2960H and 3960H are strongly recommended for CBS sophomores and juniors, respectively. Directed Research is the basis for an honors thesis completed in conjunction with BIOL 4960H.

Neuroscience B.S.

Neuroscience

- Required credits to graduate with this degree: 120.
- Required credits within the major: 79 to 84.

Neuroscience majors study the molecular and cellular building blocks that make up the brain and control its function. The study of neuroscience aims to understand how complex animals, including humans, see, hear, move, think, and feel. Neuroscientists also study abnormalities that cause diseases and mechanisms that underlie pain and addiction.

A B.S. in neuroscience prepares undergraduates to pursue advanced studies in neuroscience, professional degrees in medicine or related fields.

Admission Requirements

Freshmen students are usually admitted to pre-major status before admission to this major.

A GPA above 2.00 is preferred for the following:

- 2.50 for students transferring from another University of Minnesota college.
- 2.50 for students transferring from outside the University.

For information about University of Minnesota admission requirements, visit the [Office of Admissions website](#).

Program Requirements

Chemistry

- CHEM 1021—Chemical Principles I (4 cr)
 CHEM 1022—Chemical Principles II (4 cr)
 CHEM 2301—Organic Chemistry I (3 cr)
 CHEM 2302—Organic Chemistry II (3 cr)
 CHEM 2311—Organic Lab (4 cr)

Quantitative Requirement

- MATH 1271—Calculus I (4 cr)
Take exactly 1 course(s) from the following:
 MATH 1272—Calculus II (4 cr)
 STAT 3011—Introduction to Statistical Analysis, MATH (4 cr)
 CSCI 1901—Structure of Computer Programming I (4 cr)
 CSCI 3003—Introduction to Computing in Biology (3 cr)

Physics

- PHYS 1301W—Introductory Physics for Science and Engineering I, PHYS, WI (4 cr)
or PHYS 1201W—Introductory Physics for Biology and Pre-medicine I, PHYS, WI (5 cr)
 PHYS 1302W—Introductory Physics for Science and Engineering II, PHYS, WI (4 cr)
or PHYS 1202W—Introductory Physics for Biology and Pre-medicine II, PHYS, WI (5 cr)

General Biology

- BIOL 2002—Foundations of Biology for Biological Sciences Majors, Part I, BIOL (5 cr)
or BIOL 2002H—Foundations of Biology for Biological Sciences Majors, Part I, BIOL, H (5 cr)
 BIOL 2003—Foundations of Biology for Biological Sciences Majors, Part II (3 cr)
or BIOL 2003H—Foundations of Biology for Biological Sciences Majors, Part II, H (3 cr)
 BIOL 2004—Foundations of Biology for Biological Sciences Majors, Part II Laboratory (2 cr)
or BIOL 2004H—Foundations of Biology for Biological Sciences Majors, Part II Laboratory, H (2 cr)

Organismal Biology

Take 1 or more course(s) from the following:

- BIOL 2012—General Zoology (4 cr)
 or BIOL 3211—Animal Physiology (3 cr)
 and BIOL 2005—Animal Diversity Laboratory (1 cr)
 or PHSL 3051—Human Physiology (4 cr)
 and BIOL 2005—Animal Diversity Laboratory (1 cr)
 or PHSL 3061—Principles of Physiology (4 cr)
 and BIOL 2005—Animal Diversity Laboratory (1 cr)

Biology Core

- BIOL 3407—Ecology (3 cr)
 or BIOL 3408W—Ecology, WI (3 cr)
 or BIOL 3807—Ecology (4 cr)
 or BIOL 3409—Evolution (3 cr)
 or BIOL 3411—Introduction to Animal Behavior (3 cr)
 or BIOL 3811—Introduction to Animal Behavior (4 cr)
 BIOG 3021—Biochemistry (3 cr)
 or BIOG 4331—Biochemistry I: Structure, Catalysis, and Metabolism in Biological Systems (4 cr)
 BIOL 4003—Genetics (3 cr)
 BIOL 4004—Cell Biology (3 cr)

Neuroscience Requirements

NSCI 4100 and 3102W cannot be used to meet multiple requirements in the major.

