# College of Biological Sciences

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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 both 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 the application materials. New freshmen are admitted once a year in the fall. Transfer students are admitted at any point in their course of study and can enter either fall or spring semesters. Admission of transfer students is also 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.

For more information, see the Admissions and Prospective Student Services section of this catalog, or visit the Office of Admissions Web site at [http://admissions.tc.umn.edu](http://admissions.tc.umn.edu).

Freshman

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 [http://admissions.tc.umn.edu](http://admissions.tc.umn.edu).

Admission requirements for students transferring from within the University of Minnesota:

1. 2.00 or higher grade point average (GPA) and grades of at least C- in the following courses are usually required:
   - a. CHEM 1021 or equivalent
   - b. MATH 1271 or 1281 or equivalent
   - c. General biology with lab recommended (Please contact CBS student services for information about appropriate courses.)

2. Prerequisite courses must usually be completed at the time of application, with the following exception: students with a 3.00 or higher GPA may be admitted with two of the three prerequisite courses completed and the last prerequisite course in progress (courses in progress during summer session are not included). For specific transfer information visit the CBS Web site at [www.cbs.umn.edu](http://www.cbs.umn.edu) or call 612-624-9717.

Admission requirements for transfer students from higher education institutions other than the University of Minnesota:

The College of Biological Sciences (CBS) admits qualified transfer students to all of its majors. Admission is competitive and based on an overall assessment of the applicant’s academic record and potential for success as presented in the application materials. 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.

Most successful CBS applicants have completed one semester each of calculus, chemistry, and biology.

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 Web site at [www.cbs.umn.edu/studentsservices/transfercredits.html](http://www.cbs.umn.edu/studentsservices/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).

Beginning College in Biological Sciences

If you’re about to begin college and think biology may be your area of interest, there are some important questions you need to consider. (If you’ve already completed one or two years of college work and are thinking of transferring to the University of Minnesota, see Transfer Admission in the General Information section of this catalog.)

How do I know if biology is a good choice for me?

Some students have always had an interest in biology. Others were inspired to learn more about biology by a special teacher or course in high school. Some see biology as a step toward a career in medicine or preserving the environment; others think they may have a strong interest, but want to learn more. If you fall into one of these categories and have a strong high school background in science and math, consider the following questions.

Is biology a good choice right now? Do biology careers look promising for the future?

Thanks to advances such as the sequencing of the human genome and the development of new biotechnologies, biology is playing an increasingly important role in health, agriculture, the environment, the economy, and society in general. New career opportunities are emerging in the biotechnology industry, government, and education. As a result, there has never been a better time to earn a degree in biology.
The University of Minnesota is a research university. What does this mean for undergraduates?

It means that faculty are engaged in federally sponsored research, which gives undergraduates many opportunities to gain research experience by working with faculty in laboratories. It also means that many of your classes will be taught by leading researchers in their fields.

Do all students have the opportunity to be involved in research?

Most CBS students participate in research, choosing from opportunities in basic sciences, medicine, dentistry, pharmacy, veterinary medicine, agriculture, and natural resources. Hands-on experience in a laboratory or in the field is an essential part of the educational experience in CBS. Research experiences help students gain admission to competitive graduate programs, and many employers require candidates to have research or internship experience.

The University has a College of Biological Sciences rather than just a department. What does this mean for students?

As a college, CBS has a much larger faculty, more varied course offerings, and more services for biology students. Services and opportunities for students include the University Honors Program, research, internships, study abroad opportunities, and career services offered jointly with the Institute of Technology.

What if I'm not sure I want to major in biology? If I choose CBS now, will I have problems if I change my major later?

All undergraduates take general education courses, including biological science with a lab course. It is always possible to change your major and transfer to another college, but this decision may affect your ability to graduate in four years. If you are undecided and considering several options, liberal education courses can help you explore a variety of interests.

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 2-credit course; the first part of the course takes place in the summer at the Itasca Field Station 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. Transfer orientation is a one-day orientation program which includes an online pre-orientation component. Transfer orientation is designed to help students make a smooth transition to campus. For more information on these programs, see the New Student Orientation, Nature of Life, and Welcome Week sections of this catalog or contact Orientation & First-Year Programs (612-624-1979 or 1-800-234-1979) or www.ofyp.umn.edu.