- NSCI 3101—Introduction to Neuroscience I: From Molecules to Madness (3 cr)
 NSCI 3102W—Introduction to Neuroscience II: Biological Basis of Behavior, WI (3 cr)
 or NSCI 4100—Development of the Nervous System: Cellular and Molecular Mechanisms (3 cr)
 NSCI 4105—Neurobiology Laboratory I (3 cr)
 Take 1 or more course(s) totaling 2 or more credit(s) from the following:
 NSCI 4167—Neuroscience in the Community (1–3 cr)
 NSCI 4794W—Directed Research: Writing Intensive, WI (1–6 cr)
 NSCI 4994—Directed Research (1–6 cr)

Neuroscience Major Electives

Take 9 or more credit(s) from the following:

Group A: Cell and Molecular Biology

One course required in Group A

- NSCI 4100—Development of the Nervous System: Cellular and Molecular Mechanisms (3 cr)
 or NSC 5201—Computational Neuroscience I: Membranes and Channels (3 cr)
 or NSC 5461—Cellular and Molecular Neuroscience (4 cr)
 or EEB 5221—Molecular and Genomic Evolution (3 cr)
 or GCD 4034—Molecular Genetics (3 cr)
 or GCD 5036—Molecular Cell Biology (3 cr)
 or PHCL 4001—Mechanisms of Drug Action (2 cr)

Group B: Neural Systems and Behavior

One course required in Group B

- NSC 5202—Theoretical Neuroscience: Systems and Information Processing (3 cr)
 or NSC 5462—Neuroscience Principles of Drug Abuse (2 cr)
 or NSC 5561—Systems Neuroscience (4 cr)
 or NSC 5661—Behavioral Neuroscience (3 cr)
 or NSC 5667—Neurobiology in Disease (2–3 cr)
 or EEB 5321—Evolution of Social Behavior (3 cr)
 or EEB 5327—Behavioral Ecology (3 cr)
 or PSY 5036W—Computational Vision, WI (3 cr)
 or PSY 5038W—Introduction to Neural Networks, WI (3 cr)
 or PSY 5061—Neurobiology of Behavior (3 cr)
 or NSCI 3102W—Introduction to Neuroscience II: Biological Basis of Behavior, WI (3 cr)
 or NSCI 4100—Development of the Nervous System: Cellular and Molecular Mechanisms (3 cr)

Group C: The Scientific Method: History and Philosophy

One course required in Group C

- HMED 3001W—Health, Disease, and Healing I, HIS, WI (4 cr)
 or HMed 3002W—Health Care in History II, WI (3 cr)
 or HSCI 3211—Biology and Culture in the 19th and 20th Centuries (3 cr)
 or HSCI 3242—The Darwinian Revolution (3 cr)
 or PHIL 3601W—Scientific Thought, WI (4 cr)
 or PHIL 4607—Philosophy of the Biological Sciences (3 cr)
 or PSY 3801—Introduction to Psychological Measurement and Data Analysis (3 cr)
 or PSY 3801H—Honors Introduction to Psychological Measurement and Data Analysis, H (3 cr)
 or STAT 3011—Introduction to Statistical Analysis, MATH (4 cr)
 or STAT 3021—Introduction to Probability and Statistics (3 cr)

Program Sub-plans

A sub-plan is not required for this program.

Honors (UHP) Sub-plan

Students admitted to the University Honors Program (UHP) must fulfill UHP requirements in addition to degree program requirements. Honors courses used to fulfill degree program requirements will also fulfill UHP requirements. Current departmental honors course offerings are listed at www.honors.umn.edu/academics/curriculum/dept_courses_current.html.

Honors students complete an honors thesis project in the final year, most often in conjunction with an honors thesis course, or with an honors directed studies or honors directed research course. Students select honors courses and plan for a thesis project in consultation with their UHP adviser and their departmental faculty adviser.

BIOL 2960H and 3960H are strongly recommended for CBS sophomores and juniors, respectively. Directed Research is the basis for an honors thesis completed in conjunction with BIOL 4960H.

Plant Biology B.S.

Plant Biology

- Required credits to graduate with this degree: 120.
- Required credits within the major: 70 to 82.

Plant biologists study all aspects of biology as they pertain to plants or fungi and make important contributions to analyzing and preserving biodiversity worldwide. They work to enhance the nutritional value of crops as well as their resistance to disease, pests, and drought while working to reduce the need for pesticides, fertilizer, and irrigation.

Current faculty research interests include genomics, gene expression, chromosome structure, plant growth substances, signal transduction, plant responses to stress, the plant cytoskeleton and cell morphogenesis, metabolic activities during development, cellular structure and ultrastructure of vascular and nonvascular plants, aquatic biology, lichenology, molecular evolution and systematics, fungal/plant interactions, biological rhythms, and fungal diversity.

Plant biology majors follow one of two tracks. One track fits the need of students who are primarily interested in environmental biology, evolution, or other aspects of whole organisms; the other track is appropriate for students interested in molecular, cellular, and developmental biology. All plant biology majors are guaranteed experience in a research laboratory as long as they show satisfactory progress toward their degree and make arrangements by the middle of their junior year.

Admission Requirements

Freshmen students are usually admitted to pre-major status before admission to this major.

A GPA above 2.00 is preferred for the following:

- 2.50 for students transferring from another University of Minnesota college.
- 2.50 for students transferring from outside the University.

For information about University of Minnesota admission requirements, visit the [Office of Admissions website](#).

Program Requirements

Chemistry

CHEM 1021—Chemical Principles I (4 cr)
 CHEM 1022—Chemical Principles II (4 cr)
 CHEM 2301—Organic Chemistry I (3 cr)
 CHEM 2302—Organic Chemistry II (3 cr)
 CHEM 2311—Organic Lab (4 cr)
 or BIOC 4025—Laboratory in Biochemistry (2 cr)

Quantitative Requirement

MATH 1271—Calculus I (4 cr)
 Take exactly 1 course(s) from the following:
 MATH 1272—Calculus II (4 cr)
 STAT 3011—Introduction to Statistical Analysis, MATH (4 cr)
 CSCI 3003—Introduction to Computing in Biology (3 cr)

Physics

PHYS 1201W—Introductory Physics for Biology and Pre-medicine I, PHYS, WI (5 cr)
 or PHYS 1301W—Introductory Physics for Science and Engineering I, PHYS, WI (4 cr)
 PHYS 1202W—Introductory Physics for Biology and Pre-medicine II, PHYS, WI (5 cr)
 or PHYS 1302W—Introductory Physics for Science and Engineering II, PHYS, WI (4 cr)

General Biology

BIOL 2002—Foundations of Biology for Biological Sciences Majors, Part I, BIOL (5 cr)
 or BIOL 2002H—Foundations of Biology for Biological Sciences Majors, Part I, BIOL, H (5 cr)
 BIOL 2003—Foundations of Biology for Biological Sciences Majors, Part II (3 cr)
 or BIOL 2003H—Foundations of Biology for Biological Sciences Majors, Part II, H (3 cr)
 BIOL 2004—Foundations of Biology for Biological Sciences Majors, Part II Laboratory (2 cr)
 or BIOL 2004H—Foundations of Biology for Biological Sciences Majors, Part II Laboratory, H (2 cr)

General Plant Biology

BIOL 3007W—Plant, Algal, and Fungal Diversity and Adaptation, WI (4 cr)
 or Take all of the following in the same term:
 BIOL 3002—Plant Biology: Function (2 cr)
 BIOL 3005W—Plant Function Laboratory, WI (2 cr)

Biology Core

BIOC 3021—Biochemistry (3 cr)
 or BIOC 4331—Biochemistry I: Structure, Catalysis, and Metabolism in Biological Systems (4 cr)
 BIOL 3407—Ecology (3 cr)
 or BIOL 3408W—Ecology, WI (3 cr)
 or BIOL 3807—Ecology (4 cr)
 or BIOL 3409—Evolution (3 cr)
 BIOL 4003—Genetics (3 cr)
 BIOL 4004—Cell Biology (3 cr)

Plant Biology Major Electives

One course must be completed from Group A and Group B. Courses from Group C may be used if additional credits are needed to reach 11 total credits. Other Group C electives can be approved by the director of undergraduate studies or a faculty mentor. Approval must be sent to CBS Student Services.

Take 11 or more credit(s) from the following:

Group A: Organismal Biology

Take 1 or more course(s) from the following:
 FR 3104—Forest Ecology (4 cr)
 EEB 4068—Plant Physiological Ecology (3 cr)
 PBIO 4321—Minnesota Flora (3 cr)
 PBIO 4511—Flowering Plant Diversity (3 cr)
 PLPA 5203—Introduction to Fungal Biology (3 cr)

Group B: Cell Biology and Genetics

Take 1 or more course(s) from the following:
 PBIO 4601—Topics in Plant Biochemistry (3 cr)
 PBIO 5301—Plant Genomics (3 cr)
 PBIO 5309—Molecular Ecology And Ecological Genomics (3 cr)
 PBIO 5412—Plant Physiology (3 cr)
 PBIO 5514—Plant Molecular Genetics and Development (3 cr)
 PBIO 4516W—Plant Cell Biology: Writing Intensive, WI (3 cr)
 or PBIO 5516—Plant Cell Biology (3 cr)

Group C: Statistics, Mathematics, and Electives

EEB 3963—Modeling Nature and the Nature of Modeling (3 cr)
 or STAT 3011—Introduction to Statistical Analysis, MATH (4 cr)
 or STAT 3021—Introduction to Probability and Statistics (3 cr)

Lab/Field Requirement

Any course 3xxx or higher offered at the Lake Itasca Biological Station and Laboratories may be used to fulfill the Lab/Field Requirement. BIOL 3002 and 3005W or BIOL 3007W may be used for the Lab/Field Requirement if not used in the General Plant Biology area. Courses that are listed in both Major Electives Group A or B AND the Lab/Field Requirement can count in both areas.