Advising

The CBS Office of Student Services provides advising, 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. 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, planning internships, or arranging directed research in laboratory and field settings.

Undergraduate Programs

Students choose CBS because it has high quality programs offered 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, freshman seminars, 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 courses 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
College of Biological Sciences

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 the first year, students take foundation courses in mathematics, chemistry, and general biology 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 for graduation 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
Beginning in fall 2008, the University Honors Program (UHP) will offer 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 sizes, 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 Web site at www.honors.umn.edu.

Students admitted 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 will follow the requirements of the new University Honors Program. Students admitted to a college honors program before fall 2008 and who change colleges must apply to the 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.

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 community. For more information, visit the Housing and Residential Life Web site 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—These discussion-focused small classes are taught by the University’s finest faculty. Students explore exciting topics and also learn more about the wide range of services and opportunities available at the University.

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 about career-related issues such as career options, the value of networking and gaining work experience, resume writing, and interviewing skills. Mentors also provide feedback and support to help students succeed in their chosen fields.

Multicultural Affairs—CBS and its constituent programs are committed to providing equal access to educational opportunities while promoting diversity and fostering successful academic experiences. Diversity includes educational disadvantage, special talents, leadership qualities, race or ethnicity, disability, sexual orientation, and gender identification.

Achieving College Excellence in the Sciences (ACES)—This is a multicultural honors tutorial program for high-achieving students in mathematics or science who plan to attend professional or graduate programs in the life sciences. Freshmen in ACES may receive individual attention from distinguished faculty through a SEAM (Student Excellence in Academics and Multiculturalism) freshman seminar: Success on the Road to Medical School or Graduate Programs in the Science Community. Graduate student mentors help students earn As and Bs in University mathematics and science courses.

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

- developing plastics from renewable resources at a new 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

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/studentservices/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/studentservices/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 printing for research posters. Biodale is located in Snyder Hall on the St. Paul campus. Web site: 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, Institute of Technology, and Medical School for interdisciplinary research and training in emerging areas of biotechnology such as 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 David Tilman, Regents Professor of Ecology, who studies 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 land 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. 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. Web site: www.cbs.umn.edu/itasc.

**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/itasc for a description of courses and facilities.
The **Jane Goodall Institute’s Center for Primate Studies** is the University of Minnesota branch of the Goodall Institute’s worldwide organization, which is devoted to studying and protecting chimpanzees. Anne Pusey, a former student of Goodall’s, is director of the center and of the JGI international research program. The center houses all of Goodall’s notebooks and photos from her more than 45 years of research in Tanzania’s Gombe National Park. Visit [www.discoverchimpanzees.org](http://www.discoverchimpanzees.org).

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 biotechnology 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](http://www.uelmn.org).

**International Programs**

CBS encourages all students to consider an international experience as part of their undergraduate program. Many unique opportunities exist for students to study abroad in the biological sciences. Study abroad 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. Students are also encouraged to consider how an experience abroad might enhance language learning or help them 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](http://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 biology programs should contact the director of graduate studies in the appropriate program area.

**Biochemistry, Molecular Biology, and Biophysics**—Anja-Katrin Bielinsky, 612-624-2469, and Claudia Schmidt-Dannert, 612-625-5782

**Conservation Biology**—Susan M. Galatowitsch, 612-624-3242

**Ecology, Evolution, and Behavior**—Andrew Simons, 612-624-6292

**Genetic Counseling**—Bonnie LeRoy, 612-624-7193

**Joint Program in Law, Health, and Life Sciences**—Susan Wolf, 612-625-3556

**Microbial Engineering**—Robert J. Brooker, 612-624-3053

**Microbiology, Immunology, and Cancer Biology**—Sandra Armstrong, 612-625-6947

**Molecular, Cellular, and Structural Biology**—Tom Neufeld, 612-625-5158

**Neuroscience**—Paul Letourneau, 612-624-5999

**Plant Biological Sciences**—Jerry Cohen, 612-624-9212

**Water Resources Science**—Ray Newman, 612-624-7456

**Career Information**

Biology encompasses many fields and appeals to students with diverse interests. Career avenues are equally broad, including employment by scientific research and testing laboratories, pharmaceutical and medicine development industries, health-care organizations, and federal, state, or local government agencies.

According to the Bureau of Labor Statistics, employment of biological scientists is projected to grow over the next 10 years and beyond, as biotechnological research and development continue to drive job growth. The outlook for science-related jobs in sales, marketing, and research is also very good.

CBS majors prepare students for careers in many different fields of research. For example, CBS students can participate in research related to health issues such as AIDS, cancer, Alzheimer’s disease, obesity, and heart disease. Students assist in the development of bio-based products and methods that help protect and improve the environment. Students learn about new industrial applications of biotechnology and how to improve agricultural products.

A CBS degree provides a good foundation for professional training in the health sciences. Entry requirements for health sciences programs generally include courses similar to those required by CBS (mathematics, chemistry, physics, and biology). Nearly a third of CBS graduates continue their education in health fields such as medicine, dentistry, pharmacy, veterinary medicine, and public health. Some students combine their training in the biological sciences with other fields, such as engineering, law, business, or computer technology. CBS graduates are regularly admitted to competitive, highly ranked graduate schools and professional programs.

The Career Center for Science and Engineering provides resources and services for students at all levels to explore career options and prepare for professional success in the multitude of biotechnology-related careers available to CBS and IT graduates. The Career Center provides assistance to undergraduates and alumni.

These resources include career advising, job search assistance, workshops on resume writing, professional networking, and interview preparation. The Career Center also provides employer and company information, publicizes current job openings, arranges on-campus interviews, and keeps updated information on salaries, employment outlook, and hiring trends.

More information is available at [www.ccse.umn.edu](http://www.ccse.umn.edu) or by calling the Career Center for Science and Engineering at 612-624-4090.

**Student Organizations**

CBS is committed to building an inclusive community and providing resources and support to help our 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, go to [www.cbs.umn.edu/studentservices/involvement.html](http://www.cbs.umn.edu/studentservices/involvement.html).
AED—Alpha Epsilon Delta, the Pre-Med Honor Society, is for anyone considering becoming a physician in the future. 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 connect with other students who share their interests in the health sciences and helps prepare members for medical school and the MCAT.

Biological Science Journal Club—The purpose of the Biological Science Journal Club is to provide students with experience in interpreting scientific journal articles. Students will have an opportunity to practice reading and discussing journal articles, and give informal presentations on articles of their choice.

Biology Club—The Biology Club is for all students who would like to explore majors, careers, and research opportunities available in CBS. Club events include a mix of social and academic activities, featuring a different CBS major each month.

Biology Hoopla Club—A club to increase awareness of biology-themed activities and provide communal recreation for students in biology.

Biology Without Borders 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 works collaboratively with the CBS administration, departments, and student organizations, builds community and connections among CBS students, and serves as the official student representation to the CBS Administration.

A CBS club for every field and career interest
Numerous CBS clubs represent fields of biology and career paths. These allow students with similar interests to meet each other and faculty who are knowledgeable in these areas. Clubs offer guest speakers, field trips, tours of labs, connections for research experience, meetings with potential employers, and social and volunteer opportunities. For details, go to http://www.cbs.umn.edu/studentservices/involvement.htm.

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
123 Snyder Hall (St. Paul)
612-624-2244
Robert Elde, dean, elde@umn.edu
Huber Warner, associate dean, warner033@umn.edu
Robin Wright, associate dean, wrightr@umn.edu
Jean Underwood, assistant dean, jmunder@umn.edu

Student Services
Advising and Registration
229 Snyder Hall (St. Paul)
612-624-9717

Biology Colloquium
305 Bell Museum of Natural History (Mpls.)
612-626-1674

Career Center for Science and Engineering
50 Lind Hall (Mpls.)
612-624-4090
cse@umn.edu

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

International Education
123 Snyder Hall (St. Paul)
612-624-2244

Internship Program
50 Lind Hall (Mpls.)
612-624-4090

Multicultural Affairs
229 Snyder Hall (St. Paul)
612-625-8634

Nature of Life Program
229 Snyder Hall (St. Paul)
612-624-9717
nol@cbns.umn.edu

Directors of Undergraduate Studies
Biochemistry
158 Gortner Laboratory of Biochemistry (St. Paul)
612-625-4928

Biology
612-625-5480

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

Electronic Instrument Services
25 Biological Sciences Center (St. Paul)
612-625-6745

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 and 6-160 Jackson Hall (Mpls.)
612-624-3110
ecd@umn.edu

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

Institute of Human Genetics
4-122 Moos Tower (Mpls.)
612-625-6109

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
(St. Paul)
460 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
Biochemistry B.S.