Take 2 or more course(s) from the following:

BIOC 4025—Laboratory in Biochemistry (2 cr)
 BIOC 4125—Laboratory in Molecular Biology and Biotechnology (3 cr)
 BIOC 4794W—Directed Research: Writing Intensive, WI (1–6 cr)
 BIOC 4994—Directed Research (1–6 cr)
 EEB 4068—Plant Physiological Ecology (3 cr)
 EEB 4794W—Directed Research: Writing Intensive, WI (1–6 cr)
 EEB 4994—Directed Research (1–6 cr)
 EEB 5605—Limnology Laboratory (2 cr)
 FR 3104—Forest Ecology (4 cr)
 GCD 4025—Cell Biology Laboratory (2 cr)
 GCD 4794W—Directed Research: Writing Intensive, WI (1–6 cr)
 GCD 4994—Directed Research (1–6 cr)
 MICB 3301—Biology of Microorganisms (5 cr)
 MICB 4215—Advanced Laboratory: Microbial Physiology and Diversity (3 cr)
 MICB 4235—Advanced Laboratory: Virology, Immunology, and Microbial Genetics (3 cr)
 MICB 4794W—Directed Research: Writing Intensive, WI (1–7 cr)
 MICB 4994—Directed Research (1–7 cr)
 PBIO 4321—Minnesota Flora (3 cr)
 PBIO 4511—Flowering Plant Diversity (3 cr)
 PBIO 4794W—Directed Research: Writing Intensive, WI (1–6 cr)
 PBIO 4994—Directed Research (1–6 cr)

Program Sub-plans

A sub-plan is not required for this program.

Honors (UHP) Sub-plan

Students admitted to the University Honors Program (UHP) must fulfill UHP requirements in addition to degree program requirements. Honors courses used to fulfill degree program

requirements will also fulfill UHP requirements. Current departmental honors course offerings are listed at www.honors.umn.edu/academics/curriculum/dept_courses_current.html.

Honors students complete an honors thesis project in the final year, most often in conjunction with an honors thesis course, or with an honors directed studies or honors directed research course. Students select honors courses and plan for a thesis project in consultation with their UHP adviser and their departmental faculty adviser.

BIOL 2960H and 3960H are strongly recommended for CBS sophomores and juniors, respectively. Directed Research is the basis for an honors thesis completed in conjunction with BIOL 4960H.

PBIO 5516—Plant Cell Biology (3 cr)
PBIO 5960—Special Topics (1–3 cr)
PLPA 5203—Introduction to Fungal Biology (3 cr)

Plant Biology Minor

Plant Biology

- Required credits in this minor: 10.

Plant biologists seek to understand plants and associated organisms, including fungi and algae, at all levels of biological organization, from molecules to ecosystems. Biochemical, physiological, developmental, genetic, evolutionary, and ecological studies of plants are fundamental to improve human welfare and global conditions in the areas of health, food, energy, and environment. Some current examples of research in plant biology include developmental genetics for bioenergy and food production, ecological studies of carbon cycling, evolutionary responses to climate change, cellular responses to pathogens and abiotic stress, natural product discovery, symbiosis, molecular evolution, informatics, and the pursuit of other fundamental questions.

Minor Requirements

The plant biology minor is available to students in the College of Biological Sciences pursuing another major in the college as well as to non-CBS students. Minor courses must be completed A-F and a grade of C- or better is required. Students must take at least one 4xxx or 5xxx course.

Students who wish to declare a minor in plant biology can do so online at the College of Biological Sciences website.

Minor Courses

Up to 4 credits of plant biology Directed Research (PBIO 4994/4794W) and/or Directed Studies (PBIO 4993/4793W) may be used.

Take 10 or more credit(s) from the following:

BIOL 2022—General Botany (3 cr)

BIOL 3002—Plant Biology: Function (2 cr)

BIOL 3005W—Plant Function Laboratory, WI (2 cr)

BIOL 3007W—Plant, Algal, and Fungal Diversity and Adaptation, WI (4 cr)

EEB 4068—Plant Physiological Ecology (3 cr)

FR 3104—Forest Ecology (4 cr)

PBIO 4321—Minnesota Flora (3 cr)

PBIO 4511—Flowering Plant Diversity (3 cr)

PBIO 4516W—Plant Cell Biology: Writing Intensive, WI (3 cr)

PBIO 4601—Topics in Plant Biochemistry (3 cr)

PBIO 4993—Directed Studies (1–7 cr)

PBIO 4994—Directed Research (1–6 cr)

PBIO 4793W—Directed Studies: Writing Intensive, WI (1–7 cr)

PBIO 4794W—Directed Research: Writing Intensive, WI (1–6 cr)

PBIO 5301—Plant Genomics (3 cr)

PBIO 5309—Molecular Ecology And Ecological Genomics (3 cr)

PBIO 5412—Plant Physiology (3 cr)

PBIO 5514—Plant Molecular Genetics and Development (3 cr)