Biochemistry, Molecular Biology, and Biophysics
- Required credits to graduate with this degree: 120.
- Required credits within the major: 74 to 81.
- This program requires summer terms.

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.

Program Requirements

Chemistry
- CHEM 1021—Chemical Principles I, ENVT, PHYS SCI/L (4 cr)
- CHEM 1022—Chemical Principles II, ENVT, PHYS SCI/L (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)
- CHEM 3501—Introduction to Thermodynamics, Kinetics, and Statistical Mechanics (3 cr)
- CHEM 3502—Introduction to Quantum Mechanics and Spectroscopy (3 cr)

Mathematics
- MATH 1271—Calculus I, MATH (4 cr)
- MATH 1281—Calculus with Biological Emphasis I, MATH (4 cr)
- MATH 1272—Calculus II (4 cr)
- MATH 1282—Calculus With Biological Emphasis II (4 cr)

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

General Biology
- BIOL 2002—Foundations of Biology for Biological Sciences Majors, Part I, BIOL SCI/L (5 cr)
- BIOL 2002H—Foundations of Biology for Biological Sciences Majors, Part I, BIOL SCI/L, ENV T, H (5 cr)
- BIOL 2003—Foundations of Biology for Biological Sciences Majors, Part II (5 cr)
- or BIOL 2003H—Foundations of Biology for Biological Sciences Majors, Part II, BIOL SCI/L, ENV T, H (5 cr)

Biochemistry 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, ENV T (3 cr)
- BIOL 3408W—Ecology, ENV T, WI (3 cr)
- BIOL 3807—Ecology, ENV T (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)
- and BIOL 2005—Animal Diversity Laboratory (1 cr)
- and BIOL 2005—Animal Diversity Laboratory (1 cr)
- and BIOL 2005—Animal Diversity Laboratory (1 cr)
- and BIOL 3002—Plant Biology: Function (2 cr)
- and BIOL 3005W—Plant Function Laboratory, WI (2 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 can not also fulfill other areas in the major.

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

Laboratory and Field Courses
- Take 1 or more course(s) from the following:
  - 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)
  - 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 4007—Plankton Ecology (4 cr)
  - EEB 4794W—Directed Research: Writing Intensive, WI (1–6 cr)
  - EEB 4994—Directed Research (1–6 cr)
  - FW 3136—Biology of Fishes (4 cr)
  - GCD 4015—Genetics Laboratory (2 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)
**Program Requirements**

**Chemistry**
- CHEM 1021—Chemical Principles I, ENV, PHYS SCI/L (4 cr)
- CHEM 1022—Chemical Principles II, ENV, PHYS SCI/L (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, MATH (4 cr)
- MATH 1272—Calculus II (4 cr)
- MATH 1281—Calculus With Biological Emphasis I, MATH (4 cr)

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

**General Biology**
- BIOL 2002—Foundations of Biology for Biological Sciences Majors, Part I, BIOL SCI/L (5 cr)
- BIOL 2002H—Foundations of Biology for Biological Sciences Majors, Part I, BIOL SCI/L, H (5 cr)
- BIOL 2003—Foundations of Biology for Biological Sciences Majors, Part II (5 cr)
- BIOL 2003H—Foundations of Biology for Biological Sciences Majors, Part II, BIOL SCI/L, ENV, H (5 cr)

**Organismal Biology**
- Take 1 or more course(s) from the following:
  - **Animal Biology**
    - BIOL 2012—General Zoology (4 cr)
    - BIOL 3211—Animal Physiology (3 cr)
    - BIOL 3005W—Plant Function Laboratory, WI (2 cr)
  - **Plant Biology**
    - BIOL 2002—Botany (3 cr)
    - BIOL 2003—Botany (3 cr)
    - BIOL 2004—Botany (3 cr)
  - **Microbiology**
    - MICB 4235—Advanced Laboratory: Virology, Immunology, and Microbial Genetics (3 cr)
  - **Biochemistry**
    - BIOL 3007W—Plant, Algal, and Fungal Diversity and Adaptation, WI (5 cr)
    - CHEM 1021—Chemical Principles I, ENV, PHYS SCI/L (4 cr)
  - **Genetics**
    - BIOL 3002—Plant Biology: Function (4 cr)
    - BIOL 3005W—Plant Function Laboratory, WI (2 cr)

**Note:** Programs listed in this catalog are current as of March 2008.
Microbiology
VBS 2032—General Microbiology With Laboratory (4 cr)
or BIOL 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, ENVT (3 cr)
BIOL 3408W—Ecology, ENVT, WI (3 cr)
BIOL 3807—Ecology, ENVT (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)
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)
BIOL 3807—Ecology, ENVT (4 cr)
BIOL 3811—Introduction to Animal Behavior (4 cr)
BIOL 3820—Aquatic Toxicology (2 cr)
BIOL 3825—Ecological Genetics (2 cr)
BIOL 4862—Biological Photography and Digital Imaging Techniques (3 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 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)
EEB 5605—Limnology Laboratory (2 cr)
FW 3136—Biology of Fishes (4 cr)
GCD 4015—Genetics Laboratory (2 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)

Additional Electives

Take 0–8 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)
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)
BIOC 3960—Research Topics in Biochemistry (1 cr)
BIOC 4xxx, 5xxx
BIOC 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 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 3xx

Program Sub-Plans
A sub-plan is not required for this program.

Health Sciences Track
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’s 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

- 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.

Admission Requirements

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

Minor Requirements

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

Required Courses for the Program

- 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 1009H—General Biology, BIOL SCI/L (4 cr)
- or BIOL 2002—Foundations of Biology for Biological Science Majors, Part I (5 cr)
- or BIOL 2002H—Foundations of Biology for Biological Science Majors, Part I (5 cr)
- CHEM 1021—Chemical Principles I, ENVT, PHYS SCI/L (4 cr)
- CHEM 1022—Chemical Principles II, 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 2xx
  - BIOL 2xx
  - EEB 2xx
  - GCD 2xx
  - MICB 2xx
  - NSCI 2xx
  - PBIO 2xx

- Take 3 or more credit(s) from the following:
  - BIOC 3xx, 4xxx, 5xxx
  - BIOL 3xx, 4xxx, 5xxx
  - EEB 3xx, 4xxx, 5xxx
  - GCD 3xx, 4xxx, 5xxx
  - MICB 3xx, 4xxx, 5xxx
  - NSCI 3xx, 4xxx, 5xxx
  - PBIO 3xx, 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.

Program Requirements

Quantitative Requirement

- MATH 1271—Calculus I, MATH (4 cr)
- or MATH 1281—Calculus with Biological Emphasis I, MATH (4 cr)
- MATH 1272—Calculus II (4 cr)
- or MATH 1282—Calculus With Biological Emphasis II (4 cr)
- STAT 3011—Introduction to Statistical Analysis, MATH (4 cr)
- or STAT 3021—Introduction to Probability and Statistics (3 cr)

Chemistry

- CHEM 1021—Chemical Principles I, ENV, PHYS SCI/L (4 cr)
- CHEM 1022—Chemical Principles II, ENV, PHYS SCI/L (4 cr)
- CHEM 2301—Organic Chemistry I (3 cr)
- 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 SCI/L, WI (5 cr)
- or PHYS 1301W—Introductory Physics for Science and Engineering I, PHYS SCI/L, WI (4 cr)
- PHYS 1202W—Introductory Physics for Biology and Pre-medicine II, PHYS SCI/L, WI (5 cr)
- or PHYS 1302W—Introductory Physics for Science and Engineering II, PHYS SCI/L, WI (4 cr)

General Biology

- BIOL 2002—Foundations of Biology for Biological Sciences Majors, Part I, BIOL SCI/L (5 cr)
- or BIOL 2002H—Foundations of Biology for Biological Sciences Majors, Part I, BIOL SCI/L, H (5 cr)
- BIOL 2003—Foundations of Biology for Biological Sciences Majors, Part II (5 cr)
- or BIOL 2003H—Foundations of Biology for Biological Sciences Majors, Part II, BIOL SCI/L, ENV, H (5 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 BIOL 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.

- BIOL 3021—Biochemistry (3 cr)
- BIOL 4003—Genetics (3 cr)
Take 13 or more credit(s) from the following:
EEB biology core. 
may be used for upper division EEB major electives if not taken for the

Take 2 or more course(s) from the following:
BIOL 3409—Ecology (3 cr)
BIOL 3407—Ecology, ENVT (3 cr)
or BIOL 3408W—Ecology, ENVT, WI (3 cr)
or BIOL 3807—Ecology, ENVT (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. BIOL 3407, BIOL 3408W, BIOL 3807, BIOL 3409, BIOL 3411 or BIOL 3811 may be used for upper division EEB major electives if not taken for the EEB biology core.

Take 13 or more credit(s) from the following:
Field/Lab Experience
Take 4 or more credit(s) from the following:
BIOL 3807—Ecology, ENVT (4 cr)
BIOL 3811—Introduction to Animal Behavior (4 cr)
BIOL 3820—Aquatic Toxicology (2 cr)
BIOL 3825—Ecological Genetics (2 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 (2–5 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 (4 cr)
EEB 4129—Mammalogy (4 cr)
EEB 4134—Introduction to Ornithology (4 cr)
EEB 4329—Primate Ecology and Social Behavior (3 cr)
EEB 4607—Plant Ecosystem 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—Quantum 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 (4 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)

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
CHEM 3xxx, 4xxx, 5xxx
CSCI 3xxx, 4xxx
GCD 4xxx, 5xxx
MICB 4xxx, 5xxx
NSCT 3xxx, 4xxx
NSC 5xxx
PBIO 4xxx, 5xxx
PHYS 3xxx, 4xxx
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
FW 3136—Biology of Fishes (4 cr)

Genetics, Cell Biology, and Development B.S.

Genetics, Cell Biology, and Development
• 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.

Program Requirements
Chemistry
CHEM 1021—Chemical Principles I, ENVT, PHYS SCI/L (4 cr)
CHEM 1022—Chemical Principles II, ENVT, PHYS SCI/L (4 cr)
Take 1 or more course(s) from the following:

**Animal Biology**
- BIOL 202—General Zoology (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)

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

**Biology Core**
- BIOL 3407—Ecology, ENVT (3 cr)
  - or BIOL 3408W—Ecology, ENVT, WI (3 cr)
  - or BIOL 3807—Ecology, ENVT (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)
  - or BIOL 3021—Biochemistry (3 cr)
  - or BIOL 4331—Biochemistry I. Structure, Catalysis, and Metabolism in Biological Systems (4 cr)
  - or BIOL 4003—Genetics (3 cr)
  - or 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 can not 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. Directed research can only be used for one elective lab requirement and a maximum of 7 credits can count for major electives.

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

**Elective Labs**
- 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)
  - GCD 4015—Genetics Laboratory (2 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)
  - MIBC 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)
  - MIBC 4131—Immunology (3 cr)
  - NSCI 3101—Introduction to Neuroscience I: From Molecules to Madness (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 0–5 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
  - FW 3136—Biology of Fishes (4 cr)
  - MIBC 3301—Biology of Microorganisms (5 cr)
  - MIBC 4131—Immunology (3 cr)
  - NSCI 3xxx, 4xxx
  - NSCI 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
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.

**Program Requirements**

**Chemistry**
CHEM 1021—Chemical Principles I, ENVT, PHYS SCI/L (4 cr)
CHEM 1022—Chemical Principles II, ENVT, PHYS SCI/L (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, MATH (4 cr)
MATH 1281—Calculus with Biological Emphasis I, MATH (4 cr)

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

**General Biology**
BIOL 2002—Foundations of Biology for Biological Sciences Majors, Part I, BIOL SCI/L, H (5 cr)
BIOL 2002H—Foundations of Biology for Biological Sciences Majors, Part I, BIOL SCI/L, H (5 cr)
BIOL 2003—Foundations of Biology for Biological Sciences Majors, Part II (5 cr)
BIOL 2003H—Foundations of Biology for Biological Sciences Majors, Part II, BIOL SCI/L, ENVT, H (5 cr)

**BIOC 4331—Biochemistry I: Structure, Catalysis, and Metabolism in Biological Systems (4 cr)**
BIOC 4341—Biochemistry I: Structure, Catalysis, and Metabolism in Biological Systems (4 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)

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.

**Program Requirements**

**Chemistry**
CHEM 1021—Chemical Principles I, ENVT, PHYS SCI/L (4 cr)
CHEM 1022—Chemical Principles II, ENVT, PHYS SCI/L (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, MATH (4 cr)
MATH 1281—Calculus with Biological Emphasis I, MATH (4 cr)

**BIOC 5361—Microbial Genomics and Bioinformatics (3 cr)**
BIOC 5352—Microbial Genetics and Bioinformatics (3 cr)

**Elective Labs**
If directed research is selected, at least 6 credits of MICB 4994 must be completed; directed research can only fulfill one of the two required labs. Credits may be spread out over multiple terms.

Take 2 or more course(s) from the following:
- MICB 4235—Advanced Laboratory: Microbial Physiology and Diversity (3 cr)
- MICB 4255—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)

For the most up-to-date listing of program requirements, visit the Online Catalog at [www.catalogs.umn.edu/programs.html](http://www.catalogs.umn.edu/programs.html).
### Organismal Biology
Take 1 or more course(s) from the following:
- BIOL 2012—General Zoology (4 cr)
- BIOL 3211—Animal Physiology (3 cr)
- and BIOL 2005—Animal Diversity Laboratory (1 cr)
- or PHIL 3051—Human Physiology (4 cr)
- and BIOL 2005—Animal Diversity Laboratory (1 cr)
- or PHIL 3061—Principles of Physiology (4 cr)
- and BIOL 2005—Animal Diversity Laboratory (1 cr)

### Biology Core
- BIOL 4003—Genetics (3 cr)
- BIOL 4004—Cell Biology (3 cr)
- 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)
- NSCI 4105—Neurobiology Laboratory I (3 cr)
- BIOC 3021—Biochemistry (3 cr)
- or BIOC 4331—Biochemistry I: Structure, Catalysis, and Metabolism in Biological Systems (4 cr)
- BIOL 3407—Ecology, ENVT (3 cr)
- or BIOL 3408W—Ecology, ENVT, WI (3 cr)
- or BIOL 3807—Ecology, ENVT (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)

### Directed Research
Take 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)

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

#### Group A: Cell and Molecular Biology
One course required in Group A
- 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 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)

#### Group C: The Scientific Method: History and Philosophy
One course required in Group C
- HMED 3001W—Health Care in History I, HP, IP, WI (3 cr)
- or HMED 3002W—Health Care in History II, HP, IP, WI (3 cr)
- or HSCI 3211—Biological and Culture in the 19th and 20th Centuries, HP (3 cr)
- or HSCI 3242—The Darwinian Revolution (3 cr)
- or PHIL 3601W—Scientific Thought, OH, WI (4 cr)
- or PHIL 4607—Philosophy of the Biological Sciences (3 cr)
- or PSY 2801—Introduction to Psychological Measurement and Data Analysis, MATH (3 cr)
- or PSY 2801H—Honors Introduction to Psychological Measurement and Data Analysis, MATH, H (3 cr)
- or STAT 3011—Introduction to Statistical Analysis, MATH (4 cr)
- or STAT 3021—Introduction to Probability and Statistics (3 cr)

### Plant Biology B.S.

#### Plant Biology
- Required credits to graduate with this degree: 120.
- Required credits within the major: 66 to 80.
- This program requires summer terms.

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 development 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.

#### Program Requirements

##### Chemistry
- CHEM 1021—Chemical Principles I, ENVT, PHYS SCI/L (4 cr)
- CHEM 1022—Chemical Principles II, ENVT, PHYS SCI/L (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, MATH (4 cr)
- or MATH 1281—Calculus with Biological Emphasis I, MATH (4 cr)

Take exactly 1 course(s) from the following:
- MATH 1272—Calculus II (4 cr)
- MATH 1282—Calculus With Biological Emphasis 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 SCI/L, WI (5 cr)
- or PHYS 1301W—Introductory Physics for Science and Engineering I, PHYS SCI/L, WI (4 cr)
- PHYS 1202W—Introductory Physics for Biology and Pre-medicine II, PHYS SCI/L, WI (5 cr)
- or PHYS 1302W—Introductory Physics for Science and Engineering II, PHYS SCI/L, WI (4 cr)

##### General Biology
- BIOL 2002—Foundations of Biology for Biological Sciences Majors, Part I, BIOL SCI/L (5 cr)
- or BIOL 2002H—Foundations of Biology for Biological Sciences Majors, Part I, BIOL SCI/L, H (5 cr)
- BIOL 2003—Foundations of Biology for Biological Sciences Majors, Part II, BIOL SCI/L, ENVT (5 cr)

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**Note:** Programs listed in this catalog are current as of March 2008.
or BIOL 2003H—Foundations of Biology for Biological Sciences Majors, Part II, BIOL SCI/L, ENVT, H (5 cr)

General Plant Biology
BIOL 1007W—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)
BIOC 3407—Ecology, ENVT (3 cr)
or BIOC 3408W—Ecology, ENVT, WI (3 cr)
or BIOL 3807—Ecology, ENVT (4 cr)
or BIOL 3409—Evolution (3 cr)
BIOC 4033—Genetics (3 cr)
BIOC 4040—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 (4 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 Genetics (3 cr)
PBIO 5309—Molecular Ecology and Ecological Genetics (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
Take 1 or more course(s) from the following:
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 (1.0-6 cr)
BIOL 4801—Flowering Plant Systematics (4 cr)
BIOL 4994—Directed Research (1.0-6 cr)
EEB 4068—Plant Physiological Ecology (4 cr)
EEB 4794W—Directed Research: Writing Intensive, WI (1.0-6 cr)
EEB 4994—Directed Research (1.0-6 cr)
EEB 5605—Limnology Laboratory (2 cr)
FR 3104—Forest Ecology (4 cr)
GCD 4015—Genetics Laboratory (2 cr)
GCD 4025—Cell Biology Laboratory (2 cr)
GCD 4794W—Directed Research: Writing Intensive, WI (1.0-6 cr)

GCD 4994—Directed Research (1.0-6 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 (1.0-7 cr)
MICB 4994—Directed Research (1.0-7 cr)
PBIO 4321—Minnesota Flora (3 cr)
PBIO 4511—Flowering Plant Diversity (3 cr)
PBIO 4794W—Directed Research: Writing Intensive, WI (1.0-6 cr)
PBIO 4994—Directed Research (1.0-6 cr)

Plant Biology Minor
• Required credits in this minor: 10.

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.

Minor Requirements
The plant biology minor is available to CBS students pursuing one of the other college majors. It is also available to non-CBS students. Students must take all courses A-F and earn at least a C- in all courses used for the minor. Students who wish to declare a minor in plant biology can do so online at the College of Biological Sciences Web site.

Program Requirements
The use of Plant Biology Directed Research (PBIO 4994/4794W) or Directed Studies (PBIO 4993/4793W) for the minor can be discussed with the plant biology director of undergraduate studies.

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

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)
PBIO 4321—Minnesota Flora (3 cr)
PBIO 4404—Developmental Plant Anatomy (3 cr)
PBIO 4511—Flowering Plant Diversity (3 cr)
PBIO 4516W—Plant Cell Biology: Writing Intensive, WI (3 cr)
or PBIO 5516—Plant Cell Biology (3 cr)
PBIO 4801—Plains and Boreal Flora (4 cr)
PBIO 4811—Flowering Plant Systematics (3 cr)
PBIO 5109—Current Questions in Fungal Biology (2 cr)
PBIO 5301—Plant Genomics (3 cr)
PBIO 5412—Plant Physiology (3 cr)
PBIO 5416W—Plant Cell Biology: Writing Intensive, WI (3 cr)
or PBIO 4601—Topics in Plant Biochemistry (3 cr)
PBIO 4801—Plains and Boreal Flora (4 cr)
PBIO 4811—Flowering Plant Systematics (3 cr)
PBIO 5109—Current Questions in Fungal Biology (2 cr)
PBIO 5301—Plant Genomics (3 cr)
PBIO 5412—Plant Physiology (3 cr)
PBIO 5416W—Plant Cell Biology: Writing Intensive, WI (3 cr)
or PBIO 4601—Topics in Plant Biochemistry (3 cr)
PBIO 5416W—Plant Cell Biology: Writing Intensive, WI (3 cr)
PBIO 4404—Developmental Plant Anatomy (3 cr)

For the most up-to-date listing of program requirements, visit the ONLINE CATALOG at www.catalogs.umn.edu/programs.html.